EXCHANGE RATE REGIME AND BEHAVIOUR OF ECONOMIC PARTICIPANTS
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Povzetek

Režim deviznega tečaja in ekonomsko obnašanje udeležencev

Uvod

Spremembe ekonomske politike vplivajo na obnašanje udeležencev v ekonomiji. Rečemo lahko, da je namen ekonomske politike spremeniti obnašanje udeležencev v ekonomiji in ga usmeriti v želeni smeri. Obnašanje udeležencev v ekonomiji je najbolj vidno iz ekonomskih podatkov, in sicer na način, da spremembe obnašanja udeležencev v ekonomiji spremenijo karakteristike ekonomskih podatkov. Če se udeleženci v ekonomiji nahajajo v različnih ekonomskih okoljih, potem je logično pričakovati, da imajo različna ekonomska okolja različne ekonomske karakteristike, ki se jih da zaznati iz ekonomskih podatkov. Ta disertacija raziskuje, ali izbira tečajnega režima vpliva na obnašanje udeležencev v ekonomiji in na kakšen način. Osnovna teza disertacije je, da izbira tečajnega režima bistveno vpliva na obnašanje udeležencev v ekonomiji in da spremembe tečajnega režima spreminjajo obnašanje udeležencev v ekonomiji. Osnovna hipoteza te disertacije uvaja implikacijo, da sprememba tečajnega režima spremeni ekonomsko okolje za udeležence ter tudi, da centralna banka s samo izbijo tečajne politike v veliki meri določa obnašanje udeležencev v ekonomiji in s tem tudi karakteristike ekonomskih podatkov. Z osnovno hipotezo se prav tako vsiljuje implikacija, da je vpliv monetarne politike večji od vpliva, ki se doseže s nadzorom stabilnosti finančnega sistema in stabilnosti cen.

Poleg osnovne hipoteze, ki se nanaša na izbiro tečajnega režima v ekonomiji, so v disertaciji, v skladu z dispozicijo, predlagane tudi podhipoteze, ki dodatno definirajo, kako izbira tečajnega režima in sprememba tečajnega režima vplivata na vsakega udeleženca v ekonomiji posamezno in katere so pričakovane oblike obnašanja pod vsakim tečajnim režimom za vsakega udeleženca v ekonomiji. V podhipotezah je posebej poudarjena medsebojna povezanost udeležencev v ekonomiji, vsem pa je skupno, da ima izbira tečajnega režima bistven vpliv na sprejemanje odločitev in da so različni tečajni režimi jasno vidni v obnašanju udeležencev v ekonomiji, s tem pa tudi ekonomskih podatkih v povezavi s posameznimi udeleženci.

Izbira monetarne politike in vpliv monetarne politike nista ločena od procesa tranzicije, ki so ga preživele države bivšega socialističnega bloka. Tranzicijske države so s koncem socializma prešle na tržno ekonomijo. Različne države so imele različne načine, kako pretvoriti ekonomijo v tržno ekonomijo, vendar so bili končni cilji ekonomskih politik v večini tranzicijskih držav enaki, in sicer priključitev k zvezi NATO, priključitev EU in vstop v EMU.
Večina tranzicijskih držav je dosegla enega od teh treh ciljev, so pa tudi države kot sta Slovenija in Slovaška, ki sta dosegli vse tri.

Pri samem procesu tranzicije izvajalci ekonomskih politik niso natančno vedeli, kako bodo posamezne odločitve vplivale na ekonomijo. Obstajali so javni cilji, vendar so mehanizmi izvedbe v veliki meri temeljili na poskusih in napakah, zato so nekatere države v procesu tranzicije danes uspešnejše kot druge. Tranzicijske države so se prav tako morale odločiti, ali bodo delovale, ali pa najprej analizirale obstoječe ekonomsko stanje in šele po jasni analizi delovale. Zato imamo primer, kjer so se ene države hitreje, druge pa počasneje odločale za določene korake. Najboljši primer procesa tranzicije in različnih odločitev pri procesu tranzicije je proces privatizacije.

Države v ekonomski tranziciji so se podale v tranzicijo z jasno definiranimi cilji, vendar so lahko pri doseganju teh ciljev storile eno od dveh potez: analizirati in delovati. Analiza pomeni, da izvajalci ekonomskih politik analizirajo obstoječe ekonomsko stanje in nato delujejo počasi, da bi socialistično ekonomijo prilagodili tržni ekonomiji. Druga opcija je hitro delovanje, s katerim se proces tranzicije čim prej zaključi. Čeprav je hitro delovanje zaradi hitrega zaključka procesa bolj privlačno, je vprašanje, ali je takšno ravnanje optimalno. Disertacija kreira model, ki temelji na matematičnih modelih teorije igre in tako pojasnjuje proces tranzicije iz perspektive sprejemanja odločitev izvajalcev ekonomskih politik. Poleg dinamičnega modela procesa tranzicije je v disertaciji prav tako modelirana možnost učenja, tako da se imajo nosilci ekonomskih politik možnost "naučiti" sprejemati pravilne odločitve in prilagoditi svoje politike, da bi dosegli zastavljene cilje.

Dodatna dimenzija procesa tranzicije je obnašanje udeležencev v mali odprti ekonomiji, v kateri imata fiskalna in monetarna politika drugačne učinke kot v velikih ekonomijah. Obnašanje udeležencev v mali odprti ekonomiji s prostim pretokom blaga in kapitala daje dodatno dimenzijo ekonomskim politikam in otežuje njihovo izvajanje. Prav zato disertacija razširjuje Mundell-Flemingov model in skozi njega analizira monetarno in fiskalno politiko pa tudi ekonomske šoke, s katerimi se srečuje mala odprta ekonomija. Čeprav gre za starejši model, ki nima temeljite mikro ekonomske podlage in adekvatno vključenih pričakovanj, se ga ga lahko kljub temu uporabi kot osnovo za analizo ekonomskih politik v mali odprti ekonomiji. Osnovni sklep analize Mundell-Flemingovega modela v disertaciji je, da je koordinacija monetarne in fiskalne politike bolj pomembna v mali, odprtih ekonomijah kot v velikih ekonomijah. Mundell-Flemingov model se tudi odlično vklaplja v proces tranzicije in prikazuje, kako je bila pri procesu tranzicije potrebna velika previdnost., saj ekonomske politike niso enake v mali odprti ekonomiji in v velikih ekonomijah. Disertacija Mundell-Flemingov model uporablja kot temelj, iz katerega izhajajo vprašanja, na katera bomo odgovorili v drugih delih disertacije, ko se bodo udeleženci v ekonomiji modelirali s kompleksnejšimi modeli.

Posebno zanimanje v tej disertaciji je namenjeno izbiri tečajnega režima in za kateri tečajni režim se bo mala odprta ekonomija odločila. Namen disertacije je poudariti, kako se udeleženci v ekonomiji obnašajo pod različnimi tečajnimi režimi. Poudarek disertacije sloni na tezi, da izbira tečajnega režima sama po sebi diktira obnašanje udeležencev v ekonomiji. Osnovna teza disertacije pravi, da je ekonomsko obnašanje udeležencev v ekonomiji pod različnimi tečajnimi režimi različno. Za dokazovanje te hipoteze je v disertaciji potrebno:
Definirati, kateri tečajni režimi se bodo preučevali
Katere udeležence v ekonomiji je treba modelirati
Kakšno je njihovo obnašanje pod različnimi tečajnimi režimi in katere so razlike v obnašanju pod različnimi režimi
Razčleniti dinamični model obnašanja udeležencev v ekonomiji pod različnimi tečajnimi režimi in pojasniti interakcijo udeležencev v ekonomiji pod različnimi tečajnimi režimi
Z analizo ekonomskih podatkov ugotoviti, ali obstaja sprememba v obnašanju pod različnimi tečajnimi režimi, z namenom, da bi se hipoteza in podhipoteze dokazale ali zavrnile.
Disertacija se začne z izbiro tečajnega režima v mali odprti ekonomiji. Pri izbiri tečajnega režima v modelu, ki je predstavljen v disertaciji, ima centralna banka dve možnosti: Ohranjati stabilen tečaj
Aktivno uporabljati tečaj kot instrument monetarne politike

Treba je tudi definirati, kateri tečajni režimi obstajajo in katere so glavne karakteristike posameznih tečajnih režimov v mali odprti ekonomiji. Za namen te disertacije sta definirana dva tečajna režima:

- **Stabilni tečaj**: centralna banka ohranja tečaj stabilen in sčasoma tečaj nima jasno definiranega trenda. Tečaj lahko oscilira okoli neke vrednosti, vendar centralna banka tečaja ne uporablja aktivno in ne določa jasne smeri gibanja tečaja.
- **Variabilni tečaj**: centralna banka aktivno uporablja tečaj skozi monetarno politiko in svojim akcijam daje jasno smer gibanja tečaja. Zaradi akcij centralne banke ima gibanje tečaja sčasoma jasen trend.

Razdelitev tečajev v tej disertaciji ne temelji niti na nihajnosti tečaja niti na stabilnosti tečaja skozi čas, ampak na tem, ali ima tečaj smer gibanja skozi čas. Fiksnki tečaj, ki ima prilagoditve v določenih obdobjih, se v kontekstu te disertacije šteje za stabilnega, če se zaradi prilagoditev ne vidi jasen trend gibanja tečaja; fiksnki tečaj se prav tako smatra za variabilnega, če centralna banka skozi prilagoditve kontinuirano slabi tečaj. Prav tako se prosti tečaj, ki nenehno oscilira okoli nekega povprečja, šteje za stabilni tečaj, saj nima jasno definiranega trenda gibanja. Opcija, pri kateri centralna banka skozi monetarno politiko kontinuirano slabi tečaj, ni modelirana in analizirana, čeprav so se takšni primeri kasneje pojavili v podatkih.

Delo kot osnovno hipotezo postavlja prav to, da izbira tečajnega režima, naj bo stabilen ali variabilen, vpliva na proces sprejemanja odločitev udeležencev v ekonomiji. Tečajni režim, ki ga izbere centralna banka, je za druge udeležence v ekonomiji eksogen in centralna banka s svojo odločitvijo tečajno politiko vsiljuje drugim udeležencem v ekonomiji. Glede na to, da
Jim je tečajna politika vsiljena, se bodo drugi udeleženci v ekonomiji morali prilagoditi vsiljenemu tečajnemu režimu in se bodo glede na vsiljen tečajni režim tudi odločali. Tako je tudi v tem delu osnova predpostavka, da se bodo udeleženci v ekonomiji pod različnimi tečajnimi režimi različno odločali.

**Udeleženci v ekonomiji**

Da bi lahko analizirali ekonomijo pod različnimi tečajnimi režimi, je treba definirati udeležence v ekonomiji, katere so karakteristike njihovega obnašanja in kako različni tečajni režimi vplivajo na njihovo obnašanje in na njihove ekonomske odločitve. Analizirani so naslednji udeleženci v ekonomiji:

- **Centralna banka**: centralna banka je udeleženec v ekonomiji, ki nalaga tečajni režim vsem drugim udeležencem v ekonomiji. Ko se centralna banka odloči za posamezen režim, ta režim oznani drugim udeležencem v ekonomiji, ki bodo nato prilagodili svoje obnašanje izbranemu tečajnemu režimu. Sprememba tečajnega režima bo povzročila spremembo obnašanja udeležencev v ekonomiji, ker se udeleženci v ekonomiji obnašajo drugače pod stabilnim in pod variabilnim tečajnim režimom, kot je to definirano v tej disertaciji. Izbira tečajnega režima diktira tudi izvajanje monetarne politike. Z izbiro variabilnega tečajnega režima lahko centralna banka aktivno uporablja tečaj in ima možnosti boriti se zoper realne apreciacije tečaja in druge negativne ekonomske trends. Z izbiro stabilnega tečajnega režima se centralna banka odreka možnosti izvajanja monetarne politike, akcije centrale banke pa so diktirane z vstopom in izstopom kapitala iz ekonomije. Prav zaradi diktiranega obnašanja z izbiro stabilnega tečaja centralna banka izgublja možnosti boriti se zoper realne apreciacije in druge negativne trende.

- **Banke**: Banke prenašajo odločitve monetarne politike na druge udeležence v ekonomiji. Poleg tega je za ekonomijo zelo pomembna tudi kreditna politika bank. Banke so podjetja, ki si prizadevajo maksimizirati svoj dobiček. Kot takšna si prizadevajo zadovoljiti kreditne zahteve. Če banke nimajo dovolj rezidenčnih sredstev za kreditiranje, bodo uvozile sredstva in na taj način povečale zunanji dolg. Za disertacijo je posebej pomemben odnos med gospodinjstvi in bankami oziroma, ali banke kreditirajo gospodinjstva s potrošniškimi krediti in kako potrošniški krediti vplivajo na druga gibanja v ekonomiji.

- **Gospodinjstva**: so osnovna mikro ekonomska enota. Izbira tečajnega režima na njih deluje preko tečajnega tveganja. Če je tečaj stabilen, potem za gospodinjstva ni tečajnega tveganja, kar bo gospodinjstvom omogočilo povečanje količine dolga, ki ga imajo. Pri variabilnem tečaju gospodinjstva ne bodo podvržena zadolževanju, saj se bodo morala zadolževati z valutno klavzulo ali v tuji valuti. Zadolževanje pod variabilnim tečajem avtomatsko pomeni tudi prevzemanje valutnega tveganja. Zato pod režimom variabilnega tečaja gospodinjstva ne bodo podvržena zadolževanju. Variabilni tečaj gospodinjstvom vsiljuje trdo proračunsko omejitev, medtem ko jim stabilni tečaj
omogoča mehko proračunsko omejitev. Poleg odnosa gospodinjstev do količine dolga, ki so jo pripravljena prevzeti, gospodinjstva odločajo tudi o potrošnji. Gospodinjstva lahko v mali odprti ekonomiji konzumirajo doma proizvedene dobrane ali uvozene dobrane. Odločitve gospodinjstev o potrošnji bodo diktirane z gibanjem realnega tečaja v ekonomiji. Apreciacija realnega tečaja bo podražila domače blago, zato bodo gospodinjstva v večji meri konzumirala uvozeno blago. Realna deprecijacija tečaja bo imela nasproten učinek. Preko količine dolga so gospodinjstva povezana z bankami, preko potrošnje pa so povezana z domačimi podjetji.

• **Podjetja**: v mali odprti ekonomiji lahko proizvajajo blago in storitve. Svojo proizvodnjo lahko prodajo na domačem trgu ali izvažajo. V disertaciji se vloga podjetja analizira skozi dve različni perspektivi: odnos podjetja do realnega tečaja in nastajanje novih podjetij. Realna aprecijacija tečaja bo povzročila, da bodo podjetja s svojim izdelkom vedno bolj nekonkurenčna. Zato bodo izgubila prihodke, saj svojega blaga ne bodo mogla prodajati niti na domačem niti na tujem trgu. V primeru, da ima ekonomija realno deprecijacijo, bo konkurenčnost podjetij povečala in podjetja bodo lahko prodajala blago na vse večjem trgu. Za analizo, kako izbira tečajnega režima vpliva na ekonomijo, je prav tako pomembno analizirati, za katero vojno ekonomijo se bodo odločila novo nastala podjetja. Ko želi podjetnik odpreti podjetje, se mora odločiti, s katero dejavnostjo se želi ukvarjati. Na takšen način omejen podjetnik bo pred izbiro dejavnosti proučil gibanje realnega tečaja. Če realni tečaj slabi, se bo podjetnik odločil za odprtje podjetja, ki se bo ukvarjalo s proizvodnjo in izvozom. Če se realni tečaj kreira, se bo podjetnik odločil za odprtje podjetja, ki se bo ukvarjalo z uvozom in trgovino. Na ta način gibanje realnega tečaja v veliki meri vpliva na podjetnike in izbiro dejavnosti.


Zaradi vizualne jasnosti lahko odnose med udeleženci v ekonomiji prikažemo na spodnjem diagramu.
Graf: Razmerje med udeleženci v gospodarstvu

Udeleženci v ekonomiji so povezani. Sprememba obnašanja enega udeleženca v ekonomiji vpliva na druge udeležence v ekonomiji, sprememba celotnega ekonomskega sistema, kot sprememba tečajnega režima, pa vpliva na vse udeležencev v ekonomiji. Zato disertacija obravnava izbiro tečajnega režima kot izbiro ekonomskega sistema, znotraj katerega se morajo udeleženci v ekonomiji odločati. Model, ki je razvit v disertaciji, je model, ki temelji na dinamičnih modelih matematike optimalne kontrole. Osnovna karakteristika matematike optimalne kontrole je v tem, da lahko modelira kompleksne sisteme z velikim številkom udeležencev in tudi interakcije med udeleženci. Poleg analize interakcije z matematično optimalne kontrole je prav tako možno analizirati, kako razni šoki vplivajo na spremembo obnašanja udeležencev v ekonomiji.

Osnova uporabljene matematike je dinamično programiranje. Udeleženci v ekonomiji si prizadevajo rešiti dinamični problem, kako optimizirati sprememljivke skozi čas. Za to kot osnovno izhodišče za iskanje rekurzivne rešitve dinamičnega problema uporabljajo Bellmanovo enačbo. Stohastični elementi izhajajo iz obstoja deviznega tveganja in spremembe tečaja. Obstoj deviznega tveganja zaradi spremembe tečaja (variabilni tečaj) spremeni obnašanje udeležencev v ekonomiji glede na stabilni tečaj. Če ima ekonomija režim stabilnega tečaja, ni stohastičnih šokov, zato se modelirani udeleženci obnašajo drugače.

Kot osnova za ekonomsko teorijo je v dispoziciji uporabljena teorija racionalnih pričakovanj. Poleg enostavnosti, s katero se lahko modelirajo pričakovani udeležencev v ekonomiji, je ta teorija koristna tudi zato, ker uporablja predpostavko o enem modelu, ki je znan vsem udeležencem v ekonomiji. Zaradi te predpostavke je možno povezati odnos udeležencev v ekonomiji in način, kako odločitve enega udeleženca vplivajo na druge in skupaj na makro ekonomijo.
Vsak udeleženec v ekonomiji je posebno modeliran, saj se tako lahko analizira njegovo obnašanje v stanju stabilnega in v stanju variabilnega tečaja. Model prav tako analizira obnašanje udeležencev v primeru, ko pride do spremembe režima. Posebna pozornost je namenjena primeru, ko pride do spremembe tečaja iz stabilnega v variabilnega, saj se v tem primeru udeleženci v ekonomiji morajo "naučiti" točnega modela, ki ga uporablja centralna banka. Proces učenja točnega modela, ki ga uporablja centralna banka po prehodu s stabilnega na variabilni tečaj, je modeliran z uporabo bayesianskega procesa učenja.

Poleg modeliranja udeležencev v ekonomiji se disertacija ukvarja tudi z dodanimi monetarnimi elementi, ki so vezani na malo odprto ekonomijo. Poseben poudarek je na odnosu monetarne politike do preostalega dela ekonomije. Z modelom centralne banke je prikazano, da je centralna banka, ki izbere politiko stabilnosti tečaja, centralna banka, ki se odreka aktivnemu vplivu v ekonomiji in postane odvisna od mednarodnega pretoka kapitala. Skozi model se analizira širina vpliva monetarne politike na druge udeležence v ekonomiji. Model prikazuje, da bi morala biti vloga centralne banke veliko širša do samokontrole stabilnosti cen.

Eden najmočnejših argumentov za stabilnost tečaja je običajno ta, da če je tečaj variabilen, se bodo vse nominalne spremembe tečaja samo prenesle v inflacijo. V tem delu je z modelom prikazano, da je takšen primer izrazito pozitiven in da ima centralna banka v primeru popolnega prenosa spremembe nominalnega tečaja v inflacijo odlično orožje za kontrolo stopnje inflacije v ekonomiji. Z najavami o slabljenju tečaja lahko centralna banka naprej stabilizira pričakovanja in jih uporabi kot element za kontrolo inflacije. Prav tako, če je prenos nominalnega tečaja v inflacijo ena za ena in če ima preostali del sveta pozitivno stopnjo inflacije, to omogoča realno deprecijacijo tečaja.

Kontrola realnega tečaja je v modelu posebno pomembna za podjetja. Če realni tečaj aprecira podjetja, ki se ukvarjajo s proizvodnjo, bo sčasoma postala vse bolj nekonkurenčna in ne bo mogla obstati na prostem trgu. Razen za obstoječa podjetja je v modelu prikazan tudi odnos realnega tečaja in novih podjetnikov v ekonomiji, ki želijo investirati, odpreti podjetja in nova delovna mesta. V ekonomiji, ki je krepitev realnega tečaja kontinuirana, bo naklonjenost novih podjetnikov usmerjena k trgovini in storitvenim dejavnostim in ne k proizvodnji in izvozu. Zmanjšanje števila podjetij, ki proizvajajo, bo povečalo zgolj potrošo tujih dobrin v ekonomiji in uvoz. Realna aprecijacija bo zagotovila tudi novo odprita delovna mesta v trgovini in storitvenih dejavnostih, ne pa tudi v proizvodnji. Na ta način so z modelom povezani: potrošnja gospodinjstva, monetarna politika in podjetja v mali odprti ekonomiji. Znotraj modela se analizira tudi odnos monetarne politike do kreditne politike. Prikazano je, kako vloga centralne banke ne sme biti samo monetarna politika s cilji kot sta stabilnost cen in stabilnost finančnega sistema, ampak mora obstajati tudi kontrola kreditne politike banke. Skozi model je prikazano, da je za dolgoročno stabilnost in prosperitet ekonomije pravilna kreditna politika bank veliko pomembnejša kot stabilnost cen. Na ta način je skozi model prikazano, da obstajajo ekonomski odnosi, v katerih je dolžnost centralne banke spremljati alokacijo kreditov in ne samo fokusirati se na stabilnost tečaja.

Vloga kreditne politike v ekonomiji in potreba kontrole kreditne politike sta v disertaciji kontinuirano analizirani skozi model. Model, ki je postavljen, olajša gospodinjstvu, da
istočasno povečujejo količino prihrankov, ki jih imajo in pa tudi količino dolga. Povečanje količine dolga, ki ga imajo gospodinjstva, je seveda omejeno s kreditno sposobnostjo gospodinjstev in s pripravljenostjo bank, da gospodinjstvom odobrijo kredite.

Banke lahko gospodinjstvom omogočijo kredite, ki temeljijo na realni ekonomski aktivnosti (nakup trajnih dobrin), prav tako pa lahko odobrijo kredite, ki ne temeljijo na realni ekonomski aktivnosti kot potrošni krediti. Takšni krediti, poleg tega, da olajšajo gospodinjstvom življenje iznad njihovih zmožnosti in povečajo profitabilnost bank, nimajo ekonomskega namena. Rast potrošniških kreditov bo umetno povečala agregatno povpraševanje, vendar bo tudi umetno povečala količino DDV-ja, ki ga država dobi iz potrošnje gospodinjstev. Če centralna banka dovoli bankam kreditno politiko, ki temelji na maksimiziranju dobička, bo prišlo do kreditne alokacije, ki ni optimalna za ekonomijo, vendar je profitabilna za banke in kratkoročno dobra za gospodinjstva in državo. Dolgoročna politika življenja nad zmožnostmi ni možna in model tudi analizira primere, ko pride do kreditnega zloma in implikacije zaustavljanja kreditne zadolženosti oz. kreditnega zadolževanja gospodinjstev.

Z modelom je prikazano, da variabilni tečaj gospodinjstvom vsiljuje trdo proračunsko omejitev in da gospodinjstva v tečajnih režimih niso podvržena zadolževanju. Majhna kreditna zadolženost gospodinjstev preprečuje oblikovanje umetnega agregatnega povpraševanja in zmanjšuje proračunski prihodek od kreditov. Manjše povpraševanje po kreditih s strani gospodinjstev odpira prostor za kreditiranje podjetij. Stabilni tečaj oblikuje okolje mehke proračunskih omejitev in ima v skladu s tem nasproten učinek.

Skozi modeliranje kreditnega razmerja med bankami, državo in gospodinjstvi je prikazano, da se monetarna politika v majhni odprti ekonomiji ne more fokusirati samo na stabilnost cen, ampak je predvsem potrebna kontrola kreditne politike in kontrola alokacije kreditov v ekonomiji, da ne bi prišlo do negativnih trendov in bi se omogočila dolgoročna stabilnost ekonomije.

Skozi model je jasno, da je politika variabilnega tečaja superiorna, saj centralni banki omogoča več vpliva na stanje ekonomije in kontrolo potrebn potreb ekonomije. Poleg tega se variabilni tečaj vsiljuje kot način, na katerega lahko centralna banka zaustavi prekomerno zadolženost gospodinjstev in vse navedene negativne učinke, ki lahko iz tega nastanejo, saj sama izbira variabilnega tečaja vsiljuje trdo proračunsko omejitev gospodinjstvom in državi.

Rezultati modela

Osnovna hipoteza je, da obstaja razlika med obnašanjem udeležencev v ekonomiji pod različnimi tečajnimi režimi. Zato sta v dispoziciji oblikovana dva modela, po en model za vsak tečajni režim. Tako je skozi modela analizirano obnašanje udeležencev v ekonomiji pod dvema različnima režimoma in različnima parametroma modelov. Z analizo modelov lahko povzamemo obnašanja udeležencev pod različnimi tečajnimi režimi in analiziramo njihovo obnašanje skozi model. Ta analiza je pomembna, saj se kasneje v disertaciji analizira točnost modela glede na dejanske ekonomske podatke.
Karakteristike režima stabilnega tečaja in obnašanje udeležencev v ekonomiji v modelu stabilnega tečaja lahko povzamemo:

- Aprecijacija realnega tečaja, saj centralna banka ne more vplivati na nominalni tečaj ali z nekimi drugimi sredstvi delovati na slabitev tečaja. Zaradi izbire stabilnega tečaja centralna banka ne more prilagoditi nominalnega tečaja gibanju realnega tečaja.
- Stabilni tečaj pomeni, da ne obstaja tečajno tveganje za gospodinjstva, kar gospodinjstvom omogoča mehko proračunsko omejitev in rast zadolževanja vse do mej, ki so jih banke pripravljene financirati.
- Povečanje povpraševanja za kredite s strani gospodinjstev pripelje do tega, da banke kreditirajo porabo in življenje nad zmožnostjo gospodinjstev, namesto da banke kreditirajo podjetja za investicije. Banke si prizadevajo maksimizirati svoj dobiček, s povečanjem povpraševanja bodo banke restrukturirale svoj portfelj in povečale obrestno mero, da bi zadovoljile rast kreditov. Zaradi povečanja povpraševanja po kreditih, bodo gospodinjstva s kreditnega trga izpodrinala podjetja.
- Če banke z domačimi sredstvi ne bodo mogle zadovoljiti kreditnega povpraševanja, bodo uvozile sredstva iz drugih delov sveta in povečale zunanjih dolg ekonomije. Rast zunanjega dolga v stabilnem tečajnem režimu bo povečala likvidnost ekonomije, ker bo centralna banka odkupovala devize, da bi preprečila krepitev tečaja.
- Zaradi realne aprecijacije in rasti stroškov kreditov bodo podjetja, ki se ukvarjajo s proizvodnjo, postajala vse bolj nekonkurenčna.
- Povečanje kreditiranja gospodinjstev bo povečalo prihodke države na račun DDV-ja, čeprav bodo to prihodki prišli zaradi povečanja kreditne mase in ne zaradi povečanja realne ekonomske aktivnosti. Takšni prihodki se bodo ustavili, ko se bo zaustavila rast kreditne zadolženosti gospodinjstev, saj banke ne morejo večno financirati življenja nad zmožnostmi.
- Stabilni tečaj bo državi omogočil mehko proračunsko omejitev in tudi država bo podvržena zadolževanju, saj povečanju zunanjega dolga ne bo treba prevzeti valutnega tveganja.

Karakteristike režima variabilnega tečaja so v modelu nasprotne od karakteristik stabilnega tečajnega režima in se jih lahko povzame na naslednji način:

- Obstoj variabilnega tečaja vsiljuje trdo proračunsko omejitev gospodinjstvom, zaradi valutnega tveganja pa gospodinjstva ne bodo nagnjena k zadolževanju in življenju nad svojimi zmožnostmi.
• Če ni pritiskov na povpraševanje po kreditih s strani gospodinjstev, bodo banke lahko izkoristile kreditni potencial za kreditiranje podjetij, kar bo v ekonomiji povečalo investicije.

• Ne bo prišlo do eksplozije rasti kreditov gospodinjstev, ne bo prišlo do restrukturiranja kreditnega portfelja bank in s tem tudi ne do umetno ustvarjenega povečanja v povpraševanju.

• Realni apreciaciji se je možno izogniti, pride lahko do deprecijacije realnega tečaja. To se lahko zgodi, ker ima centralna banka z variabilnim režimom kontrolo nad nominalnim tečajem in možnost aktivnega delovanja, tako da med nominalno deprecijijo oslabi tečaj.

• Z realno deprecijacijo ali stabilnim realnim tečajem firme ne bodo izgubile mednarodne konkurenčnosti, novi podjetniki pa bodo vlagali v proizvodnjo in odpirali delovna mesta v proizvodnji.

To analizo je mogoče prikazati skozi tabelo. Tabela prikazuje, kako je izbira tečajnega režima udeležencem v ekonomiji vsiljena in kako oni le usklajujejo svoje obnašanje s tečajnim režimom, ki ga je izbrala centralna banka.

Spodnja tabela prikazuje razmerje med posameznimi udeleženci v ekonomiji in stabilnim tečajnim režimom ter gibanje spremenljivk.

**Tabela: Stabilen režim deviznega tečaja**

<table>
<thead>
<tr>
<th>Celoto gospodarstvo</th>
<th>Gospodinjstva</th>
<th>Banke</th>
<th>Podjetja</th>
<th>Vlada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Povečanje cenzurnega režima</td>
<td>Povečanje primanjkljajev in potenciala razvoja</td>
<td>Povečanje kreditov gospodinjstvom</td>
<td>Zmanjšanje kreditnih obveznosti</td>
<td>Povečanje cenzurnega režima</td>
</tr>
<tr>
<td>Realna devizna aprecijacija</td>
<td>Povečana potrošnja</td>
<td>Povečala kapitala.</td>
<td>Povečane obveznosti</td>
<td>Povečanje proizvodnje</td>
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<td>Povečane obveznosti</td>
<td>Povečanje proizvodnje</td>
</tr>
</tbody>
</table>
Enako tabelo lahko naredimo tudi za variabilni tečaj. Spodnja tabela nam prikazuje razmerje med posameznimi udeleženci v ekonomiji in variabilnim tečajnim režimom ter gibanje spremenljivk.

**Tabela: Spremenjiv režim deviznega tečaja**

<table>
<thead>
<tr>
<th>Celotno gospodarstvo</th>
<th>Gospodinjstva</th>
<th>Banke</th>
<th>Podjetja</th>
<th>Vlada</th>
</tr>
</thead>
</table>

Kot je razvidno iz tabele, je model v disertaciji narejen tako, da bi različni tečajni režimi morali voditi k različnim obnašanjem udeležencev, kar bi nato moralo imeti različne posledice za ekonomijo.

Navedeno obnašanje udeležencev je izpeljano iz matematičnega modela, ki ga je, da bi bil le-ta pravilen, treba primerjati s podatki. Model, ki je razvit v disertaciji, se opira na monetarni pristop, v katerem monetarna politika in monetarne spremenljivke pomembno vplivajo na druge spremenljivke v ekonomiji. Možni fiskalni aspekti modela so namenoma zanemarjeni, saj niso predmet analize disertacije.

Da bi model lahko preverili in ugotovili, ali je pravilen, je treba predvidevanja iz modela primerjati z ekonomskimi podatki. Samo s primerjavo odnosov v modelu in dejanskih ekonomskih podatkov je možno preizkusiati hipoteze, ki so postavljene v tem delu.

Izbira podatkov mora, enako kot model, omogočiti analizo razmerij med udeleženci v ekonomiji in realnimi in monetarnimi spremenljivkami. Za analizo modela je treba analizirati obnašanje ekonomskih spremenljivk v času stabilnega tečaja in v času variabilnega tečaja ter ugotoviti, ali obstaja sprememba v spremenljivki spremembe tečajnega režima. Tako bi možno odgovoriti na vprašanje, ali sprememba tečajnega režima oz. posamezni tečajni režimi generirajo podatke z različnimi karakteristikami. Prav tako je treba izbrati podatke, ki se lahko povežejo s spremenljivkami, ki so modelirane in katerih gibanje je opisano v modelu. Zato so v tem delu analizirani naslednji ekonomski podatki:
Krediti gospodinjstev, da bi ugotovili, ali obstaja razlika v kreditiranju gospodinjstev v času različnih tečajnih režimov in ali sprememba tečajnega režima spremeni kreditne preference gospodinjstev.

Realni tečaj, da bi ugotovili, ali variabilni tečaj lahko omogoči depreciacijo realnega tečaja.

Inflicacija, da bi ugotovili, pod katerim tečajnim režimom je lažje kontrolirati inflicacijo in pod katerim režimom je stopnja inflicacije stabilnejša.

Potrošnja, da bi ugotovili, po katerih tečajnih režimih gospodinjstva več trošijo in ali variabilni tečajni režim povečuje potrošnjo gospodinjstev.

Investicije v fiksni kapital, da bi ugotovili, kateri tečajni režim je ugodnejši za investicije.

Uvoz, da bi ugotovili, ali variabilni tečaj zmanjšuje uvoz.

Izvoz, da bi ugotovili, ali variabilni tečaj povečuje izvoz.

Prihodkovna stran BDP-ja, da bi ugotovili, kako posamezni tečajni režim vpliva na proizvodnjo in ali variabilni tečaj povečuje proizvodne dejavnosti.

Ekonomska rast, da bi ugotovili, kateri tečajni režim omogoča večjo ekonomsko rast in pod katerim tečajnim režimom je stopno ekonomske rasti stabilnejša in odpornejša na krize.

Zunanji dolg, da bi ugotovili, ali imajo ekonomije s stabilnim tečajem večji zunanji dolg kot ekonomije z variabilnim tečajem.

Struktura zaposlenosti v ekonomiji, da bi ugotovili, ali izbira tečajnega režima vpliva na oblikovaje delovnih mest v ekonomiji.

Da bi lahko analizirali implikacije izbire tečajnega režima na ekonomijo, je treba narediti skupino ekonomij, ki so imela podobne ali enake začetne točke v tranziciji in pa tudi podobne ekonomske cilje, ki smo jih že definirali. Zato je bilo pomembno poiskati ekonomije, ki so zaključile s procesom tranzicije ali so blizu konca procesa tranzicije.

Države, ki zadovoljujejo kriterije podobnosti, velikosti in ekonomskih karakteristik, ki so analizirani v tej disertaciji, so: Bolgarija, Češka, Estonija, Hrvaška, Latvija, Litva, Madžarska, Romunija, Slovenija in Slovaška. Takšen izbor nam omogoča širok spekter ekonomij, ki so imela podobno startno pozicijo z začetkom tranzicije in so sedaj na koncu procesa tranzicije, hkrati pa so imela različne tečajne režime in se sedaj nahajajo v različnih ekonomskih pozicijah.

Za vsako od analiziranih držav je ugotovljeno, kakšen tečajni režim je imela in ali je prišlo do spremembe tečajnega režima v opazovanem obdobju. Pri nekaterih navedenih ekonomijah je bilo preprosto ugotoviti, kakšen režim so imela, pri drugih pa je bila potrebna ekonomska analiza. Nekatere ekonomije so celotno obdobje imele stabilen tečajni režim (Bolgarija, Češka, Estonija, Litva), Romunija je imela variabilni tečaj skozi celotno analizirano obdobje, nekatere so imela spremembo tečajnega režima (Hrvaška, Madžarska, Latvija, Slovenija, Slovaška). Tako je možno analizirati, ali obstaja razlika v različnih ekonomijah z istim tečajnim režimom in ali obstaja razlika v ekonomskem obnašanju znotraj
ene ekonomije, ko pride do spremembe tečajnega režima. Takšna širina podatkov možnostim analize omogoča dodatno globino.

Da bi ugotovili ali je hipoteza pravilna, je treba dejanske podatke primerjati s predvidevanji iz modela. Spodnja tabela nam prikazuje razmerje med posameznimi spremenljivkami, predpostavkami modela in dejanskim gibanjem podatkov. Poleg tega lahko takoj vidimo, ali so bila predvidevanja modela pravilna ali ne.

<table>
<thead>
<tr>
<th>Spremenljivka</th>
<th>Predvidevanje modela</th>
<th>Podatki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gospodarska rast</td>
<td>Največja gospodarska rast je v gospodarstvih z variabilnim režimom deviznega tečaja</td>
<td>Podatki potrjujejo to domnevo. MODEL JE PRAVILEN</td>
</tr>
<tr>
<td>Odpornost na krizo</td>
<td>Gospodarstva z variabilnim režimom deviznega tečaja so odporne na krizo.</td>
<td>Ni jasnih zaključkov. MODEL JE NEPRAVILEN</td>
</tr>
<tr>
<td>Realni tečaj</td>
<td>Gospodarstva z variabilnim tečajem bi morala biti sposobna nadzorovati realno</td>
<td>Vsa gospodarstva imajo realno apreciacijo deviznega tečaja.</td>
</tr>
<tr>
<td></td>
<td>apreciacijo deviznega tečaja.</td>
<td>Toda gospodarstva z variabilnim režimom deviznega tečaja imajo nižjo stopnjo apreciacije. MODEL JE DELNO PRAVILEN</td>
</tr>
<tr>
<td>Inflacija</td>
<td>Stabilni režim deviznega tečaja ni jamstvo za nizko stopnjo inflacije.</td>
<td>Ekonomije v EU nimajo niti približno sličnih inflacij. MODELEJ PRAVILEN</td>
</tr>
<tr>
<td>Cenovna stabilnost</td>
<td>Stabilni režim deviznega tečaja ne vodi k nizki stopnji inflacije.</td>
<td>Odvisnosti v podatkih. MODEL JE PRAVILEN</td>
</tr>
<tr>
<td>Razmerje med izvozem in uvozem</td>
<td>Gospodarska z variabilnim režimom deviznega tečaja bi morala imeti višje razmerje med uvozem in izvozem.</td>
<td>Podatki ne podpirajo. MODEL NI PRAVILEN</td>
</tr>
<tr>
<td>Krediti</td>
<td>Višja raven kreditov gospodinjev je v okviru stabilnega režima deviznega tečaja.</td>
<td>Podatki jasno kažejo višjo raven kreditov v okviru stabilnega režima deviznega tečaja in povečanje gospodinjskih kreditov po prehodu z variabilnega režima deviznega tečaja v stabilni režim deviznega tečaja. MODELEJ PRAVILEN</td>
</tr>
<tr>
<td>Zunanji dolg</td>
<td>Gospodarstva z variabilnim režimom deviznega tečaja naj bi imela manjši zunanji dolg. Prehod z variabilnega režima deviznega tečaja v stabilni režim deviznega tečaja naj bi povečal zunanji dolg.</td>
<td>Gospodarstva z variabilnim režimom deviznega tečaja imajo manjši zunanji dolg in prehod z variabilnega v stabilni režim deviznega tečaja bo povečal zunanji dolg. MODEL JE PRAVILEN</td>
</tr>
<tr>
<td>Poraba</td>
<td>Gospodarstva s stabilnim režimom deviznega tečaja naj bi imela višjo stopnjo porabe</td>
<td>Podatki ne podpirajo. MODEL JE NEPRAVILEN</td>
</tr>
<tr>
<td>Naložbe v osnovna sredstva</td>
<td>Gospodarstva z variabilnim režimom deviznega tečaja naj bi imela višjo stopnjo naložb.</td>
<td>Podatki ne podpirajo. MODEL JE NEPRAVILEN</td>
</tr>
<tr>
<td>Blagovna proizvodnja in storiitve</td>
<td>Gospodarstva z variabilnim režimom deviznega tečaja bodo imela večjo proizvodnjo a manj storitev. Prehod z variabilnega v stabilni režim deviznega tečaja bo pozitivno vplival na rast storitvenih dejavnosti.</td>
<td>Stabilni režim deviznega tečaja spodbuja rast storitev, prav tako tudi prehod z variabilnega v stabilni režim deviznega tečaja. MODELEJ PRAVILEN</td>
</tr>
<tr>
<td>Zaposlanje</td>
<td>Gospodarstva z stabilnim režimom deviznega tečaja bodo odpirala več delovnih mest v storitvenih dejavnostih kot v proizvodnji blaga, to se bo dogajalo tudi kadar je režim deviznega tečaja na prehodu z variabilnega v stabilni.</td>
<td>Podatki kažejo, da prehod z variabilnega v stabilni režim deviznega tečaja bolj podpira odpiranje novih delovnih mest na področju storitev kot v proizvodnji. MODELEJ PRAVILEN</td>
</tr>
<tr>
<td>Aktivno sodelovanje</td>
<td>Variabilni režim deviznega tečaja naj bi povečal zaposlenost. Prehod z variabilnega v stabilni režim deviznega tečaja naj bi zmanjšal stopnjo udeležbe.</td>
<td>Podatki ne podpirajo. MODEL NI PRAVILEN</td>
</tr>
<tr>
<td>Javnofinančni primanjkljaj</td>
<td>Stabilni režimi deviznih tečajev bodo imeli nižje primanjkljaje zaradi višjih prihodkov od povečanih zadolžitev ljudi zaradi večje potrošnje.</td>
<td>Stabilni režim deviznega tečaja ima manjše primanjkljaje, prav tako tudi prehod z variabilnega v stabilni režim deviznega tečaja. MODELJE PRAVILEN</td>
</tr>
<tr>
<td>Skupni dolg</td>
<td>Variabilni režim deviznega tečaja mora voditi k nižji stopnji dolga.</td>
<td>Podatki ne podpirajo. MODEL NI PRAVILEN</td>
</tr>
</tbody>
</table>
Pri obravnavi zbranih podatkov, predvidevanj modela in pravilnosti modela je jasno, da je model pravilen za neke spremenljivke, vendar ne za vse. Prav tako je potrebno opozoriti, da je model pravilen predvsem, ko gre za monetarne spremenljivke ali spremenljivke, na katere neposredno vpliva monetarna politika. To ne preseneča, saj model izhaja iz tega, da imata monetarna politika in centralna banka pomemben vpliv na ekonomijo. Razmerje med modeloma in podatki kaže na to, da model ni toliko pravilen pri fiskalni politiki in realnih ekonomskih spremenljivkah. To razmerje med podatki in modelom kaže na možnost, da tudi fiskalna politika pomembno vpliva na ekonomijo in da se motnje in negativni trendi v ekonomiji, ki so posledica napačne monetarne politike, lahko ublažijo s fiskalno politiko. Najboljši primer ekonomije, ki je uspela spremeniti negativne monetarne trende, je Češka. Takšen odnos monetarne in fiskalne politike nas vrača na Mundell-Flemingov model, ki prikazuje, da akcije monetarne politike brez fiskalne politike in akcije fiskalne politike brez monetarne politike nimajo učinka v mali odprti ekonomiji.

Skozi analizo podatkov se je potrdilo, da je osnovna hipoteza dispozicije pravilna in da različni tečajni režimi povzročajo različno obnašanje udeležencev v ekonomiji. Različno obnašanje udeležencev v ekonomiji se manifestira v različnih karakteristikah ekonomskih podatkov, ki so analizirani.

Model predvideva in podatki potrjujejo, da imajo različni tečajni režimi različne karakteristike podatkov in da spremembe tečajnega režima spremenijo obnašanje udeležencev v ekonomiji. Tudi to predvidevanje modela se je pokazalo kot pravilno.

Model ni popolnoma pravilen in tudi vse podhipoteze niso potrjene. Glede na analizo, ki je opravljena v tej dispoziciji, je jasno, da ima izbira tečajnega režima v mali odprti ekonomiji pomemben vpliv na to ekonomijo. Z modelom in podatki je prav tako prikazano, da je vpliv monetarne politike na ekonomijo veliko širše od vpliva te politike na stabilnost cen, kar je bil do sedaj standarden pristop k analizi centralne banke.

Ta dispozicija nedvomno prikazuje, da je vloga centralne banke v ekonomiji izrazito široka in se ne može omejiti samo na stabilnost cen in stabilnost finančnega sistema. Prikazano je namreč, da centralna banka vpliva na skoraj vse dele ekonomskega obnašanja. Posebej je prikazano, da mora biti centralna banka pozorna na kreditno politiko v ekonomiji in da ima izbira tečajnega režima pomemben vpliv na kreditno politiko bank.

Ključne besede: tečajni režim, dinamična optimizacija, udeleženci v ekonomiji, monetarna politika.

UDK: 336.748(043.3)
Summary

This thesis investigates the impact of the exchange rate regime choice on participants in the economy. The usual approach to investigate the impact of the exchange rate changes in the economy is to investigate how do the changes in the exchange rate value impact the changes in the inflation rate. In order to stabilize inflation many central banks often adopt fixed or very stable exchange rates. This thesis takes another approach entirely and contests the narrow view of the exchange rate to just inflation. This thesis postulates that the choices of the exchange rate regime in itself dictates the behavior of economic agents. Under different exchange rate regimes the economic participants will make different choices and the difference in choices will be exhibited in the economic data. So economies with different exchange rate regimes will have different data properties for same economic variables.

The focus of analysis is the transition small open economies which have to make a choice between stable and variable exchange rate regime. The interaction between participants in the economy is investigated through a dynamic model with optimizing agents under two states: stable and variable exchange rate regime. The participants analyzed in the thesis are: central bank, banks, households, firms and governments. Each participant makes optimal choices under each state of the exchange rate regime. Once the model is implemented interactions between the participants is investigated and how different choices change the data behavior. The model created is heavily skewed towards the impact of the monetary policy on the economy and does not investigate deeply into the fiscal policies.

The predictions from the model are compared to the actual data on a sample of 10 transition economies: Bulgaria, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Romania, Slovakia, Slovenia. The model does very well in terms of the monetary variables like foreign debt, household debt. From the data it is clear there are possible fiscal policies which could offset the effects of a particular exchange rate regime, but on the data set this was only done in Czech Republic.

Comparing the model and the data it is clear the choice of the exchange rate regime and the change of the exchange rate regime (switch in the regime) does cause different economic behavior of economic participants. This brings another light to the influence of the monetary policy on the economy since from the model and the data it is clear the choice of the exchange rate regime play a significant role in the process of decision making of economic participants. The model predicts and the data confirms there is a considerable differences in the economic variables between the two regimes. The most striking differences are in: household debt and foreign debt. The model and the data both show the variable exchange rate is superior to stable exchange rate regime.

Key words: exchange rate regime, dynamic optimization, economic participants, monetary policy

UDK classification 336.748(043.3)
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- Analysis of the bank's term structure, liquidity and re-pricing risks with respect to: products, currency structure, business units, residency, term, type of interest rate.
- Performed simulations and projections of bank's assets and liabilities. Creation of budget and projections/simulations with respect to the changes in the regulation with special attention to the liquidity risk, sources of funding, currency structure.
- Participated in creation of models for assessment and forecast of the interest rate and liquidity risk. Performed stress test simulations. Analysis of the monetary policy and the impact of the monetary policy on liquidity of the banking system.
- Analysis of the Central bank's regulation, determination of the impact of the regulation on the bank's balance sheet. Creation of the strategic proposals for the structure of the bank's balance sheet (currency, residency, term, interest rate type) presented at the ALCO meetings. Development of models and strategies to optimize the balance sheet, cost of funds and profitability with the respect of the current and possible future changes in the regulation and other business changes.
- Participated in the ALM project with the goal of implementing ALM software: analysis of the balance sheet structure, product mapping and individual transaction characteristics. Creation of reports using ALM software output.
- Used the ALM software: to perform calculation of the marginal and absolute cost of funds; determine product profitability, simulate P&L effect of new products and new business strategies; participated in creation of internal funds transfer prices model.
- Development of mathematical models in order to track interest rates movement and macroeconomic variables in Croatian economy. Performed model simulation to determine the impact of the macroeconomic factors (exchange rate, quantity of money and other monetary police variables, unemployment) on the bank’s balance sheet, liquidity and quality of portfolio.

Risk specialist, Intesa Sanpaolo, 15/4/09 – 31/12/11, Milano, Italy
- Monitoring and evaluation of liquidity, interest rate, market and operational risks for the ISP subsidiary banks. Focus on term structure, structural liquidity, repricing risk, interest rate structure, economic value of capital and operational loses.
- Development of trading and banking book portfolios for individual banks. With focus on: advising subsidiary banks about possible instruments they are allowed to hold, determination of position and VaR limits, risk monitoring techniques, software needs, local requirements, chart of accounts augmentation and other ISP requirements.
- Policy review for subsidiary banks, technical help in creation of policies, evaluation and alignment of the subsidiary policies with the head office policy (liquidity risk, interest rate risk, fair value, functional portfolio policy). Participation and coordination between subsidiary banks and head office in adopting ISP standards (reports, presentations).
- Assistance in coordination of activities between subsidiary banks, ISBD Risk monitoring and other ISP units. Providing technical support and education for subsidiary bank’s staff.
- Creation of reports presenting the situation of the individual subsidiary banks with focus on regulation, market conditions, liquidity constraints and above mentioned risks.

Portfolio manager/Trader: Carnegie Trading Group
1/06/03 – 1/05/05, Cleveland, USA
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- Participated in development of mathematically based software in order to optimize options, futures and cash trading.
Internship: Banka Brod 2/5/00 - 12/7/00 Slavonski Brod, Croatia

- Participated in short and long term development and planning of credit expansion. Wrote forecasts based on current macroeconomic and microeconomic developments in Croatia.
- Forex analysis of dollar, euro, markets.
- Research about credit exposure and the impacts of credit exposure on general business of the bank.

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February 2013 – Senior lecturer Business School Effectus, Zagreb
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Editor:
Ekonomija/Economics September 2008 – April 2009

Books:
Banks and banking business. Textbook in banking for undergraduate and graduate courses, joint with Miroslav Gregurek RRIF Zagreb 600 pages, Second edition Effectus Zagreb

Theory of Rational Expectations and the Choice of Monetary Policy in a Small Open Economy (2007), masters thesis Faculty of Economics, University of Ljubljana 89 pages


Published papers (original scientific articles):

3. The effect of global crisis on SME companies in Croatia (2009) Libertas Business School papers Editor Ivo Andrijanić. ISSN: 1846-728 UDK:338.124.4: 65.017.2/.3(497.5) pages 1-16 (joint with Miroslav Gregurek and Josip Grgic)


6. Economic policy, soft budget restraints and the creation of foreign debt in Croatia (2008) *Ekonomija/Economics* year 14, issue 2 pages 495-518; ISSN 1330-0636 UDK 336.27330.534.4


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**Other papers:**

Alice in wonderland or how the economic policy is conducted *Moja Banka- glasnik PBZ-a* December 2009 issue 36, 12.13

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Milton Friedman 1912-2006 *Moja Banka- glasnik PBZ-a* December 2006 Issue 30 p. 13
In memoriam: Milton Friedman Informator issue 5234 November 2006 p. 10

**Conferences and Seminars:**

International economic conference "From consumer towards production economy" organized by RIFIN-a paper presented: *Labor force and possibilities of economic recovery in Croatia* September 2011.
International economic conference "National vs. Global" organized by RIFIN-a paper presented: *The coordination between monetary and fiscal policy in Croatia* October 2009
International economic conference "Inflation in Croatia" organized by RIFIN-a paper presented: *Inflation in Croatia: the impact of the middleman* September 2008
International economic conference "Foreign debt in Croatia" organized by RIFIN-a paper presented: *Economic policy, soft budget restraints and the creation of foreign debt in Croatia* March 2008
International economic conference "Economic policy" organized by RIFIN-a paper presented *Economics policies and the mathematics of optimal control - critique* October 2006
International economic conference "Exports as the Foundation for Development of Croatian Economy" paper presented: *Theory of Rational Expectations and Exports* October, 2005
IZJAVA DOKTORSKEGA KANDIDATA

Podpisani-a ___Neven Vidaković______________, vpisna številka __ 83055537__________

izjavljam,

da je doktorska disertacija z naslovom

EXCHANGE RATE REGIME AND BEHAVIOUR OF ECONOMIC PARTICIPANTS

• rezultat lastnega raziskovalnega dela,
• da predložena disertacija v celoti ali v delih ni bila predložena za pridobitev kakeršnekoli izobrazbe po študijskem programu druge fakultete ali univerze,
• da so rezultati korektno navedeni in
• da nisem kršil-a avtorskih pravic in intelektualne lastnine drugih.

Podpis doktorskega-e kandidata-ke:

________________________________
Some preliminaries

For a very long time I belied the monetary policy does not only impact the inflation or real economic variables, but the fact monetary policy has an impact the whole economic decision making process. In college I have postulated the choice of the monetary regime in itself has great significance.

At the time (cca 2000) there was a great debate about should FED and all other banks choose explicit inflation targets. This idea never sat well with me. I did not know what was wrong with it at the time, but something felt wrong. Later this wrong feeling was vindicated during the post 2008 period when ECB had to choose between the achieving the inflation target and helping the economy by increasing liquidity, the one scenario no one counted when arguing for inflation targeting.

When I came back from the USA to Croatia in 2005 I started working in a bank in Strategic ALM unit. There I learned about the nuances of the bank’s balance sheet and how different choices about term, currency and interest rate structure of the bank’s balance sheet have significant long term effect. At the same time I started writing research papers and lecture at a business school so I was able to sit on two chairs at the same time: microeconomic finance within a bank and macroeconomic academia environment.

The more time I spent in both worlds the more it became apparent to me the choices made by the economic participants are significantly governed by the behavior and decisions of the central bank. At the time the idea of the importance of the choice of monetary regime resurfaced, but this time within the content of the exchange rate regime and impact of the exchange rate. Since academic papers do not allow the needed breath for the scope of research I had in mind; this is where the PHD dissertation came into full force.

The creation of the dissertation had two parts. The first version of the dissertation was written in 2009. At that time the economic crisis which started in 2008 was only starting to spill over from monetary to real economy. Many variables I wanted to analyses did not have the data from the crisis period. The data was incomplete and to me, at that time, the analysis of the crisis did not present much additional value added to the dissertation. I was wrong! Now in 2012 when the final draft of the dissertation was written the ability to investigate exchange rate regimes and impact of crisis has provided additional dimension to the dissertation.

Working on the dissertation in 2012 and re-reading older material written in 2009, showed to me the original hypothesis regarding the effects of the exchange rate regime was much more tractable with the crisis data included. New data created during the economic crisis gave much more to the initial hypothesis.

In the end I am sorry the dissertation comes as a post festum instead of something which can be used for active policy making. The dissertation looks back at the choices made and investigates what was the optimal choice, maybe 20 year ago the dissertation would have been an academic hypothetical investigations into possible scenario and then maybe it would have different impact. Today it is a study and explanation of choices.
The work on this thesis has been an consuming task for me, during which actual writing of the dissertation was least of the problems. The largest problem came in terms of my own boundaries and possibilities which got pushed considerably because of this dissertation. Professor Dušan Zbašnik who is my mentor did a superb job in providing me an opportunity to work on this thesis and with him I was able to exchange important views on conduct of monetary policy in Slovenia. This experience served as an important corner stone for development of explicit models. The second person who has enormous impact is Guste Santini, without him and without his encouragement to write papers arguably this thesis might not ever happen. In terms of inspiration the papers of Robert Lucas and Thomas Sargent, which are heavily quoted through the dissertation, provided an inspiration and ideal to strive for. Special thanks goes to my wife Danijela and family who always supported me in all my research.
1. Introduction

Over the years monetary policy has become one of the most fruitful and most intriguing parts of the economics research. The economists have brooded over money in order to gain full understanding how does money influence the economy and how does the economy influence money. In recent years study of the exchange rate regimes has become an integral part of that body of research. With the onset of globalization and after the initial developments by Mundell (1968) international economics and especial international monetary policy have been focus of much of the research in economics.

For eastern European, post-communist economies, monetary policy has been particularly important part of economic policies. Once the communist/socialist organized markets ceased to exist market economies took over, the question of monetary policy was extended beyond just the choice of the exchange rate regime and into the realm of the impact of monetary policy on the rest of the economy.

The main difference between the monetary policy in socialism and capitalism is the degree of independence. Monetary policy in socialism has to serve the current most important needs of the planned economy, while in free market economy the monetary policy tries to achieve preset goals for economic variables under the control of the monetary policy.

With the change of the economic system there was also a change in what monetary policy meant for the economy. The economic path and economic structure of post socialist economies are significantly different from large economies. The large economies like the USA are not extremely dependent on imports from abroad and exhibit much higher self-sufficiency simply due to their size. Also until the mid-1970s the exchange rate was fixed under the Breton Woods system. The exchange rate system was given as fixed so there was no need to investigate the alternate exchange rate regime. Because of large level of economic self-sufficiency there was no need for theoretical work on impact of imports and exports. At the same time the capital flows were not as fast or as large as they are today.

Because of the economic set up under the Breton Woods system the economics as a science did not develop full understanding of monetary policy in small open economies, as it has of monetary policy in large "closed" economies. When the end of socialism came there is was a large vacuum in understanding of functioning of small open economies. One of the important questions was how to use monetary policy, more specifically how to use the exchange rate.

Quickly two opposing sides developed. One side was for the active use of monetary policy and the control of the exchange rate. This side believed that if the economy controls the exchange rate it can stimulate exports, increase the competitiveness of the economy and offset

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1 Central bank also had active role in credit policy, not just monetary policy.
2 Except for maybe oil
3 Closed is deliberately put under quotations, the explanation will be provided later in the dissertation.
negative external shocks. The other side believed the fixed exchange rate would provide the economy with price stability and would remove the element of uncertainty from economic participants. The removal of exchange rate risk would be good for firms, households and financial institutions. Even more important, stable exchange rate would give possibility for inflow of capital and investments into ex-socialist countries. Because of foreign investments the stable exchange rate was perceived as bringer of stability and prosperity to the country.

At the time there was no way to determine what was the best way to proceed with the exchange rate regime choice. One side argued for stable and other for flexible exchange rate regime, however there was no way to test either of the hypothesis. There simply wasn't any past data which could be used to test the model or any good, all-encompassing model.

Applied economics could be perceived, at its very basics, as very simple, especially when it comes to new economic policies. When there is a proposal for a new policy all that is needed is to look at the data and see what has happened the last time when there was a similar policy implemented. This type of approach is misleading. There are two large caveats to this way of approaching economic problems.

The first caveat: the implementation of a new economic policy and the analysis of the reaction to the policy have to be done on a very similar or exactly the same economies. If we want to see what a tax cut is going to do in USA we can look at the past data of USA to see what effects have occurred or we can for example see what has happened in Canada when similar policies were implemented. It is impossible to compare a tax cut in USA and in Croatia since the tax structures, histories, sizes of the economies are different. Although this point might seem very obvious it was often violated as we shall present later in this dissertation. The second caveat is: the data has to exist in the first place. How are you going to compare a future event with the past one if the past events have never occurred?

The ex-socialist economies of Eastern Europe had both of those problems. The choice of the monetary policy with respect to the exchange rate system has never before occurred. Whatever policies regarding the exchange rate were implemented in the past were implemented in completely different economic setup. The economic structure and behavior was changed radically in ex-socialist economies. The planned and organized economy was out of the window and free market economy was all in. All of a sudden there were no limitations on imports and exports imposed by the government. Free enterprises were allowed to develop, many other structural changes in the economy have occurred. Due to this it was impossible to look at the past policies and see how they have impacted the economy. Simply put: the socialist economies from 1985 and the economies from 1992 were not the same, in any way.

Another possibility was to look at the economies that have gone a similar transformation and then analyze how the choice of the monetary policy has impacted them. This possibility was out of the window as well, since no economies have undergone as rapid and as radical transformation as the ex-socialist economies have in the early 1990s. This kind of peaceful transformation (except in case of ex-Yugoslavia) cannot be found in recent history. This problem brings us to the purpose and goals of this dissertation.
1.1. Goals of this dissertation

The object of the dissertation is three fold:

- Look at what monetary policy choices can be made in small open economies.
- Explain the behavior of economic participants and to what results does a particular behavior lead. Here we are going to assume that the behavior of economic participants is conditioned by the choice of the exchange rate regime in small open economy.
- Look at the data and see does the model work.

The order to the objectives is deliberately mismatched. At first glance it might seem obvious that the natural way for economic analysis would be to first look at the economic data and then to create a model in order to explain what we can see in the data. Why such an order? Would it not make more sense to start from the data and then move on the modeling? The answer is no, not in the case of this dissertation. The dissertation is not going to analyze just the choices of monetary policy is a small open economy. The dissertation is going to make a claim that most of the economic behavior we can observe in the data is strictly conditioned by the choice of monetary policy in a small open economy.

The main thesis of the dissertation is: Choice of exchange rate regime is a fundamental choice for small open economy with significant effects on all economic participants. When a central bank chooses a particular exchange rate regimes in effect the central bank chooses a certain economic set-up which will have significant impact on the behaviour and choices of the participants in the economy. Stability or variability of the exchange rate will have an impact the participants in the economy through FX risk. Economic participants will behave differently if there is FX risk (variable exchange rate regime) and if there is no FX risk (stable exchange rate regime). The choice of exchange rate regime will lead to distinct differences in the economic characteristics for economies which have stable exchange rate regime and economies which have variable exchange rate regime.

The foundation for hypothesis comes from Zbašnik (2008a, page 554) “Because of the anomalies of the capital flows there is possibility for the change of the exchange rate, and with the change in the exchange rate signification numbers of other economic variables will change as well”. The above stated hypothesis is focused on verifying and expanding the initial claim from prof. Zbašnik, that changes in the exchange rate have much broader impact on small open economy then just inflation.
Once the central bank chooses the monetary policy, economic participants observe the given monetary policy and make plans according to that monetary policy. We can say that in effect by choosing the monetary policy in a small open economy the central bank chooses a certain path for the economic participants and then naturally the course for the rest of the economy. Because of this claim it is more important to first develop the economic model and then to analyze the data, rather than the other way around.

We are not only going to look at the choice of the monetary policy but we are going to try to link the choice of the monetary policy with the behavior of economic participants in small open economy.

1.2. Research methodologies and sub-hypothesis

In order to understand the methodologies used for research, connection between the participants in the economy and sub-hypothesis the easiest way is to run through the outline of the dissertation. The outline of the dissertation is:

Part 1 - INTRODUCTION

The introduction is going to serve as an overview of the monetary policy in large economies and in small open economies. We are going to analyze the choices small open economy has when choosing the monetary policy and we are going to briefly touch on the actual conduct of the monetary policy in small open economies. This analysis is going to be done while contrasting small and large open economies. The difference between small open economy and large closed economy is going to be mentioned many times thought the dissertation and we are going to emphasize this difference right from the start.

Then we are going to move on and describe the process of economic modeling in economics as a science. Here we will try to make a contrast between two ways of modeling economics process. Modeling from data and modeling specific economic situations in order to determine how the economic participants might behave.

We are going to analyze the tools used in the dissertation and review the basic problem of economic modeling and that is the change in the structure of the models due to changes in the structure of the economy. The tools which we are going to use will be based on mathematics of optimal control with the workhorse of dynamic macroeconomics the: bellman equation.

We will also look into one of the earliest models of international economics and that is Mudell-Fleming model. This model we are going to use two fold. We will use this model to gain basic insight into the workings of small open economy from the “old school” perspective of the Keynesian model. We are also going to look into the game of transition the ex-socialist countries have faced using a dynamic setting. Here we are going to start with the dynamic
programming models. This part of the dissertation is not meant to answer any questions, it is meant to raise a lot of them.

The process of economic transition was one of the most extraordinary economic events of the last century and in order to fully understand the thesis and proposition the dissertation wants to analyze we will have to understand the process of transition, both from the economic theory perspective and from the real events which have occurred.

**Part 2 – THE CHOICE OF THE MONETARY POLICY**

We have already mentioned the monetary policy in small open economy and the monetary policy in large economies are very much different. They are not only different in their importance and the breath of impact they can have on the economy and economic participants, but they are also different in their conduct of monetary policy and monetary policy mechanisms they use. In this brief chapter we are going to clarify those differences.

This chapter will serve as a brief overview of the differences of monetary policies in small and in large economies. The focus of this chapter will be both on the differences in economic theory and differences in the actual practice of economic policy.

We will show what choices the small open economy has in terms of monetary policy. Clearly defining what exchange rate regimes the central bank can choose.

**Part 3 – ECONOMIC PARTICIPANTS**

This chapter will model the behavior of economic participants. All of the claims made about the economy and the structure of the economy are now going to be explicitly modeled in a dynamic stochastic setting.

The object of the mathematics in the dissertation is not to explicitly calculate and then give us a number regarding some variable. This mathematics in the dissertation is going to be used in order to explain the behavior of economics participants. Using mathematics we will try to formally explain how and why do certain economic participants behave, not obtain quantitative results. The economic participants whom we are going to model are: **households, firms, banks, central banks, government**.

**Households:** are the main economic participant and are the central focus of this dissertation. We are going to look at who do households react to changes in the monetary (exchange rate) policy. Since the main premise of the dissertation is that economic participants behave differently under different monetary (exchange rate) policies in small open economy we are going to have two models of households, one for each exchange rate regime. We are going to contrast the models and see how do households change their economic behavior with
respect to exchange rate regime. The sub-hypothesis relating to households will focus on the
debt and the effect the households’ debt has on other participants in the economy.

**H1:** The behaviour of the exchange rate plays fundamental role in the decisions making
process for the household and the choice of the amount of debt the household is willing to
hold.

**H2:** If the household is faced with a depreciating exchange rate, the household will be
credit averse and will create consumption plans with minimum debt holding.

**H3:** If the household is faced with stable exchange rate households will create
consumption plans which are more skewed towards present consumption and will increase
their debt holdings in order to achieve those plans.

Change in consumption plans and deviation from stability of income will increase
aggregate demand, the increase in aggregate demand because of rise in credit will impact
policies of banks and government budget.

**Firms:** firms provide jobs and income for households, but also taxes for government.
We are going to see how the choice of the monetary policy impacts the business firms do.
Since we are in a small open economy we are going to try to determine does the choice of
monetary policy push firms towards imports and trade or towards production and exports. We
are also going to focus on new entrepreneurs and their choice of the economic area when they
start their business. The sub-hypothesis relating to firms will reflect how under different
exchange rate regime the country will have different sector of employment affecting the
aggregate participation rate.

**H1:** Different exchange rate regimes will create different economic environments for
firms. In different economic environments firms will chose different business options in terms
of service or production and different structures of employment.

**H2:** Under stable exchange rate regime firms will be more oriented towards services
and trade, while under variable exchange rate regimes firms will be more oriented towards
production.

**H3:** Variable exchange rate regime will have higher level of employment and higher
level of labour participation rate.

Firms follow business climate and adjust to the existing climate. If the foreign goods are
cheaper the economy as aggregate will move from production towards imports and services.
However without the production the economy will not be able to reach high level of
employment.
**Banks**: are important part of small open economy. They play a dual role. First they are the conduits of the conduct of monetary policy, but they also serve as vessels for the flow of capital in and out of the country. In this part we are also going to focus on the conduct of monetary policy by the central bank and what does the conduct of monetary policy mean for other participants in the economy. One questions which we are going to pay a lot of attention to is how does the conduct of monetary policy affect the liquidity of the economy. We are also going to analyze the credit portfolio structure of the banks and what governs the banks in terms of the sector distribution of loans. Special attention will be paid to the role of credit in the economy and how credit affects other economic variables and participants.

Banks are profit maximizing firms and they are going to lend money to the most profitable and least risky clients. At the same time the banks are going to respond to the demands of the clients. The sub-hypothesis relating to banks will focus on sector distribution of credit under given exchange rate regime and foreign debt.

**H1**: Banks as profit maximizing companies which will give loans to sectors of economy from which the banks can generate highest income. This implies the sector distribution of loans in the banks’ balance sheet will be based on the assumption of what is most profitable for banks, not what is optimal for the economy.

**H2**: Under stable exchange rate banks will lend more to households then the firms. Under variable exchange rate banks will lend more to firms. The banks will have different sector distribution of credit under different exchange rate regimes.

**H3**: Economies with stable exchange rate regime will have higher foreign debt then under stable exchange rate regime.

Consumption choices will have direct impact on balance sheet of banks. If the exchange rate regime is stable and if the household’s demand for loans increases, the banks will meet higher demand by importing funds from abroad. Higher demand for loans will be reflected in the bank’s balance sheets through sector distribution of loans.

**Central bank** is an institution which determines the exchange rate regime. For the central bank the choices of the exchange rate regime is endogenous choice. For all other participants in the economy the choice of the exchange rate regime is exogenous since the exchange rate regime is imposed on them and they have to accept it as given. **With the choice of the exchange rate regime the central bank imposes “rules of the game”**. These rules are then taken into consideration by other participants in the economy when they make their choices. By choosing a certain exchange rate regime the central bank imposes rules, by changing the exchange rate regime the central bank imposes a new set of rules on the economic participants. The change in exchange rate regime will change the decision process of economic participants and the change in the decision process will be reflected in the
economic data. The sub-hypothesis relating to central bank in small open economy will focus choice of the exchange rate regime and switches in the exchange rate regime.

**H1:** Central bank chooses the exchange rate regime. The choice of the exchange rate regime sets economy on a particular path.

**H2:** Change in the exchange rate regime will change the decision making process of participants in the economy. Since the participants will behave differently under different exchange rate regimes there is going to be a clear difference in behaviour of certain economic variables under different exchange rate regimes. Exchange rate regime switch will cause a structural break in the economic data.

**H3:** Economies with stable exchange rate regime will have higher level of foreign debt. Switch of exchange rate regime from variable to stable will lead to increase in foreign debt.

**H4:** Central bank is more able to control inflation under variable exchange rate regimes then under stable exchange rate regime.

Thought the dissertation it will be emphasized the role of the central bank cannot be only to achieve price stability. The central bank has to take a broader view of the impact of its policies on all other participants in the economy.

**Government:** the importance of government is both economic and non-economic. The non-economic importance lies in the rule of law. The economic importance of government lies in the budget and the source of income for the federal budget. We are going to analyse how the choice of monetary policy impacts the structure of the government income. We are also going to make a conclusion about the exchange rate regime the government prefers, from the perspective of the size of budget.

Changes in the aggregate demand because of household’s credit choice will have impact on government VAT receipts. The sub-hypothesis relating to fiscal policy will connect how is government’s income and government’s spending influenced by the exchange rate regime.

**H1:** Fiscal policy will have different deficit plans under different exchange rate regimes. If the exchange rate is stable the government deficit will be higher than under variable exchange rate. Variable exchange rate limits foreign borrowing for the government and serves as deterrent against high deficits.

**H2:** Government receives revenue from household’s consumption through VAT. Higher consumption funded by credit growth will artificially inflate government’s VAT receipt in the period of credit boom. When the credit booms stops there will be a significant decrease in VAT receipts.
**H3:** Because of receipts from credit funded consumption and possibilities to get funds from foreign markets the fiscal policy will prefer stable exchange rate over variable exchange rate.

Just like in the case of households the government will also have different amounts of debt depending on the exchange rate regime.

For all participants we are going to model behavior under stable and variables exchange rate regime. We are also going to investigate how a regime switch impacts the participants. In this segment we are also going to make some notes of what we are expecting to see in the data. The model created will be dynamic stochastic models rooted in the mathematics of optimal control.

**Part 4 – DATA**

This part of the dissertation is going to look at the economic data. Here we are going to contrast what the model is telling us with what we have observed in the data through econometric testing.

This part is the crucial part for the dissertation in terms of model quality. If the model assumes that there should be considerable difference between the economic behavior of economic participants between the regimes and we do not see that in the data, in that case we will conclude that the choice of the monetary regime does not impact the economic behavior of economic participants. On the other hand if we see considerable difference between economic data for different exchange rate regimes then we will have to conclude that the choice of the exchange rate regime plays an important part for small open economy.

The data we are going to focus on will be: the nominal exchange rate, real exchange rate, inflation, growth of GDP, investment, consumption, imports, exports, foreign debt, household’s debt, sector employment.

Since we have already noted there are potential problems with data testing we are going to analyze the model on ten countries: Bulgaria, Croatia, Czech Republic, Lithuania, Latvia, Hungary, Romania, Slovenia and Slovakia. For each country we are going to determine what was the exchange rate regime used in the time period we are analyzing, were there any regime switches and then we are going to analyze the data and see what the model is telling us and what the data is telling us.

When needed econometric techniques are going to be used to determine significant properties in the data.

**Part 5 – CONCLUSION**
The last part of the dissertation will serve as both a comprehensive overview and as a conclusion to the dissertation. We are going to determine was the model of the importance of the choice of the exchange rate regime successful or the path of ex-socialist countries was determine long before they made their choice of the exchange rate regime by other factors.

* * *

Before we proceed with the rest of the dissertation I am going to state the main claim of the dissertation again. Thorough the dissertation I will argue the choice of the exchange rate regime in a small open economy has a major influence and impact on the economy. The choice of the exchange rate policy regime pre-determines the economic path of the country and guides the economic participants towards certain economic behavior. **Once the exchange rate regime is chosen in a small open economy the rest of the economic occurrences are merely the natural result of that initial choice.** Again the focus is not going to be on how the central bank has behaved once the exchange rate policy was chosen, but on how the economic participants have started to behave once the monetary policy was chosen or changed due to the regime choice or regime switch.
2. Monetary policy

In this part of the dissertation we are going to create a general introduction into monetary policy and we are going to analyze some contrasts between small open economies and large economies when it comes to the monetary policy. The first issue we have to address is the need for the monetary policy and that can best be seen from the graph picture below:

**Graph 1: Inflation Index for Major World Powers 1600 - 2000**

![Graph 1: Inflation Index for Major World Powers 1600 - 2000](Source: Thomas Sargent’s web site http://homepages.nyu.edu/~ts43/)

The picture is both startling and fascinating. The picture represents the price index for major world powers over last 400 years, with the base year of 1913=100. The index shows France, Castile (Spain), England and US, however what is the most startling feature of this picture is the interpretation of prices. We clearly see that there are two separate histories of the evolution of the price level. The first part is from 1600 to 1900 and the second part is from 1900 until today.

The first time period is the time period without inflation. The price level in 1600 and in 1900 in the countries shown has not changed at all. This is a fascinating implication. However if we look at the second part of this picture the period from 1900 to 2000 we can clearly see that the inflation is rampant. The price index in France has gone from 100 in 1900 to 100,000 in 2000 or a thousand times increase.
There was price stability for 300 years, if we exclude the Napoleonic wars and then the price stability ceased to exist. We have moved from the age of price stability to the age of inflation or price growth. How did this happen? The first answer to this question is that we do not have commodity money, but technically that is not true. The gold standard and the Breton woods system existed well into 1970s, while the inflation started to increase at the end of WWI, so the gold standard is not the answer to why did the inflation process start. We can clearly see the inflation is the phenomenon of the 20th century. Other reasons for rise in prices might be globalization, paper money, capital flows, and introduction of global banking. Maybe the only true answer to the questions of inflation is that monetary economics is still looking for an answer.

Over the years monetary policy has become a fruitful part of economics science and next to the labor theory, probably the most important to the general public. It would be hard to argue that any other branch of economics receives as much press as does the monetary policy, however the science of monetary economics is still far from solving all of the problems. One thing everybody can agree upon is that there is inflation and that high uncontrolled inflation is a problem for the economy. However regarding anything else in the field of monetary economics the jury is still out.

Before we look at what different approaches to the monetary policy we have to make a distinction regarding the approach towards monetary policy. Should monetary policy use micro or macro approach? Initially following Fisher (1955) and Keynes (1964) the monetary policy was strictly a macro science which was concerned with the big picture. Then in the 1970s with the onslaught of the rational expectations economics it became generally accepted that the monetary policy is a macro science, but with important micro foundation as shown in Lucas (1972, 1981). Ever since Friedman (1963, 1968a, 1968b 1969,1977) and Lucas and Sargent (1981, 1981) on one side and Ball, Mankiew, Romer (1988) on the other side, in theory there are several levels of discontent and that winter does not seem it will pass for some time.

- **First level of discontent is the term.** Should the economic policies be oriented towards the long term or towards the short term? Lucas (2003) says that there are benefits from the short term adjustments of economy, but they are nothing compared to the long term proper policies. Following this line of argument the policy makers should have a long term general overview of what to do and how to do it while ignoring the short term small adjustment policies. On the other hand as Keynes pointed out in the long run we are all dead.


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4 First print was in 1930 and 1936 respectively

5 Naturally the original rational expectations model is the model of futures markets presented in Muth (1961)
Barsky, Makiew, Zeldes (1986), Ball and Makiew (1994). Both have made significant progress in the understanding of the monetary policy and the behavior of economic agents, but without any conclusive definition of the exact behavior. Maybe the real solution is somewhere in between and we have to look at economic agents as more human being which have the ability to learn. So the learning theory based on the Bayesian economics is becoming more and more appealing to the economists. This middle of the road path has been pursued initially by Sims (1998, 2003) and further developed by Makiew and Reis (2002) and Reis (2006, 2006a).

• **The third level of discontent is the issue of causality.** Without going deep in the theory the best example of this would be the Phillips curve. If we assume there is an inflation output trade off, which is caused by which? Should we regress the inflation on output or output on inflation? Another issue here is what causes economic behavior. It has been generally believed the monetary policy has effects on monetary variables. However a fiscal theory of price level has been put forth (Bassetto 2002, 2003). This theory point cases where the changes in prices are caused by the changes in the fiscal policy and the level of government debt, not just the monetary policy. The issue of causality if often found in economic papers and most economic papers just assume which way the causality moves, this point was stressed in Sims (2005) although the argument can easily be dated as far back as Friedman (1969). The problem of causality by its very nature forces researcher to make mistakes, we are going to do the same (or make the same mistake) in the dissertation as well, but we are going to be aware of them.

• **The fourth level of disagreement is the very approach to the research.** Sims (2005) and Mankiew (2006) have raised this question and it is an interesting one. How should we approach the problem of monetary economics or for that matter of economics in general? Should the economist be more of a scientist or an engineer? Should we try to analyze the data more and use econometric techniques, should we more really on mathematics to describe the behavior of economic data, or even more important should we use mathematical and statistical techniques at all, maybe the words are just enough. Not to mention the issue of using the wrong model and knowing it is wrong as presented in Hansen and Sargent (2000, 2001, 2005).

• **The fifth and the most important level of discontent in my view is the actual approach to the theory of monetary policy.** Monetary economist is caught in a tautology. We really on data to see how the economic agent are going to behave, but at the same time we are aware that economic agents do not always repeat their behavior from the past nor that their economic decisions are in line with the models. This is clearly seen in the impulse response functions in papers where the impulse response function depends on the model and often contradicts the data; clearly pointed out by Mankiew and Reis (2002) Another problem along these lines is the fact that economists are making theories about the behavior of economic agents; they are not making exact
formulas. If we had formulas instead of models then we would be able to replicate the real world instead of using the model world⁶.

So how do we proceed from this point on? The five general problems which were stated here are something we have to keep in mind all the time we are immersed in the science of monetary economics. Some of the problems can simply be ignored; economist might prefer one theory over the other and then acknowledge the theory’s deficiencies. Some economists might just choose math over words since the math allows more complexity then words, that the words are just too narrow to be able to express everything. Some might also assume which way the causality moves, as already noted. In the end the most important question of all arises: The applicability of the theory put forth? As we shall see in the dissertation one of the main reasons for the large breath of the dissertation is the issue of applicability to the situations we find in economic data.

The problems we have put forth we are going to address immediately right at the now and how they concern this dissertation:

1. We are going to take the long term view of the economics. In the dissertation we are going to analyze the effects of the choice of the exchange rate regime. In order to do this to the full extent we have to take a long term view of the effects of the choice. By long term I mean 10 years and more.

2. We are going to use the rational expectations models for most part, but we are also going to use the learning techniques which are closer to the Bayesian economics.

3. The direction of causality is as follows: The central bank chooses the exchange rate policy, this choice affects the behavior of the economic agents and this behavior is manifested in the economic data. In order to understand the economic agents we are going to model their behavior based on the a priori assumption of the change in the economic behavior due to the changes in the exchange rate policy and then look for the confirmation in the data. First theory then empirics.

4. The approach to the research is going to be more “engineering” approach as Mankiew (2006) termed it. The economy is a system; we need to understand the system and then how to govern that system.

5. The problem of past data as something which has dubious usages will be noted through the layout of the dissertation. We are going to put forth the theory, without looking into the data, we are going to make assumptions regarding the behavior of the economic agents and then we are going to look at the data to see was our theory correct or not correct.

⁶ If we had a model which fully replicated the real world then we would not need models.
In the next part of we are going to look at the monetary policy in large economy, and then in the small open economy.

2.1. Monetary policy in large economy

The object of the dissertation is the investigation into the monetary policy of small open economy, however in order to understand small open economy we have to understand large economies first. One of the main differences between the large and small economies is the focus on the exchange rate and external balances. The central banks of large economies are not primarily concerned with the status of the exchange rate. The best example of this is the USA and the FED. It has been noted on several occasions that the value of dollar vs. other currencies is being watched by the FED; but FED does not choose policies based on the value of the dollar. USA wants a strong dollar, but do not conduct policies based on how they are going to affect the dollar. This is why most large economies focus on interest rate or inflation targeting and research monetary policy with those regimes presented in Woodford (2003a, 2003b)

Naturally it would be wrong to state the USA policy makers do not want more exports, but the USA policy makers do not designed the policies in order to stimulate exports per se, but rather to promote job growth and economic growth. At the same time the flow of capital is considered just to be there by the USA policy makers. While most countries always look for the buyer of their debt the status of the USA allows their policy maker's assumption the buyer of the government debt is just going to be there when the new debt is issued.

This particular set up makes the USA different from all other economies. Also there is the issue of size. The USA is 20% - 25\% of the world’s GDP, so the economic processes are different in USA then in the other countries. This is the reason why most models regarding the monetary policy do not look at the external balances of the USA. At the same time most models created in USA work best in the USA and not so good in other economies.

Due to these properties of the economy the behavior of the large economy like the USA is significantly different then small open economy. This explains why the policy designs are different. The difference between small and large economies is going to become apparent when we look at the Mundell-Fleming model, a large economy model which is adjusted for external balances.

The set-up of the monetary policies in large economies revolves around the interplay between the government and the central bank. In USA there are two distinct policies: the monetary policy and the fiscal policy. However those two policies are bonded together by simple balance sheet relationship: the FED’s assets are liabilities of USA Treasury.

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7 This point has often been stressed by the FED Chairman, Secretary of Treasury and the USA Presidents.
8 Source IMF
department. Change in monetary policy changes the outstanding amount of the government’s debt.

This is not the case in small open economy. Small open economies in most cases have made legal restrictions towards this policy interplay.\(^9\) There is no direct interplay between the monetary policy and the central bank in small open economies like there is in large economies.

The fact that the large economy is mostly self-sufficient is also reflected in the self sufficiency of the monetary system. The central bank produces the money and the money is used by the participants in the economy. Thus the impact of the monetary policy is large economies directly on economic participants is much more straightforward then in the case of the small open economy.

Large economy is not explicitly depended on the capital flows, nor do capital flows present a policy variable. Although with rapid increase of debt in USA and EU this assumption has becoming more and more questioned. No need to depend on foreign capital flows also presents another level of monetary self-sufficiency for large economies. One has to fully grasp the technological developments in last two decades. Before 1990s the money transfer was a complicated and slow affair, today it can be done within seconds. The fact that money today has no boundaries has opened a completely new level of economic policies.

It would be foolish to state that there is no relationship between the monetary and fiscal policy in the small open economy. This will be clearly shown in part 2.7 of the dissertation when we look at the Mundell-Fleming model and analyze the proper coordination between the fiscal and monetary policy.

### 2.2. Monetary policy in a small open economy

The very first questions we have to ask here is: what is a small open economy? For example Svensson (1997) considers New Zeeland a small open economy, an economy which has twice the size of GDP of Croatia or Slovenia.\(^10\)

There is a strong inversely proportional relationship between the size of the economy and external balances, just as there is an inversely proportional relationship between the sizes of the economy the speed of economic policies. The smaller the economy the level of self-sufficiency is going to be smaller, thus the dependency on the imports and outside world is going to be greater. Because of the issue of the size there is a strong possibility the small open economy has to have some external imbalances.

Friedman (1961, 1963) made a strong point regarding the lag in monetary policy. The data he has used was the data from USA, again in case of the small open economy we have to question this relationship. Following the logic of size we have to imply the changes to the policies are not necessarily instantaneous, but much faster in small than in large economies.

\(^9\) The Central Bank act in Croatia, within this law there is a clause strictly prohibiting the central bank from lending directly to the government as stated in article 40 of Croatian Central Bank Act, NN 75, May 2008.

\(^10\) Source: National statistical institutes
The dimensions of the policy making in small open economy are significantly larger than in large economies. Due to its monetary and economic size the policies in large economies do not necessarily have to take into consideration the world around them. This is not the case in small open economies. Whatever policy is considered in small open economies always another dimension has to be added: the outside world manifested through capital flows. Whatever policies are adopted the policy makers have to take into account how those policies are going to impact the current and capital accounts. This makes the decision making in small open economies harder and multidimensional.

For example let say the policy makers want to increase the level of employment in the economy. This can be done by attracting the green field investments which are going to hire local labor. The policy is going to imply the inflow of capital, the investments have to be made in the local currency. The inflow of capital is going to create appreciating pressures on the local currency, which might impact the exporter’s level of income, which then is going to decrease the government revenue from income tax if the exchange rate is allowed to appreciate. The impact on the government’s revue is just one of the variables which might present an issue with this policy What is if the appreciation is too high and the exporters lose jobs? On the other hand what if the central bank purchases the currency and keeps the exchange rate at the same level as before the inflow of capital. This action undertaken by the central bank will increase the liquidity in the system, decreasing the interest rates on the local currency and increase borrowing activity. Where is this increased borrowing going to go, to households for consumption or firms for investments? Also if there is a loss of jobs in the exporting sector due to the currency appreciation, will this loss of jobs be offset by the hiring in the Greenfield investment? What happens if the investor one day decides to leave and simply closes the investment? So the simple and straightforward policy to create jobs might be good, but the increase in the lending activity might be not so good, so what to do if this happens?

In the example above we have presented in a simple, but forceful way, the intricate relationships in small open economy. This simple example has a powerful message: the policies in small open economies are never simple and straightforward and with most policies the impact is both on the monetary and on the real economy.

2.3. The question of choice of monetary policy in large economy

In large economies the central bank can primarily choose between two policies: the control of monetary aggregates or the control of the interest rates in the economy. In Part 3 we are going to analyze in depth the monetary policy in large economies. For now we are going to state there is important difference between the control of the monetary aggregates and the control of the interest rate

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11 We are talking about the actual instrument of control money vs. interest rate, not the policy objective like exchange rate targeting or inflation targeting.
The main difference between the control of interest rates and monetary aggregates lies in the level of willingness the central bank to commit itself to the control of the economic business cycle. Let me be very clear on this. When the central bank chooses to control the quantity of money, the central bank has to let go of the control of the interest rates. If the central bank does not control the interest rate, the market forces will set the level of the interest rates based on the supply and demand for money. The control of the monetary aggregates has a very strong impact on the public’ perception of the central bank. By committing to the control of monetary aggregates the central bank clearly commits to the control of inflation, as was described in Blanchard (1984). However by letting the interest rates be determined by the market the central bank leaves the interest rates to move freely. The businesses and the general public have to take the interest rates as offered and at the same time suffer the consequences of the level of the interest rates.

On the other hand if the central bank chooses to control the interest rates the central bank has the ability to actively manage the economy and the business cycle as well. If the central bank controls the interest rates, then the central bank can use the interest rates and directly commit to the cyclical or anti-cyclical monetary policy. This approach to the monetary policy was practiced by Alain Greenspan as shown in Blinder and Reis (2005).

There is a very clear distinction between these two variables since they present two different ways the central bank can impact the economy. The first way the when the central bank only looks at the inflation and states that the control of the inflation is the absolute priority for the central bank regardless of the rest of the economy. The second way is then the central bank takes a broader view of the economy and tries to use monetary policy to guide the economic participants towards wanted path. This is done by influencing business decisions through interest rates.

2.4. The question of choice of monetary policy in small open economy

In case of the small open economy the question of monetary policy is not what to control, but what to do. Small open economy is directly opened to the effects of the outside world. Due to this the central bank uses exchange rate as the monetary policy variable to control. So the question arises what to do with the exchange rate. Should the exchange rate be fixed or should the central bank use the exchange rate as needed to adjust the economy.

The underlying question of this problem is the same as with the large economies. If the central bank stabilizes the exchange rate, the central bank will lose the ability to adjust monetary policy based on needs of the economy. In this particular case the central bank does not look outside of the box and just focuses in the exchange rate.

In case the central bank decides to actively use the exchange rate the central bank is faced with a problem who will shoulder the burden of adverse changes in the exchange rate. The question arises: How to conduct the policy with the minimum negative impact on the economic agents and what is the potential benefit of active use of the exchange rate? We are
talking in terms of a classical economic trade-off. Do the negatives of the active use of the 
exchange rate outweigh the benefits of the active use of the exchange rate? We will present 
though the model that the answer to this question lays in the scope of economic effect the 
central bank wants to have on the economy.

The main focus of the dissertation is the question of what to do with the exchange rate. 
As we shall see in the model presented in Part 3 the choice is very important for the economic 
agents. It is the **actual choice of the monetary policy that causes economic agents to 
change their behavior.**

In case of the large economies the choice of the monetary policy does not impact the 
economic agents as much as the conduct of the monetary policy does, especially with respect 
to the interest rates. This is the reason why in economic models the interest rate is such an 
important variable. With the change in interest rate, because of the actions of the monetary 
authority, the economic agents are going to adjust their economic behavior.

In small economies the conduct of the monetary policy does not have significant and 
immediate impact on the economic agents. Since the monetary policy is tied to the exchange 
rate the conduct of the monetary policy does not impact the behavior of economic agents. The 
best example of this is the case of the fixed exchange rate system. If the exchange rate system 
is fixed, economic agent it is not relevant what the central bank does to keep the exchange rate 
fixed, but it is more relevant the very fact the exchange rate is fixed. In this case it is not the 
conduct of the monetary policy (keeping the exchange rate fixed) which is important to the 
economic agent, but the fact the central bank has chosen to keep the exchange rate fixed.

### 2.5. Economic modeling

This part of the dissertation is going to make an overview of the modeling process in the 
economics as a science and it is going to try to create a description of the modeling process 
which is going to be used in this dissertation. If economics is a science then the object of the 
science should be to understand what it is studying. The natural sciences are using controlled 
experiments in order to be able to understand the world in which we live.

If a physicist tries to boil water, he will conclude the water changes its state from liquid 
to gas at 100 degrees Celsius given fixed atmospheric pressure. The reverse experiment might 
be trying to cool water in order to observe the water changing to solid state at 0 degrees 
Celsius given fixed atmospheric pressure. If we take air pressure as fixed exogenous variable 
the water is always going to boil at 100 and freeze at 0 degrees Celsius. This experiment can 
be repeated and results duplicated.

Social sciences or humanities observe human behavior and try to interpret the human 
behavior with respect to some events and here are the differences between natural and social 
sciences. While in natural sciences the experiment can be repeated more than once, in some 
social sciences the experiment can happen only once and can never be repeated again.
Economics as a science is in between, in some kind of purgatory. The events can occur more than once, however they can never be repeated in the exactly the same way. There are many instances of hyperinflation; Sargent (1986) in an excellent overview shows four of hyperinflations and their economic effect, one of the earliest examples is Cagan (1956). Similarly Rohatinski, Anusic, Sonje (1994) cover the inflation in Croatia. However neither of the inflation described can be repeated. In Sargent (1986) all hyperinflations have exhibited some similar patterns, they have grown slowly over time, the inflation spiraled out of control and in the end the inflation came to an abrupt end. However it would be very bold to put German inflation in 1920s and Croatian inflation in 1993-1994 in the same bucket and explain them in a same way.

How do we explain events we are observing the economics? Because if there is abundance of data in any fields of science it is in baseball and economics. Today within the tip of our fingertips the statistics regarding any aspect of economic life are readily available. In the dissertation we are going to use many forms of data in order to analyze the events which have transpired over certain period of time. However each of these economic data were generated under particular and unique circumstances. Some circumstances might have been similar, but never exactly the same.

In comes: the question of modeling. The history of economic modeling is a history of a paradox. At the beginning there was no modeling. Hume (1752) and Ricardo (1817) did not use any mathematical formulas in order to explain the economic events which have occurred in the economy and yet centuries latter their ideas are transferred into mathematical equations, like the ones presented in Lucas (1972) and Barro (1974, 1979) who both cite above works. Graph (1) clearly shows there was no need for any kind of modeling of inflation until the start of 20th century. It is interesting to make an overview of the development of economics models so that we can better understand the models we are going to use in this dissertation.

In the beginning the economics was a verbal science. Hume and Ricardo wrote books which would be characterized today as nonfiction popular writing. Then with the ascent of the First Chicago school, mathematics started to enter economic writings. Once the econometric Society was formed in Statler Arms hotel in Cleveland in 1930 mathematical techniques started to be used heavily in economics.

By the time of the Second Chicago School, an argument between economists has developed. One side of the argument was Milton Friedman and the other side of the argument was Jan Tinbergen. Keynes and Friedman were very weary of economist's use of econometrics. The main reason for this weariness was the very nature of econometrics.

What econometrics does is use past data and try to create the best fit for the past data. Both Friedman and Keynes have observed the purpose of economics cannot be to create a best fit line through the data. Even if Tinbergen’s purpose was noble it was extremely ambitious. Tinbergen tried to create a business cycle model with econometrics and then use the model in order to curb the volatility of the business cycle. However this can not only be achieved with econometric, there has to be a deeper understanding of relationships in economics. To some extent avoiding large business fluctuations is the very purpose of economics and especial macroeconomics as a science. Lucas in his (2003) paper states that this purpose of
macroeconomics has been achieved since we did not have another Great Depression. The policy response to the financial crisis of 2008 and 2009 showed the main purpose of macroeconomics has been achieved in practice.

The obsession with the understanding of macroeconomic behavior is still at the very heart of modern macroeconomy; what can an economist do in order to help improve the current state of the economy? However the very nature of the economist in this whole process is still ambiguous. As Gregory Mankiew asked correctly “economist: scientist and engineer”? (Mankiew 2006).

Once the basic econometric techniques were developed, paralleled with the invention of computers and increase in the computing power econometrics needed a stable economic theory in order to be fully exploited. The use of econometrics came to a full force in 1960s. With the theoretical background of Keynesian economics and the policy tool of inflation-output tradeoff it was easy to calculate how to govern economy. All of a sudden the governing of the economy was easy.

The mathematical models were created in the form of the IS-LM model and the AS-AD model. Each of these models had a strong mathematical explanation and the graduate students were though how to develop and improve some small portion of the IS-LM model, as ironically pointed out by Lucas and Sargent (1981). The econometric models were created in the form of the linear regressions. The policy objective was to decrease unemployment with understanding that there will be an inflation tradeoff. In case of rise in employment the policy maker should use the IS-LM model in order to prevent the economy from overheating. This prevention of overheating would come at the cost of increase in unemployment, but decrease in inflation. In case of high unemployment the IS and LM curves could be used to stimulate inflation and then decrease unemployment. There three pillars (mathematics, econometrics, policy) provided the perfect trinity for stable, low business cycle oscillation.

However the Keynesian economics collapsed onto itself and the stagflation period of 1970s brought into question the whole economics as a science. There were two main problems with the Keynesian model.

- The first one was the problem with the microeconomic foundation. The Keynesian models were aggregate macro models. The IS-LM model assumed uniformed behavior.
- The second problem was lack of expectations. The Keynesian economics assumed once the policy was announced the economic participants would behave as the model predicts every single time for exactly the same policy. There will be no changes in behavior before the policy announcement, hence there is no anticipation of the policy behavior and no reaction before the policy is announced, only after the policy is announced.

There has never been any doubt the expectations are part of the economic behavior. In order to understand expectations in economics we do not need to move any farther than the mirror in the bathroom. I get a salary and I make plans what I am going to do with the money I receive. I also read the press and if I read in the press the bank is having problems, given the past bank
failures in Croatian economy, I will go to my bank and take the money out. However the question is how to incorporate the expectations parameter in the economic model?

The first most notable attempt was from Friedman with the theory of adaptive expectations. The principle of the adaptive expectations is that the economic participants have expectations regarding the future. The expectations are created using past observations of the economic data, plus the difference between the previous expectation and the actual observed data.

The adaptive expectations can be represented in the following equation

\[ y^e_{t+1} = \alpha y_t + \alpha(1-\alpha)y_{t-1} + \alpha(1-\alpha)^2y_{t-2} + \alpha(1-\alpha)^3y_{t-3} + \ldots + \alpha(1-\alpha)^ny_{t-n} \]

If we multiply the above equation with \((1-\alpha)\) we get

\[ (1-\alpha)y^e_{t+1} = \alpha(1-\alpha)y_t + \alpha(1-\alpha)^2y_{t-1} + \alpha(1-\alpha)^3y_{t-2} + \alpha(1-\alpha)^4y_{t-3} + \ldots + \alpha(1-\alpha)^{n+1}y_{t-n} \]

By subtracting the second equation from the first one we get

\[ y^e_{t+1} = \alpha y_t + (1-\alpha)y^e_t \]

Where \( y \) is a variable and \( \alpha \) is parameter.

In the adaptive expectations framework we have the future expectation based on weighed past data and the expectations of the current data. This mechanism allows us a mathematical formulation of the expectations. The adaptive expectations can also be incorporated in the econometric models. Economic participants can learn and develop over time.

However the problem with this modeling approach is the model based on the past data. The fact the model is based on the past data is one of the fundamental problems. We are faced with this problem in this dissertation as well. Lucas in his 1975 paper (Lucas 1975), raised the question of the use of the past data in econometric policy evaluation. How are we going to use the past data if the economic settings have changed? Using our water analogy, what Lucas tried to say is the in economics we know there is water, we know that if the water heats up and at some point the water is going to boil, however we do not know at what temperature. So what economists do, they sample the different observations of boiling of water and then run regressions.
It is hard to repeat the state of hyperinflation in economic. Although the water boils every time, uncontrolled increase in the quantity of money will lead to inflation but over the long run if the supply exceeds the demand. But it is hard to predict when the inflation will come up and when it will turn into hyperinflation? We cannot conclude that every time the quantity of money increases the inflation will have the same development. This was the crux of the Lucas critique; same policies do not give exactly the same results all the time. Although this point may seem as obvious as the light of the sun on a bright sunny day it is still sometimes ignored by the economists.

Let us look at three cases in Croatia Cota, Bahovec, Erjavec (2005), Podsedel and Tica (2007) and Stučka (2003). All of these papers analyze the impact of exchange rate on other economic variables. Cota et all (2003) look at the impact of exports and exchange rate volatility. Using econometric techniques Cota et. all try to model Croatian export function using the data on exports and exchange rate movement. In Podsedel and Tica (2007) the authors try to analyze the pass through effect in Croatia and at what change of the exchange rate the pass through effect is going to take place. After extensive econometric modeling there is a conclusion and a percentage number when the change in Croatian exchange rate is going to be transferred into inflation calculated based on the existing data. However there is no mention of effects due to the change in the exchange rate regime, in spite of the fact the authors are investigating deviations in the exchange rate. Stučka (2003) tried to model exports and made a conclusion at what exchange rate change the imports could increase or decrease. He concludes, based on the data with stable exchange rate, the exchange rate has no effects on exports; thus implying after the exchange rate regime switch the data will retain exactly the same properties.

All these papers are ignoring the Lucas critique and methodologically are completely flawed. The papers take the data generated under one exchange rate regime and then try to make conclusions about what would happen if the system changed, completely ignoring the fact that the change in the exchange rate regime would also change the behavior of the participants which have generated the data. The models are strictly econometric, without explicit modeling of the economic participants and their relationships. As stated by Zbašnik (2008a, page 554) “Because of the anomalies of the capital flows there is possibility for the change of the exchange rate, and with the change in the exchange rate significant numbers of other economic variables will change as well”. What the econometrics show is a relationship in the data, not what caused this relationship to occur.

It is wrong to create an econometric model and then analyze what would happen if the exchange regime changed, because the assumption that the parameters would remain the same is wrong. It is wrong because the behavior of economic participants would change and so would the process of the data generation. However it is not wrong to conclude how the variables would change if we remain with the same exchange rate regime. So the models created are not useless, they are just good for one exchange rate regime and cannot be used for alternate policy valuations, which is what Lucas (1975a) tried to say in the first place. The models can be used to explain the behavior of economic agents under existing exchange rate regime, but cannot be extended into alternative exchange rate regimes.
In order to strengthen the case even more, let us now look at a very simple AR regression for a real economic variable:

\[ y'_{t+1} = \alpha + \beta y_t \]

What we just concluded that if the exchange rate regime changes so do the parameters \( \alpha \) and \( \beta \). Now what can be done to test alternative exchange rate regimes?

We could use the data from another economy which has different monetary regime. So for example we could use Slovenian data from 1995 to 2004; in order to determine what would happen to exports if we change the exchange rate. However this has no practical meaning since the currency values of the exports in Croatia and in Slovenia are not the same. Because of this once we get the parameters \( \alpha \) and \( \beta \) from two regimes we would still not be able to have a quantitative answer. The best we could do is to see what is the change in the behavior of variables; but without a definite quantification for policy behavior. What can we do? Before we answer that question we will map the modeling process in economics.

There are two ways to create a model in economics. The first way is to model a very specific economy which has some special feature. This modeling process is very common in economics. One of the best examples of this kind of modeling is Lucas (1972). In this paper Lucas tries to analyze the behavior of economic participants when they do not have complete information, but try to act as best as they can getting the maximum benefit using the information they have. Another example of this is Lucas and Stokey (1983) where the authors try to model the economy which has no capital; or Woodford (2000) where we see a model of economy which has no money. The overall characteristic of this type of modeling is the fact that is an economic hotcource. What we are getting in these papers is high level economics and high level mathematics, but with questionable applications in the real world. This is the reason why economic modeling is a paradox. Economics as a science to a large extent has moved from no math to too much math for sake of math.

The problem with this kind of modeling that is very often leads to high theory which loses touch with economics reality. These kinds of models are, for example, theoretical models of multiple models where the policy makers do not know what the “true” model is so they are using multiple models in order to approximate the economy. An interesting, but limited use of a model as seen in Hansen and Sargent (2006).

The second way to approach modeling in economics is to look at the data and then try to explain what we can see in the data and why do those events transpire\(^\text{12}\). This type of modeling can be done in two ways. The first way is through econometrics, which we have already flagged as somewhat dubious. Since the economic situations change, the reactions of economic participants are not always the same, so in trying to get the best fit line what econometrician is doing, is just trying to mathematically replicate the past using the past data and then make predictions about uncertain future. Mathematics in to create models where

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\(^{12}\) Please note the use of present not perfect
economic participants are behaving in the way the data suggests. This is the approached used in DGSE models.

Let us use Croatia as a simple stage for mathematical modeling. Looking at the banking statistics at the end of 2008 the total loans to households were 122.7 bln HRK and that the total household deposits were 136$^{13}$ bln HRK. Loans to households and household’s deposits in the banks are almost the same. How do we explain this in a model? One way is to create a model of a small open economy and then try to see what it means for the economy when we have an unnatural disturbance where investment does not equal savings, but savings equal loans. In the process of research the economist might ask himself the following questions:

- What sources of economic growth does a country have if savings equal loans?
- How stable are the banks' balance sheets given this loans and savings distribution if there is an economic crisis?
- Is there a split inside the population to those who save and those who borrow or all households both save and borrow.

The economist might try an initial economic set up and then try to mathematically develop the behavior of consumers is a such a way so that eventually the participants in the economy start to behave and produce patterns we can see in the data.

The process of modeling economic participants by trying to replicate the behavior we can see in the data appears to be more natural and it will be used extensively through this dissertation. However the backdrop of this approach is inability to be used quantitatively. This use of modeling will be able to provide us with explanations of how economic events have occurred and it might also be used to extended economic situations, but it will not provide us with a quantitative values. As we have stated in economics we know that the water is going to boil, however we do not know at what temperature and in what time in every experiment. That is the reason why modeling should be done is a way to try to replicate and explain events we see in the data. There is no need to have quantitative explanations about the exact number behavior of economic participants, but all policy maker needs is to know how the economic participants are going to behave, not necessarily with what magnitude.

### 2.6. Mathematics and economics

Using mathematics in economics is a sword with two edges, on one side it can provide us with an easy way to represent behavior, but on the other hand it can also cause us to become involved with the complexity of mathematics and lose the sight of the ultimate goal. For starters we have to underscore two items when we try to model economic participants:

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$^{13}$ Data from www.hnb.hr
• Economics participants create expectations about the future and participants are going to behave in accordance with their expectations.
• Economic participants execute their economic behavior over some time horizon.

Naturally there are instantly two caveats to this proposition. The first caveat is how the expectations are formed and the second is for how long to economics participants create their plans. Expectations of economic participant are what make economics an interesting science. Economics participants not only make plans about what is happening right now, but what is going o happen in the future. So in their plans the economic participants are incorporating expectations about future events.

One of the fundamental question, and the debate is still open, is how the expectations are formed. One way to explain expectations creation is through some adaptive process. This method was popularized in 1960s in the works of Milton Friedman (Friedman 1969, Friedman 1977). According to this theory the economic participants have some past observations and based on their past observations economic participants create expectations about the future. So the expectations are the rolling average of the past. However the economic participants also have past data of their own expectations and how those expectations match with the actual data. So each period the expectations get updated in order to be more precise. Since the updating process takes time the economic participants adapt their expectations over time as well. This adaptive process can easily be incorporated into economic models and can be used to develop explanations about certain developments over time.

The adaptive process does not allow for large and fast breaks in the economic behavior. Since the process is adaptive over time nothing fast can happen in the economy. This adaptive expectations process precludes the economy from having any kind of extreme and sudden change in behavior. The economic participants develop slowly over time; they cannot just change their behavior in a short period of time. For our analysis this is very inconvenient since we are trying to analyze sudden changes in the economy in the form of the exchange rate regime switch.

The second way to form expectations is rationally. This implies economic agents create the best possible expectations given the information they have. It is important to point the expectations are formed under existing information which might not be full and the expectations are best and optimal under given circumstances. One of the fundamental arguments against the rational expectations is that economic agents are not rational and that their expectations are not rational either. The basis for this critique lies in the word rational. However the rational expectations do not have anything to do with the rational behavior. For starters the whole theory of rational expectations was first developed as a model to price futures by Muth (1961), Lucas (1972) developed a model to explain why the Philip’s curve exists in the economy with information flows. Lucas (1972) saw Philip’s curve as development of economic participants who have different sets of information. Each economic participant tried to behave optimally under existing set of information, however because of different set of information the outcome would not be in line with the expectations for each participant and there was a whole distribution of expectations in economy. This also does not
preclude the possibility, that in retrospect, a decision which seems good turns out to be bad. What might seem best today in retrospect is not. Hindsight is always 20/20.

Lucas and Sargent (Lucas and Sargent 1979) showed all economic participants have to have the same model. This assumption of the same model, one model in the economy, in 1970s might have seemed highly controversial and radical but today is the state of facts. We are going to fully elaborate on this assumption both in words and in mathematics.

First we are going to elaborate “one model” assumption from the mathematical point of view. Let us assume that economic participant is faced with a problem in the economy. How to predict prices in the economy? The economic participant has the following model:

\[ p_t = \alpha + \beta p_{t-1} + \varepsilon \]

The price level today is based on the price level in the previous period and \( \varepsilon \) is the error term with \( N(0, \sigma) \) distribution. If the economic system does not change and it is not radically altered the parameters \( \alpha \) and \( \beta \) are going to be stable over time. In the above equation the economic participant is backward looking.

If the economic participant is forward looking the above equation would be

\[ p_t = \alpha + \beta E_{t+1} \left[ p_t | \Omega_t \right] + \varepsilon \]

Now the parameter \( \Omega \) is the available data/information set at time \( t \). Moving the above equation one period in time forward we get

\[ p_{t+1} = \alpha + \beta p_{t+2} + \varepsilon \]

Substituting the equations we can move we get

\[ p_t = \alpha + \beta (\alpha + \beta p_{t+2}) + 2 \varepsilon \]

Doing this repeatedly and then taking the expectations we can come up with the solution to the above equation as

\[ p_t = \alpha + \beta p^* \]
With

\[ p^* = \frac{\alpha}{1 - \beta} \]

How did we come to this solution? We have used two main assumptions. The first one is that \( p_t \equiv p_t^* \equiv p^* \) in steady state. The expectations of economic participants are correct. This immediately leads us to the second assumption and that is that the expectations of the error term \( \varepsilon \) are 0. The main characteristic of the solution lies in the value of \( \beta \). In case \( \beta = 1 \) there is no solution. In case \( \beta < 1 \) there will be stable solution and in case \( \beta > 1 \) the solution will be unstable. The properties of the solutions of the rational expectations models can be found in Blanchard (1983), Blanchard and Kahn (1980), Christiano (2002), Sims (2001) Sims and Zha (1998).

The fact the predictions of economic participants have to be correct was a controversial assumption. The rational expectation economics assumes that the policy makers and the economic participants have the same model of economy. Is this truly so hard to believe?

Who are the policy makers? Central bankers who are in charge of the monetary policy and government ministers who run the fiscal policy. Who are the economic participants? People in banks, other financial institutions and general public. However the people in the financial institutions, the analysis, have the same education as do the people in ministries and central bank. They have all went to the same schools and they have the same access to the research papers published. How can any of us believe the bankers in City group or Goldman Sacks have significantly different economic model then the economists working in the central bank or ministry of finance? The models are the same since the source of the knowledge is the same. They, based on the model predictions the financial analysis, through media and other public appearances, make their predictions about relevant economic variables publicly known. So the general public has the information regarding the possible future variables in the economy and that information is obtained using the same models. Now the circle is complete and the fundamental assumption of the rational expectations of “one model” is revealed as both the beginning and the end\(^{14} \). The source of the economic knowledge is the same, the economic data is the same and the message is through the media given to the general public. Since the amount of knowledge is bounded but expanding and the data sets are the same the results of individual models have to be very similar. It is not possible for the central bank to predict GDP growth of 5%, one investment bank of 2% and the third independent research think tank economic growth of -1% for the same economic period. This logic is the foundation of the theory of rational expectations and even if we take out the entire math out the equation the assumptions of one model still holds.

\(^{14}\) To quote the Architect from the movie Matrix 2.
We now understand why the error term from previous equations has to be equal 0 on average. If the error term was not 0 in that case the value of the parameters $\alpha$ and $\beta$ are systematically wrong and economic participants would correct their model to make the error term equal to 0. This is the basic assumption behind the premise the public cannot be fooled by the government policies in the long run as pointed by Lucas (1972, 2003). However the main caveat of the rational expectations and the critique of econometrics in general is that the parameters $\alpha$ and $\beta$ will remain the same if the economic system does not change. This implies that a change in economic system might alter the behavior of economic participants and the change in the behavior of economic participants is going to change the value of the parameters $\alpha$ and $\beta$. The dissertation is going to argue and try to look for proof in the economic data a switch from variable to stable exchange rate regime or vice versa is such event.

The use of rational expectations has become standard in modern macroeconomics either as a mathematical tool (Blanchard 1983, Blanchard and Kahn 1980, Sims 2001,) or as an underlying assumptions in the model (Reis 2006, 2006a, Mankiew and Reis 2002, Woodford 2006) or as a framework for economic research (Sargent 1980, 1986, Sargent and Hansen 1991, Sargent and Wallance 1973, 1981, 1982). We assume economic participants have expectations, we are also assume economic participants try to create plans about the future, operate over some time horizon and are faced with constraints. For example one of the most commonly used mathematical problems in the economics is how to maximize consumption given the constraint of income.

In order to fully understand the use of mathematics in the model we have to look at the thought process of an economist when he creates a model. An economist observes a pattern in the data and then tries to replicate the process in mathematics. Let us stick with the maximization of consumption. The economist tries to explain how the consumers maximize consumption. The income can be split between consumption and savings so we have:

\[ I = c + s \]  \hspace{1cm} (2.1)

However what if the consumer has access to loans we have

\[ I + \varphi = c + s \]  \hspace{1cm} (2.2)

Where $\varphi$ is new credit. Now the problem we face is how to model the issue of time. If we have credit we know the credit has to be repaid to the bank, we can assume the credit has to be repaid in the next period so now we might extend our model to

\[ I + \phi = c + s - \varphi_{t-1} \]  \hspace{1cm} (2.3)
Now the equality for period \( t \) (\( t \) subscript for \( t \) period variables is omitted) has to be split between the income and credit in time period \( t \) on income side and consumption, savings and credit from the previous period on the expenditure side. But what if credit is not free and some cost has to be paid for the use of credit facilities. In that case we have to extend our model even further to:

\[
I + \varphi = c + s - \phi_{t-1}(1 + r)
\]

(2.4)

Where \( r \) is the interest rate paid on the amount of used credit from the previous period. We can see how the model is extending into more and more directions.

Another question which has to be raised is how to model the process through time over several time periods. One way is to tackle the problem of maximization in each period separately. This can easily be done using linear programming. But the problem with linear programming is the fact that the linear programming solves the problem for each time period separately. What we are looking to solve is the behavior of economic participants over several periods while obtaining the **optimal path through time**. In order to be able to perform mathematical optimization over several periods we have to have a mathematical procedure which is going to be able to provide us with following items:

- Clearly defined variables in the model which the economic participant has the ability to control
- Clearly defined constraints the participant is facing
- Ability to incorporate expectations in the model

The mathematical technique which solves all of these problems is dynamic programming. We have a consumer who is trying to maximize utility and utility comes from consumption. The consumer has some utility function \( u(c) \). The utility function is at least twice differentiable, continuous and concave. The consumer is going to maximize this utility over certain period of time.

Now we have the control function, which is \( u(c) \), it is called the control function because the consumer has the ability to control how much it is going to consume each period. The problem the consumer is trying to solve is:

\[
\max \sum_{t}^{t+n} \beta^t u(c_t)
\]

(2.5)

What the consumer wants is to maximize the present value of utility from consumption starting from period \( t \) to period \( t+n \), or for \( n \) periods. The parameter \( \beta \) serves as a discount
parameter. This implies that the consumption tomorrow is worth less than the consumption today. The equation 2.5 can be calculated as a value, so we can say that:

\[
V(A) = \max_c \sum_{i=1}^{t+n} \beta^i u(c_i)
\]  

(2.6)

With \(c_1 = x\), some positive value

With \(c_{t+n} = C\) total value in last period

Now what happens at the end of the very last period \(t+n\)? In this period the planning horizon for consumer is over and he is going to consume everything he has left. So the last period consumption is equal to \(u(c_n)\). This is hardly surprising since the planning horizon is over there is nothing more for the consumer to do, but to consume everything. What about the period \(t+n-1\), or one period before the end. In this period the consumer will have to balance the consumption between the last period and the one before period. In this case the equation would look like:

\[
V(A_{t+n-1}) = \max_c u(c) + \beta V(A_{t+n})
\]  

(2.7)

We can now move backwards one period and then one more and perform the recursion all the way back to the period \(t\). In period \(t\) (or starting period) we are going to have the function:

\[
V(A_t) = \max_c u(c) + \beta V(A_{t+1})
\]  

(2.8)

The above equation is called the bellman equation and it is the workhorse of the dynamic programming and recursive economics. For developing economic dynamic programming problems see Adda and Cooper (2003) or Gong and Semmler (2006). In time period \(t\) the consumer has to optimize between the consumption today and the remaining amount of present value of utility. Doing this process recursively the consumer can obtain the optimal path of consumption.

Now we are going to extend the bellman equation and incorporate the expectations. We do not need create the expectations about the value of consumption in the current time period, since we are deciding how much to consume in the current time period, the only expectations we can create is about the remaining amount of the present value of all of the future utility from consumption so the expectations augmented bellman equation will look like this:
We are going to maximize the current time period utility with respect to the expected future present value of utility conditioned on the information we have at the time period t. What we have done is to break the time path of n periods into two periods: today and the rest of the time. The solution to the problem was procured by going backward from the end and then solving the problem forward. This process of going to the end; then calculating the perfect path; then going from the beginning back to the end is the recursive procedure which enables us to obtain the optimal time path.

The expectations are conditioned on the information we have in time period t, this is right up the alley of the rational expectations assumptions about the expectations creation. What the economic agent is going to do is try to predict the optimal consumption using his expectations about the future. The expectations are going to be formed using all of the available information at that time period.

Once the recursion is solved the economic agent obtains the policy function, which is optimal consumption in each time period:

\[ h(c^*) \]  

We are using the approach of an engineer in our approach to the economics? If we try to explain the economic behavior sooner or later we are going to start using mathematical tools. One equation is worth a thousand words. The human behavior is very complex and in order to make our models more and more realistic, it is inevitable the economics moves closer and closer towards more and more complex mathematics. Before the development of the dynamic programming the economics did not have a tool to explain the behavior of economic participants over time. Once the dynamic programming was invented and fully implemented with the onset of rational expectations revolution the door was opened. In this simple modeling example we have also shown how it is easy to implement the rational expectations into bellman equation. Naturally we are assuming the expectations are created rationally, they can be created in a different ways as well.

After the initial introduction of high level mathematics it was only a question of time before boundaries of economics were pushed more and more and with each new push another more complex mathematical tool was used. Today is not surprising to have optimal control or topology in a paper about monetary policy and use of high level of mathematics is standard in macroeconomic textbooks (Blanchard and Fisher 1989, Romer 2006, Stokey, Lucas and Prescott 1989, Lungqvist and Sargent 2004, Hansen and Sargent 2007). The methods used in those books are also used in the dissertation as well.

\[ V(A_t) = \max_c u(c) + E[\beta V(A_{t+1})|t] \]  

15 Lucas (1972) states “models presented here are based on dynamic programming”
The main purpose of mathematic still remains the same, try to explain the human behavior which we can find in the data. The purpose of mathematics as tool of analysis is to be used to explain how the behavior of economic participants changes, given the changes in the structure of economics. This is how we are going to use math in this dissertation. The models created are going to serve as tools for and of indicative behavior of economic participants. Then we are going to change the structure of the math, the change in mathematical structure of the model is going the predicted the change in behavior of economic participants. Once the math is done we are going to see does the math match the economic behavior and see do our theoretical assumptions make sense.

The next part of the dissertation is going to re-examine the Mundell-Fleming model of open economy. There are two main reasons why we are doing this digression. The first reason is the fact that Mundell-Fleming model has some imperfections, but it is still the workhorse of modern international economics. The second reason is that the Mundell-Fleming model presents a great starting point to develop the questions we want to investigate in this dissertation.

2.7. Introduction to small open economy

This part of the dissertation will serve as a basic overview of small open economy. It would not be prudent to dwell into the details of the functioning of a small open economy without first understanding some of the basics problems small open economy is faced with. This part of the dissertation is going to have two major functions. The first function will be to serve as a “question maker” for the rest of the dissertation and the second function will be to present us with the basic problem all ex-socialist economies have faced: the problem of transition.

In order to be able to model the micro foundations of small open economy we are going to start with the mother of all small open economies models and that is the Mudell-Fleming model based on Mundell (1968). This basic macro Keynesian model will provide us with some explanations of the problems the small open economies face, but at the same time we are going to analyze the gaps in the modeling process and open questions which we will try to answer thought out this dissertation. Later work on this topic was done in a seminal work by Dornbush (1976)

We are also going to look at the process of economic transition the ex-socialist economies have faced and here we are going to look at what is the meaning of the transition, what are the main goals of the economic transition and in the end what might be some results of the transition process. We are going to introduce the transition process as a game theory problem. The game theory problem is particularly interesting for us since we are going to focus on one of the main strategies used in the transition process and that is the choice of the exchange rate regime.
2.7.1. Mundell-Fleming model of small open economy

Standard Keynesian model was focused on the issues like the effects of the fiscal and monetary policy, model developed by Mundell (1968) looked at the importance of outside effects on the economy mostly shown through the imports, exports and the capital flow.

The model developed by Mundell uses the basic Keynesian model for its foundation. When Mundell approached the standard Keynesian model of aggregate demand presented through the IS-LM relationship, he realized the model is insufficient and cannot be applied to an open economy. The reason for non-applicability is lack of oscillation in the values of the country’s currency, changes in the real exchange rate and free flow of capital. In order to model those changes and show how changes in the values of currency and capital flows affect the economy Mundell (1968) introduced a capital mobility factor in the model. The addition of this factor can be seen as a third line in the IS-LM model, the capital mobility curve, creating the IS-LM-CM model. The new, third curve represented the real interest rate imposed upon the country from the rest of the world. Of course the CM line was not fixed for ever, only in the short run and over the long term the CM curve could change.

We are going to assume the aggregate supply curve is sloped upward and static. There are no real shocks to the economy in the short run. The shift in the aggregate demand curve will cause a change in the GDP with an adjustment to the price level. The money can influence real variables in the short run.

One of the main postulates of the IS-LM model is the Hick’s assumption the economy can fall in the liquidity trap, due to Hicks (1937). This assumption is strongly rejected in the IS-LM-CM model. The main reason for this is the addition of the capital mobility (CM) curve to the model. With the CM curve there can be no liquidity constraints since the economy can always get funds from the rest of the world. The domestic interest rate has to converge to the world interest rate. The country can borrow money from the rest of the world, thus the government deficit, government budget and capital spending by the government could be funded totally exogenously, without any crowding out. The model also assumes the economy can undergo strong inflation due to devaluation of the currency on the foreign open market or due to an increase in the monetary base because of the over expansive monetary policy.

The model and interpretation of the model here follow Vidaković (2005b). We are going to make some basic assumptions. In the world we are analyzing, there are two parts or we will call them countries. One is our small open economy and the second one is the “World”. There are no constraints on the capital mobility and no barriers on trade. We shall assume the “World” has expectations about the real exchange rate and real rate of return on investments they are expecting when they invest in our economy. If there is a shift in the expectations all shifts in the expectations are simultaneous for all investors in the “World”. The same thing holds for our small open economy. Both the “World” and our economy are stable countries without any internal political, social or political crisis and insecurities.

The basic function of the model is the function of GDP, the function consists of four separate functions: public (household) consumption, investment, government spending (as
usual here are only real spending and not government transfers) and the current account, which is composed of the import and export functions. So we have the following standard notation

\[ y = c + i + g + (im - ex) \]  

(2.11)

Where each element has its usual meaning, \( Y \) is the gross domestic product, \( C \) is consumption, \( I \) investment, \( G \) is government spending, \( IM \) are imports, \( EX \) are exports.

Now we are going to develop each of the functions from the GDP function and analyze them. First we are going to look at the consumption function. The consumption function is the function of the following variables:

\[ C(Y, r, \pi, W/P, E/P) \]  

(2.12)

Where each variable has the following notation: \( r \) is real interest rate, \( \pi \) is the inflation rate, \( W/P \) is real wage and \( P \) is the price level, \( E/P \) is real exchange rate.

The consumption has a positive relationship with the real wage, as the economy is producing more goods the consumption will go up. The changes in the nominal and the real wage will also simulate consumption in the economy. The relationship \( E/P \) is the extension of the standard Keynesian model; here we can see the influence of the open economy in the form of the real exchange rate. The appreciation of the real exchange rate increases consumption. If the real exchange rate appreciates the demand for foreign goods increases and the participants can buy more of the foreign goods for the same amount of money due to the real appreciation. However this behavior increases consumption, but it decreases the GDP since the economy is consuming more of the foreign goods. We will expand the consumption function and write it in the following form:

\[ C = c^o(-r, Y) + A + c(Y, -r, -E/P, W/P) \]  

(2.13)

Where \( A \) is

\[ A = z + (y, E/P) \]  

(2.14)

c\(^o\) now denoted the autonomous consumption give as a function of \( c^o(-r,y) \). The autonomous consumption is the basic “sustenance” level of consumption in the economy. The notion of the autonomous element in the economy will become clearer once we look at the imports. The variable \( A \) is in fact a function that represents the demand for imports. The function \( A \) is a function of the autonomous demand for imports denoted by \( z \) and the variable
part which is a function of real GDP and real exchange rate. The autonomous demand for imports is the representation of demand for goods which are necessary for the economy to function, but can be not produced in the small open economy. The smaller the economy, the higher level of autonomous imports, one of the basic examples of the autonomous imports in case of the European small open economies is oil. The only way for the economy to completely eliminate the autonomous imports is to become self-sufficient.

The investment function represents all investments in the economy and it depends of the following variables:

\[
I (E/P, A^*, CM) \tag{2.15}
\]

Where \( A^* \) is foreign demand for the domestic goods, \( CM \) is the real interest rates imposed by the rest of the world on our economy. Using the same logic as with the consumption function we can now expand the investment function into the following form:

\[
I = i(-r)^0 - i(CM) + iA^*(CM,E/P) \tag{2.16}
\]

The investment function is composed of autonomous investments \( i(-r)^0 \) which depend inversely on the medium term real interest rate. The logic of the autonomous investments is the same as with the autonomous consumption, there has to be some level of investments in the economy that represents the basic economic activity. The second part of the investment function is the foreign investments, denoted as \( i(CM) \). Foreign investments will depend only on the capital mobility curve or the current level of real interest rate imposed on the country by the world. To be more precise the foreign investments will depend on the difference between the interest rates in the resident country of investor and the real interest rate in the small open economy we are modeling. A rational investor will invest in the country which has higher level of real return. The third part of the investment function is the investments made abroad. These investments can be in the form of exports or actual contracts between the resident firms and the firms from other countries. The investment from our small open economy to the rest of the world will depend on the temporary disequilibrium between IS-LM-CM and the long run trend in the real exchange rate.\(^{16}\)

As in most Keynesian models, this model assumes that the government spending is an exogenous variable and has direct effect on the GDP. Increase in spending will increase GDP; decrease in government spending will decrease GDP, with necessary adjustments to the price level depending on the course of the fiscal policy. Although in this model it will be assumes the government can determine its spending and run an unlimited amount of deficit through the foreign debt. In reality this assumption might not be so realistic, since there is an upper level o

\(^{16}\) Long run changes in the real exchange rate will not be analyzed and are left for other parts of this dissertation
the government debt, for this short term model it will be assumed the government can borrow enough to fund all of its projects and budget. The main foundation behind the government spending being exogenous is the fact the government collects taxes and all of the budget deficit can be financed through either domestic or foreign borrowing. Ricardian equivalence is ignored here and assumed to be undone as proposed in the Barsky, Mankiew, Zeldes (1986).

The import function has the following form:

$$\text{IM} (E, E/P, Y)$$

(2.17)

Imports as an element of the GDP are inversely related with the nominal and real exchange rate and positively related to the GDP. As the currency is appreciating the level of imports will rise, opposite will happen when the currency is losing value. However in the case of the fixed exchange rate, when there are no changes in the nominal exchange rate we have to focus on the real exchange rate. The movement of the IM function because of the changes in the real exchange rate is the same as with the nominal exchange rate. As the real exchange rate is appreciating in value the level of imports will go up, since the foreign goods are becoming cheaper. In case the real exchange rate is depreciating the imported goods are going to become more expensive and imports are going to go down. IM function will have the following form:

$$\text{IM} = \Theta(y) + \text{im}^e (E/P) \pm \zeta(CM, E/P)$$

(2.18)

$$\Theta(y)$$ is the consumption of imports that depends on the current level of real GDP. With higher level of GDP the consumption of imported goods is going to increase. However this increase can have negative or neutral impact on the growth rate of GDP, depending on the increase in demand for foreign goods.

The autonomous level of imports \(\text{im}^a\) has two interpretations. The first is that there are some goods which are impossible for the economy to produce, in most cases the best example is oil. If a country does not have oil, it will never have oil and it will always have to import it. The second interpretation of the autonomous level of imports depends on the medium and the long run oscillations in the real exchange rate. Let us assume the economy is in some current state at time \(t\), in this state there is a good which is currently not being produced in the economy, but it could be produced under different economic circumstances. The reason for this good not being produced is the fact that this good is cheaper if the good is imported. The domestic production is not profitable. We shall now move on to the time period \(t + n\) and we shall assume that in this time period the real exchange rate has depreciated significantly. We shall also assume this depreciation has made the domestic production of the good profitable. If this is the case, the economy can start with the domestic production of the good and good which was not profitable for production in time period \(t\) but it will be profitable for production in time period \(t + n\). The IS-LM-CM model is not very good for analyzing such changes over
time. The model is both mathematical and structurally constrained. Latter in the dissertation this process shall be developed as we move into the dynamic modeling.

The export function follows standard Keynesian principles and it is dependent on the nominal, real exchange rates and the level of foreign demand for economy’s exports.

\[ \text{EX} (E, E/P, A^*) \]  

(2.19)

The nominal and the real exchange rate have the opposite meaning in the case of the IM function. The appreciation of the nominal and real exchange rate leads to the decrease of exports and the depreciation of the nominal and real exchange rate leads to the increase of exports.

A* is the level of foreign demand for the economy’s goods. We will assume that A* is constant in the medium run. It is naturally to look at the A* from the inverse perspective of the autonomous variables that we have analyzed in this model. A* represents the goods which are unique for our economy, these goods are demanded by the rest of the world. We can now expand the export function:

\[ \text{EX} = A^*(y^*) + \text{ex}^o(E/P) \pm \zeta(CM, E/P) \]  

(2.20)

In this expanded form we have the element A*(y*) which implies that the level of exports is going to change with the level of GDP. This comes from the assumption economy cannot influence the world price. All the goods produced for exports, if the price is right, can be sold in the foreign markets. We also have the element \( \pm \zeta(CM, E/P) \) which represents the capital flows to and from the country. Examples of the inflows are the dividends received from abroad. Dividends received from abroad will increase the domestic GDP and are thus equivalent to return on our export of capital.

Now that we have set up the basic functions for the GDP, we are going to proceed with the derivation of the IS-LM curves. The derivation of the IS and LM curves will be based on their standard derivations procedure and it as noted the IS-LM curve functions for the closed economy.

The goods that are produced in the economy can be used in three ways. The goods can be consumed by the consumers or by the government and the goods can be saved. We can present this relationship in the following equation:

\[ y = c + g + s \]  

(2.21)
The income in the economy can also be used in three ways. The recipients of the income can use income for consumption, pay taxes to the government or invest the income. The income relationship can be presented in the following equation:

\[ e = c + g + i \]  \hspace{1cm} (2.22)

Since we are still describing closed economy the equations (2.21) and (2.22) have to be equal because there is no inflow or outflow of the goods and/or services. In a closed economy y has to equal e since all goods that are produced have to the distributed. In the open economy, the relationship e=y does not have to hold. In the open economy equation (2.21) has to be expanded for imports and exports and will be:

\[ y = c + s + g + (ex-im) \]  \hspace{1cm} (2.23)

Following this we have to also augment the expenditure equation for international effect. So the expenditure equation is now:

\[ e = c + g + i + f - d \]  \hspace{1cm} (2.24)

The equation (2.22) has been augmented for the international elements that flow through the economy and agents in the economy can spend goods, give it to government, invest it domestically or invest it into foreign assets; foreign assets are noted as f. At the same time the foreigners can come in to the country and the can invest as well into the domestic assets denoted by (d).

In the closed economy if we combine the equations (2.22) and (2.23) we get that \( i = s \). So in the closed economy investments have to equal savings. In the open economy if we combine the expenditure and income equations we get:

\[ ex – im = f – d \]  \hspace{1cm} (2.25)

This result is the fundamental relationship for a small open economy. When the economy is running a current account surplus, it is effectively investing abroad into the foreign assets. On the other hand, if the economy is running a current account deficit it is effectively borrowing from abroad. What we are showing in the equation (2.25) is the use of savings in the economy. If the country has current account deficit it means the country is forced to import other country's savings in order to meet its expenditures. If however the
country is running a current account surplus that means the country is borrowing its savings to other countries.

The equation (2.25) is a medium and long run equilibrium, but in the short run the equation can be in a disequilibrium while the capital inflow or outflow adjust to the IS-LM-CM equilibrium. Over time if the equation (2.25) is not balanced the country will have net foreign borrowing or net foreign debt. The country will either be a lender to others or borrower from others.

Now we shall proceed with the development of our model. We shall assume the government spending is always in equilibrium, which is g = t + v, where t is the amount of taxes collected and v is the variable government deficit or surplus. We shall also assume there is some autonomous government spending noted as g°; as before the explanation of the autonomous spending is the same. The autonomous government spending represents the basic level which government uses for investments. The issues of changes in government spending shall be discussed latter in detail.

We are now going to review the model which we have developed in full:

\[ y = c + s + g + (ex - im) \]

\[ e = c + I + g + (f - d) \]

\[ c = c_0(-r, y) + A + c(y, -r, -E/P, W/P) \quad A = z + \phi(y, E/P) \]

\[ I = i(-r) + i(CM) - iA^*(CM, E/P) = i^o + p \]

\[ im = c(y) + im^o + \zeta(CM, E/P) = im^o + m \]

\[ ex = ex^o(E/P) + A^*(y^*) + \zeta(CM, E/P) = ex^o + x \]

\[ g = g^o \]

We can combine the equations (2.23) and (2.13, 2.16, 2.18, 2.19) and we get 2.26

\[ y = c_0(-r, y) + c(y, -r, -E/P, W/P) + i^o(-r) + g^o + im^o + ex^o + [A + p + m + x] \]

(2.26)

This equation is the open economy equation for the IS curve. It specifies the locus of r and y values for which there is equilibrium in the commodity sector. All of the variables are constants except c(y, -r) and i(-r). Therefore, the derivative the equation (2.27) is

\[ \Delta r/\Delta y = -i'(r) - c(y, -r, E/P, W/P)^* \Delta y/\Delta r \]

(2.27)
Since the derivative is negative the IS curve will be sloped downwards. The curve will have negative relationship between the output and real interest rate.

The LM relationship will be derived from the standard MV=PY relationship. That is

\[ Y = \frac{MV}{P} \quad (2.28) \]

Where \( M \) is the quantity of money, \( V \) is the velocity of money and \( P \) is the price level in the economy. If we log equation (2.28) we get

\[ y = m + v - p \quad (2.29) \]

We can also present the demand for the real money balances in the economy. This demand is shown in the equation (2.30):

\[ \frac{M}{P} = \frac{y^h L(r + \pi)}{V} \quad (2.30) \]

Where \( \pi \) is the inflation and \( r \) is real exchange rate. If we log the equation (2.30) we get

\[ m - p = hy - l(r + \pi) - v \quad (2.31) \]

We can now combine the \( m - p + v = x \) representing the real money balances and solve for \( r \) to get

\[ r = \frac{hy - x - l\pi}{l} \quad (2.32) \]

Now we have a function that has a positive correlation with the output, as the output increases so will the real interest rate. The inflation and real money balances are constants and the changes in those variables will cause the LM curve to shift.

We have derived open economy IS and LM curves, now we have to derive the CM curve. The CM stands for capital mobility or the movement of capital in and out of the country. We are going to present the CM curve as static in the time period for which we are analyzing it and the CM curve will be presented in the following equation:
Where \( \omega \) is the real interest rate imposed on the country from the rest of the world. The \( \varepsilon \) is the expected change in \( w \) at some point in the future. We can also interpret \( \varepsilon \) as the future credit spread movement or the liquidity premium imposed on the economy. This implies that \( \varepsilon \) is a drifting parameter and that the values of \( \varepsilon \) can change from one time period to other. For our purposes we shall assume that \( \varepsilon \) is fixed in the period for which we are performing the analysis.

We are now going to present the full model in its graphical representation. Upward sloping LM curve and the downward sloping IS curve, with the fixed CM curve in the short run, that is why the CM curve is parallel to the x axis\(^{17}\).

Now we will solve several problems with the model using the comparative static method. We are going to focus on the model solution about the impact of monetary and fiscal policy in the economy. The main question of this part is: can growth in a small open economy be stimulated through the monetary and fiscal policy? To answer this questions we will analyze movements in the IS, LM and CM curves.

**Problem 1: The unexpected shift in the CM curve**

\(^{17}\) In reality it might be more prudent to make the CM curve positively sloping, but we are not using the model for investigation into particular policies, but more for illustrative purposes, so we shall content with the flat curve.
The main reason for the shift in the CM curve will be present or the expected change in the real level of the exchange rate or future expectations about the recession or a boom. Here the variable ε from the definition of the CM curve becomes important. Due to changes in ε the investors from the “World” might demand different real rate on their investments then they are currently getting.

The problem we have stated basically refers to the optimal policy reaction of fiscal and monetary policy when there is an unexpected shift in the CM curve. The shift is graphically presented in graphs 3 and 4.

**Graph 3: CM curve shift down**

![Graph 3: CM curve shift down](image)

The shift up:

**Graph 4: CM curve shift up**

![Graph 4: CM curve shift up](image)

When does the world decides the real interest rate imposed on small open economy is too high and the rate should be lowered? Possibilities why this might occur in the real world
might be multiple; some reasons might even be political and not economical. Political stabilization of the economy, joining NATO or EU might produce such effect. Also the economic reasons might be various from economic stabilization to decrease of inflation. In the case the CM curve shifts down there will be disequilibrium between the stability locus of IS-LM-CM. In such a case there is only one optimal policy to regain equilibrium and that is for the central bank to increase in the real money balances and shift of the LM curve to the right. On the graph 5 we can see the effect of such policy. The interest rates go down and the GDP expands.

**Graph 5: Monetary policy response to CM shift down**

As the graph shows, the LM curve should be shifted to the right, by increasing the money supply in the economy. The increase in the money supply would shift the LM curve, lower the level of real interest rates and restore the IS-LM-CM equilibrium.

The other policy to establish the equilibrium would be to contract the government spending, shift the IS curve to the left. This would produce a new stable equilibrium, but at the cost of lower level of Y, however this is not an optimal policy since it leads to contraction of GDP.

The opposite case will be the shift of the CM curve up. Here the “World” decides to increase the interest rates imposed on our small open economy. In that case the CM curve shifts up and the IS-LM-CM locus will be out of equilibrium. Although this seems bad because of the rise in the real interest rates, the remedy is quite simple and it can be seen on the graph below:
As the graph shows the IS curve should be shifted to the right because of the increase in the government spending. This would cause a rise in the interest rates, but the increase in government spending will have a positive effect on the aggregate expenditure and the end result will be a higher interest rate, but the higher level of Y as well. As we saw both positive and negative shocks in the CM rates can be used to expand the economic activity. This prediction of the model is opposite of what we have right now in the world where adverse external shocks are amplified in small open economies.

**Problem 2: The optimal behavior of the monetary policy?**

The monetary policy in a small open economy is significantly different from the one in large open and large closed economy. The differences are mostly advantages in suppressing inflation and the main disadvantage is the fact the economy is open to both cost-push and demand-pull inflation which is not the case in large economies which are open only to demand pull inflation\(^\text{18}\). Since the economy is small, the ripple effect of any shocks will be much larger.

Let us first examine the prediction of standard IS-LM model when we have a shift in the LM curve as it can be seen on graph 7. In standard IS-LM closed economy model the shift in the LM curve will decrease the interest rates thus causing the increase in the level of investments. This will in turn stimulate aggregate demand, shift the AD curve to the right and produce higher level of output. Expansionary monetary policy leads to higher GDP. However, in the case of IS-LM-CM this is not the case.

\(^{18}\) This point was clearly shown in Barsky and Kilian (2002), although Blanchard and Fisher (1989) have claimed a possibility of the supply side driven inflation in the AS-AD framework.
As in the standard IS-LM model, in the case of Mundell-Fleming model with an expansionary monetary policy the LM curve will shift to the right and the interest rates will decrease because of the increase of the amount of money. However, this shift will cause disequilibrium between the IS-CM curves on one side and the LM curve on the other side. The domestic interest rate will be lower than the interest rate the ‘World’ is imposing. Because of lower interest rate there will be a capital outflow, causing increase in interest rate and the LM curve will shift back to stable IS-LM-CM equilibrium.

In a small open economy with high capital mobility, monetary policy will be ineffective since any behavior of the monetary authorities will be offset by the opposite effect of the investors through capital flows. We immediately see how the addition of the CM variable to the IS-LM model has fundamentally changed the dynamics of the model. Standard Keynesian prescription of expansionary monetary policy as appropriate solution to business cycle in case of small open economy in this model simply does not work. The effects can be seen on the graph.

Graph 7: Monetary policy shift

In a small open economy monetary policy, in either direction, is ineffective. The capital mobility from the “World” and into the “World” offsets any policy measures imposed by the Central Bank.

Problem 3: The optimal behavior of the fiscal policy

We will now turn our focus to the government side of policymaking and what can government do with the fiscal policy. Recall the government spending equation is \( g = g^o \) and \( g^o = t + v \). The government revenues are composed of taxed collected from consumers, firms,
and the v part, which is borrowing. In a closed economy model the government is responsible for the IS part of the model. In the case the country is in recession the government can increase the spending the thus through the multiplication effect increase the aggregate demand in the economy and increase the level of GDP. The increase in the government spending will cause the shift in the IS curve to the left. Now the IS curve will be out of the equilibrium with the LM-CM curves. The interest rates in the country will be higher than the one that is imposed by the world. The domestic investment will be very attractive to the foreign investors and this will cause an inflow of capital in small open economy. The capital inflow will decrease the interest rates in the economy and the IS curve will shift back into the original IS-LM-CM equilibrium.

Opposite effect will occur in case of the restrictive fiscal policy. The interest rate in the economy will decrease causing the capital outflow from the economy. This outflow will increase the interest rate and it will restore the IS-LM-CM balance.

Like in the case of monetary policy, the fiscal policy alone is not effective. This is interesting and it shows the economies policies, because of the increase in the globalization, have to be coordinated.

**Problem 4: Best combination of monetary and fiscal policies**

By now it is clear the only way to stimulate aggregate demand in the small open economy is have coordinated move by both the government and the Central Bank. In order for the economy to remain the IS-LM-CM balance a coordinated action in the same direction of both monetary and fiscal policy is needed. Both expansionary monetary and fiscal policies are needed. In that case we are going to have increase in GDP without intrusions from the capital.
flows. This can be done very easily, when the budget is made for the following year both monetary and fiscal policies are matched and there will be a simultaneous shift in the IS and LM curve along the CM curve. The graph below shows us the net effect of such policy.

**Graph 9: Combined policy reaction: fiscal and monetary policy**

The new IS-LM-CM equilibrium will be established along the CM curve, but with the higher level of GDP. This is the only way that the government and Central Bank can stimulate the aggregate demand and thus offset the existence of the CM curve.

**Problem 5: Foreign debt?**

The flow of capital from one country to the other necessarily has to be matched with the changes in the net wealth of the country. Capital inflow means liabilities for a country. Under liabilities here we mean both debt and capital so we are using accounting interpretation. The inflow of capital is in fact someone else’s money the country is using. In case of the capital outflows the country is borrowing to others.

We are interested what happens when the economy is in the state of permanent disequilibrium. As the graph 10 shows we have a case where LM curve is parallel to the CM curve. This case makes the domestic interest rate constantly higher than the interest rates imposed to our small open economy from the rest of the world.

In this case the economy will experience a constant inflow of funds with ever increasing foreign debt. How is this scenario possible? The answer is simpler then it might seem. The interest rates in the economy are not be determined only through the supply and demand for money. The interest rates in the economy can also be determined through the regulation imposed by the central bank. In case the regulation is extremely high, blocking high level of deposits it is possible to have high interest rates in the economy, even if the monetary policy is
not restrictive. This is possible due to the fact that high reserve requirement imposed by the central bank might not reflect the supply and demand of money but rather the cost of funds for the banks.

High regulation can cause interest rates to be above their natural limits in fact making the LM curve parallel to the CM curve as we have presented in the graph 10. Although this example might see extreme, once we model the behavior of banks later in the dissertation we will see this scenario is highly possible.

Graph 10: Permanently high interest rates

This set-up where the LM curve is parallel to the CM curve will cause a permanent inflow of funds into the economy, ever increasing the foreign debt. The model is a medium term model and it assumes there is no upper limit to foreign debt, however in the long run situation from Graph (10) is not possible.

We have developed the "old school" Keynesian model, but augmented to function in the small open economy. Some of the conclusions of the model are very powerful. As we saw individually the monetary and fiscal policy cannot produce higher levels of GDP, for that coordinated actions of fiscal and monetary policy are needed\(^\text{19}\). We have also analyzed one problem which will play a major part in our model latter and that is the problem of foreign debt. As presented in the model the economy can experience a perpetually increasing foreign debt in the case there is a constant mismatch between the LM and the CM curve making the economy constantly outside of the IS-LM-CM curve.

What are the problems of this model? The main problem of this model is the fact there aren't any micro foundations to the model and no explicit modeling of expectations. We do not know what the households, firms, banks or any other participants are doing and what is their

\(^{19}\text{As often as this is repeated the coordination of monetary and fiscal policy can not be stressed enough.}\)

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behavior. The model is inherently macroeconomic and it just assumes that microeconomic elements behave in a uniform way and the way they are supposed to be behaving.

Following the problem of lack of micro foundations we also have to talk about the lack of expectations and learning in the model. The economic participants do not have the ability to learn new types of behavior and they cannot act on their expectations in this model. The model predicts uniform behavior for all simulations every time. So the fiscal policy if used in one way will always lead to the same result, regardless.

The model does not account for the banks and what is the effect the banks have on the economy. The model does not have time dynamics. The model assumes the economy is experiencing shocks in the short run and adjusts to those shocks in the medium run; however there is no determination of the paths of those shocks.

In the end it has to be noted there are some deficiencies in the model, but at the same time the model has provided us with some very important insights that will be explored latter in the dissertation. As a matter of fact the graph of the parallel CM and LM curves will be a center piece in the analysis of the monetary policy and the behavior of banks in the economy in Part 3.
3. Choice of exchange rate regime is a small open economy

This part of the dissertation is going to be used to set up definitions of the exchange rate regimes which are going to be used in the dissertation. We are also going to have a brief discussion about the purpose of the monetary policy in general and investigate the decision making process during economic transition.

Why investigate the monetary policy and not the fiscal policy or for that matter any other economic policy? The answer to this question lies in the assumption the choice of the monetary policy in small open economy subsequently dictates all other policies. The choice of the monetary policy sets up the playing field for all other policies and economic participants; therefore once we understand the choice of the monetary policy we will be able to understand all other economic behavior. Monetary policy superimposes itself on the economic participants which then have to mold their choices given this exogenous imposition.

This assumption of all importance of the monetary policy is rather bold, the discussion about the importance of the monetary policy goes back as far as Hume (1752), however as we have seen in Part 2 the importance of the monetary policy has come into full view in 20th century. The impact of monetary policy on the economy and the effects of monetary policy can be seen in Ball and Mankiew (1990); Barro (1974) discusses fiscal policy but his argument is essentially tied to the conduct of monetary policy. Other papers investigate monetary policy in great depth, like Barro and Gordon (1983, 1983b), Lucas (1972, 1986), Chari, Christiano, Kehoe (1996). Several papers investigate how does a change in monetary impacts the economy (Sims and Zha 2006a, 2006b, Leeper, Sims and Zha 1996). The impact of the monetary policy on the economy and the effects of monetary policy has clearly been shown in Barsky and Killian (2001). One of the most comprehensive discussions about the impact of the monetary policy can be found in Friedman (1969) and Friedman and Schwartz (1971).

The depth of analysis of these papers (any many more since it is impossible to account for all) is astounding. However all of them are basically contrasting the impact of the conduct of monetary policy on the economic behavior. They are not necessarily interested in the choice of the monetary policy regime. Apart from Sims and Zha (2006b) which try to analyze were there switches in the USA monetary policy most of the monetary policy papers look at the conduct of monetary policy, not the choice and why that choice was made. But what is the choice of the monetary policy in a large economy? The choice is between the control of the interest rates and the control of the monetary aggregates. In the small open economy the choice is just as simple, stable or variable exchange rate, but the effects of that choice are much more complex for the economy as whole.

In the introductory part of the dissertation we have set out a very ambitious plan for the dissertation and have raised many interesting questions regarding small open economies. We have looked at the early models, analyzing what are their strong points and what are their weak points. We have looked in depth what is the modeling process in the economics as a
science. In this part we are going to start building our model. Before we move towards mathematical modeling we have to define the basic set up of the exchange rate regimes and what their importance is. Here we have to analyses the issue of causality as mentioned in Sims (2007). Does the monetary policy choose the exchange rate regime to influence the economy or the needs of the economy impose the exchange rate regime?

3.1. Economic transition

The process of economic transition is probably one of the most important economic events of the 20th century and it certainly is the most unique economic event in the recent economic history. Unlike the economic recession or even the Great depression which might be repeated it is hard to believe that any time soon an economic transformation such as the fall of the eastern block is going to occur again.

The fall of the eastern bloc, was in effect a fall of an economic system. The planned economy has failed, now the free market economy was the only reasonable choice left. The ex-socialist economies have on the path of transition from planned economy towards the free market economy. The whole notion of economic transition from one economic system to the other was in fact a journey into the unknown. It would be very hard to say that the policy makers have known exactly what they were doing. The policy makers knew where they wanted to end up, but the path was in fact somewhat of a mystery.

We are now going to model the process of economic transition. We are going to treat economic transition from a game theory perspective as done in Gregurek and Vidaković (2007). We are going to set up a rather sterile problem and the process of economic transition, but in the next part we are going to expand the model and make it more lifelike. We are going to assume the policy makers are utility maximizing agents; the utility comes from the fact that they create policies which in turn bring the country closer to the stated goals. The policy makers are not all knowing and they tend to make mistakes due to their lack of knowledge about the effects of their policies.

3.1.1. Economic decisions during the transition process - optimal choice threshold

First we are going to look at individual problem. Let us assume there is some element, economic or non-economic, of the country the policy makers wish to change or to transition from socialist and planned into capitalist and free market economy.

The model we will follow is standard optimization approach which can be found in Casti and Larson (1982). We are going to assume that there are two states of the system, the first state is going to be denoted as A and it means the state of the system is acceptable and the second states of the system is going to be noted as U which means the system is not acceptable. The policy makers are trying to move all elements within their power from the U state into the A
state. It is important to note the policy makers do not know what the effects of their policies are going to be, so the policy makers do not know for sure the policy is going to move the system from U to A. The policy makers also do not know is the element in state U and not in state A.

Once the socialism was over there was a legitimate need to make some changes in the transition countries. Some of the changes were absolutely necessary, but the need for some other changes was somewhat ambiguous. The best example of the changes which had to be made, were the laws which have allowed the freedom of speech and multi-party political system. However the need to privatize banks to foreigners was more arguable and it is not a type of the change which had to be done under any circumstances. So it boils down to the policy maker’s view is something in state U or in state A.

Considering the fact the policy maker does not exactly know which state the system is in, there are two operations he can perform. The first operation is R, this type of operation reduces the probability that the system is in state U by factor of $0<\alpha<1$. The second type of operation is the operation E, this type of operation is type of operation used to determine the actual state of the system, it is obvious that R stands for reaction and E stands for examination. The policy R a priori assumes the system is in the wrong state and imposes a policy which changes the state of the system from U to A. On the other hand the policy E is the analytical tool used to determine what state the system is in and then to act. We are going to impose that there can be only one policy at the time. So it is impossible to have both R and E policies at the same time implemented on one element of the economy. We are also going to impose that each policy takes one unit of time.

Now we can define the problem of the policy maker. What the policy maker tries to do is in fact set up the best sequence of R and E policies in order to transform the system from U to A with complete certainty. Obviously there is no time constraint, but we shall assume that there is a time preference. That is the policy makers want to be in the state A as soon as possible. The expediency assumption is realistic. It is hard to imagine the policy can be implemented and at the same time analyzed what the situation is and what should be done. Also it is obvious the policy makers have just one mandate to perform political and economic actions, so although the time is not of the essence it is important to get things done in time.

We are going so assume that there is a probability x the system is in state U, also by default there is 1-x probability that the system is in state A. We are going to have a function $I(x)$, this function is the expected time which is required to transform the system into state A with complete certainty, given the probability x that the system is in U. The function $I(x)$ assumes the optimal policy is followed.

As a result of decision R the probability of x is transformed $x \rightarrow \alpha x$, while with the decision E transforms $x \rightarrow 1$ if the system is in state A and $x \rightarrow 0$ if the system is in state U. Following this system we can use the bellman principle of optimality to get the following set up:

$$ I(x) = \min \begin{cases} R : 1 + I(\alpha x) & \text{with } I(0)=0 \\ R : 1 + xI(1) & \end{cases} \quad (3.1) $$
To solve the equation (3.1) the policy maker knows there exists a value x* (breaking point) such that the policy maker chooses E if x<x* and R if x>x*. This means there has to be some level of threshold between the points when the policy maker is certain about the state of the system and the policy maker will choose to act. The values of x for which the policy maker is not certain about the state of the system will choose not to act, but to analyze.

Also we can have x=x* in that case we have

\[ 1 + x^* I(1) = 1 + I(\alpha x^*) \]  \hspace{1cm} (3.2)

Since \( \alpha x^* < x^* \) we must have

\[ I(\alpha x^*) = 1 + \alpha x^* I(1) \]  \hspace{1cm} (3.3)

Which means if we add 1 on both sides

\[ 2 + \alpha x^* I(1) = 1 + I(1) \]  \hspace{1cm} (3.4)

Consequently for the critical value of x* we obtain

\[ x^* = \frac{1}{(1-\alpha)I(1)} \]  \hspace{1cm} (3.5)

In order to obtain the solution to the problem at hand we have to know how to calculate I(1) in terms of \( \alpha \). In order to be able to do the calculation we are going to use a little bypass. We are going to note that there must be a positive integer M such that:
\[ I(1) = 1 + I(\alpha), \]
\[ I(\alpha) = 1 + I(\alpha^2), \]
\[ I(\alpha^3) = 1 + I(\alpha^3), \]
\[ \cdots \]
\[ I(\alpha^{M-1}) = 1 + I(\alpha^M), \]
\[ I(\alpha^M) = 1 + \alpha^M I(1) \]

Then we have

\[ I(1) = M + 1 + \alpha^M I(1) \]  \hspace{1cm} (3.7)

If we rearrange the equation (3.7) we are going to get:

\[ I(1) = \frac{M + 1}{1 - \alpha^M} \]  \hspace{1cm} (3.8)

The unknown value of \( M \) has to be some positive integer which minimizes the (3.8) equation, thus we have

\[ I(1) = \min_{M=1,2,\ldots} \frac{M + 1}{1 - \alpha^M} \]  \hspace{1cm} (3.9)

We have now determined the minimum need to differentiate between \( R \) and \( E \).

In order to better and more fully understand the transition process in the next chapter we are going to move to the realm of the game theory which will make the whole mathematical model much more tractable.

### 3.1.2. Game theory and economic transition

We can look at the economic transition as a game the economies undergoing the transition have played. It should be noted immediately the end of the game was clear for all ex-socialist countries. The full transition was achieved when the economies of the eastern bloc were on equal footing with the economies of the Western Europe, the free market economies. The only way the ex-socialist economies could be on the equal footing was if the ex-socialist economies
joined the same associations the free market economies were members of. This meant the ex-socialist economies had to join NATO and EU. Within joining the EU there were three separate objectives:

- Join the EU and NATO.
- Join the Schengen system in order to be able to remove the physical borders between the countries.
- Join the EMU in order to gain economic integration within the single currency system.

Each of these objectives required a separate set of mandatory requirements. So far the only countries which have managed to finish this whole process are Estonia, Slovenia, Slovakia. Other countries have joined EU and NATO, but still lag on the other requirements while some countries like Serbia or Bosnia have completed none of the three objectives.

The transition was a process with very clear objectives. Because of this we can look at the transition as a process very similar to the processes we find in game theory. We are going to use this approach here as well.

In most cases the policy makers do not know what are the effects of their policies are going be. In the case of large economies there is some past data and there is history of the occurrences after similar policies have been undertaken, however in the case of the transition process all of the policies where performed with a large leap of faith that this particular action is going to have positive effects. This presents an important modeling challenge. Since the policy makers did not know exactly what they were doing, the only way of doing things was to just act, since the analysis would probably be deficient.

In part 3.1.1 we have discussed how the policy makers have two possible actions: examine the situation E and react with a policy R. But at the same time we have left open for the fact that the policy makers are not sure which state the system is in and thus what reaction is needed. Now we have provided the policy makers with the mathematical tools to tell us when and how to react and which reaction to use, but there were a lot of deficiencies in the previous model. For starters it related only to one part of the economic system, we are now going to rectify that problem. Also the model did not allow to the policy makers to learn from their actions. We are now going to change that as well.

Again we assume the policy makers are utility maximizing agents who get utility from performing economic policies, the better and more successful the policies are the more utility the policy makers get.

We are going to set up a model where the policy maker has the ability to evolve over time and learn from the policies implemented. The model we have created so far, presents the policy maker with choices and states. Now we are going to introduce learning and the policy maker will be the ability to learn that reaction R lead to state U and not repeat such mistakes.
Because of these issues we are going to model the whole process of transition from the perspective of the policy maker as a dynamic process. The policy maker needs to determine what the current state of the system is; this determination comes from a lot of noisy observations. In order to determine the optimum estimation of the system the policy maker uses a following discrete system equation

\[
x(t + 1) = g[x(t), w(t), t]
\]  

(3.10)

Where the \( x \) is \( n \) dimensional state vector, \( w \) is \( r \) dimensional random forcing function and \( g \) is \( n \) dimensional vector function. The policy maker does have a model which he uses to measure the system and the equation is

\[
z(t) = h[x(t), v(t), t]
\]  

(3.11)

Here \( z \) is an \( s \) dimensional measurement vector and we are going to assume that \( s < n \), \( h \) is an \( s \) dimensional vector function and \( v \) is the \( d \) dimensional vector of random noise.

The probability density function \( p[w(t)] \) and \( p[v(t)] \) are going to be assumed to be known and independent from sample to sample. The probability density function of the initial state before any measurements are received denoted as \( p[x(0/-1)] \) is going to be assumed to be known. Some of the information might be completely irrelevant and some of the information might be extremely relevant, but it is possible for relevant information just “flies under the radar”.

The initial assumption about the state of the system might be the most controversial function and hard to translate into the real world. The initial state of the function is more subject to uncertainty then risk, therefore the initial state of the system might have been more subjective then objective. If the initial assumption regarding the state of the system is more subjective then objective there is a possibility for a policy error just because the policy maker is overestimating his strengths and underestimating his weakness\(^{20}\).

We can formulate the problem as follows. Given the system which was described by the equation (310) and the measurement system which described by function (3.11), given the probability functions \( p[w(t)] \) and \( p[v(t)] \) and the noisy measurement of the system \( z(1), z(2), \ldots, z(k) \) we need to find the maximum likelihood estimate of the entire trajectory \( x(0), x(1), \ldots, x(t) \), this estimate of the trajectory is noted as \( X(t/t) \).

Keep in mind we are looking to the entire trajectory of the system. It is extremely important for the model that we are looking at the entire trajectory of the path. Since we are trying to model the game with a known ending, but a variable length of time it is important for the policy maker to arrive at the ending as soon as possible. There are no time constraints.

\(^{20}\) We have mention probability distributions, but we have not separated risk (known distributions) from uncertainty (assumed distribution).
Although we are going to use the Bayes’ theorem this problem is somewhat different from the usual problems. It is custom to have the existing data and then figure out what is the state we are in. In this particular problem we are not doing that. We are assuming we know the state of the system and then trying to create the trajectory of the system, while learning as we go along, which is the same case the policy makers in the process of transition have faced.

The process we are going to use here is very similar to the dynamic programming, as a matter of fact the procedure and the logic of the dynamic programming are going to be used here as well but instead of the principle of optimality we are going to derive iterative relation for the maximum trajectory estimate by applying Bayes rule.

We are going to make the following definitions

\[
X(t) = \{x(t), x(t-1), x(t-2), \ldots, x(0)\} 
\]

(3.12)

\[
Z(t) = \{z(t), z(t-1), z(t-2), \ldots, z(0)\} 
\]

(3.13)

In that case the function \( I[x(t), t] \) is defined as

\[
I[x(t), t] = \max_{x(0), x(1), x(2), \ldots, x(t-1)} \left\{ p_x( x(t), x(t-1), \ldots, x(0) ) \right\} = \max_{x(0), x(1), x(2), \ldots, x(t-1)} \left\{ \frac{p( X(t) )}{Z(t)} \right\} 
\]

(3.14)

What we are now looking to do is to obtain the desired relationship by deriving \( I[x(t+1), t+1] \) in terms of \( I[x(t), t] \). Bayes’ rule can be written as

\[
p \left[ \frac{X(t+1)}{Z(t+1)} \right] = p \left[ \frac{X(t+1)}{x(t+1)} \right] * p \left[ \frac{X(t+1)}{Z(t)} \right] 
\]

(3.15)

The term \( p[X(t+1)/Z(t)] \) can be written as

\[
p \left[ \frac{X(t+1)}{Z(t)} \right] = p \left[ \frac{x(t+1)}{x(t)} \right] * p \left[ \frac{X(t)}{Z(t)} \right] 
\]

(3.16)

Substituting this relationship into (3.14)
The equation (3.17) yields the desired result, the maximization is now done over a single value of x(t), rather than over the entire set of past series x(0), x(1), ..., x(t) just like in the dynamic programming problems.

The quantity p[z(t+1)/x(t+1)] is determined by equation (3.15) and the knowledge of p[v(t+1)] while the p[x(t+1),x(t)] is determined by the equation (3.16) and p[w(t)]. The function p[z(t+1)/Z(t)] serves only as a normalization factor, and the maximum likelihood estimate can be determined without explicitly computing it. The recursive relationship can then be written as

\[
I^*[x(t+1), t+1] = \max_{x(t)} \left\{ p \left[ \frac{z(t+1)}{X(t+1)} \right] \times p \left[ \frac{x(t+1)}{X(t)} \right] \times I^*\left[ x(t), t \right] \right\}
\]

(3.18)

Where the function I^*[x(t), t] is proportional to, but not equal to, I[x(t), t]. However we are constantly working with t+1, and we have t as a terminal condition and end of the transition process. Whoever setting is analogous to the forward dynamic programming. We just need to quantify the state vector x(t). We are going to use a priori probability density function as the initial condition

\[
I^*[x(0), 0] = p \begin{bmatrix} 0 \\ -1 \end{bmatrix}
\]

(3.19)

Each quantified value of x(1), the quantity inside the brackets in equation (3.19) is evaluated for every quantified value of x(0). Naturally then the maximum value is selected as I^*[x(1), 1]. The corresponding value of x(0) is stored along with it. From then on we are going to calculate each I^*[x(j), j] is computed based on I^*[x(j-1), j-1] and the corresponding value of x(j-1) is carried along with it. This procedure is then carried on up to the terminal point of I^*[x(t), t] when the game is over.
The maximum likelihood trajectory is then determined by computing the value of $x(t)$, which maximizes the $I^*[x(t),t]$. Then retrieving the $x(t-1)$ that corresponds to this value, finding $x(t-2)$ corresponding to this value of $I^*[x(t-1),t-1]$ and repeating until all values of $x$ along the trajectory have been found. Following this feed forward- feedback procedure we are able to calculate the optimal path of the transition.

Also keep in mind the $t$ value here is not the time how long it takes to reach the terminal point, but rather number of steps which have to be undertaken in order for each country to reach its objective of becoming a member of all four integrations. This is in real time measured in time, but as we have noted the time is important, but there is no time constraint on each country. Naturally the value $t$ is going to depend from country to country.

This was how the mathematics predicts the process of transition can be solved. Naturally if the policy makers were the perfect forward looking agents, or even simple Bayesian agents the process of transition would have been much shorter, easier and fruitful for everybody; alas the policy makers are not such agents.

In the dissertation we are not going to look at all of policies, the policy makers have made, but only at one policy and that is the monetary policy. We are going to see what policy choices were made and how they would have influenced the economic agents first in theory and then in real life. The set-up we have created in this part of the dissertation can easily be related to the real life. When it came to the determination of which monetary policy to use the central banker had option of E or R. Regardless of which initial choice was made some monetary policy was chosen. What is more interesting is the question was the dynamic Bayesian model utilized when the policy was chosen. It is extremely important to know did the policy makers have the end goal in sight when the monetary policy was chosen, or where they just interested in making some policy choice, any kind of policy choice.

While in the game theory set up, we have utilized for the whole country the end game is very simple. We could doubt what the end game was for the monetary policy? Again we come to the issue of the purpose and use of the monetary policy. If the purpose of the monetary policy is price stability then the end game has to be different from when the monetary policy has a broader purpose then just the price stability. Different policy choices will by their very definition lead to different results for the economy. Again this is in theory; we still need to determine is there a policy choice difference in real life.

### 3.2. The meaning of monetary policy

In the previous chapter we have seen the model of transition from the perspective of game theory, although this is somewhat remote from the topic of the dissertation it was needed because of the set-up. The principal problem in the process of transition was from state U to state A. As we have noted it was hard to exactly say what is the state A and what is the state U. In order to determine the state A and state U for the monetary policy we have to look at the very hard and purpose of the monetary policy.
First of all the title of two seminal monetary policy text books in Yugoslavia were "Credit and monetary policy" by Ivo Perišin\(^{21}\) and "Monetary analysis" by Dimitrije Dimitrijević. Both books pay attention to the monetary policy and the conduct of the monetary policy from the macroeconomic perspective, but at the same time both dwell deep into the impacts of the monetary policy with extreme attention paid to the issue of credit policy.

In large economies there was never any need for the analysis of monetary policy and credit policy since the issue of credit policy was implicitly stated by Keynes in S=I. The S=I is not complete since the exact formula is savings = credit = investments. But if all credit is used for investments there is no need for explicit modeling of banks. This fact put banks outside of economic modeling. Why model something which is only an intermediary? The implicit agreement was that banks will lend to business for investments or households for real consumption of durable goods. This took out any need for banks as part of macroeconomic model. But this formula was negated by people like prof. Ivo Perišin who perceived monetary policy as a tool to govern and determine credit policy. This is why we have the title "Credit and monetary policy". The focus was on the way and for what banks use money. As noted in large economies the issue of what form banks use money was complete bypassed by the model. However with the 2008 crisis the purpose of the monetary policy came into question in papers like Mishkin (2009a, 2009b)

This brings us to the process of transition. The process of transition allowed banks to be privatized and focus on profitability. The banks started to lend to the most profitable sector in the economy: short (medium) term retail consumers which used money to live above their means. So all of a sudden in transition economy the savings were used for credit, but not for investments. At the same time the central banks rejected any kind of monitoring of credit policy and focused on price stability. The obvious question now is: what is state A and what is state U:

- **Monetary policy which uses tools available at disposal of the central bank for price stability?**
- **Monetary policy which uses tools available at disposal of the central bank for control of credit policy?**

I will not answer this question now, because for me this question is what monetary policy is all about at its core and definition. It is easy to focus of price stability and disregard any other aspect of economy, but it is hard to focus on credit policy and govern the economy as a whole. Perišin (1975) has the following quote from Miloš Vukičević (1955)\(^ {22}\): **"But in spite of this microeconomic importance, the development of the total given loans (credit volume) has its own macroeconomic importance. We can easily say that there is not a single other relation between corporation and community; between individual and common connection, which like this measure, so explicitly and so totally has effect like the relationship between our**

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\(^{21}\) Latter Perišin and Šokman; even latter as Perišin, Šokman, Lovrinović, but the tile never changed.

\(^{22}\) Miloš Vukičević „Poduzeće i kredit“ VI Intercollege conference of economic colleges held 1 - 4 October 1955.
corporations and credit.” This is the key question: do we understand the credit in the economy? Do we understand the credit in small open economy in economic transition? Similar questions were posed in Zbašnik (2008b, 2009)

The approach of the dissertation is holistic; I look at the economy as whole and try to understand how economic participants interact under different sets of economic rules, in our case exchange rate regime. This makes monetary policy a part of the economy, in some aspects an essential part. At the same time it is impossible to separate monetary and credit policy since credit is one of the money through which money circulates through the economy.

This is why the exchange rate regime is given as exogenous to the economic participants. They simple have to take it, but the issue of credit policy is much more important and it is the credit policy which has long term significant implications for economic participants as we shall demonstrate latter.

3.3. Choices of the exchange rate regimes in small open economy

Before we move on towards the creation of our own model we are going to analyze the choices of the monetary policy the central bank has in a small open economy.

To state the obvious, the central bank controls the amount of money in the economy. Out of this main point of the monetary policy we can differentiate the goals of monetary policy and the targets of monetary policy.

The goals of the monetary policy cover a large spectrum. The goals of the monetary policy can be stable prices, economic growth, financial stability, and increase in employment. Apart from this we can also look at hidden goals which are not directly announced or observed by the public. These hidden goals can be to minimize the entrance of speculative capital in the economy which was explained as one of the goals of monetary policy in Slovenia (Ribnikar 2003). Based on goals the monetary policy determines the targets which are used to achieve those goals. Using these three levels of monetary policy we can say the monetary policy has its:

- **Purpose**: what monetary policy is trying to achieve on a larger economic scale.
- **Goals or objectives**: what is the desire of monetary policy to control
- **Targets**: economic variables the monetary policy is trying to target

The purpose of monetary policy is the most general definition of the monetary policy. The central bank usually tries to create a stable and comfortable environment for economic agents. The central bank tries to facilitate economic activity by performing its duties to the best if its abilities. The central bank also serves as an economic entity which controls quantity of money and produces money.
The goals of the monetary policy are much more defined and clearly stated. Here the central bank usually defines the economic (monetary variable) it tries to control. The central bank tries to achieve goals (price stability or low inflation) using monetary tools.

The monetary policy targets are quantifiable variables which the central bank is trying to control. Here the central bank might want to target inflation, target interest rates or target monetary aggregates. The targets are achieved by using monetary policy tools like the reserve requirement, lombard loans, repo auctions, open market operations.

The actual conduct of the monetary policy and the tools used in the conduct of monetary policy are not going to be the topic of this dissertation. The tools and how those tools are used are of no concern to us. The goals of the monetary policy and the purpose of the monetary policy are of interest to us. Looking at the large economies we can see how the monetary policy is perceived differently across the Atlantic. The roots of the difference in understanding monetary policy between USA and EU can be directly traced to the great depression. The economic perils of Great depression in USA was unemployment (Friedman and Schwartz 1971) in EU it was inflation (Sargent 1986). Out of this the main purpose of the monetary policy in USA is to try to keep the unemployment as low as possible. On the other hand in EU the main purpose of monetary policy is to have low inflation, even if other economic agents have to suffer because of this.

This difference in the purpose of the monetary policy is essentially a question of the political economy and not necessarily the question of monetary policy. The question of the purpose of the monetary policy is of great importance to us. The small open economies born out of ex-socialist economies did not have the past of Germany or USA in order to determine what is the purpose of their monetary policy.

The purpose of the monetary policy in large economies was to some extent dictated by their past in the case of ex-socialist economies that was not the case, so now what? Should monetary policy just try to keep the inflation low and let free markets work out the past kinks in the socialist economies? Or should monetary policy take a more proactive role in the economy? We are going to argue the answer to the above questions in essence is: the choice of the exchange rate regime in small open economy.

However it would be narrow minded just to think the choice of monetary policy is all there is to monetary policy in the small open economy. Once the monetary policy is chosen we are going to investigate what is the importance of the conduct of the monetary policy. The conduct of monetary policy from the perspective of the central bank is guided through the policy function. Once the monetary policy is chosen the conduct is taken as a given, however the conduct of monetary policy has large effects on the other economic agents.

The monetary policy of a central bank is essentially conducted in a same way, regardless of the monetary arrangement, goals or targets of the monetary policy in all economies. We can see this just by observing the balance sheet of the central bank. The assets are reserves: bonds, foreign currency or gold. The liabilities of the central bank are: cash and deposits received from the banks in form of the reserve requirement. There may be other items in the balance sheet due to the fine tuning like lombard loans, REPO or just deposits from banks because of
extra liquidity. But the main items in the central bank's liabilities are cash and deposits from banks due to reserve requirement. However the asset side is where things get interesting.

Central banks in large economics like EMU or USA have government bonds or gold in assets (for the most part), while in small open economies the central banks have foreign currency and foreign currency denominated assets in their balance sheets. The reason for this is the fact that in large economies the central bank controls the quantity of money through the purchase of government debt. So when the central bank wants to increase the quantity of money in the economy the central bank purchases government bonds. In effect the central bank takes government bonds from the banks and gives them money thus increasing the quantity of money in the economy. If the central bank wants to decrease the quantity of money in the economy the central bank sells the government bonds it owns to the banks and takes the money from the banks. What is important to note here is that in the large economies the central bank conducts the monetary policy through the money market in the country.

In small open economies, mostly due to the past instabilities, the central bank does not buy government debt but buys foreign currency. The monetary policy is conducted in the same way as it is in the large economies. Except the good transacted is not the government bond, but it is some other currency. When central bank wants to increase the quantity of money in the economy the central bank buys foreign currency from the banks and gives local currency to the banks, thus increasing the quantity of money in the economy. In case the central bank wants to decrease the quantity of money in the economy the central bank would sell foreign currency to the banks and get local currency from them, effective by taking the currency out of the circulation. What is important to note here is that the central bank does not intervene through the domestic money market but through the domestic market for foreign currency market.

Since the central bank in small open economies tries to control the relation of domestic currency to the foreign currency the central bank has to decide what its stance towards the movement of the exchange rate is going to be. This stance is called the monetary regime or exchange rate regime or monetary arrangement. Following the arguments presented in Ribnikar (2004c) we are going to make an overview of the exchange rate regimes in the literature and then we are going to go and proceed with our own definition of the exchange rate regime for the purpose of this dissertation.

One of the basic distributions of the exchange rate regimes is the one which is done by IMF and it can be found in Von Hagen and Zhou (2002), Frankel (1999) and Crockett (2003). These authors have three main exchange rate regimes:

- FIXED EXCHANGE RATE REGIMES
  - Dollarization (euroization)
  - Monetary union

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23 In Croatia it is explicitly written in the Central bank act that the Croatian national bank does not give loans to the government. Purchasing government debt, even on the secondary market, is in effect lending to the government.
Currency board
'Truly' fixed exchange rate regime

- **INTERMEDIATE EXCHANGE RATE REGIMES**
  Conventional pegged arrangement or adjustable peg
  Pegged exchange rate within horizontal bands or target zone or band
  Crawling peg or basket peg
  Crawling band
  Managed floating

- **FREE FLOWATING EXCHANGE RATE REGIME**
  Independent floating
  Free or pure float

It is important to note how the regimes are actually separated here. The separation of regimes according to this classification is exclusively based on the degree of available movement of the local currency with respect to the foreign currency.

Fixed exchange rate regimes have no mobility with respect to the foreign currency. Monetary union for example means that there is no local currency, local currency is in fact abandoned by several countries in order to create one currency; the best example of this is European Monetary Union. In case of EMU Slovenia basically forgo Tollar for Euro as its own currency. Dollarization of euroization is when a country, based on its own decision adopts another countries currency. This is the case of Montenegro with Euro or Ecuador with the dollar. These countries use another country's currency as its own.

Intermediate monetary regimes are regimes where there is some movement in the value of the local currency with respect to some foreign currency. The intermediate regimes are a wealth of possibilities. These exchange rate regimes are appropriately called intermediate because they offer a wide range of ways to be structured. A country can for example have an adjustable peg. This is a fixed exchange rate regime where the fixed value is revaluated at some point in time. In this particular set up there is no movement of the currency, just jumps in value on certain periods. Another possibility which is to the extreme is managed float which is the case in Croatia.

In Croatia the central bank claims the value of Euro is strictly determined by the market, however the central bank intervenes to maintain exchange rate stability\(^{24}\). Excerpt from CNB’s web site (with authors translation):

**KAKO SE FORMIRA TEČAJ KUNE?**

_Hrvatska provodi režim fluktuirajućeg tečaja. To znači da tečaj nacionalne valute nije fiksiran prema nekoj stranoj valuti ili košarici valuta, već se slobodno formira na deviznom tržištu. Tečaj, dakle, fluktuira ovisno o ponudi i potražnji deviza na deviznom tržištu, no Hrvatska_
HOW IS KUNA’S EXCHANGE RATE FORMED?

Croatia has free floating exchange rate regime. This means the exchange rate of national currency is not fixed with some other currency or some basket of currencies, but it is freely formed in the foreign currency market. The exchange rate fluctuates based on the supply and demand of foreign currency in the foreign currency market, however the CNB is occasionally a participant in that market in order to stop large exchange rate fluctuations and maintains the exchange rate relatively stable.

However if we look at the exchange rate movements of Croatian currency we will see very small oscillations from a certain level in the last several years. So the exchange rate might be free floating on the CNB’s web site, however the data tells us different story.

Free floating regimes are regimes where the central bank in effect does not participate in the foreign currency market. Instead the central bank monitors the local currency situation and the domestic money markets. The best example of this is the US dollar.

Again, when it comes to the exchange rate regimes they are based on the amount of the movement, not on the direction of the movement. For the purpose of the dissertation we are going to make another definition of the exchange rate regimes. Our definition is going to be based on the active participation of the central bank in the management of the direction of the exchange rate.

We are going to have three exchange rate regimes. The first exchange rate regime we are going to name stable exchange rate regime; the second exchange rate regime we are going to name variable exchange rate regime; the third exchange rate regime is going to be real and pure free floating. The first two regimes imply active role of the central bank, while the third regime implies the absence of the central bank’s involvement.

Here are the definitions of each of the regimes:

**STABLE EXCHANGE RATE REGIME:** is a type of exchange rate regime where the central bank keeps the exchange rate fixed at one value or close to one central value over large period of time. During this period of time the exchange rate does not exhibit a clear directional movement, the movement of the exchange rate is similar to a flat line or mean reverting series.

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25 The data is going to be provided in Part 5 of this dissertation.
**VARIABLE EXCHANGE RATE REGIME**: the central bank actively participates in the exchange rate and uses monetary policy to create a clear directional movement of the exchange rate.

**FREE FLOATING REGIME**: the central bank does not participate in the FX market and the central bank is not concerned with the movement of the exchange rate over time. Exchange rate is freely allowed to move up or down and there is not a clear trend over time.

There are several points which have to be clarified. As we have noted the central bank in small open economies uses the exchange rate and foreign currency to change the quantity of money in the economy. This implies we are going to see smaller (if any) free floating regimes since if the central bank is using foreign currency for monetary operations, then automatically the FX rate is going to be impacted by the monetary operations. The central bank operations are performed on the domestic market for foreign currency.

The definitions and division of the exchange rate regimes given in Von Hagen and Zhou (2002), Frankel (1999) and Crockett (2003) were based on the amount of the oscillations of the exchange rate from one clearly defined point. So the fixed exchange rate regimes have no oscillations from a predefined fixed point. Intermediate exchange rate regimes have increasing oscillations from one point. While the free floating exchange rate regimes do not have any fixed point, they just move depending on the supply and demand of a particular currency. The approach we are taking in the dissertation is to strictly separate the exchange rate regimes based on the direction of the movement of the exchange rate.

To demonstrate the point of our definition of the exchange rate regime, take an example of the exchange rate regime named "adjustable peg". This exchange rate regime under the Von Hagen and Zhou (2002), Frankel (1999) and Crockett (2003) classification falls under intermediate exchange rate regimes. Under my definition of the exchange rate regime it would fall under variable exchange rate if the central bank is adjusting the peg in one direction over time. If the central bank is just dancing around one level with the peg, than it is a stable exchange rate regime. It is obvious that the determination of the exchange rate regime is not going to be simple affair and in Part 5 of the dissertation we are going to establish a very clear econometric methodology of definitions of the exchange rates for each country we are going to analyze. It is important to note the exchange rate determination used in the dissertation is not going to be based on what the central bank is saying the exchange rate regime is, but based on what the exchange rate data is telling us. It is ex post derivation of the definition of the exchange rate regime.

Next we are going to move towards discussion of each exchange rate regime and its benefit for the economy, but also the problems the central bank might face when implementing a particular exchange rate regime.
3.4. Advantages and disadvantages of stable exchange rate regime

Monetary policy, just like any other policy can have as large of a depth and breath as it wants. The designed impact of the monetary policy is limited only by the construction of the policy maker. Monetary policy is a macroeconomic policy; as such the impact of the monetary policy is either directly or indirectly felt on all segments of economic activity. Maker/creator of the monetary policy has to decide how much influence the monetary policy wants to have on the economy.

The perceived impact of the monetary policy is determined by the central bank in its conduct of the monetary policy. If the central bank wants to have a narrow impact it will focus on one or just few variables and will act only when those variables change. This is the clear case when the central bank believes that the monetary policy should be used only for the control of the price level. The central bank can also use monetary policy to have a large impact on the economy by having multiple targets which are going to demand a reaction from the central bank. This is the case when the central bank not only looks at the price level, but also at other economic variables like employment, exports, foreign investments, amount of credit in the economy.

The size of the impact of the monetary policy and the choice of the size of the impact the central bank wants to have is the dilemma about the free market economy. If the markets are efficient then all monetary policy has to do is to keep the inflation low and markets are going to take care of the rest, making the economy optimal. However if the markets are not efficient; the economic participants might need a larger involvement from both the fiscal and monetary policy in order to achieve the optimal levels. When the socialism was over, for some that meant not only the end of one system, but the end of the way of economic life. At the same time for some the end of socialism meant only changes in the capital structure of firms. While in socialism the firms were owned by the people, commonly mistaken by state, but that is not the same as pointed out in Ribnikar (1994), in free market economies the capital is in possession of the shareholders. So the economic transition was in effect the transformation of the capital structure of firms and nothing more.

The appeal of the “free market” paradigm was alluring to lot of people. The need for “sloppy and stagnant” involvement from the government over night became something to be abhorred and the onslaught of the free market perfection was welcomed. In light of this there was the choice of the monetary policy, the purpose of the monetary policy. In light of the free market paradigm the active economic involvement from the monetary policy was something to be avoided at all cost. The central bank is supposed to create an economic stability and the economic stability can best be achieved by the stable exchange rate regime. With the exchange rate stability all other economic agents would have a much easier time to go about using their free market privileges.

The main reasons to have stable exchange rate regime is to achieve financial stability. One of the best explanations for the stable exchange rate regime is given by the Latvia's central bank.26

26 http://www.bank.lv/eng/main/all/monpolicy/ls-euro/cmp1/
Why was the pegging of the Lats necessary?

Commencing the implementation of an independent monetary policy in the early 1990s, the Bank of Latvia had to decide on an exchange rate regime. Since 1993, Latvia has been using the fixed exchange rate based stabilization program. In February 1994, the Bank of Latvia pegged the lats to the SDR basket consisting of the four major currencies: the US dollar, the euro, the British pound sterling and the Japanese yen. Such a durable and credible peg has served to reduce uncertainty, eliminate currency risk and provide businesses with a sound basis for planning and pricing. It fostered international investment and international trade, which are of a particular importance for the ability to compete of the small, open economy that Latvia is.

Judging from the description in case of the Central bank of Latvia the main focus of monetary policy is on:

a) reduction of uncertainty
b) elimination of currency risk
c) help business conduct their business

The above three points are in fact the purpose of the monetary policy, but in which order? The goal of the central bank is price and financial stability. The central bank of Latvia has concluded the best way to achieve its goal is to have stable exchange rate according to our definition and currency peg according to the IMF exchange rate regime classification.

What is important to note is the absence of the need for active involvement of the monetary policy. The best way the monetary policy can help the economy is to have exchange rate stability. Once the exchange rate stability is achieved, the exchange rate risk would be removed and that would foster the competitiveness of the Latvian economy. We are seeing the free market paradigm in full effect. If there is exchange rate stability the firms are going to have no need for any additional boost from the monetary policy in any way, since the firms are going to have the benefits of the free market.

It should be noted that we are not going to make any presumptions regarding the success of the monetary policy; we are going to leave that for the Part 5 and 6 of this dissertation. But we have to note the monetary policy objectives were more than sound. What more can a central bank provide to the economic participants then elimination of uncertainties in the economy? From the central bank which has instituted a peg it is clearly implied variable exchange rate has impact across the board on the economic participants. If there is a currency risk, then there is an increase in the uncertainty for economic participants. Since there is uncertainty the economic participants cannot make longer business plans if foreign currency risk would impact their business plans. Looking at this explanation from the Latvian central bank, if the stable exchange rate regime brings all these benefits, then it is implicitly assumed the variable exchange rate regime has the opposite effects.
With such noble intentions the obvious question is what can be the bad side effects of such policy choice? The main negative effect of the fixed exchange rate regime is the fact once the fixed exchange rate regime is chosen the monetary policy is tied. The policy function becomes given and the maneuvering ability of the central bank ceases to exist. Since any changes in the quantity of money would automatically affect the exchange rate stability. The central bank is forced to rely upon the inflows of foreign currency in order to be able to provide sufficient liquidity to the system. This point is going to be further elaborated in Part 4 of this dissertation.

However the last part of the statement is the one which we are going to dwell over and over it states "...which are of a particular importance for the ability to compete...". This implies that if the exchange rate is fixed and all of the aforementioned risks are removed the competitive advantages of business in the economy are going to increase?!

The main difference between the monetary policy in socialism and monetary policy in the free market economy can also be found in the title of the monetary policy. In socialism the economic policy conducted by the central bank was credit and monetary policy, while in free market economy the central bank only looks at the monetary policy, with little or no regard for the credit aggregates or the credit structure of banks.

The central bank in socialism was always separated into its macro and micro segment (Perišin and Šokman 1988). The central bank performed its functions by conducting monetary policy, but at the same time the central bank also paid attention to the micro distribution of the monetary policy which was the loan structure in the bank’s balance sheet. This particular structure made monetary policy in socialism unique, because central bank ceased to be a macro agent and became a micro agent as well. This type of monetary policy was completely abandoned with the fall of socialism and central bank focused only on the macro aspect of the monetary policy, neglecting the credit structure of the bank’s balance sheets.\(^{27}\)

In free market economies the central bank only pays attention to the price stability, while the credit structure of the bank’s portfolios is left to the individual banks to decide and free markets. This brings important question: does the choice of the monetary policy dictate the structure of bank’s credit portfolio? If it does, then the choice of the exchange rate regime cannot be just the question of how to achieve price stability, but the central bank has to take a broader view how the choice of the monetary policy is going to affect the economy.

### 3.5. Advantages and disadvantages of variable exchange rate regime

Using logic and the text in Part 3.2 we can conclude the variable exchange rate will give an economy uncertainty which will stem from the exchange rate changes. Given no empirical data and no models provided it is hard to argue anything different at this time. Taken at the

\(^{27}\) Some regulation to control the structure of the bank’s loans was implemented in Croatia (limited credit growth) and Serbia (limits on lending to households); but there was not a comprehensive targeted policy of the credit structure in the economy.
face value the elimination of uncertainty and increase of competitiveness of the economy are always good. It is obvious the central bank could assume the variable exchange rate regime is going to introduce exchange rate uncertainty into the business plans of firms. There is no denying this aspect of the variable exchange rate policy. But at the same time the variable exchange rate policy implies active involvement of the central bank. If the central bank imposes variable exchange rate policy (as we have defined it) the central bank is in effect choosing to use exchange rate policy to give those firms a positive boost in making their goods cheaper. By depreciating the exchange rate the central bank is introducing uncertainty, but at the same time is increasing competitiveness of the firms and is providing them with larger revenues from exports. The argument can go both ways. The stability of the exchange rate might provide the firms with the removal of the uncertainty, but at the same time changes in the exchange rate might provide them with the increase in the competitiveness on the foreign markets. The issue of exchange rate volatility was analyzed in Aghion, Bacchetta, Rancier, Rogoff (2009).

Let us go back to the transition model presented earlier; the choice of the monetary policy when the policy maker has to choose between options is to analyze and to react. Since there was no material to analyze (no historical data or country for comparison) the only choice was to choose an exchange rate regime. The choice of the exchange rate regime depended on the purpose of the central bank. What the choice of the monetary policy in the end comes down to, from the perspective of the policy maker, is the choice of how much active involvement is needed from the monetary policy. The variable exchange rate gives the central bank mobility to react not just to changes in the domestic foreign currency market, but to react to other economic changes as well.

In next part of the dissertation we are going to argue the monetary policy impacts all economic agents. We are going to create a formal mathematical model which will be based on the assumption the choice of the exchange rate regime is in effect a choice of the playing field, and different choice is going to impose different behavior on economic agents.
4. Modeling economic participants

In this part of the dissertation we are going to mathematically model the economic participants. The economic participants we are going to model are: central bank, banks, firms, households, government. Each of these presents a fundamental piece of the economic structure in a small open economy. We are interested how the choice of the exchange rate regime impacts each of economic participants. We are also interested does the choice of the exchange rate regime impact the interaction between the economic participants.

The central bank is the most important player in the model since the central bank is the one who determines the exchange rate regime. The choice of the exchange rate regime is imposed onto the other economic participants who try to optimize their behavior under the given exchange rate regime. Here is the short summary of economic activity for each participant:

- **Households** are faced with two fundamentals choices, choice of consumption and choice of the amount of debt the households are willing to hold. The first choice is the combination of consumption between the domestic and foreign goods. The second choice is the amount of credit the households is willing to borrow. We are going to specifically focus on the impact of the exchange rate regime on the level of debt the households are willing to hold and the impact of this household’s debt on all other participants.

- **Firms** are faced with the choice of business sector they are in. The firms have two fundamental choices the first choice is to produce for domestic and foreign market and the second choice is to import and sell on the domestic market.

- **Banks** are the participants who transfer the choice of the monetary policy on to the other economic participants. We are going to model the banks, but at the same time we are going to analyze the relationship between the banks and economic participants under alternative exchange rate regimes. This relationship is going to be reflected in the sector distribution of loans in the bank’s portfolio. Special attention is going to be paid to the relationship of the banks with the central bank.

- **Government** in this model we are going to focus on the impact of the choice of the exchange rate regime on the budget of the government. Specifically we are going to focus on the income of the government and we are going to try to determine is there a difference between the income of the government under alternative monetary regimes. We will also investigate the interaction between monetary and fiscal policy in each regime.

From the notes above we can see how every economic participant is connected to other economic participants. The Graph (11) shows the connections between each participant. In the Graph (11) there is no central bank, because the central bank imposes the exchange rate regime onto other participants.
From the graph we see the direct relationship between the banks and the government. The bank lends money and pay taxes to the government, but we also see the indirect relationship through households. The households get debt from the bank and if they spend that debt on consumption the government will receive more VAT. Therefore increase in credit will lead to increase in consumption and consequently to increase in VAT. We are going to investigate is the relationships between the economic participants and now those relationships change when there is a change in the exchange rate regime.

**In the dissertation we are assuming the behavior of economic participants is governed by the choice of the exchange rate regime.** If the exchange rate regime is changed two changes in the economy are going to occur. The first change is going to be the change is the behavior of the economic participants and the second change is going to be the change is the relationship between the economic participants. Because of this we have to develop model which are going to allow us to model two states of the economy given the choice of the exchange rate regime, imposed by the central bank on other economic participants.

### 4.1. Modeling states caused by the monetary policy regime choice

As shown in Part 3 of the dissertation there are two possible options for the monetary policy as we have defined the exchange rate regimes. We are going to assume the monetary policy for a
small open economy is controlled through the control of the exchange rate through purchase and sale of foreign currency. This is an important and fundamental assumption. If the monetary policy controls interest rates through purchases and sales of the government debt the structure of the economic relationships would be fundamentally different.

Before the central bank starts to conduct monetary policy the central bank has to determine what kind of monetary policy it wants to conduct. The first possibility is to have a stable exchange rate system. The central bank does not control the direction of the exchange rate over time. In this exchange rate regime, as we have defined it, the central bank keeps the exchange rate steady (fixed) with respect to another currency or pool of currencies. The exchange rate does not have been to be exactly fixed, but it can be kept in a band or a range. In case of a band or a rage the central bank will react every time the exchange rate moves outside of this band. **The main character of stable exchange rate regime is the fact the conduct of monetary policy is set once the exchange rate regime is chosen and that over time the exchange rate is not going to exhibit a clear directional trend.** The central bank is going to react every time there are movements which are going to change the level of the exchange rate imposed by the central bank. Mathematically we can show the stable exchange rate regime as:

\[
f(e) = x
\]  

(4.1)

In case of a fixed exchange rate regime, the x is some level of exchange rate. As the equation (4.1) is telling us for any level of the exchange rate e is set with a value x. If the central bank wants to keep the exchange rate is a band, we can show this as:

\[
f(e) = x^* \begin{cases} 
  x_u^* < y \\
  x_l^* > z 
\end{cases}
\]  

(4.2)

The equation (4.2) is telling us the exchange rate x* is set between two bands the lower and the upper band noted with subscripts u and l. Once the exchange rate moves to levels of y and z the central bank is going to react and through interventions bring back the exchange rate within a predetermined band.

The second possibility for the exchange rate regime is for the central bank to **actively** govern the exchange rate in order to achieve economic goals. While in the stable exchange rate regime the central bank is only interested in the stability of the exchange rate regime, in variable exchange rate regime the central bank changes the exchange rate when it sees fit and uses the exchange rate as a tool. **In variable exchange rate regime the central bank changes the exchange rate when there is an economic need for it as determined by the central bank.** While in the stable exchange rate the exchange rate is a purpose onto itself, in variable exchange rate regime the exchange rate is a policy tool to be used when needed and adjusted as needed. This is the key difference; in stable exchange rate regime the central bank
maintains the stability of the exchange rate, regardless of the other variables in the economy. This difference will be more elaborated in the part about the conduct of the monetary policy. The main characteristic of the variable exchange rate is that over time the exchange rate is going to exhibit a clear trend. Mathematically we can show the variable exchange rate as

\[ f(e) = \sum_{t=0}^{n} (1 + \delta_t) x_0 \]  

(4.3)

In this exchange rate regime the exchange rate starts at some initial level \( x_0 \) and then it changes over time with because of the changes in the exchange rate given by \( \delta \) which is the rate of change. The factor \( \delta \) is the effect of the monetary policy actions on the exchange rate; it is a percentage change in any time period. Parameter \( \delta \) may or may not be stochastic. Is \( \delta \) stochastic or not, will depend on the choice of the monetary policy conduct by the central bank. In any time period \( \delta \) has the value set between 0 and \( \infty \) in each time period\(^{28}\).

We are going to avoid econometric modeling of the economic participants. Since we are going to be dealing with several countries creating econometric models would be complicated and strenuous\(^{29}\). Also we are not interested in the behavior of economic participants under a particular exchange rate regime. We are interested in the differences in behavior caused by the exchange rate regime and even more importantly determination what are the differences in the behavior of economic participants under different exchange rate regimes.

In order to model economic participants we are going to use dynamic mathematical models based on the mathematical tools developed in the field of optimal control. The optimal control models were used in economic in Kydland and Prescott (1980, 1982), Hansen and Sargent (2003, 2005), Sargent and Ljungqvist (2004), Stokey, Lucas and Prescott (1989), Adda and Cooper (2003). Today the use of optimal control in economics is standard. For more sophisticated elements of optimal control there are initial works by Bellman (1957, 1962), Bertsekas (1876, 1987) and Bertsekas and Shreve (1978).

Use of optimal control mathematics is very important. The economic participants cannot be analyzed in one time period; we have to model the behavior of economic participants over time. The equations are going to serve as an indication of the behavior from which we are going to explain the possible patterns in behavior. These patterns in behavior should be reflected in the economic data if the assumptions of the model are correct. The parallels between the economic behavior as predicted by the model and the behavior seen in the data are going to be subject of analysis in Part 5 of this dissertation.

\(^{28}\) The fact the upper bound is \( \infty \) is just a mathematical property. In each time period the central bank can change the exchange rate as much as it wants, but it is hard to imagine devaluations close to \( \infty \), although historically they have almost happened as noted in Sargent (1986) in case of German mark in 1920s

\(^{29}\) This refers to the economic data analysis of the dissertation which will be done in Part 5 of this dissertation.
4.2. Central bank

This part of the dissertation will introduce the model of the central bank. The central bank is the crucial economic participant in our model. It is the central bank who chooses the exchange rate regime and it is the central bank that has the ability to change the exchange rate regime. The main focus of this part of the dissertation is going to be separated into three parts. The first part is going to be on the choice of the monetary policy. Here we are going to draw parallels between the monetary policy in large economies and in small open economies. The second part will focus on the model of the central bank’s behavior. The third part is going to make a loop back to the first part and here we are going to see how does the choice of the monetary policy impacts the conduct of monetary policy and what does the conduct of monetary policy mean for the economic participants.

The central bank forces the monetary policy on other economic participants. For other economic participants the monetary policy is exogenous and given. They cannot influence it, all economic participants can do is to optimize their behavior under given exchange rate regime. Since the main premise of the dissertation is that under alternative monetary policies the economic participants are going to behave differently it is important to have full understanding of the choices the central bank has in terms of the monetary policy regimes and then to analyze how does each of the monetary policy choices impacts other economic participants.

4.2.1. The choice of monetary policy

The main objectives of the central bank in any economy can be stated in terms of three main goals:

- Stability of prices
- Financial stability
- Banking system supervision\(^{30}\)

The stability of banking system is a micro objective and it is achieved through the regulation of the banking system and direct supervision of the banks. This part of the role of the central bank we are not going to investigate in this dissertation. The other two goals, the stability of prices and stability of the financial system are the macro objectives of the monetary policy. The central bank is trying to achieve those by implementing monetary policies and performing the actual monetary policy while using available instruments.

\(^{30}\) Although this the not absolute, there are some countries like Bosnia and Herzegovinia which have two separate institutions, one for monetary policy and one for banking supervision.
In large economies in order to achieve the objective the monetary policy the central bank sets up goals and then uses the monetary mechanisms to achieve those by aiming monetary policy tools at some preset target levels. The targets the central bank can set can be split into three large categories.

- monetary aggregates,
- interest rates
- expectations

The control of the monetary aggregates has been long advocated by Friedman (1959, 1963, 1968) who proposed the so called “k rule”. The basis for the control of the monetary aggregates as monetary policy tools lives on the foundation that in the long run the inflation rate is equal to the rate of the growth of the money aggregates. So in order to achieve price stability the central bank should set a k% value to change the monetary aggregates each year. This type of monetary policy would lead to stabilize growth of monetary aggregates, which in turn would lead to stable inflation rate. This theory has been implemented into practice; the best example is the Volcker disinflation in the early 1980s as described in Blanchard (1984). During the reign of Fed Chairman Volcker Fed used targeting of the monetary aggregates in order to decrease inflation. However this approach to the monetary policy has recently been brought into question by Woodford (2000) who showed that the quantity of money is not important in the conduct or effects of monetary policy and hence the whole approach to monetary policy through monetary aggregates targeting is not the optimal way to approach the monetary policy. Similar event occurred after 2008 when large quantitative expansions did not result in increase in inflation.

The second approach to the monetary policy is through the control of the interest rates. This approach to the monetary policy was popularized by Alain Greenspan while he was the chairman of the Fed as described in Blinder and Reis (2004). In this type of monetary policy the central bank sets the target interest rates and then uses the open market operations in order to achieve the preset target for interest rates. The central bank can change the targeted interest rate as it sees fit and based on the judgment of what should be the current level of interest rates given the current position of the economy in the business cycle.

The third approach to the monetary policy is through the control of expectation which is manifested in the targeting of the inflation rate. In this monetary policy set up the central bank sets a certain level of inflation and then uses the monetary policy tools in order to achieve the preset rate of inflation. This approach to the monetary policy is rather new and it has been implemented in last two decades. The approach has been described in Woodford (2004), however Ball and Sheridan (2005) bring the inflation targeting approach into questions since they have not found that the inflation targeting improves the success of the monetary policy considerably.

One of the underlying connections between all three approaches to the monetary policy is the forced trade-off the central bank faces when conducting the monetary policy. The central bank in essence controls the money supply. In large economies the changes in money supply are
achieved through the purchase or sale of the government bonds. The central bank then needs
to decide which variable is going to be in the bank’s criterion in control function. The central
bank can either control the quantity of money in the economy or the central bank can control
the interest rates in the economy. It is impossible to control both at the same time. The choice
between the control of the quantity of money and interest rates is the trade-off the central bank
has to make in order to be able to control the monetary policy. The essence of this choice is
the bases for the famous rules versus discretion debate best described in Kydland and Prescott
(1977, 1980, 1982)\textsuperscript{31} who discuss economic policies in general, not just monetary policy. But
we have to understand the trade-off between the rules and the discretion and how does this
trade-off effect small open economy.

If the central bank uses the k-rule (or any other monetary rule for that matter) the central bank
has committed itself to a certain monetary policy conduct and the central bank has a given
policy function. In this case the criterion function in essence becomes a response function for
the central bank. The basic premise for having monetary policy rules lies in the fact that once
the rules are set the uncertainty caused by the monetary policy for other economic participants
decreases. If the rules are publicly known then all economic agents can observe the rules,
observe the variables which the rules try to control and know what the central bank is going to
do at any point in the business cycle.

On the other hand if the central bank is setting monetary policy based on discretionary policy,
the central bank is essence is using the monetary policy to stir the economy during the
business cycle. The discretionary conduct of monetary policy gives the central bankers ability
to effectively respond with a monetary policy to changes in the business cycle.

The question what is better, rules or discretion in my view has been resolved by the financial
crisis of 2008. If the central bankers have had a fixed set of rules, instead of the quick response
to the newly developed crisis the effects of the crisis would have been much greater. Since the
central bankers acted forcefully to prevent the development of crisis the whole rules argument
was out of the window. Chari, Christiano and Kehoe (2008) made this point clear, according
to them the economic situation was bad, but without the monetary policy interventions it
would be much worse.

The “rules vs. discretion” argument can easily be related to the small open economy. While
the monetary policy in large economies is conducted through the purchase or sale of the
government bonds in small open economies the monetary policy is conducted through the
purchase or sale of foreign currency. The variable in the criterion function of central bank in
large economy can be the interest rate or the quantity of money, in case of small open
economy the variable in the criterion function is the exchange rate. Once the central bank
chooses the exchange rate regime, using the definition for the exchange rate regime we have
set up in this dissertation, the criterion functions for the monetary policy, as well as the
conduct of monetary policy are known.

In case the central bank chooses the monetary policy to be stable exchange rate the criterion
function for the central bank is:

\textsuperscript{31} Other papers in this filed are, Calvo (1978), Chari, Kehoe, Prescott (1989),

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\[ f(E) = x \quad \text{for a fixed exchange rate} \quad (4.4) \]

\[ f(e) = x^* \begin{cases} x^*_a < y \\ x^*_b > z \end{cases} \quad \text{for an exchange rate within a certain band} \quad (4.5) \]

The policy function in this case is also the response function for the central bank. If the exchange rate is absolutely fixed with some other currency the central bank will serve as an exchange office. All of the FX trades are going to go through the central bank and are going to be at some pre-determined level. On the other hand if the central bank sets a band for the exchange rate the central bank will react only when certain levels of the exchange rate are hit. In this case the central bank might not be an active participant in the FX market, but will just react when it is needed to adjust the exchange rate.

The policy of the stable exchange rate is the exchange rate regime of rules. The central bank reacts according to the preset rules in order to achieve the wanted level of the exchange rate. The central bank in the regime of the stable exchange rate is not focused on the needs of the economy in terms of money demand nor does the central bank react given the point of the business cycle the economy is in. The central bank just sets the exchange rate level and performs the actions in order to preserve the given level of the exchange rate.

In case the central bank chooses the variable exchange rate regime, as we have defined it in the dissertation the policy function is given as:

\[ f(E_{i+1}) = E_i (1 + \delta_i) \quad (4.6) \]

For the economic participant in case the exchange rate change \( \delta \) is not announced the central bank’s policy function is:

\[ f(E_{i+1}) = E_i (1 + \delta^*_i) \quad (4.7) \]

Where \( \delta \) is the change in the exchange rate given the actions performed by the central bank and \( e \) is the expectations operator how the central bank is going to change the exchange rate. In this exchange rate regime there is a possibility to have both rules and discretion. The rules would come into play if the central bank sets the \( \delta \) to the fixed for each reaction. This would be the parallel of the k-rule for large economies. In this case the central bank would periodically adjust the change in the exchange rate for the same (or some pre-announced) amount. The other possibility is for \( \delta \) to be stochastic, in that case the central bank changes the exchange rate as it sees fit. This is the case when the conduct of the monetary policy is strictly discretionary.
In case the monetary policy is discretionary the central bank has wide possibility how to use the exchange rate in order to react to the occurrences in the economy. In case the central bank chooses stable exchange rate the central bank is just set on the level of the exchange rate. Other economic variables do not enter the consideration of the central bank. However if the central bank chooses the variable exchange rate regime the central bank can extend the monetary policy to react to a whole spectrum of events in the economy like us the change is the exchange rate to target inflation. More on this point will be analyzed when we look at the pass-through effect.

The main point of difference between the stable and variable exchange rate regime lies in the level of involvement the central bank wants to have in the economy. When the stable exchange rate is chosen the central bank in essence ties its own hands and becomes an institution whose only purpose is to safeguard the set level of the exchange rate. In this case the objective of the monetary policy becomes the exchange rate stability under all and any cost. In case the central bank chooses the variable exchange rate policy the central bank has the option to use the monetary policy to actively affect the economy. If the exchange rate is variable the central bank has a free reign over the use of policy tools.

We have now looked at the two options the central bank has when choosing the monetary policy in small open economy. We have also defined the goals the central bank tries to achieve. In next section we are going to extend our argument and we are going to question what is the purpose of the monetary policy.

4.2.2. The question of goals of monetary policy

When we have stated the objectives of the monetary policy we have put two macro objectives, the stability of prices and stability of the financial system. We have also mentioned the monetary policy is a trade-off; something has to be lost for some gain. The central bank in large economies can choose between the control of the interest rate or the control of the monetary aggregates. In small open economy the choice is more subtle. The central bank has to choose to control the exchange rate. So the emphasis of the “choice” is not what to control, but how to use what is being controlled. Should the central bank set the exchange rate or actively manipulate it? From the perspective of use of the exchange rate one important question has to be asked: what is the price of the trade off? Another question which has to be asked, and it closely related to the above mentioned trade-off is: what is the purpose of monetary policy? Both of these questions are going to be discussed in this part of the dissertation.

If the purpose of the monetary policy if to keep prices stable then it seems that the optimal monetary policy choice is to have a stable exchange rate and then just put the monetary policy on autopilot. This belief was echoed officially by the Central Bank of Lithuania as cited in Part 3.

However if the central bank wants to move outside of just the control of the price level the central bank has to choose the variable exchange rate regime and then use the exchange rate to
off-set adverse events in the economy. The equivalent of the variable exchange rate regime in small open economy is the control of the interest rate in large economies. Just like the Fed sets the interest rate based on the need of the economy, depending on the position of the economy in the business cycle, so could the central bank use the exchange rate.

There are many ways to use the exchange rate for other purposes than just the control of the price level. One of these examples is Ribnikar (2003), who states the objective of the monetary policy in Slovenia was to have price stability, but at the same time to cover the uncovered interest rate parity. Covering the interest rate parity had the purpose to discourage the inflow and capital into Slovenia and rise in foreign debt. This was novel approach to the monetary policy and also an approach which is not covered in standard textbooks. This approach demonstrates in practice what the dissertation is trying to develop in theory: the importance of the use of the exchange rate and the effects of the exchange rate on the economy.

The exchange rate can also be used to offset the differences in productivity between the small open economy and rest of the world. So if productivity in the world grows by $p$ and in small open economy by $r$ and given that $p>r$ the exchange rate can be adjusted by $p-r$. Naturally this would have to come with a tradeoff of slightly higher inflation, but again the question remains is this price worth paying for. This position was advocated by Rohatinski and Santini (1994).32

Another use of the exchange rate could be to retroactively offset the real exchange rate changes and keep the competitiveness of domestic economy. As we shall latter see, the real exchange rate is one of the fundamental variables of the model. In case the central bank tries to control the real exchange rate the policy of the central bank would be to change the exchange rate by the adverse move in the real exchange rate index in the previous period.

Another overlooked economic variable is the credit policy. The banks undertake credit policy, but the central bank through monetary policy does have the ability to stir the direction of the credit policy. It is the impact of the credit on economic agents which we will directly tie in with the exchange rate regime choice latter in the dissertation. The control of credit policy opens room for a hidden agenda of monetary policy: control of the credit policy in the economy as mentioned in Perišin and Šokman (1988) or Dimitrijević (1981). The central bank can use monetary policy to govern the direct and control the aggregate balance sheet of the banks. I believe all can agree that credit card loan and loan used to open a factory do not have the same economic impact. The issue of credit broadens the impact of monetary policy and as we shall demonstrate in the dissertation it is the choice of the exchange rate regime which plays the crucial role in the credit policy of banks.

The above mentioned uses of the exchange rate are just a few of the possible uses of the exchange rate for purposes other than just the price stability. We will show in the dissertation it is possible to have price stability while using exchange rate to meet other goals.

One of the strongest arguments against the variable exchange rate, or the use of the exchange rate as an active policy tool is the exchange rate pass-through. The exchange rate pass-through is an economic occurrence when the changes in the exchange rate are reflected in the changes

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32 References to this position can be found in Santini (2009), web site www.rifin.com.
of prices in the economy. Meaning that the changes in the exchange rate are not going to change the price of exports at all since changes in the exchange rate are going to be off-set by the changes in the inflation. Although this proposition is one of the main arguments against the variable exchange rate we are going to show that this argument is just smoke and mirrors.

4.2.3. Dynamic model of the central bank's behavior

The central bank conducts monetary policy based on the choice of the exchange rate regime. The conduct of monetary policy is significantly different between the two regimes and it will be clearly reflected in the policy function for the central bank. The main difference between the exchange rate regimes is the involvement of the central bank in the business cycle and the response of the monetary policy to changes of needs of the economy. The stable exchange rate regime is characterized by the focus of the central bank to keep the exchange rate steady, while the variable exchange rate regime is characterized by central bank’s reaction to the changes in the economy.

First we are going to look at the sable exchange rate regime. Under stable exchange rate regime the central bank wants the exchange rate to be completely fixed with some other currency or to stay within a certain range, so the problem the central bank is trying to solve is:

$$V(\nu) = \min E \sum_t (E_t - \bar{E})$$

(4.8)

Where $E$ is the nominal exchange rate and $\bar{E}$ is some preset level of the exchange rate. The central bank wants to minimize the oscillations of the nominal exchange rate around some level. The central bank uses its instruments to achieve the wanted minimization, the instruments are given as

$$f(\text{RR}, \text{L}, \text{R}, \text{P})$$

(4.9)

Where RR is the reserve requirement, L is Lombard loan and R is the repo with the central bank and P are the open market purchases. This is the set of policy measures the central bank has at its disposal. The transition equation is:

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33 Obviously the instruments stated here are not the only instruments the central bank has. There are any other types of regulation the central bank can impose from the capital needs to direct control of credit. We are trying to investigate the behavior of the central bank on the economic system in general and not determine the impact of any particular regulation, that is why only three instruments were used.
\[ M_{t+1} = \alpha^\epsilon M_t \] (4.10)

\( M \) is the monetary aggregates and \( \alpha \) is the change of the monetary aggregates and it evolves in each time period as

\[ \alpha^\epsilon_t = \Pi_t + \epsilon \] (4.11)

Where \( \Pi \) is the central bank's expected rate of change of the monetary aggregates and \( \epsilon \) represents random shocks to the capital flows in and out of the country.

Using the above setup the bellman equation for the problem is:

\[
V(v) = \min_{E \in E} \left\{ f(RR, L, R, P) + E[V(v_{t+1})] \right\}
\] (4.12)

Subject to: (62), (63), and \( RR_0, L_0, R_0, B_0 \) where \( B \) is the initial central bank's balance sheet and subscripts 0 denote the initial time period when the central bank tried to solve the problem. As we can see the problem is stochastic since the central bank does not know what the necessary changes in the money supply are going to be. The usual solution to the dynamic programming problem would be a policy reaction function:

\[ f(RR^*, L^*, R^*, P^*) \] (4.13)

The reaction function in the open market for the central bank is:

\[
f(P^*) = \begin{cases} 
1 & \text{if } \left| E^s - E^d \right| > \Delta E^{CB} \\
0 & \text{if } \left| E^s - E^d \right| < \Delta E^{CB}
\end{cases}
\] (4.14)

Where \( E \) is the supply and demand for foreign currency at the current market equilibrium and \( E^{CB} \) is the level of the exchange rate the central bank wants to maintain.

The reaction function of the central bank under stable exchange rate is strictly based on the changes in the exchange rate. **The reaction of the central bank is going to be determined by the supply and demand of foreign currency on domestic market for foreign currency.** Clearly in this set up the central bank only looks at one market (domestic market for foreign
currency) and only one variable (exchange rate). All other variables are of no interest to the central bank.

Now we are going to model the behavior of the central bank under variable exchange rate. First we have is to determine what the central bank is trying to maximize or minimize. The usual choice of the variable central bank wants to control is inflation. But the number of variables can be extended to: uncovered interest rate parity, productivity, foreign debt, liquidity of the system, target level of the exchange rate, expectations stabilization, and real exchange rate. In we have assumed so far the central bank uses the exchange rate and actively depreciates the exchange rate, however this might not the a complete explanation since the changes in the exchange rate can be direct or indirect. There are two separate cases. The first case is when the central bank uses the exchange rate and actively moves the exchange rate with some clear objective. The second case is when the exchange rate is the byproduct or the result of the actions of the central bank. The best example of this is the case when the central bank controls the interest rates and through its actions changes the interest rates as needed and the subsequent changes in the exchange rate are just a byproduct of the original actions.

For now we are assuming the object of the central bank is to control the real exchange rate and this is done through persistent depreciation of the nominal exchange rate. In part 4.2.4 we will see that the approach we are using is very close to the inflation targeting approach described in Svensson (1999, 2002, 2007) and Svensson and Woodford (2005) and Bernanke and Woodford (2005). This will come more into light when we analyze the exchange rate pass-through effect.

In this particular model we are going to assume the central bank targets the nominal exchange rate in order to keep the level of the real exchange rate the same or depreciate the real exchange rate. The central bank tries to

\[
V(v) = \min E \sum_{t=1}^{n} (e_t - \bar{e}_t)
\]

(4.15)

Where \( e \) is the change in the real exchange rate and \( \bar{e} \) is the desired level of the real exchange rate the central bank wants to achieve. We have states that the nominal exchange rate can evolve acceding to two different processes:

\[
f(e_{t+1}) = (1 + \delta_t) e_t\]

(4.16)

Or

\[
f(e_{t+1}) = (1 + \delta^* e_t\]

(4.17)
The parameter $\delta$ represents the rate of change and it can be stochastic. The control function of the central bank is the same again, since the instruments the central bank has are always the same regardless of the regime:

$$f(RR, L, R, P)$$  \tag{4.18}$$

We are also going to introduce a new variable, this variable is going to be a sunspot variable and it will encompass reactions of the central bank which are not directly tied to the main object of maximization. The characteristics of sunspot variables was developed in Woodford (1990). The central bank might have for the first object to depreciate the real exchange rate, but that does not mean the central bank is only going to react for this reason. The central bank might also react when there is an increase in demand for money or when there is a particular reason to decrease the interest rates. The sunspot variable is going to be noted as $\Psi$. The bellman equation for the problem is:

$$V(v) = \min_{c \in \mathcal{S}} \left\{ f(RR, L, R, P) + E[V(v_{t+1}) + \Psi] \right\}$$  \tag{4.19}$$

Subject to: (4.16), (4.17), and $RR_0, L_0, R_0, B_0$ where $B$ is the initial central bank's balance sheet and subscripts 0 denote the initial time period when the central bank tried to solve the problem. As we can see the problem is stochastic since the central bank does not know what the necessary changes in the money supply are going to be. The usual solution to the dynamic programming problem would be a policy function:

$$f(RR^*, L^*, R^*, P^*)$$  \tag{4.20}$$

So what is the difference since everything is the same? The difference is in the object of maximization, the policy function result and the reasons for the reactions of the central bank. Under stable exchange rate the central bank is only interested in the domestic market of foreign currency. In case of the stable exchange rate the central bank can use the exchange rate for other purposes. That is why is the model we have presented the sunspot variable to be able to include other elements into the behavior of the central bank, elements not explicitly stated in this model.

Now that we have determined mathematically the model of behavior for the central bank under alternative exchange rate regimes we are going to go and investigate the conduct of the monetary policy and how does the conduct of monetary policy impact economic variables and other participants in the economy.
4.2.4. **Consequences of the conduct of the monetary policy**

This part is going to investigate the consequences of the choices of the exchange rate regime. The focus of this part is going to be on: real exchange rate, pass through effect, conduct of the monetary policy, effects of the foreign debt on the quantity of money and responses of the monetary policy to the needs of the economy.

In Part 4.2.2 we have stated that regardless of what is the criterion variable for the central bank in a large open economy there has to be some trade-off. In its basics the trade-off was presented as the choice between the control of the interest rates and the control of the quantity of money. In broader term the trade-off was between the ability of the central bank to be fully transparent in its decision, but not to be able to respond to the needs of the economy since the behavior of the central bank was given by the policy rules on one hand or to be able to respond to the needs of the economy, but lack transparency in its behavior.

In small open economies the choice is the same, does the central bank want exchange rate stability or does it want to have an active role in the economy and use exchange rate as a policy tool? In this part we are going to illustrate the choices the central bank has to make while it is conducting the monetary policy.

**4.2.4.1. Real exchange rate**

The first variable we are going to tackle is the real exchange rate. The real exchange rate represents the relation of the nominal exchange rate to the changes in prices in small open economy and the rest of the world. The real exchange rate as a variable is going to have a central role in our model we are going to show that the consumption choices of the households are tied to the real exchange rate. We are also going to relate real exchange rate to the economic decisions made by firms.

For households the real exchange rate is important because it is the relation of prices between domestic and foreign goods which are perfectly complementary. The household, as a utility maximizing agent will try to consume as much goods as it can given the budgetary constraint. The changes in the real exchange rate are going to make some goods cheaper and some goods more expensive. The changes in the price of goods are going to affect the structure of the consumption basket for households.

Same goes for producers who have to sell the goods. The real exchange rate is going to be a variable affecting the competitiveness of the firms. If the real exchange rate is appreciating the prices of domestically produced goods are going to increase, if the real exchange rate is depreciating the prices of domestically produced goods are going to decrease. Therefore the changes in the real exchange rate are going to affect the competitiveness of firms.

The mathematical relationship between the real exchange rate and the choices by firm and households is going to be shown latter. Right now we shall develop a very simple real exchange rate index as used in Vidaković (2007a). The index can be presented as follows:
\[
\Lambda_i = \Lambda_{i-1} \left\{ 1 + e_{ex}^i - e_{im}^i + \frac{E_{i-1} - E_i}{E_{i-1}} \right\}
\] 

(4.21)

\begin{align*}
\Lambda & - \text{Constant, the beginning value of index.} \\
E & - \text{nominal exchange rate} \\
e_{ex} & - \text{price change in a country (percentage change or inflation)} \\
e_{im} & - \text{world inflation, in this case inflation in EU, in percentages.}
\end{align*}

If the index is going up the prices in domestic country are rising faster than the prices in the rest of the world\footnote{Naturally there is a reverse interpretation in the case of deflation. The domestic prices are falling at a slower rate than the prices in the rest of the world.}: the real exchange rate is appreciating. The domestic goods are more expensive, foreign goods are cheaper. Under the assumption of perfect substitutability between domestic and foreign goods in this case the domestic consumers will substitute domestic more expensive goods for cheaper foreign goods. On the other hand if the index is going down, the prices in the rest of the world are increasing faster than the prices in domestic country and the real exchange rate is depreciating, the households will start to substitute domestic goods for the foreign goods. According to the basic theory fall in this index should be positive for the exports in small open economy. Alternatively a rise in index and real appreciation of domestic goods should be negative for exports and positive for imports.

**The real exchange rate should be depreciating the in the small open economy.** From the perspective of the exchange rate regimes this can be achieved under both exchange rate regimes. If the economy has stable exchange rate regime the real exchange rate is going to be depreciating of the economy has smaller rate of inflation then the rest of the world. However given the structure of the small open economy and its susceptibility to supply side shocks it is to be expected the volatility of the inflation is going to be greater in the small open economy then in large economies. Therefore from the theoretical perspective it is hard to expect a stable exchange rate regime can lead to the real exchange rate depreciation unless there is internal devaluation.

Under the variable exchange rate regime the central bank has the ability to move the nominal exchange rate and use the nominal exchange rate to offset the adverse changes in the real exchange rate. Since the inflation rate in the rest of the world cannot be controlled by the central bank from small economy the only two variables the central bank can control in order to achieve real depreciation are inflation and nominal exchange rate. Since the process of price creation is complex it is easier for the central bank to control the nominal exchange rate and use the nominal exchange rate to archieve the desired level of the real exchange rate.

Since the control of the real exchange rate boils down to the amount of instruments available and the flexibility of those instruments the variable exchange rate regime is more agile in
order to prevent real exchange rate appreciation. The explicit calculation of the index and analysis of index under alternate exchange rate regimes is going to be presented in Part 5.

4.2.4.2. The pass-through effect

The variable exchange rate is usually frowned upon because of two arguments:

- Stable exchange rate brings stability to the economy; therefore variable exchange rate would bring instability to the economy.
- What is the point of trying to devalue the currency to make our goods cheaper is the depreciation gets transferred into inflation.

The question stability and instability given the exchange rate regime is immaterial. We are taking a much broader view of the economy as a system. We are looking how the choice of the exchange rate regime affects the behavior of economy agents. In my view the perception of monetary policy just through the “stability” or “uncertainty” of the exchange rate is superfluous. The monetary policy should be considered in much broader and larger view then just the stability on one variable, even if that variable is as important as the exchange rate. The issue of the pass through effect is the fact that “changes in the exchange rate get transferred into inflation” are going to be addressed in this part of the dissertation.

Important thing to note about the pass-through effect is that it is based on the nominal variables, not real variables. We are interested in how economic participants react to the real variables, not the nominal variables. However that does not mean we should not make a connection between the pass through effect, nominal exchange rate, conduct of monetary policy, the real exchange rate and the choice of the exchange rate regime.

We are now going to analyze the model with the exchange rate pass-through and then we are going to look at the optimal choice of the exchange rate regime given the pass through effect. In order to do this we are going to adopt the model of inattentive economic agents. In latter parts of the dissertation the inattentiveness is going to be replaced with Bayesian learning framework which is much more comprehensive. We will use Bayesian assumptions and mathematics, the Bayesian econometrics, as described in Koop (2003) and Hamilton (1994) will not be used.

In his seminal work about rational inattention Sims (1998) creates a revolutionary concept. The economic agents have rational expectations, but they have the problem of processing information fast enough. So the information gets processed at some later time and we have nominal rigidities in the data. The whole concept has been extended to producers and consumers by Reis (2006, 2006b). The price stickiness and the New Keynesian models have been recently pushed back by alternative theory of rational inattention as proposed by Mankiew and Rise (2002) and in paper by Sims (2003).
The model we are going to introduce now is going to be a simple model of price creation for firms. This representative firm has rational expectations, however the assumption is rational expectations is relaxed in its swiftness of reaction. While under the classical rational expectations the economic agents should immediately react in this model the economic agents are going to know by how much they should react, but then they are going to decide are they going to react.

So the process of price creation has two steps. The first step is the determination by how much the price should change and the second step is the decision should the firm react or not. This is not a Calvo type model where the price setters are allowed to change the price only at a specified time, but it is a sticky price model like Ball and Mankiw (1994). We are also going to assume the only reason for the change in price is the change in the nominal exchange rate. This model is valid only under the variable exchange rate regime. Following the model presented in Reis and Makiew (2002) we shall set up a model with rational agent, but that have some processing issues i.e. they are inattentive.

The optimal price the firm desires at which it maximizes profits is:

\[ p^* = p_t + \alpha y_t \]  \hspace{1cm} (4.22)

Where p is the overall price level and the y is the firms output. The firm updates its price every period and the expectations of the optimal price evolve according to

\[ x_t^j = E_{t-j}p^*_t \]  \hspace{1cm} (4.23)

The aggregate price level has the following equation:

\[ p_t = \lambda \sum_{j=0}^{\infty} (1 - \lambda)^j x_t^j \]  \hspace{1cm} (4.24)

This is the process of the price creation in its first step, but the question is: when do the prices move? Here we shall introduce the threshold of attention\(^{35}\). The threshold of attention is some level of the change in the nominal exchange rate after which the firm changes the price.

\(^{35}\) The threshold of attention used in Rise (2006) is \[ \alpha = \frac{\sigma + \psi}{1 + \theta \psi} \] where \( \theta \) is price elasticity, \( \psi \) is the labour supply elasticity, \( \sigma \) variance. Ball and Romer (1990) call parameter \( \alpha \), parameter of real rigidities in the economy or it can also be interpreted as the threshold of attention for a producer. Here we are using a much simpler case in order to illustrate the point and are on interested in mathematical sophistication.
The threshold of attention is \( \alpha \), \( E \) is the nominal exchange rate and \( \Delta E^* \) presents some level of change in the nominal exchange rate after which the firm is going to change or update its prices.

Following this set up, let us create the state variable for the price changes in economy with variable exchange rate regime. We know the price shocks are caused by the changes in the exchange rate, in that case we can set up a process for the changes of those shocks and we can define the total level of shocks from period 0 to period \( j \). The total shock is:

\[
S_t = \sum_{i=0}^{N(j)} x_i
\]  

The shocks \( x \) in the nominal exchange rate are generated based on some process, let us now set up that process.

Let \( N(j) \) be a homogenous Poisson's Process with intensity, \( \lambda > 0 \) and \( u \) the number of shocks up to the point t, \( x \) is the amount of the shock and \( S \) is a compound Poisson's process. This process is the changes in the nominal exchange rate. The future changes in the nominal exchange rate are known only to the central bank and are not known to the firms since the monetary policy is exogenously imposed.

We shall assume \( x \) is iid across the economy. So each economic participant has his level of inattention and his threshold when the prices get updated. Also \( N(t) \) is independent of all \( x \). From this we can derive the expected value of \( S \):

\[
E[S_t] = \lambda * \mu * t \text{ with } \mu = E[x_i]
\]  

\[
p \in [p_0, p_1]
\]

\[
p \leq p_1
\]

**Proposition 1:** in the long run the absorption of shock is one for one.

Proof: the proof is trivial. If we take the limit as \( t \) approaches infinity we get:
This implies in the long run all of the shocks get absorbed or as the usual economic jargon states the shocks have a pass through from depreciation into inflation. There have been many studies studying the absorption of exchange rate into the price level. Studies like (Corriceli, Jazbec, Masten 2006, Jazbec, Coricelli 2004; Burnstein Rebolo, Echebaum 2005, 2007), show what is the time period it takes for the exchange rate shock to get absorbed after devaluation. The graphical presentation of the described process is in Graph 12.

**Graph 12: The policy shocks in each time period and the update.**

The Graph (12) and the proof of Proposition 1 show that over time all of the nominal shocks get absorbed to the full extent. So the inflation induced by the changes in the nominal exchange rate becomes equal to the changes in the nominal exchange rate.

**Proposition 2:** under the variable exchange rate the volatility of inflation rate can be constant over time, if the rate of depreciation is announced.
**Proof:** The proof comes from the two aspects. The first aspect is the basic assumptions of the rational expectations. If we have that \( p_{t+1}^r = p_{t+1}^r \), and we assume perfect absorption we have that the rate of depreciation is effect is \( p_{t+1}^r \). So the expectations of economic participants are fixed and equal the rate of nominal depreciation. This is the fundamental proposition of the rational expectations theory as stated in Lucas (1972). The second segment of the proof comes from the proof of proposition 1. If in the long run the level of absorption is 1, then if the shock in every period is known the price changes over aggregate economy will equal to the level of depreciations. In this particular case the rational expectations equilibrium will be achieved and we will have the changes in the exchange rate equal the changes in the inflation with full pass-through effect. The achievement of the rational expectations equilibrium will open a possibility of the central bank to archive any desired level of inflation targeting. QED.

All of the nominal shocks in the long run get perfectly absorbed. This leaves room for very simple and powerful control of both the inflation and real exchange rate. If the central bank imposes a variable exchange rate regime and using the model we have presented the inflation rate is going to equal the rate of nominal depreciation. In this case the changes in the real exchange rate are going to be equal to the price changes in the rest of the world. This means that as long as the rest of the world does not have deflation the real exchange rate of the small open economy is going to depreciate at the rate of inflation in the rest of the world! Following this the optimal exchange rate policy for real exchange rate depreciation is for the central bank to announce what the rates of depreciation are going to be. In this case the firms will not need any time to adjust their behavior.

From the perspective of modeling here we have use a priori distribution and have assumed the economic participants use exactly this distribution. This might not be the case and the distribution the firms use in formation of prices might not be the actual distribution the central bank is using. But even if this was the case over time the firms are going to learn the correct distribution and we are going to have the rational expectations equilibrium.

The main objective of this exercise was to show the exchange rate pass through is not an example of the futility of the variable exchange rate, in fact the exchange rate pass thought is economic occurrence which should be directly used by policy makers. Now the possibility of no pass through would be the best possible case, since then the real exchange depreciation would be equal to the nominal depreciation plus increase in price in the rest of the world minus the domestic inflation.

There is also a possibility of too much of the good thing. In Lucas (1973) there is an overview of how as the inflation is increasing the inflation output is trade-off is decreasing. This in effect implies that the larges the nominal disturbances the smaller the real effect is going to be. In our case this points that the threshold of attention is very small\(^{36}\) which might not be the case for all markets in the economy. So if the rate of depreciation should be kept at small

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\(^{36}\) Gregurek and Vidakovic (2007b) try to calculate what is the threshold of attention for the investors who have to choose between investing in local currency in equities and savings in banks in foreign currency. The result is almost meaningless since the threshold of attention is between 5\% and 60\%. 

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levels of several percentage points. We have mentioned the possibility that the firms “learn”
the true distribution if the central bank has not announced it. The actual process of learning
and the mechanisms of learning are going to be developed latter in this dissertation.

Now after debunking the myth of the “exchange rate pass-through” we are going to analyze
the conduct of the monetary policy in small open economy. We are going to see how does the
fact that the central bank is not intervening on the domestic money market but rather on the
foreign currency market impact the economy.

4.2.5. Conduct of the monetary policy

Before we move onto the conduct of the monetary policy we are going to create the monetary
framework in which the central bank operates. Since we are in a small open economy there are
going to be three markets which are influenced by the conduct of the monetary policy. Those
are:

• Domestic market for local currency (LC market)
• Domestic market for foreign currency (FC market)
• Domestic credit market (DC market)

Conduct of monetary policy will influence those three markets. The central bank has the
ability to directly influence the LC and FC markets, and indirectly the DC market. The three
markets are shown in the Graph (13).
Conduct of monetary policy under each regime will be analyzed separately, now we will just make an overview of the conduct of the monetary policy regardless of the regime. Monetary policy can be conducted through domestic market for domestic currency LC. This is the standard way to conduct monetary policy. The central bank trades the government paper with the banks and changes the liquidity of domestic banks in local currency through the purchase or sale of government paper. The change in liquidity of the banks will have impact on the domestic market for foreign currency FC and domestic market for credit DC. The actions of monetary policy on LC will have effect on FC because the change in the quantity of domestic currency will have effect on the relation of domestic currency with other currencies ie. exchange rate. Changes in the quantity of money will also have effect on the domestic market for credit DC since the changes in the quantity of money will also change the price of the price of money, the interest rate.

This is the supply side approach. The central bank action on the LC market changes the supply of domestic currency. Now depending on the dynamic changes on the demand side there will be effects on the interest rates and on the exchange rate. It is important to notice the flow of impact of the intervention. The central bank acts on the LC market and then there is a spillover effect on the FC and DC market as shown in the Graph (14).
The central bank reacts in the Domestic Market for Domestic Currency and then there is a spillover effect on the other two markets. If the central bank acts in the Domestic Market for Foreign Currency the flow of the impact will be as in Graph (15). Again we are going to look at the increase in supply without analyzing the impact from the demand side.
Graph 15: Flow of domestic intervention FC market

Now we see the central bank intervened in the Domestic Market for Foreign Currency and there was a spillover effect on the LC and then on the DC markets. The impact on DC markets is the same if there is an increase in the supply of currency, what is different is from which market the increase comes from.
Depending on the choice of the exchange rate regime the central bank will act in different markets in order to achieve the equilibrium. In case of the stable exchange rate regime the central bank will act on FC in order to maintain the stability of the exchange rate. In case the central bank has variable exchange rate regime the central bank will have the ability to intervene on both the LC and FC markets as the central bank sees fit. The difference on which market the central bank has the possibility to intervene is the crucial one.

We are now going to investigate the conduct of monetary policy under variable and stable exchange rate regimes and see what are the implications for the economy and especially for the credit markets.

**4.2.5.1. Stable exchange rate, conduct of the monetary policy and the role of the foreign debt**

In a small open economy with stable exchange rate regime the central bank conducts interventions on Domestic Market for Foreign Currency (DC) by buying and selling foreign currency. The actions of the central bank in the foreign currency market have double impact. The interventions on the FX market will change the supply of the domestic currency and this will change the exchange rate. The second impact of the exchange rate interventions is going to be the impact on the Domestic Market for Domestic Currency (LC) since by intervening in the FX market the central bank is also changing the supply of domestic money in the economy.

First we have to state the obvious: the amount of money in the economy and the monetary reserves of central bank are connected through accounting equality. The balance sheet of the central bank, like any other balance sheet, has assets and liabilities. The Central Bank has assets in foreign currency (the reserves) and liabilities which are money and deposits from the banks. Apart from micro changes in the balance sheet the major changes in the balance sheet of the central bank occur when the central bank conducts operations in the FX market. We are particularly pointing out the amount of domestic currency in the economy is covered by the foreign exchange reserves. This comes from the accounting equality, where the assets of central bank are equal to the liabilities of the central bank. Although this equality of assets and liabilities of central banks at first glance it seems obvious in the further analysis of balance-sheet structure of the central bank will have a significant role.

In the case of pressure on exchange rate, the central bank will act to offset the changes in the exchange rate. With the changes to the amount of money in the economy and by acting on the FC market the central bank will make the exchange rate stable. In the case of appreciating

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37 If the exchange rate is perfectly fixed in that case the interventions of the central bank make sure that the set parity is maintained.
38 We are in a stable exchange rate regime so there is no need for interventions on LC market and assets in domestic currency.
39 The level of Lombard loans, REPO operations and extra liquidity deposits with the central bank could vary on the daily basis and is irrelevant for our analysis.
pressures on the exchange rate in the economy, the central bank will intervene with the aim of increasing amounts of money, if the central bank increases the quantity of domestic currency on the LC market the central bank will at the same time increase the quantity of money on the domestic money market. The increase in the domestic currency will also increase the domestic liquidity.

In the case of depreciating pressure on the exchange rate the monetary interventions will focus on reducing the quantity of domestic currency through the interventions on the FC market. At the same time with the decrease of the domestic currency in the FC market the central bank will decrease the supply of money in the money market and thus reduce domestic liquidity. Monetary intervention by the central bank on the FC market is manifested in the changes in the central bank’s balance sheet. Purchases of the foreign currency are going to increase the balance sheet of the central bank and purchases of the domestic currency are going to decrease the central bank’s balance sheet.

Now we are going to look at what forces the central bank to intervene in the FX markets and thus change the quantity of money in the economy. Let's start from the case where foreign money enters the economy and why would foreign money enter the economy in the first place. If the central bank conducts policy of stable exchange rates there is no currency risk for economic participants in a small open economy, but also there is no FX risk for foreign investors because the central bank guarantees the stability of the exchange rate. If there are no legal limits on the flow of capital foreign investor will invest the money where the investment has the largest interest rate.

The foreign investor is going to investigate does the profit from investing in his country is greater than the profit from investing in foreign country. If is $\pi^f > \pi_d$ the investor will invest in foreign country. The expected return on investments abroad has to have higher return then the domestic investments. Under the stable exchange rate regime the foreign investor who invests its portfolio in a small open economy is trying to solve the following maximization problem:

$$ \max \Pi_f = \sum_0^n \theta_r, \text{ With respect to total investments } I \quad (4.31) $$

With the condition: $\sum \theta_i = 1$.

Where $\Pi$ is the total return on all investments in small open economy, $r$ is the return on each individual investment, $\theta$ the share of each investment in the portfolio.

The same problem can easily be modified for any inflow of funds into the economy. If case of a firm or the government wants to get a loan from abroad the expected cost of the loan under the stable exchange rate regime is just the interest rate. If the interest rate is smaller when borrowing funds from abroad the government or the firm will try to obtain financing from abroad.
We now have to investigate the behavior of the central bank. Criterion function for the central bank under stable exchange rate regime is:

\[
f(e) = x \quad \text{for a fixed exchange rate} \quad (4.32)
\]

\[
f(e) = x^* \begin{cases} 
  x^* < y \\
  x^* > z 
\end{cases} \quad \text{for an exchange rate within in a certain band} \quad (4.33)
\]

If the capital importer's initial conditions are satisfied, the capital importer will have to buy local currency. The capital importer will bring fresh foreign funds into the economy. Entry of foreign funds into a small open economy will create appreciating pressures on the domestic currency, if the central bank does not want to allow depreciation of the nominal exchange rate the central bank will have to intervene in the FX market in order to prevent the nominal appreciation of the currency. Central bank will intervene with a transaction which will increase the amount of domestic currency in circulation the increase in domestic currency will reduce the appreciating pressures. In simpler terms, the central bank will buy foreign currency and thus sterilize capital inflows in the economy.

Negative economic side effect of such inflows in the economy is the increase in foreign debt of government or firms. It is irrelevant is the import of capital though investment (capital in the balance sheet) or through debt (liabilities in the balance sheet). Ultimately both debt and capital represent obligation of one nation towards foreigner. The obligations have to be paid back. The only difference is the obligations based on debt usually have maturity and are repaid back with interest. The capital obligations usually do not have expiration data and pay dividends.

The flow of impact can be seen on the Graph (16). The inflow of funds caused by foreign investment or debt will appreciate the exchange rate. The central bank will react, push back the exchange rate through intervention and the exchange rate will return to the previous point. However the intervention will increase the quantity of money in the economy, decrease the interest rate and increase the quantity of domestic currency. Increase in quantity of money will also decrease the interest rate on credit. This example is the supply side example and the shock came externally: the money was brought into the economy from outside, this outside inflow caused central bank to react.

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40 Instead of using the term foreign investor, firm or government we are going to use the generic term capital importer. This term will refer to anybody who is importing funds from abroad into the economy. For us right now it is irrelevant are those fund debt or investments.

41 Again for foreign investor the initial condition is that the expected return on his investment is higher in small open economy then in his resident economy. For firm or the government the initial condition is that the interest rate on the loan is smaller abroad then it is from the domestic bank.
Now we are going to analyze the demand side shock in the economy. The demand shock will be increase in the domestic demand for money. The shock will occur in the LC market. The reason for shock is irrelevant since we are investigating what the central bank will do once the shock occurs. The graph below shows what happens and how the shock will propagate from LC market to the other markets.
The increase in the demand for money on LC market will increase the interest rate and there will also be a spillover effect on the DC market where the interest rate will also increase. What will be the effect on the FC market? None. What will be the reaction of the central bank to the increase in the demand for money? None. Because the central bank has chosen the stable exchange rate regime the central bank will not react to changes in the domestic demand for money. There will be no reason do anything to since the exchange rate is stable.
There is a possibility for the central bank to react in the LC market and try to offset the increase in the demand for money, but in that case the central bank will risk a spill over to the FC market. So the hands of the central bank are tied in case of the stable exchange rate.

Now we can make the link between external debt and the general liquidity of the system in a small open economy with the stable exchange rate regime. If the external debt does not increase the central bank will not have any reason to intervene in the FC market. Since the central bank is not intervening in the FC market the quantity of money in the economy is going to remain the same, regardless of the demand for domestic currency. No monetary intervention, or no increase in the quantity of money in the economy and hence liquidity of the system will be held at the same level, regardless of the needs of the economy and demand for money in the economy. If this situation persists over time the demand for money will raise and cause higher interest rates in the economy. As the economic activity increases so will the need for liquidity, however given the chosen policy of stable exchange rate, the central bank simply will not be able to meet the need for more money in the economy. The only way the central bank can accommodate increases in demand for money is if there is simultaneously and increase in foreign debt. Once the central bank has chosen the stable exchange rate regime the central bank is effect commits to the control of the FC market regardless of the monetary needs of the economy. The central bank ties its own hands!

Under the stable exchange rate regime, if we assume the credibility of the central bank, the central bank and the monetary policy are tied to the capital flows. If there are no capital flows then the central bank will have no reason to change the quantity of money in the economy regardless of the economy's demand for money.

This brings us to an economic paradox, if the economy has stable exchange rate regime the economic growth will increase the demand for money. However the increase in the demand for money will increase interest rate and decrease economic activity. The push-pull mechanism will develop. The firms and maybe even government will try to stimulate the economy and increase growth, however whenever they increase growth, the illiquidity of the system and high interest rates are going to pull the economy back. The question is what the central bank can do to change the illiquidity in the economy? The answer to this question is threefold.

- **The first answer:** the central bank can abandon the stable exchange rate policy. In this case, the central bank may begin to intervene on FX market and increase the amount of money in circulation, effectively rejecting policy of stable exchange rates. Increasing amounts of money in circulation, decreases illiquidity of the system, but this leads to depreciation in exchange rates and leads to the question of servicing existing foreign debt.

- **The second answer:** the central bank or fiscal policy can increase the amount of money in the economy using the measures and policies that encourage the entrance of money into the economy thus increasing the foreign debt. Fiscal and monetary policy should create measures to increase foreign currency obligations in the economy. The best way to do this is for the central bank to impose large reserve requirement in FX funds for
banks. This will increase the cost of funds for banks and firms will borrow from abroad. The government can also do two things. The first thing is to obtain financing from abroad. The second is to sell the government owned assets to foreigners. Both of these actions will increase the inflow of foreign currency in the economy causing the central bank’s reactions on the FC market.

• **The third answer:** fiscal policies which increase exports. If the economy has capital account surplus the central bank could sterilize the surplus and increase the quantity of money in the economy. If the central bank is adamant about keeping the stable exchange rate regime then the only way for the economy to gain liquidity is on the side of the fiscal policy through the sale of assets.

**Under stable exchange rate regime the best way to increase liquidity of the system is to increase foreign debt.** This course of action requires the least amount of action from the government and the central bank. However the cost of those polices is the increase in foreign debt, and such increases cannot go on forever. At one point in time the level of foreign debt is going to reach its maximum and at that point in time the central bank and the economy will have to choose between three options:

• Decrease the liquidity of the system under any economic cost
• Suffer an economic collapse and abandon the stable exchange rate
• Join a monetary union.

From what we have seen in this simple model is that the central bank under stable exchange rate regime is addicted to the rise in foreign debt unless is has sufficient exports. Without capital inflows the economy will have to suffer high interest rates and constant lack of liquidity. The conduct of monetary policy is going to be governed by capital flows and in the short run if the economy has capital inflows everything is going to be in order. Once the economic inflows stop the economy will be in trouble. **What is even bigger paradox: with large rise in foreign debt the economy with stable exchange rate is going to be very stable and possible even prosperous.**

As the foreign debt is rising the central bank will try to sterilize the inflows and will buy foreign currency in order to stop nominal exchange rate appreciation. The sterilization will increase the foreign reserves of the central bank. This conduct of monetary policy will also increase the quantity of money in the economy; the increase in the quantity of money will decrease domestic interest rates. Lower interest rates are going to be welcomed by both firms and consumers. Everybody will be happy; however the main underlying problem of this setup remains the same: **it cannot last forever.**

Now that we have covered the conduct of monetary policy is small open economy under the stable exchange rate regime in next part of the dissertation we are going to cover the conduct of monetary policy under the stable exchange rate regime.
4.2.5.2. Conduct of the monetary policy under the variable exchange rate

We are going to start by investigating the reasons for inflow of funds and behavior of foreign investors under variable exchange rate regime. The foreign investor has the same goal as under the stable exchange rate (maximization of profits), but now the optimization problem is:

\[
\max \Pi_f = \sum_{i=0}^{n} \theta_i (r_i + \frac{E^{e}_{t+1} - E_t}{E_t}), \text{ With respect to } I
\]  

(4.34)

With the condition \(\sum \theta_i = 1\).

Were \(E\) is the nominal exchange rate and the \(E^{e}_{t+1}\) is expected value of the exchange rate in the next period. From the equation (4.34) we see if central bank imposes variable exchange rate regime the foreign investors has currency risk in his portfolio. Variable exchange rate changes the requirement of profit for the foreign investor from \(\pi^{e}_f > \pi_d\) under stable exchange rate to \(\pi^{e}_f + E^{e}_t > \pi_d\) under variable exchange rate regime where the \(E^{e}_t\) is the expected change in nominal exchange rates. Variable exchange rate changes the initial condition for the foreign investor. Now the problem for the investor is not only the expected return on the investment made in foreign country, but also the expected change in the nominal exchange rate. For investor this change in the nominal exchange rate is just as important as the expected return on the investment, what is the point to have higher return on investment if the higher return is lost to the changes in the nominal exchange rate. This is the problem of the uncovered interest rate Ribnikar (2003) addressed. From this we see that the variable exchange rate regime will deter foreign investors from investing and increasing country's foreign debt.

We have seen under stable exchange rate the conduct of monetary policy is dictated by the inflows and outflows of foreign currency, actions of the central bank are automatic. The problem of the conduct of monetary policy under stable exchange rate regime is that the central bank is trying to control the exchange rate, but at the same time the effects of the control of the exchange rate are felt in the LC and DC markets. This is the constructional paradox since the central bank is trying to control the domestic currency for the needs of the economy. The conduct of the monetary policy under the variable exchange rate is devoid of this paradox.

If the central bank controls the exchange rate the mechanism of the monetary policy is the same as under the stable exchange rate. Under the variable exchange rate the central bank buys the foreign currency and increases the supply of domestic currency, thus depreciating the exchange rate. The main difference between the stable and variable exchange rate regimes is in why the central bank intervenes in the FC market. As we have seen under the stable
exchange rate regime the central bank’s actions are driven by the inflows and outflows of money, under the variable exchange rate regime the central bank acts when it is needed to move the exchange rate or because of some other need.

The effect of FX interventions on the balance sheet of the central bank is the same regardless of the regime. If the central bank is buying the foreign currency the balance sheet is going to increase, since the central bank has to “produce” the domestic currency in order to be able to buy foreign currency.

The central bank can use the interventions also to affect the domestic interest rate. This behavior would make the monetary policy in the small open economy similar to the monetary policy in large economies. However the difference in the monetary policy would be the object of purchase since in large economies the central bank usually buys the government bonds.

If the central bank is controlling the interest rates then the central bank is focused on the domestic money market and the causality is reversed. If the central bank controls the exchange rate then the actions on the FC market affect the LC market. If the central bank controls the interest rates then the interventions on the domestic money market effect the FC market. This can clearly be seen on the example of the increase in the demand for money in the LC market and the reaction of the central bank.

The central bank under variable exchange rate regime can react to the increase in the demand for money by buying government bonds on the LC market without any fear for the effects of changes in the FC market.

If the central bank controls this variable then the exchange rate is used to “destroy” the return on investments made by foreign investors in small open economy. Going back to the condition for foreign investor \( \pi_f + E^e > \pi_d \) the central bank can use the exchange rate to decrease the return for foreign investors. If the exchange rate depreciates then the devaluation of the domestic currency is going to decrease the return the foreign investor is getting on his investments in the small open economy. This point was made clear by Ribnikar (1999, 2003) when describing the monetary policy in Slovenia. Under variable exchange rate regime the economy will not have to sell itself or increase foreign debt to change the quantity of money in the economy.

While the monetary policy under stable exchange rate regime is focused on the exchange rate stability without much concern of other structures in the economy the variable exchange rate regime offers a large spectrum of objectives for which the exchange rate can be used. This brings us back to the issue of the purpose of the monetary policy. As we have elaborated the importance of monetary policy cannot be just stability of prices because of stability of the exchange rate.

In Part 3 we have touched upon the purpose of the monetary policy. The objective of the monetary policy is control of inflation, nobody is disputing that, but the purpose of the monetary policy cannot be so narrow as to focus only and only on price stability disregarding all other economic variables. The monetary policy as one of the two main economic policies should consider larger view then just price stability for sake of price stability. The purpose of monetary policy has to be to help, guide and adjust the economy at given point of the business cycle. Considering the above argument I do not see how any
broader purpose of the monetary policy could be achieved under stable exchange rate regime. For the monetary policy to affect the economy the monetary policy has to have large maneuvering room.

Graph 18: Increase in the demand for money and the reaction of the central bank

Under stable exchange rate regime the maneuvering space of the central bank does not exist since the monetary policy actions are governed by the capital flows as we have clearly demonstrated. Stable exchange rate turns the central bank into exchange office which reacts to changes in the capital flows and disregards all other aspects of the economy.
Under variable exchange rate the central bank has enough room to react to changes in the economy and to adjust to quantity of money as needed (react to demand side shocks) by the participants in the economy and not just to react to the capital flows.

4.3. Banks

The banks in this model they are the key economic participants. Once the monetary policy is chosen the banks are put into a framework they will follow in order to gain maximum profits given circumstances. The banks are just like other economic participants in terms of how they are going to be modeled, however they are of great importance for other economic participants and how they behave given the exchange rate regime.

The issue of banks in transition countries has been a sensitive one. For example Ribnikar (1995, 2004b) saw banks as desirable to be privatizes, but important enough for the economy not to be privatized fast. On the other hand Kraft (2002, 2003) and Kraft, Faulend, Tepuš (1998) see privatization of banks and sale of bank to foreigners as something very beneficial.

The banks are important for us since they transfer the monetary policy onto other participants. The central bank conducts the monetary policy, but it is the banks that transfer the effects of monetary policy on other economic participants. The best example of this transfer is the interest rates. If the central bank increases the interest rates on the domestic currency, the banks are going to increase the interest rates on loans. This increase of interest rates on loans is going to be felt by other economic agents.

In this part of the dissertation we are also going to look at the bank as a micro element, we are going to analyze the cost of funds for banks. The cost of funds represents the “effective interest rate” the banks have to pay for deposits because of the regulations imposed on them. We are also going to look at the structure of bank’s loans per sector of the economy.

We shall see in this part of the dissertation how the foreign debt is merely the end result of the economic logic imposed on the banks and it is not the banks that are causing the foreign debt on their balance sheet, but the choice of the monetary policy in the economy. Another myth is that all banks do is lend to retail while they neglect the corporate sector. We are also going to explain how the sector choice of loans in clearly connected to the choice of the exchange rate regime. The model we are going to create will present the banks as simple profit maximizing agents which just try to optimize profits in the environment imposed on them.

First we have to see what are the similarities and differences between the banks and the other economic participants. The main difference between the banks and the rest of the economic agents is that the banks have to optimize their behavior on two fronts. The first front is with respect to the shareholders. The banks are just like any other company, a company trying to maximize its profits. However there is also a second front, the relationship with the central bank.

It is extremely important to stress the importance of the banks in the actual construct of the economy. The bank, as a financial institution, presents an economic participant which serves
as a link between the economic participants which have extra funds and those economics participants which need funds. However that is only half of the story. The second half of the story is the part which the central bank plays in the business decisions of banks. As shown in the Part 2 when analyzing the Mundell-Fleming model, the central bank can run monetary policy which causes permanently high interest rates. This effect of the monetary policy has to be considered by banks once the banks are making their business choices.

The interplay between the central bank and the bank is much more significant for the bank then to which sector of the economy the bank is going to choose to lend. The problem of sector distribution of lending is simple dynamic programming problem for the bank, which we are going to model. Once faced with the monetary policy the bank is going to make business decisions in order to maximize profit. What is important for the bank is to maximize the profit, however what is important for economy is the distribution of loans per sector of the economy. So there is possibility of a conflict. The optimal distribution of loans for the bank does not have to be the optimal distribution of loans for the economy. The importance of the sector distribution of loans in the economy is going to be mathematically modeled in this part, but the full extent of the importance of the sector credit distribution is going to be clear when the model the households and firms.

4.3.1. Modeling banks as utility maximizing economic agents

We are going to model banks as utility maximizing economic agents. The banks behave in the same way as the households do except the object of the maximization is not consumption, but profits. In banking business the profit comes from buying money (getting deposits from primary and/or secondary sources of funds) at some price and selling it (giving out loans or participating in trading activities) at a higher price\(^{42}\). The difference between cost of funds and the price of funds "sold" gives bank's net interest income and consequently profit. The pursuit of profit takes place while the banks are trying to solve the problem of minimizing the business risks and maximizing the profits. The assumption of maximizing profits, while minimizing the risk is the theoretical basis for using the utility function.

We are going to assume the utility function has following properties \(u'(\bullet)>0\) and \(u''(\bullet)<0\), utility function is continuous and as least twice differentiable. The banks are in the business of making money and that success is measured by profits. However increase in profits is necessarily tied with increase in risks taken\(^{43}\). The nature of risk-reward lies in with the form of the utility function. The bank wants more profits and gets more pleasure from earning more money (the first derivative of the utility function is greater than 0). However increase in profits is followed by increase in risk exposure, making the pleasure of each new dollar earned under higher risk less and less pleasurable (the second derivative of the utility function is less than 0). The bank has option to invest in as many investments as it can get funding for. The

\(^{42}\) This also includes propriatery trading.

\(^{43}\) The risks are various from credit, operational, liquidity, economic to political and social.
investments have a rate of return, but unless the investment is in a risk free asset the bank has to take some risk with each new investment.

In order to be able to model the behavior of banks we need to have proper utility function that will be able to reflect the nature of risk the banks are facing. There are two broad categories of risk acceptance for each asset the bank can face risk. The first is to have constant relative risk exposure per each asset invested in. This implies the bank is willing to risk x amount of monetary units per investment regardless of the size of the loan. We immediately see this is impossible in banking practice. If the bank would set a dollar amount for each investment made, the scope and the size of investments would be severely limited. Setting a fixed value on risk in monetary units would imply the risk tolerance for each investment is different and that is not the modeling path we will pursue. The second option the bank has is to have relative risk per unit of exposure. This implies the bank has a fixed percentage of risk acceptances for each investment. This gives the bank flexibility in its investments, but at the same time the bank has a fixed risk tolerance.

The profit is an accounting variable, not economic variable. So it is somewhat difficult to model profits as a variable. In accounting terms the profit is the difference between the income and the cost. Since profit is an accounting variable it is impossible for a bank, or any other firm to use the profit as a control variable. The bank can influence either the income or the costs and then see the results in the profits. The profit can be influenced only indirectly. In order to have profit in the utility function we have to derive the connection between the income, expenditures and then use that connection as the control variable. The formula for profit will be:

\[ \pi = rA - \delta L \]  

(4.35)

Where \( \pi \) is profit, \( A \) is a matrix for assets and \( L \) is the matrix for liabilities, \( r \) is the vector of the interest rates on assets and \( \delta \) is the vector of the interest rates on liabilities. Assets have to equal liabilities because of funding we get the following equation for banks profits.

\[ \pi = rA - \delta A = A(r - \delta) = \tau A \]  

(4.36)

Where \( \tau \) is the vector of the net effective interest rate the bank gets or the interest rate spread between the assets and liabilities. In the dissertation we will use profit, although we could be using \( \tau A \), the results are the same since \( \pi \) is just a summation of monetary return over every asset the bank has invested in. We are assuming all other costs are covered from all other incomes. Although this is not technically correct we are more focused on the decisions the banks make, not on the actual value of the profits. Now we have a connection between the

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44 In the dissertation we are only going to look at the interest bearing assets and interest bearing liabilities plus capital. We are not going to look at other items of the bank's balance sheet. So when we are referring to assets or liabilities we are referring to the interest bearing parts of the balance sheet plus capital.
profits as an accounting variable an items the bank can control, net rate of return and total assets.

We have talked about the risk the bank is facing; we have to find the proper utility function in order to be able to demonstrate the behavior of banks. We are going to investigate two utility functions and then use the appropriate one. The first one is the CARA function. CARA stands for constant absolute risk aversion where $\pi$ is profit and $a$ is a constant.

$$u(\pi) = -\left(e^{-a\pi}\right)$$

(4.37)

The second function is CRRA, which stands for constant relative risk aversion, Where $\pi$ is profit and $\gamma$ is elasticity of substitution with the property of $0 < \gamma < 1$.

$$u(\pi) = \frac{\pi^{1-\gamma}}{1-\gamma}$$

(4.38)

The importance of the choice of the utility function can best be found in Kimball (1993) where it is stressed that the foundation of most economic models is the utility function and the choice of the utility function can dictate the whole model. The value of the choice of the utility function lies in the standard risk aversion measure which is proposed by Kimball (1993):

$$-\frac{u''}{u'}$$

(4.39)

Using the formula from Kimball (1993) we get that in case of the CARA function the value of risk is the constant $a$. We have already stated that constant risk is impossible in banking practice. However using the CRRA function we have the relative risk as a constant. The bank is always willing to risk $\gamma$ per loan, a relative amount.

4.3.2. Bank’s dynamic programming problem

The banks face two separate optimization problems. The first problem is how to maximize the profits from the credit portfolio, which is derived from the funds collected in liabilities and then allocated in assets. The second optimization problem is how to minimize the cost of regulation. We are going to model both optimization problems separately.
The assets of the bank are going to be separated in two vectors, shown in the matrix form they are

\[
A_t = \begin{bmatrix} x_t \\ q_t \end{bmatrix}
\]

Where A is assets at time t, x is the interest bearing assets and q is the part of assets allocated specifically as demanded by the regulation.

First we proceed with the optimization with respect to the profits. The problem will be stochastic since the banks have uncertainty in their business and have to create expectation about future. Basic set up of the problem can be also found in Cooper and Adda (2003) and initially developed by Bellman (1957). The bank tries to maximize present value of expected utility from profits over time.

\[
\max E \left[ \sum_{t=0}^{\infty} (1 + \theta)^{-t} u(\pi_t) \right]
\]

The profit is noted as \( \pi \) and are discounted over by the rate \( \theta \) in order to get the present value of profit, E stands for the expectations operator, and before we set up the Bellman equation we need the value function. The value function takes the form:

\[
V_t(x_t) = \max E \left[ \sum_{t=0}^{\infty} (1 + \theta)^{-t} u(\pi_t) \right]
\]

Subject to \( x_0 > 0 \), \( x_\infty > 0 \) is free; \( x_t > 0 \) for all time periods

Where x is the part of the bank’s balance sheet that is interest bearing and is net of regulation imposed by the central bank. We are assuming that x has some initial value of; value x is a part of the bank’s balance sheet when the bank starts the control problem, the end value is free, so we do not impose a growth limit on banks. We are also assuming that through time the value of x is greater than 0, since it would be impossible for the bank to have no interest bearing assets in this part of the balance sheet.

The transition equation for interest bearing part of the balance sheet is:

\[
x_t = x_{t-1} + (\Lambda_t - \lambda_t)
\]
In each period the bank has net interest bearing assets $x_{t-1}$ from the previous period and the current period changes in the values of interest bearing assets. Where $\Lambda_t$ represents the incoming funds into the bank, $\lambda_t$ are the outgoing funds in each time period.

The assets in the bank are earning some interest. The bank has two choices of where to invest the assets. The first choice is to invest in the risk free government bonds that have return $r$, this is a risk free investment and all other investments are benchmarked with this investment in order to determine are they profitable for the bank. The second investment option for the bank is to invest in some risk bearing asset and obtain the rate $z$, however if the bank invests in this class of assets the bank will have to be exposed to risk. The interest bearing part for our purposes will be loans to firms and households. So the formula for profit in each time period is:

$$\pi_t = [x_{t-1} + (\Lambda_t - \lambda_t)]^\omega [r_t \omega_t + z_t (1 - \omega_t)]$$

with $0 \leq \omega \leq 1$

In equation (4.43) we see two rates of return. The first rate of return is $r$, which is the average rate of return on risk free assets and is portion of $\omega$ of the interest bearing assets. The second group are loans to risk bearing clients (households, firms) those loans have the $1-\omega$ portion of the risk bearing assets and the expected rate of return is $z$. As we can see both rates have subscript $t$, which denotes time period and superscript $e$ which denoted expectations about the risk bearing rate of return for the banks. Since the bank is bearing risk in its balance sheet it cannot know what the future is for certain so the bank has to make expectations about the future rate of return. The rate is expected it will have the positive value, but that does not automatically imply the actual rate will be positive, it can be negative and the bank can suffer losses on its risk bearing assets if it has too much bad loans.

To obtain of the solution for the maximization problem in equation (4.41) we need a recursive solution of the problem. To obtain that recursive solution we will use Bellman principle of optimality as described in Adda and Cooper (2003 page 14). Now we can set up the bellman equation:

$$V_t(x_t) = \max_{\pi_t} \left\{ u(\pi_t) + (1 + \theta)^{-1} E \left[ V_{t+1}(x_{t+1}) \right] \right\}$$

(4.44)

The E in bellman equation indicates expectations since the bank has risk bearing assets where the rate is not known with certainty, but it has to be obtained through expectations. Equation (4.44) is telling how the bank is going to behave. By solving the bellman equation we can find the optimal path for the bank in order to achieve the maximization of profits. First order conditions are for $\pi$
\[ u'(\pi_t) = E[(1 + \theta)^{-1}((1 + r_t)\omega_t + (1 + z_t)(1 - \omega_t))V'_{t+1}(x_{t+1})] \quad (4.45) \]

For \( \omega \)
\[ E[V'_{t+1}(x_{t+1})(r_t - z_t)] = 0 \quad (4.46) \]

In the equation (4.46) we have used the fact that \((1 + \theta)^{-1}(x_t + \Lambda_t - \lambda_t)\) is known at time \( t \).

Using equation (4.44) and the envelope theorem described in Blanchard and Fisher (1989 page 280) we can get:
\[ V'(x_t) = E[(1 + \theta)^{-1}((1 + r_t)\omega_t + (1 + z_t)(1 - \omega_t))V'_{t+1}(x_{t+1})] = u'(\pi_t) \quad (4.47) \]

Now we can conclude that marginal utility of profit has to be equal to the marginal increase in \( x \), the interest bearing part of the balance sheet. Using this relationship we can eliminate \( V'(x+1) \) from the first order conditions and get equations in (4.45) and (4.47).

\[ u'(\pi_t) = E[(1 + \theta)^{-1}((1 + r_t)\omega_t + (1 + z_t)(1 - \omega_t))u'(\pi_{t+1})] \quad (4.48) \]
\[ E[(1 + r_t)u'(\pi_{t+1})] = E[u'(\pi_{t+1})(1 + z_t)] \quad (4.49) \]

We can now substitute (4.48) into (4.49) and get:

\[ u'(\pi_t) = (1 + \theta)^{-1}(1 + r_t)E[u'(\pi_{t+1})] \quad (4.50) \]
\[ u'(\pi_t) = (1 + \theta)^{-1}E[u'(\pi_{t+1})(1 + z_t)] \quad (4.51) \]

We were very vague when it comes to the risk bearing assets and their distribution. The only distinction we have made is the sector distinction. This omission was done deliberately, for us to fully understand in which sector the bank is going to invest we have to first understand the relationship of the bank with the central bank and how the choices of the central bank can impact the behavior of the bank.

We have also not specifically stated from where does the stochastic element in the bellman equation come from. It is obvious the stochastic element comes from the risks the bank is willing to take on once the bank invests in the risk bearing assets. The general and the most often analyzed risks the bank face are the liquidity and the credit risk, as it can be seen we
have not mentioned any risks at all, we have only stated the banks face risk, so this issue will be addressed latter.

4.3.3. Banks vs. Central bank

In the previous part we have looked at the general solution to the optimal behavior of banks in economic setting where the banks have to optimize the balance sheet in order to maximize profit. In the previous part we have only looked at the business part of the balance sheet, which we have called the interest bearing part of the balance sheet. In this part we are going to look at the behavior of banks in relationship with the central bank.

The banks are under direct supervision of the central bank and have to obey the rules imposed by the central bank. In terms of game theory this set up puts banks directly in inferior position to central bank. The banks have to obey a large set of rules and regulation. The specific regulation we are going to analyze is the regulation which impacts the ability of the bank to perform its business activities. This is the regulation which forces bank to exclude some funds out of the lending process (like reserve requirement); limits banks decision on credit distribution per sector\textsuperscript{45}, or limit the growth of loans\textsuperscript{46}.

The restrictions imposed on the banks are done through regulation which specifically states a certain portion of assets has to be invested in a certain way. Usually this is determined through the structure of liabilities. The most common and the most practiced regulation of this kind is the reserve requirement. The reserve requirement requests a portion of funds received from certain liabilities has to be deposited with the central bank, or some other institution. The exact specification of the reserve requirement can vary over many parameters: term, currency, source, and residency. Apart from the reserve requirement the banks might also be regulated with strict ratios imposing certain structure on the bank’s balance sheet.

The regulation is usually used by the central bank with some very specific design in mind. The complexity of regulation automatically increases the complexity of the optimization problem for the bank. The smaller the amount of regulation, the less complex is the bank’s optimization with respect to the central bank.

The scope of the possible regulation is very broad. If the regulation is large and complex it is very important for banks to optimize the total impact of the regulation, both on the bank’s balance sheet and on the bank’s profits. Another problem for the banks is the fact the regulation might change over time and the bank also has to make expectations over the future how the regulation will look like and what will be the impact of the regulation. The possibility of changes in regulation and instability of regulation increases complexity of the optimization problem for the banks.

What we will specifically pay attention to is going to be the impact of the regulation on business choices made by the banks and how does the choice of the monetary regime impact

\textsuperscript{45} In Serbia there was regulation which imposed the maximum lending to retail as percentage of capital.

\textsuperscript{46} Croatia implemented this limit as 1% loan growth to some sectors.
the behavior of banks. Since the central bank has power to impose regulation when it sees new regulation necessary the banks are in fact faced with Stackelberg problem where they have to optimize not just their internal behavior, but also the shocks made by the behavior of the central bank.

Since banks in their essence are intermediaries between those who have funds and those who need funds the structure of balance sheet regulation is exceptionally important. First thing about regulation is that the regulation dictates the interest rates. The amount of regulation imposes the minimum interest rate on assets placed based on the interest rate of liabilities. Higher the regulation, higher the interest rate.

Through regulation the central bank has the ability to make domestic currency cheap or expensive. The central bank's regulation can also have significant impact on capital flows in the economy. The banks do not create regulation; they just try to optimize the existing regulation so the banks can maximize their profits. This is an important point, because it implies the banks will dance to the tune of the central bank, not the other way around. The banks adjust to the regulation, not the other way around.

The basic premise developed here lies on the theoretical assumption the bank is playing a game with the central bank. The object of the bank is to have the maximum benefit from the regulation, or stated differently the bank is trying to minimize the “damage” to the income caused by the regulation. Since the central bank imposes the regulation, forces banks to obey the regulation, the banks are forced to play along. So we have two players, one which is imposing the rules and the second one which is forced to play by the rules.

The model we are going to present here relies on Hansen and Sargent (2005). We shall denote the total balance sheet, regulation plus business part with vector $A$, let $A_t$ denote the history from $t$ so $s$. If the subscript is omitted we take it to be 0. If the super script is omitted we take it to be $+\infty$. The balance sheet will have two components, two vectors with different investments in them. The first vector is noted to be the endogenous vector $x$ (bank chooses what to do with the loans placed) and the exogenous one $q$ (the central bank imposes the regulation). The endogenous one is the component that is under direct control of the bank, while the exogenous one is a component that is not under direct control of the central bank. Using the vector notation these two components can be presented like:

$$A_t = \begin{bmatrix} x_t \\ q_t \end{bmatrix}$$

The exogenous part of the assets shall have the transition law,

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47 By balance sheet regulation I mean all regulation which dictates the structure of assets in any way. Either by imposing structure of assets based on liabilities like reserve requirement or limits on certain assets or capital adequacy ponders.

48 A simple example. If reserve requirement 10% and is remunerated at 0%, if the interest rate on deposit is 5% the minimum interest rate in assets to cover the cost of interest is 5.55%.
Where $\varepsilon$ is identical and independently distributed changes in the regulation with a distribution $\Phi$, this distribution is unknown to the bank and the bank can only made assumptions about it, but it is known to the central bank since the central bank is in charge of the regulation.

The shocks $\varepsilon$ are the changes in the regulation. The only way a bank can know in advance what there will be the change in regulation is if the central bank explicitly states when and to what extent the regulation is going to be changed. So the natural question arises: how does the bank obtain expectations about the future regulation changes? In order to answer this we have to use the Bayesian learning approach.

One of the main characteristics of the Bayesian approach is the fact that the prior distribution can be updated at any point in time. Using this property we can expect the bank to have the ability to learn the behavior of the central bank. Any time a change in the regulation occurs the bank can update the prior distribution used in order to determine the future changes in the regulation. With this tool the banks have a powerful learning mechanism which allows them to adopt their expectations and change their forecasts of regulation over time.

Naturally the more levels of regulation (term structure, source, currency) more expectations will have to be created and the probability distribution of expectations is going to be greater, which implies a larger margin of error for the banks. So the more regulation there is the more stochastic elements the banks are faced with.

We have set up the interest bearing part of the balance sheet and we have set up the regulatory part of the balance sheet. Now we have to ask: how does $A$ evolve over time? In order to develop transition equation we have to understand the process. By definition assets equal liabilities. In order to place assets the bank has to obtain liabilities. There are three main sources of funding for any bank. The primary source of funding which is funding received from clients; the funding which comes to the bank. The bank does not go out and try to obtain it. The secondary sources of funding are funds received from financial institutions or specific investors; the bank has obtained them by actively pursuing funding. This is the funding the bank has obtained through borrowing from someone else. The third source of funding, which is also a part of the secondary sources is the capital. In this particular case the owners of the banks or new investors are willing to give funding to the bank in exchange for the part of the ownership of the bank.

The funds enter into the balance sheet and are in terms of accounting booked in liabilities. In assets the funds get separated into two parts. The first part is part we have noted as $q$ and it is the part needed for regulation. The second part is the part used for business activities and that part has been noted as $x$. We can show changes in the size of the balance sheet mathematically as:

$$q_{t+1} = \begin{bmatrix} 0 \\ q_t \end{bmatrix} + \begin{bmatrix} 0 \\ \varepsilon_t \end{bmatrix}$$

(4.53)
\[
A_t = \begin{bmatrix}
    x_t \\
    q_t
\end{bmatrix} = \begin{bmatrix}
    x_{t-1} \\
    q_{t-1}
\end{bmatrix} + [\Omega y_{t-1} - \Omega c_{t-1}] = \begin{bmatrix}
    1 - p_t & 0 & 1 - s_t \\
    p_t & 0 & s_t \\
    0 & 0 & 0
\end{bmatrix} \begin{bmatrix}
    P^y_{t-1} \\
    P^c_{t-1} \\
    S^y_{t-1} \\
    S^c_{t-1} \\
    C_{t-1} - d_{t-1}
\end{bmatrix} \tag{4.54}
\]

The equation (4.54) has the following notation:

\begin{itemize}
    \item \text{A} - are assets
    \item \text{\Omega} - transition matrix with regulation
    \item \text{y} - incoming funds from primary sources
    \item \text{c} - outgoing funds from primary sources
    \item \text{P} – in primary sources of funds (superscript \(y\) denotes incoming and \(c\) denotes outgoing funds)
    \item \text{S} – secondary sources of funds (superscript \(y\) denotes incoming and \(c\) denotes outgoing funds)
    \item \text{C} – capital
    \item \text{p} – regulation requirement on primary sources of funds, has value \(0 \leq p \leq 1\)
    \item \text{s} – regulatory requirement on secondary source of funds \(0 \leq s \leq 1\)
    \item \text{d} – dividends paid
\end{itemize}

As we can see from the equation (4.45) the funds enter or exit and so does the structure of the balance sheet between the regulatory part and the free part change. Also we have not made any specifications on the regulation, except for the fact that there is no regulation on the capital. No regulation on capital is also assumption since the bank can impose reserve requirement on subordinated debt, which is a part of the capital. As for the values of \(p\) and \(s\) they have been bounded between 0 and 1. With 0 meaning there is no regulation and 1 meaning that the whole amount of funds received from the source has to go towards the regulation.

Now that we have set up the transition equation we can see that the problem the bank is facing is to minimize the size of \(q\) in the balance sheet. That is to minimize the amount of funds used for regulation in the balance sheet.

\[
\min E \left[ \sum_{t=0}^{\infty} (1 + \theta)^t f(q_t) \right] \tag{4.55}
\]

subject to \(A_{t=0} = \text{free}, A_t > 0\) with initial values \(A_{t=0} = \begin{bmatrix} x_0 \\ q_0 \end{bmatrix}\)

Where \(\theta\) is the discount factor with values \(0 < \theta < 1\) and \(E\) denoted expectations. So the bank wants to minimize the size of the regulation in the bank’s balance sheet.

Since we are dealing with a complex environment we are going to make some changes in the model. First of all we are going to reformulate the problem. We are not going to analyze the
balance sheet values at all, what we are going to analyze is the percentages of the regulation and interest bearing assets in the balance sheet, this implies that x+q=1. We are also going to assume that at any point in time there is some optimal distribution of interest bearing assets x* and regulation q* which will give the bank the most profit given the current regulation. The bank wants to be as close to that optimal distribution at any point in time.

The bank does not know what the central bank is planning to do with the regulation in the future. The central bank imposes the regulation on banks. So the bank has to assume what the central bank is going to do. Over time the bank has the ability to learn what the central bank is doing. This model is universal for any exchange rate regime and has nothing to do with the choice of the monetary policy. The central bank can control the banks regardless of the choice of the exchange regime.

As one bank can take the regulation and calculate the optimal balance between the x and q in the balance sheet, so can the central bank. Given the objectives of the central bank, the central bank aggregates all of the balance sheets of the banks in the economy and sets up the optimal distribution between regulatory part of the balance sheet and the interest rate bearing part of the aggregated balance sheet. The central bank wants the balance sheet of the banks to evolve over time according to the following model:

$$A^*_t = \alpha_t x_{t-1} + \beta_t q_{t-1}$$  \hspace{1cm} (4.56)

Where $A^*_t$ is the size of the balance sheet of all of the banks, x is the interest rate part and q is the regulation part. The parameters $\alpha$ and $\beta$ represent the rates of change of each part of the balance sheet in each time period. The central bank controls the change in structure of x and q over time.

Given the current state and the future expected states of the regulation the bank wants to be as close to the optimal distribution of x and q as possible. The problem the bank is trying to solve in that case is:

$$\min E \left[ \sum_{t=0}^{\infty} (1+\theta)^t \left( (x_t - x^*_t)^2 + (q_t - q^*_t)^2 \right) \right]$$  \hspace{1cm} (4.57)

What the bank wants is to minimize the covariance between the optimal structure $x^*$ and $q^*$ of the balance sheet and the actual structure x and q of the balance sheet. Since q and x are tied together the bank can either try to maximize x or minimize q, we are going to model the problem of the minimization of q part of the balance sheet. The minimization is subject to

$$q_t = \lambda^*_{t-1} z_t + \sigma$$  \hspace{1cm} (4.58)
The bank is trying to minimize the variance between the regulation and the actual structure of the balance sheet. Where \( \lambda_{t-1} \) and \( \Xi \) are \( r \times 1 \) vectors which contain the bank’s model of prediction of the changes in the regulation. The bank’s model is not the “true model” used by the central bank and the bank does not know the true model. The parameter \( \sigma \) is the vector of random iid disturbances.

In the minimization problem we have \( E \), this \( E \) denotes expectations, but what we are seeing now is that the expectations are created rationally, but based on the wrong model. The parameter \( \lambda \) also has the subscript \( t \) conditional on \( t-1 \), this means that the bank every time period collects the current set of regulation and then updates its knowledge about the changes in the regulation. This means the model the bank is using is getting better and better with each time period. The bank will update its “wrong” model in each time period

\[
q_t = \lambda_t' \Xi_t + \sigma \\
\lambda_t = \hat{\lambda}_{t-1} + \Omega
\]

Where \( \Omega \) is not correlated with \( \sigma \) and is an iid Gaussian random vector with mean zero and some covariance matrix \( K \). The mean estimate of the model is going to be

\[
\hat{\lambda}_{t|t-1} = E(q_t|\zeta_{t-1}) \\
\zeta_{t-1} = \{q_1, q_2, q_3, q_4, \ldots, q_t\}
\]

If we let

\[
Q_{t|t-1} = \text{Var}(\hat{\lambda}_{t|t-1})
\]

Given the bank’s model the mean estimates are optimally updated via the Kalman filter. Given the values of \( \hat{\lambda}_{t|t} \) and \( Q_{t|t-1} \) the Kalman filter algorithm updates \( \hat{\lambda}_{t|t-1} \) with the following formula

\[
\hat{\lambda}_{t+1|t} = \hat{\lambda}_{t|t-1} + \frac{Q_{t|t-1} \Xi_t (q_t - \Xi_t' \hat{\lambda}_{t|t-1})}{\sigma^2 + \Xi_t' Q_{t|t-1} \Xi_t}
\]
The learning process from the Kalman filter\textsuperscript{49} is eventually going to converge to the correct model of the central bank. The desired distribution of the bank’s balance sheet is going to be achieved as the banks learn the true model. The model presented here refers to the structure of the balance sheet given the distribution of the regulation and the non-regulation parts of the balance sheet. We have confronted the bank with the central bank and have not juxtaposed bank and other participants in the economy. The sector distribution of loans is nowhere mentioned and for our analysis the sector distribution of loans is the key. It is the sector distribution of loans which is different under different exchange rate regimes.

What we have demonstrated is that the central bank can under any exchange rate regime structure the balance sheet of the banks, but the sector distribution of loans does not depend on the regulation, it depends to the profit margin. Precisely because of this the central bank cannot allow banks to just move credit in order to maximize profits, but the central bank has to use monetary policy to achieve the desired structure of credit in the economy. The role of the credit in the economy and how economic participant’s use of credit impacts the economic will the analyzed thought this dissertation.

4.3.4. Banks discussion

In this part we are going to analyze the model and try to relate the model we have developed for bank’s behavior to other economic participants and that is households and firms. We are also going to analyze the relationship of lending to the income of government, but we are going to tie this knot using households. Now that we have introduced banks into the model it is time to start relating economic participants and their behavior to each other.

4.3.4.1. Banks and households

Before we start our discussion we are going to repeat the function which shows the funding problem for the bank:

\[
A_t = \begin{bmatrix} x_t \\ q_t \end{bmatrix} = \begin{bmatrix} x_{t-1} \\ q_{t-1} \end{bmatrix} + \begin{bmatrix} 1 - p_t & 1 - s_t & 1 \\ p_t & s_t & 0 \end{bmatrix} \begin{bmatrix} p_t^{y} - p_t^{c} \\ S_t^{y} - S_t^{c} \\ C_{t-1} - d_{t-1} \end{bmatrix}
\]

\[
Q_{t+1} = Q_{t} - \frac{Q_{t-1} \bar{z}_t}{\sigma^2 + \bar{z}_t} + K
\]

(4.64)

\textsuperscript{49} Kalman filter was developed by Kalman (1960) and Kalman and Bucy (1961)
The bank has three sources of funding: primary (domestic), secondary (domestic and foreign) and capital (domestic or foreign depending on the ownership). The bank will use the net funding from primary sources (funding available after regulation); once the primary funding is used up for lending the bank will try to get more funding from secondary sources. If the bank cannot secure funding from domestic sources, which is often the case in small open economies, the bank will move outside the country’s borders and import funds, thus increasing the foreign debt. The increase in foreign debt will have an impact on the conduct of the monetary policy, as we have already described. However we have to focus on the reason why this happens? Why would a bank move outside the borders of the country in order to obtain funding? The answer to these questions is fundamental; the bank will follow the demand for loans, as long and the loans granted by the bank have satisfactory level of credit risk and are profitable the bank’s lending portfolio will grow. The banks are profit maximizing institutions; so if the new lending is profitable and within the prescribed limits, why not pursues it. It would be unreasonable to expect anything else from banks.

The banks will lend to the economic participant to whom they can lend at the highest rate, making highest profit. An increase in the demand for loans the banks will respond to the increase in demand and if the banks cannot obtain enough funding domestically from primary sources of funding, the banks are going to try to obtain funding from alternative sources, which as we have noted are most likely to be non-residents.

Once the loans are given to the household, two separate effects will take place. The first effect is due to loans the households will create an illusion of higher standard of living since the loans in effect allow households to live at whatever level of consumption the household demands, as long as the bank is willing to fund such life. The second effect, which is directly tied to the first effect, is the increases in the aggregate demand. The households will spend loans on goods and services. If the goods are domestically produced, the produces will have a demand for goods sold. In case the goods are not domestically procured, they will be imported in order to meet the increase in aggregate demand. However at this point in time we are not interested in the sources of consumption, as much as we are interested in the fact that new loans give higher revenue to the government through VAT tax. We are going to analyze simple case; the more complex case is going to be analyzed in the section 4.4. The household has income I and obtains each period loan L so the total consumption is I+L=Z if we assume Z is constant and households do not save, in this case the government gets, each period, an amount of taxes Z*VAT. Now if the households were not allowed to get loans the level of government’s revenue would be lower by the amount L*VAT, so growth in loans and new loans each period for households, allows households to live at a higher standard of life, but at the same time new loans each period give higher revenue to the government.

Ultimately what happens is double fall. As the loan to households first peak and then start to be repaid the government income not only goes down to the level I*VAT, but it falls down to (Z-L-L*r)*VAT, where L is loan and r is the interest rate payment on the loan. What we have

A point which will the explicitly modeled latter.
demonstrated now is the in a case where banks fund expenditure they not only allow higher than normal standard of living for the households, but provide an important revenue source for the government as well.

Another aspect of bank’s balance sheet which has to be analyzed is the fact that the usual economic assumption of savings equals investments or per usual notation S=I. However in case where the households demand for loans is strong and banks focus on lending to retail, this postulate does not hold any more. In the case where lending to retail is the most profitable for banks, the banks are going to be using retail savings for lending to retail. Retail savings will equal lending to retail.

In terms of classical economic postulates lending to retail equaling retail savings does not make sense. In that case we have separation of the economy on two types of households. The first type is savers, which save today in order to consume more in the future; the second type of households are consumers which get as much debt as possible in order to consume as much as they can as soon as they can, then in the future they have to repay their debt. There is no room for firms to get loans and there is no investment and development of the economy since the banks serve as time preference go between. The banks merely transfer funds from savers to consumers, the firms and lending for investments in the economy does not appeal to banks. The state where savings equals credit is unnatural.

It is extremely tempting to tie the level of foreign debt to the ownership of the banks, however the model has demonstrated this is not the case. In the model presented the banks are profit driven institutions and they try to meet domestic demand for loans. If the banks do not have enough resident funds for lending the banks are going to try to get funding from nonresident sources regardless of the ownership structure of the banks.

We have tied the economic behavior of banks with households and firms, but the relationship has not been developed to the full extent. We have also shown the way the banks behave, but we have not addressed two important issues:

- What causes the households to increase their demand for loans?
- Where does the choice of the exchange rate regime come in?

We are going to see that the choice of the sector lending and the demand for bank’s loans from households are extremely dependent on the choice of the exchange rate regime. We are going to see the demand for loans from households causes the banks to switch their lending from firms to households and we are going to see that the main reason for this is the choice of the exchange rate regime. However before we can be able to see the full picture we have to model households and firms. Once we have modeled both households and firms we will have the full picture of the relationship of other economic participants with banks and only then we will be able to make proper analysis. So in the next part we are going to proceed and model households and then we are going to model firms..
4.4. Households

The households, the consumers, are the most important economic agents. In this part we are going to model the behavior of the households. The households are also at the tail end of any economic policy. We are going to assume the households have two different models, one for each of the monetary policy regimes. What is important is the difference between the choices made in alternative models. We are going to focus on the goods the households consume, but we are also going to pay attention to the choice of the amount of credit the households are willing to have under each exchange rate regime choice. The choice of the amount of credit the households are willing to have is of the fundamental importance for the whole of the economy.

In order to be able to model the households first we are going to develop the objective or control function and that is the utility function. We are not going to focus just on the mathematical form of the utility function, we are going to focus on what are the variables in the utility function as well, especially what is the relationship between the composition of consumption in respect to the domestic and foreign goods. After that we are going to develop two models for the households using the mathematical tools of dynamic programming which we have been using throughout this dissertation. In the end of this chapter we are going to model a regime change. We are going to focus more on the switch from fixed to the variable exchange rate regime.

4.4.1. Utility function

We will now turn our attention to the utility function. In developing the utility function we are going to assume we are developing the utility function for consumers, but as we have noted this approach can be extended for any economic participant which uses the utility function as we have already done with the banks. This particular review is needed to establish the relationship between the utility function, consumption and the origin of the goods the households consume.

We are going to assume there are many goods in the economy, but the number of goods is finite and it is n. We can put all of the goods in the economy together we can get a set of goods which are available in the economy to the consumer for consumption, regardless of the good’s origin. Each good is going to be noted as \(x_i\); in that case if we group goods we can get the following set:

\[
\Omega = (x_1, x_2, x_3, \ldots, x_n)
\]  

(4.65)
We are going to assume that each of the good in the set has a positive value and the consumption cannot be negative. Since there are many sets of goods we can derive from the n goods in the economy, we are going to define a space where all of the sets of goods are:

\[ C = \{ \Omega = (x_1, x_2, x_3, \ldots, x_n) | x_j \geq 0, j = 1,2,\ldots,n \} \]  

(4.66)

We are going to look at a particular subset of the space and that is a subset X. The subset X contains m goods. We are going to assume that the subset X is more preferable to some other subset Y; this means that a particular consumer given the choice of subsets X and Y is going to choose X over Y. There is also an option where the consumer is going to be indifferent between sets X and Y. This relationship is not absolute for all time periods. It is possible subset of goods X is more preferable over subset Y in time t, then at time t+n the consumer is indifferent between the subsets and then at time t+\( n \) the subset Y becomes more preferable over subset X. Ultimately this transformation of preferences is going to play key role in our analysis, but for now we are just going to allow this transformation as possibility.

Right now we are going to assume that consumer prefers X over Y or that the consumer is indifferent between the groups of goods. Mathematically we can note this as \( X \succ Y \) \( \sim \)

(4.67)

This type over preference is known as weak preference. In case X is strictly more preferable over Y we would have strong preference. In case X is just as good as Y for the consumer we are going to note such a case \( X \sim Y \)

(4.68)

The equations (4.67) and (4.68) imply that if and only if \( X \succeq Y \) and \( X \preceq Y \) we have \( X \sim Y \) or that the consumer is indifferent between the subsets. When subsets are indifferent that is if \( X \sim Y \), then we have the axiom of reflexivity, which implies \( Y \sim X \). If the consumer is indifferent between X and Y, the consumer is also going to be indifferent between Y over X.

It is obvious that for any subset of X we have to have that \( X \succeq X \) and \( X \preceq X \). So X cannot be strongly preferred over X or itself and between X and X the consumer has to be indifferent.

Since we are dealing with a space it is necessary to define that the space is continuous and strictly defined. This means that for each point is space the preferences are strictly defined. There is no possibility in the given space that there is a point where the preferences between two subsets of goods are not defined. Since the space is strictly defined we can have transitivity between the groups.

51 Most of the derivations used here are standard, an excellent review can be found in Intriligator (1971).
We are now going to extend now our analysis to three groups, from the already used X and Y, we are going to introduce subset Z as well. This implies that if we have \( X \geq Y \) and \( Y \geq Z \) that we have to have \( X \geq Z \), this property is transitivity. In case that the consumer is indifferent between the subsets we are going to have transitivity between the sets so if we have \( X \sim Y \) and \( Y \sim Z \), then we have \( X \sim Z \). This particular relationship between the subsets is called equivalence relation. With transitivity we are going to have reflexivity as well, so if we have \( X \sim Y \), then we have to have \( Y \sim X \) as we have noted, also if we have \( X \sim Y \sim Z \) we also have to have \( Z \sim Y \sim X \).

Now we are going to compare particular subsets of goods. We know that there are three possible cases:

a) the consumer is indifferent between set X and set Y

\[
I_x = \{y \in C | Y \sim X\} \quad (4.69)
\]

b) the consumer prefers Y over X with weak preference

\[
NP_x = \{y \in C | Y > X\} \quad (4.70)
\]

c) the consumer prefers Y over X with strong preference

\[
P_x = \{y \in C | Y < X\} \quad (4.71)
\]

Following the axioms of continuity we can conclude that there is a real function which is defined in space \( C \) for which we have:

\[
f(X) \geq f(Y) \quad \text{If and only if} \quad X \geq Y \quad (4.72)
\]

This function we are going to call utility function and we are going to note this function with \( U(\cdot) \). The properties we have had with the subsets of goods are just as valid with the utility function, so we are going to have:

\[
X \geq Y \quad \text{it follows that} \quad U(X) \geq U(Y) \quad (4.73)
\]
We have defined that the consumption cannot be negative and that the object of consumers is to maximize the consumption so we are going to have that with the increase in consumption the consumer is going to gain more utility, this implies that the first derivative of the utility function is positive:

\[
\frac{\partial U}{\partial X} (X) = MU(X) = \left( \frac{\partial U}{\partial x_1}(X), \frac{\partial U}{\partial x_2}(X), \frac{\partial U}{\partial x_3}(X), \ldots, \frac{\partial U}{\partial x_n}(X) \right) > 0 \quad (4.74)
\]

The increase in consumption of any good from the subset X is going to lead to the increase in total utility for the consumer.

\[
MU_j(X) = \frac{\partial U}{\partial x_j}(X) > 0 \quad j=1,2,3,\ldots,n \quad (4.75)
\]

Although this is considered trivial in economic science, I would like to stress one more time that if the consumer can increase the consumption of one good in the subset X, the consumer can increase the total utility. This point is going to be fundamental in the future analysis.

Next what we are going to analyze is the strict convexity of the utility function. In order to be able to prove strict convexity of the utility function we need to set up the axiom of strict convexity: If we have subset of goods X and subset of goods Y in space C such that \( Y \approx X \) then we have:

\[
\alpha Y + (1 - \alpha) X \succ Y \quad \text{for any } \alpha \text{ if } \alpha \text{ has the following property } 0 < \alpha < 1 \quad (4.76)
\]

This implies that if X is weakly preferred over Y, in that case any combination of X and Y has to be more preferred over Y alone.

Prof: Prof of this axiom can come from the example. Lest assume \( \alpha = 0 \). In that case we have \( X \succ Y \), which we have stipulated as a condition. In case that \( \alpha = 1 \) we have that \( Y \succ Y \) which is a contradiction since Y cannot be strongly preferred over itself. Also any combination of \( \alpha \) with the given property of \( 0 < \alpha < 1 \) will give us the result that X is more preferred over Y.

There is a much stronger proof of this axiom and that is the Hessian matrix. In case the utility function is convex the Hessian matrix has to be negative:
Negative value of the Hessian matrix implies that the utility function is strictly convex. This also implies that following property of the utility:

\[
\frac{\partial^2 U}{\partial x_j^2}(X) < 0 \quad j = 1, 2, 3, \ldots, n \quad (4.78)
\]

The second derivative of the utility function is negative. The first derivative positive implies that increase in consumption increases utility, the second derivative negative implies that each increase in consumption brings less and less pleasure. The law of decrease in the marginal utility with each extra unit of consumption is known as the Gossen's law as described in Intriligator (1971).

### 4.4.2. Utility function derivation

In this part we are going to derive two utility functions using the properties we have set up at the beginning of this section. We are going to develop two alternative approaches to the development of the utility function.

The first approach we are going to call the modeling approach. This approach relies on developing the utility function to conform to certain needs we have in our model. In this case the economists try to develop the utility function which will have mathematical properties which soothe the model. The second approach is to develop the utility function which is going to reflect certain properties we have seen in the economic data. In this approach the economist tries to develop a utility function which reflects the economic data.
Barro and Sala-i-Martin approach

In order to demonstrate the first way to derive a utility function we are going to look at an example from Barro and Sala-i-Martin (1995). They try to model the consumer who has to make a decision regarding the time preference of consumption.

If \( r \) is the real interest rate and \( \rho \) the time preference of consumption. If we start with the present value Hamiltonian we are going to have:\(^{52}\)

\[
J = u(c)e^{-\rho t} + \nu \left[w + (r - n)s - c\right]
\]

(4.79)

Where \( c \) is consumption, \( w \) is wages, \( r-n \) is the real rate of return, \( s \) is savings and \( \nu \) is the Lagrange multiplier In order to maximize utility over time the first order conditions are:

\[
\frac{\partial J}{\partial c} = 0 \Rightarrow \nu = u'(c)e^{-\rho t}
\]

(4.80)

We can write for \( \nu \)

\[
\dot{\nu} = \frac{\partial J}{\partial c} \Rightarrow \dot{\nu} = -(r - n)v
\]

(4.81)

Once we take the differentiate equation (4.79) with respect to time and substitute \( \nu \) for \( \dot{\nu} \) from the equation (4.81) we get the first order condition for time preference of consumption

\[
r = \rho - \frac{(du'/dt)}{u'} = \rho - \left[\frac{u''(c) * c}{u'(c)}\right] * (\dot{c}/c)
\]

(4.82)

The equation (4.82) tells us the consumer is going to try to equate the rate of return on investments which we have noted as \( r \) and the time preference of consumption \( \rho \) since the first derivative of the utility function is negative.

In this example the rational consumer is faced with a choice of consuming today or postponing the consumption for some time in the future. In order for a consumer to postpone the consumption, the consumer has to have some return on the goods not consumed in the current period. The consumer has to get some rate of return \( r \) on its savings.

---

\(^{52}\) (equation 2.5 in Barro i Sala-i-Martina 89 page) we follow their notation in this chapter
In case $r > \rho$ the consumer is going to save more, that is consume less today in order to consume more tomorrow. In case we have $r < \rho$ the time preference of consumption is going to be more towards present rather than in the future. So the consumer is going consume more today and less in the future.

However when analyzing the consumption we have to note several important properties regarding the consumers and their consumption. The first property is the fact that if the consumer does not consume today and defers consumption for the future there is an element of uncertainty since the future is not known. So the return on investment also has to have some embedded risk premium, this risk premium has to be high enough for the consumer so that the consumer does not have the impression his risk taking is more than the consumer is willing to bear. The expected return has to be greater than the expected risk. The second important property of consumption is that the consumption today is always better than the consumption tomorrow, since the future consumption is discounted at the rate $\rho$. The third important property of consumption is that the consumers try to smooth consumption over time. This implies the consumers try to roughly consume the same amounts in all periods. As we might presume these three properties of consumption, especially their relation to the time might not actually hold in the real world.

The intertemporal elasticity with respect to consumption in our model is given with $\frac{\partial u}{\partial c} = \frac{cu}{u'(c)}$. The equation (4.82) shows that if we want to find the steady state solution in which $r$ is constant and the change in consumption over time $\dot{c}/c$ is constant as well, the intertemporal elasticity has to be constantly asymptotic. In order to meet the given requirements we have to have the utility function in the following form:

$$u(c) = \frac{c^{1-\theta} - 1}{(1 - \theta)} \quad (4.83)$$

With the fact that $\theta > 0$, this way the elasticity of marginal utility is equal to a constant and that is $-\theta$. Elasticity of substitution for this utility function is constant and it is equal to $1/\theta$. Considering the properties of the above function, this function is called CEIS utility function, Constant Intertemporal Elasticity of Substitution.

As we can see from the function if we take the first derivative of the function we get

$$u'(c) = \frac{1}{c^\theta} \quad (4.84)$$

With the greater $\theta$ the greater is the fall in the value of $u'(c)$ given an increase in the consumption. This property according to Barro and Sala-i-Martin means the households will
be less inclined to change the time path of consumption and will try to have their consumption as constant as possible over time periods.

On the other hand the more \( \theta \) is closer to 0 the utility function will be more and more linear which means that the consumers will be indifferent in which time period they consume, because we will have \( r = \rho \).

Combining the function (4.82) and equation (4.84) we get:

\[
\frac{\dot{c}}{c} = \left(\frac{1}{\theta}\right)^* (r - \rho) 
\]

(4.85)

From the set-up of the utility function we have seen this particular utility function satisfies the objective of the modeler. The utility function is sensitive to time preferences of consumption and can be used to describe alternate behavior.

**Kimball's derivation of the utility function**


In one of its chapters Kimball clearly expresses his believes regarding the use of the utility function in economic theory. The following quote is from Chapter 3.1.1:

"Economists in general and macroeconomists in particular, have begun to take their utility functions for granted. When a particular form has become traditional, it is useful to step back and ask which aspects of the traditional form are solidly based and which aspects are arbitrary and dispensable."

The language Kimball is using is more than clear, we are not going to take our utility function for granted and we are going to pay much attention to the purpose and the function of our utility function. In order to demonstrate the importance of the utility function, Kimball proceeds and derives a utility function for a specific problem.

The problem Kimball analyses is the one related to the real wage. In the last two centuries the real wage and the consumption per capita have increase significantly and the same time the work hours have not. During last two centuries the ratio of income and expenditure has remained roughly equal over the same time period. Using these empirical premises from the observation in the data Kimball asks the following question: which utility function can in its form and properties explain what we have observed in the data?

Consumption per capital can be defined as ratio of work to consumption:
Where \( W \) is the wage, \( N \) is the time worked in certain period (here Kimball is using workweek) and \( C \) is consumption. From the data Kimball observed that over time \( N \) is constant, work hours per week did not change in the period observed. If we follow the data and see that the ratio of wage and consumption has remained the same, this implies both the wage and consumption are increasing at the same rate in the observed time period.

In order to mathematically formalize the observation from the data we need to define \( W \) as proportional to \( C \).

\[
\frac{WN}{C} \quad (4.86)
\]

Define \( C \) as:

\[
C = \psi(N) \quad (4.88)
\]

The equation (4.88) we are also going to use as the definition of the indifference curve. Putting the restriction that the first derivative of function \( C \) has to be equal to the wage \( W \), so \( C' = \psi'(N) = W \), this implies that along the indifference curve we are going to have

\[
\frac{\psi'(N)}{\psi(N)} = \frac{W}{C} = v'(N) \quad (4.89)
\]

or

\[
\frac{d}{dN} \ln(\psi(N)) = v'(N) \quad (4.90)
\]

Considering the above chosen function \( v'(N) \) the solution to the above equation is:

\[
\ln(\psi(N)) = v(N) + \text{const} \quad (4.91)
\]

Exponentiation both sides we are going to get

\[
\psi(N) = \text{const} * e^{v(N)} \quad (4.92)
\]
Once we take equation (4.87) and equation (4.88) and put (4.92) into (4.88) and then take the natural log of both sides we are going to get

\[ \ln(C) - v(N) = \text{const} \quad (4.93) \]

Since the equation (4.88) is the definition of the indifference curve we have that the equation (4.93) is also an indifference curve equation, so the utility function has to have the following form:

\[ u(C, N) = U(\ln(C) - v(N)) \quad (4.94) \]

So the utility function has to rise in C and fall in N. The rise in C and fall in N is the basic assumption of the utility for consumers. The consumers would like to work less and consume more. The more consumer works, less time does the consumer have for consumption and thus automatically the consumer has less utility. On the other hand if the consumer works less the consumer will have more time for consumption and the consumer can obtain more utility from consumption. In the example of Kimball we have seen how the use of the data can lead to the creation of mathematical tools which reflect what can be found in the data.

What we wanted to demonstrate in the above two examples of the utility function is the derivation of the utility function and its purpose. In the Barro and Sala-i-Martin example the authors wanted to develop a model for time propensity to consume. In Kimball’s example the author wanted to model the behavior of the data trying to relate the observations in the data to the mathematical form of the utility function.

What we have seen here are two ways to develop the utility function. The first way is to conform the utility function to the mathematical properties which we want to research and use in our model. The second approach was to model the utility function trying to create the utility function with the properties found in the data.

Here we have two utility functions:

\[ u(C, N) = U(\ln(C) - v(N)) \quad (4.95) \]

And

\[ u(c) = \frac{c^{1-\theta} - 1}{(1-\theta)} \quad (4.96) \]
Both of these functions reflect the characteristics which are pertinent to the households, time preferences, consumption, and disutility of labor.

Utility function might also reflect the extreme cases for certain economic situations. Investigation of such special economic situations will need a special forms of the utility functions. One of the extreme case is an example of Uzawa's utility function used to investigate time preferences:

\[
\int_0^t \exp \left\{ -\int_0^t \theta [u(c_x)] \, dv \right\}
\]

As it can be seen from this particular function form the consumption in time period \( t \) depends on the past consumption. We will not go any further in analysis of this particular utility function now, but we will come back to this function once we move towards the analysis of the households. For more detail refer to Uzawa (1968).

### 4.4.3. Model of household's behavior under stable exchange rate policies

We are going to have two models one for each state of the monetary policy. The fundamental assumption of this model is that the state of the exchange rate regime is known to the households, so they know is the central bank conducting variable or fixed exchange rate policy. In this part we are going to look at the behavior of the households when the central bank is conducting stable exchange rate regime.

The household are utility maximizing agents, the utility comes from consumption. We are also going to assume that the time is discreet. The object of the households is to maximize consumption over a fixed period of time given constrains. We are not assuming the households are infinitely lived, but that they live a finite period of time. The wealth they have at the end of their time goes to their decedents as a bequest. There is no assumption regarding the bequests. If a household wants to consume everything in the last period, or if the household wants to leave bequests, that is simple their individual choice. The bequest and last period behavior of the households are of no importance to the model itself, they are just mathematical properties.

The households are rational and make their expectations under the rational expectations hypothesis. This means the household, given the quantity of information it has, will make the optimal decision. The household lives in the current exchange rate regime and do not assume that there is going to be an exchange rate regime switch. So the uncertainty in the model does not come from the possibility of a switch in the exchange rate regime. The objective of the households is
The household tries to maximize the utility over time, the utility comes from consumption $c$. The $U(c)$ function is a continuous, twice differentiable function, $\beta$ is a discount factor. Because of the discount factor the current consumption is valued more than the future consumption.

In this model we are going follow a novel approach and we are going to separate savings from credit. We are going to look at the flow of funds in each time period and we are going to allow households to have both credit and savings at the same time, this is not the standard approach in economic papers which usually have the “no ponzzi assumption”. We are going to investigate precisely this option where households can parallel save and increase debt since it is the option which has occurred in real life which is to allow households to have credit. The credit is obtained from the bank. It is possible for the households to have payments both for savings and credit repayments in the same time period. This research builds further on Vidaković (2005c) The inflow of money for the households in any time period is:

$$I_t = w_t + \tau S_{t-1} + \phi_t$$ (4.99)

Income of the household I or inflow of money or the households, comes come wage $w$, new debt $\phi$, the portion of savings that gets liquidated $\tau$; the values of $\tau$ are $0<\tau<1$. $S$ is the total savings the household has accumulated up to time period $t$. The $t$ subscript is not necessary, but we have put it in order to empathize the time relation to savings.

Following the inflow equation we are also going to have the expenditures equation in time period $t$. The expenditure equation is in essence the outflows for the households and we shall define in the following way:

$$E_t = c_t + s_t + \kappa \Phi_{t-1}$$ (4.100)

The household expenditures or outflows $E$ can be divided into consumption $c$, savings $s$ and the portion of the existing debt paid off in that time period. The portion of the total debt noted as $\Phi$, paid off at time period $t$ is marked with $\kappa$ and it has the value $0<\kappa<1$, $s$ is the new savings in time period $t$. Again the time subscript is not necessary, but we needed to show the debt accumulated up to time period $t$.

The models allows for very broad and complex behaviors which makes it very realistic, since it has both savings and credit repayments at the same time. Following these two equations we have given the households the ability to borrow, repay debt, liquidate savings and make new
savings all in the same time period. We have also allowed the households to repay a portion of the existing debt and to obtain new debt in the same time period.

Savings and debt accumulate over time and the accumulation can be expressed with the two following equations:

\[ \Phi_t = \sum_{i=0}^{t-1} \phi_{t-i-1} (1 + r^*_i)^{-1-i} \text{ with some maximum value of } \Phi^* \quad (4.101) \]

\[ S_t = \sum_{i=0}^{t-1} s_{t-i-1} (1 + r^*_i)^{-1-i} \quad (4.102) \]

The debt is costing the households the rate \( r^* \), this is the rate the bank is offering to the household. We shall assume the rate is the same for each household, exogenous and perfectly inelastic for any level of demand\(^{53} \). The household gets savings rate of \( r \) also from the bank.

In equilibrium the \( E=I \) holds, when we solve the equations for the \( c \) we get the equation:

\[ c_t = w_t + \tau^* S_{t-1} + \varphi_t - s_t - \alpha \Phi_{t-1} \quad (4.103) \]

The equation (4.103) represents the flow of consumption in every time period for the households. As the equation (4.103) shows there is a possibility for the households to decrease total savings, have new savings, get new debt and repay old debt. The consumption equation (4.103) is the transition equation in our model.

The main characteristic of the model and the difference between this model and the standard model is the combination of debt and savings at the same time. This is of the outmost importance because it creates the possibility to model increase in debt and increase in savings at the same time. Also we have another possibility which is important. With the inclusion of new debt \( \varphi \) in the consumption equation (4.103) we have created a possibility for households to have a \textbf{desired} level of consumption which is above their means and save at the same time. So the choice of debt will also depend on the lifestyle the household wants to live.

We are now going to focus on the consumption of the households and determine what choices the households have in terms of the source of the goods they consume. Using the model set up thus far we are now going to set up the bellman equation for the households under stable exchange rate regime.

The value function for the model is going to be

\(^{53} \text{As we shall latter in the model see the level of credit in the economy is not determined by the supply, but by the demand coming from participants in the economy.} \)
We are not going to impose a terminal condition in the model since we have stated the household lives $n$ periods. The control function for the problem is $u(c)$ so the bellman equation is

$$V(A) = \sum_{t=0}^{n} \beta^t u(c_t)$$  \hfill (4.104)$$

Subject to the equation (4.103) Out of the recursion presented in the bellman equation the households are going to obtain a policy function $h(c^*, \phi^*, s^*)$, and they are going to plan their optimal path of consumption over time.

The model presented here does not have any uncertainty or expectations. The focus of modeling is the exchange rate regime, if the exchange rate is stable, the households in this model do not face uncertainty. We have assumed the households do not lose their jobs and that the interest rates are given and fixed both for the households' savings and for households' loans. Naturally we could create models where these variables could be the source of uncertainty for the households, but here are focused on the monetary policy and under a stable exchange rate regime, so there is no uncertainty for the households. In the next part we are going to introduce uncertainty in the model via the changes in the exchange rate.

### 4.4.4. Model of household's behavior under variable exchange rate policies

The model presented in the previous chapter did not have any uncertainty for the households. We are now going to introduce uncertainty into the model.

If we have a variable exchange rate, the banks will have to hedge for the currency risk and the best way to do that is to transfer the risk over to the customer. The transfer of risk can be done easily by lending in foreign currency or embedding a foreign currency clause in the loans. Because of this transference of risk by the banks, under the variable exchange rate the households are going to take on the exchange rate risk every time they get a foreign currency loan from the bank. In order to hedge their own position, the households will have to save in foreign currency. This way the increase in loan is going to be somewhat offset by the increase in savings.

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54 We refer to the exchange rate risk uncertainty which was removed when the central bank imposed the stable exchange rate regime.
Under the variable exchange rate, with the foreign currency clause embedded in their loans the households do not know what their amount of debt is going to have in each period unless they know the changes in the exchange rate.

The income function with uncertainty is going to be:

\[ I^e_t = w_t + \tau^* S^e_{t-1} + \phi_t \]  \hspace{1cm} (4.106)

As we can see the income now is expected and it is not certain in each time period. The wage \( w \) is fixed since the household knows how much it is going to be paid in this period.\(^{55}\) The amount of new debt \( \phi \) is also not stochastic since when the households obtains the loans it knows the exact value of that loan given the exchange rate in that time period.

The expenditure function is also going to have to be augmented. The expenditures of the households are also uncertain.

\[ E^e_t = c^e_t + s_t + \kappa^* \Phi^e_{t-1} \]  \hspace{1cm} (4.107)

The consumption is expected and so is the amount of debt the household is going to have in the current time period. The actual amount of the debt repayment in local currency is not fixed since the debt is denominated in the foreign currency and the changes in the exchange rate are going to cause changes in the amount of the debt the household has. Now the value function of the households is going to change and we are going to have:

\[ V(A) = \max E \left[ \sum_0^n \beta^t \{ u(c_t) \} \right] \]  \hspace{1cm} (4.108)

By equating the \( I^e \) and \( E^e \) we get the following function for consumption

\[ c^e_t = w_t + \tau^* S^e_{t-1} + \phi_t - s_t - \kappa^* \Phi^e_{t-1} \]  \hspace{1cm} (4.109)

Where the control function is defined as

\(^{55}\) Since we are investigating the behavior of economic participants under alternate exchange rate regimes we are going to leave out the possibility of a household losing a job.
\[ f(\tau, s, \phi) \]  
(4.110)

So the bellman equation is going to be

\[ V(\tau, s, \phi) = \max_{c, \phi} \left[ f(\tau, s, \kappa, \phi) - \beta \mathbb{E} \left[ \sum_{n=1}^{\infty} \beta^n \{ u(c_n) \} \right] \right] \]  
(4.111)

From this recursion the households is going to form the policy function:

\[ h(\tau^*, s^*, \phi^*) \]  
(4.112)

The equation (4.112) shows the policy function in terms of the flow variables, but the policy function can also be shown in the balance variables as

\[ h(S^*, \Phi^*) \]  
(4.113)

The equation (4.113) shows the policy function as how much savings and debt the household is willing to hold at any point in time. Where \( S^* \) and \( \Phi^* \) represent the optimal levels of debt and savings the households is willing to have in each time period. In this model the households is not choosing how much new debt is going to obtain, but rather the household is choosing the **total amount** of debt it is willing to hold.

So why was this so important for the model? For starters we have to look at the different policy functions. In the model with the fixed exchange rate regime the households did not care about the level of debt. They just cared about the consumption, while in the model with the variable exchange rate regime the households are taking into concern the total amount of debt they have since size of the debt and repayments of the debt are stochastic. This is directly imposed by the foreign exchange rate risk created by the variable exchange rate regime chosen by the central bank.

We could look at the whole regime choice from a different perspective as well. Using the logic presented in Santini (2007) and Vidaković (2008) we could look at the choice of the monetary policy as a budget constraint. **Under the stable exchange rate regime the households have a soft budget constraint because they can borrow as much as the banks are willing to lend them. Under the variable exchange rate regime the households have a hard budget constraint. Since if they want to have more debt the households have to take exchange risk.**
From the model it is clear the exchange rate can be an important policy tool to control the level of debt the households are willing to hold thus making the exchange rate a tool for control of the credit policy in the economy. We have directly seen in the model how the choice of the monetary policy does affect the behavior of the households. Right from the start of the dissertation we have made it clear that we need to have two different models, one for each state of the exchange rate regime and now we clearly see why.

The stable exchange rate regime in essence gives the household’s free hands when it comes to debt. In that case the only determinant of the level of debt the households are going to have is the households’ time preference of consumption and the debt limit imposed by the bank. In case the households want to have preference towards present consumption, they are going to obtain as much debt as possible and consume as much as they can in the near future. If the individual household preference is towards the future then the households will increase their savings rate and save in order to be able to consume more in the future. The only policy which can offset this kind of behavior is the government imposed policy of savings for retirement or some tax benefits, but the true benefits of these types have to be examined in future research.

This is the reason why we have developed several utility functions, but have not explicitly stated which one the households are using in the bellman equation. For us to know which utility function the households are using we would have to look at the economic data.

Given the model we have presented here it is not hard to understand the strong increase in household debt in ex-socialist countries over the last two decades. If the households have strong consumption preferences towards present and there are no restrictions for the banks to meet the increase in demand for loans, there is going to be an explosion in household debt. This type of behavior was presented in Kraft and Jankov (2004).

Under the variable exchange rate the choice of the exchange rate regime is the one which serves as stopping power for the increase in household’s debt. The variable exchange rate with the exchange rate risk transfer serves as deterrent for the households to get debt just to increase their consumption.

Under the variable exchange rate policy when the household get a loan in foreign currency and the foreign currency clause the household is going to have to compare their expectations of wage growth with their expectations of the change in the exchange rate. If the exchange rate is depreciating more than the household’s wage is growing, by choosing to have debt the household will have to decrease consumption as a result of the changes in the nominal exchange rate since their payment annuities are going to go up.

The difference between the hard and soft budgetary constraints is the main source of imbalances in the economy. If the households have hard budget constraints they will have to live within their own means. If the households do not have hard budget constraints, but can borrow from the banks as much as they want, the whole dynamics of the economic system of the small open economy changes.

With the ability to borrow freely the households can satiate their consumption as much as they want. So the policy choice of fixed exchange rate directly changes the behavior of the households. However the alternate behavior of households will change their relationship with other economic participants as well. Since we have concluded the stable exchange rate regime
is going to increase the demand for loans the banks have to find ways to fund increase in demand for loans. If the banks cannot get funding from primary sources the bank will have to go outside of the country to obtain funding. This in turn will increase foreign debt.

The increase in households’ debt is going to create a temporary surge in the aggregate demand. This increase in the aggregate demand is going to push the prices higher. Also it is going to cause artificial sense of wealth. The increase in demand is also going to increase the demand for imports causing the imbalance in the current account, while the increase in foreign debt will cause disruptions in the capital account as it was theoretically presented in the Mundell-Fleming model.

The increase in demand for loans is also important for the firms as well. Increase in demand for loans by households can easily create a crowding out effect. If the banks assume they have less credit risk and higher profits with the households the banks are going to decrease their lending to the corporations and switch their business towards lending to retail. The decrease in lending to the corporations will cause corporation either to seek money abroad, even further increasing the foreign debt, or they are going to decrease their business activities due to the lack of credit.

The increase in the demand for loans is also important for the government since the increase in spending is going to increase the amount of taxes the government collects. We are going to pay attention this in the Part 4.6.

However there is one major problem and that is the fact that the households cannot live above their standard for infinite period of time, as we have mentioned this is the standard “no Ponzi assumption”. At one point in time the level of debt reaches the level where the banks are no longer willing to give loans to the household. At the point of maximum debt the household’s consumption can be presented with the following equation:

\[
I_t = w_t + \tau^* S_t \kappa^* \Phi^* \tag{4.114}
\]

Now the income of the households is the wage, plus liquidated savings minus the repayment of debt. The debt is \(\Phi^*\) and it indicates the households has reached the upper limit of debt. Naturally the paradox here is that if the household does not have any savings or it does not want to liquidate accumulated savings the available income for the households is going to be below the wage. This hard landing will decrease the consumption of the households and their standard will fall. Even if the household decides to keep the unnaturally high level of consumption by liquidating the savings this also has a limit since the savings the households have accumulated are not infinite. The stop in lending and the consequences of that stop have been described in Vidaković (2005a).

The decrease in lending is going to have impact across the economic board. The government’s income is going to fall, aggregate demand is going to shrink, gross domestic product is going to fall and ultimately the households will have to bear the consequences of their choices. After
the time of high consumption and lavish life style the rest of their life will have much smaller standard of living.

The above scenario is the direct product of the choice of the stable exchange rate regime in a small open economy. This is the reason why the dissertation has been so stubborn to emphasize the choice of the exchange rate regime, over the conduct of the monetary policy once the regime was chosen.

What is the alternative to the bleak scenario presented above? The alternative is to make a different policy choice in the first place. Part 2 presented the transition process as game theory. We have given the policy makers two options: E examine and A act. Choosing the stable exchange rate, just to act for the sake of action can leads to such bad outcome is something some countries have never fully understood. When creating a policy decision in small open economy the policy maker can not only look at one variable, but the whole chain of economic relationships.

The choice of the variable exchange rate regime leads to completely different outcome that the choice of the stable exchange rate regime. The variable exchange rate regime immediately serves as a hard budget constraint of for the households and a deterrent against living above their means.

In the model where the exchange rate is variable not only do households will have less debt, but there is going to be a completely different relationship towards other participants in the economy. If there is no surge in households‘ debt, there will be no increase in the aggregate demand. With smaller aggregate demand the tax income from VAT is going to be smaller for the government, there will be no crowing out for the firms in the credit market. The banks are not going to have to meet the high demand for loans. With lower demand for loans from the households the banks are going to be lending to firms. Also with lower demand for loans there will be no need to import capital and there will be no increase in the foreign debt.

We have clearly presented how a choice of the exchange rate regime influence the behavior of the households, but we have also presented economic agents are connected. The choice of the exchange rate regime leads to certain behavior of the households, but the behavior of the households has impact on the behavior of other economic agents like the government, the firms and banks. Economic agents are connected and we cannot look at just the behavior of one agent.

The model we have presented here is theoretical. Also the assumptions about the behavior of economic agents we have made are based on the theory stemming from the model. In order to see is the model correct we are going to have to look at the data. So the ultimate proof of the model is going to be in the data.

We are going to elaborate more on the relationship of households to firms a government in the other parts of this dissertation, but before we do that we are going to analyze the households a little more. We are going to provide a mathematically stronger relationship how do households impact firms and we are going to relate the choices of the household’s consumption with the real exchange rate. We are also going to analyze how does the change in the exchange rate regime changes the behavior of households.
4.4.5. Transition model

We have presented two models and have shown the differences between the two models, now we are going to tie up loose end in order to make the theory closer to reality and to make further ties between the households and the choice of the exchange rate regime. We are going to do this by setting up two approaches to the relationship between the central bank and the households. First we are going to look at the household’s consumption basket and we are going to see what determines the composition choices. Then we are going to model the switch in the monetary exchange rate regime and it implications. We are not going to model both switches in the exchange rate regime, but we are going to focus more when the exchange rate regime changes from fixed to a variable exchange rate regime because the switch from variable to fixed exchange rate would just have the opposite effect.

Before we move into analysis of household’s consumer behavior and economic decisions under regime switches we are going to develop a rational expectations model for regime switch with learning properties. The problem of changes of regimes in various economic situations has been heavily analyzed in economics: Farmer, Waggoner, Zha (2007) investigate new-Keynesian models and regime switching, Farmer, Waggoner, Zha (2009) investigate forward looking regime switches. The models here use learning techniques and situations where expectations are not perfectly rational like Hansen, Sargent, Turmuhambetova, Williams (2006), Marcet and Sargent (1989), Pearlman and Sargent (2005), Woodford (2006).

Since we are developing model one participant at the time now we are going to develop a general learning principle which will evolve over time and we are going to develop it on only one variable: nominal exchange rate. The same principle can be used on other variables as well. The model which we are going to present here closely follows Evans, Honkapohja, Williams, Sargent (2012) Rational expectations model for the movement of the exchange rate is

\begin{equation}
    e_t = \mu + \alpha E^{*}_{t-1} e_{t} + \delta \tilde{e}_{t-1} + \eta_t
\end{equation}

(4.115)

Where \( e \) is the nominal exchange rate, \( E^{*}_{t-1} e_t \) denotes expectations of nominal exchange rate on available information at t-1. The variable \( z \) is an exogenous observable variable following stationary AR(1) process which we will define as

\begin{equation}
    z_t = \rho z_{t-1} + w_t
\end{equation}

(4.116)

Where \( w_t \sim iid (0, \sigma^2_{w}) \) and \( \eta_t \) is an unobservable white noise shock with \( \mathbb{E} \eta^2_t = \sigma^2_{\eta} \). The value of the intercept \( \mu \) will be put to 0 for simplicity.
What this particular set up gives us is the ability to look at the monetary policy from two separate perspectives. First perspective is the expectations $E^*$ which do not have to be true rational expectations, but can be based on subjective distributions of household. The expectations $E^*$ might be something which is deeply rooted in household's mentality like fear of inflation or fear of devaluation as described in Gregurek and Vidaković (2008). But the main point is that in stable rational expectations equilibrium the $E^*$ which is subjective should become real rational expectations $E^*$ which is equal to the model the central bank has. The monetary policy of the central bank is given by the exogenous shocks $z$. The variable $z$ in our contest are monetary interventions of the central bank which change the value of the nominal exchange rate. The household (or any other participant) does not know what the central bank will do, so they have to learn how the central bank works.

For the equations (4.115) and (4.116) the rational expectations solution is

$$e_t = \frac{1}{(1-\alpha)} \bar{\varepsilon}_{t-1} + \eta_t,$$  \hspace{1cm} (4.117)

For simplicity we will set $\beta = (1-\alpha)^{-1}\delta$. What participants try to do is to learn the changes of $\beta$ over time and to be able to do that they will have to employ Bayesian techniques. Using simplified notation we can now get the participants beliefs and how they evolve over time.

$$e_t = \beta\varepsilon_{t-1} + \eta_t,$$ \hspace{1cm} (4.118)

Where we will assume $\eta_t \perp z_{t-1}$ and $\eta_t \sim N(0, \sigma^2_{\eta})$. The equation (4.118) is the foundation for the law of motion of the variable $\beta$. As times goes by the exogenous shocks $z$ will change the value of the variable $\beta$ because the households will learn the central bank's model. So now we are going to set the law of motion as

$$e_t = b_{t-1} \varepsilon_{t-1} + \eta_t,$$ \hspace{1cm} (4.119)

Where $b_{t-1}$ is the t-1 estimate of $\beta$. For mathematical purposes we are going to assume there is some prior distribution of $\beta$, which means the exchange rate regime switch did not occur in time period t-1 but some time before and the household is able to already have some prior values of $\beta$ which are going to be distributed as $\beta \sim N(b_0, V_0)$, this prior distribution implies a posterior distribution of $f(\beta | y^{t-1})$ where $y$ is equal to $y^t = (y_t, y_{t-1}, y_{t-2}, ...)$ and $y^t = (p_t, z_t)$ of the form $N(b_t, V_t)$. In order to update the parameters we set up standard Kalman filter.
In their paper Evans, Honkapohja, Williams, Sargent (2012) formally prove the model converges with probability 1 if \( \alpha < 1 \) and they also get that

\[
V_t = \frac{\sigma^2_\eta}{\delta_t - \frac{\sigma^2_\eta}{\delta_t + \frac{\sigma^2_\eta}{\delta_t}}} \rightarrow 0
\]

(4.122)

With probability 1 for all \( \sigma^2_\eta \) regardless of whether \( \sigma^2_\eta \) is correct or not.

The model presented here tells us how the households (any other economic participants) learn over time and how eventually the rational expectations model prevails, that is the central bank and the economic participants end up having the same model.

We are now going to implement the learning process in our model and we are going to connect the household consumption choice with the learning model. In our case the households are going to “learn” the central bank’s true model after the switch from stable to variable exchange rate regime.

Recalling the policy equations for the variable exchange rate regime we have defined the variable exchange rate regime as

\[
f(e) = \sum_{r=0}^{n} (1 + \delta^r) x_0
\]

(4.131)

Where \( \delta \) is the change in the exchange rate given the actions performed by the central bank. The parameter \( \delta \) is stochastic, known to the central bank, but now known to the households. In this case there is need for Bayesian learning. The household knows there are going to be changes in the exchange rate, but they do not know by how much in each time period.

When the exchange rate regime changes the households are aware that now they have to modify their model for the exchange rate risk. If the exchange rate is known, then the expectations are made rationally and the bellman equation has the same form as before:

\[
V(\tau, s, \phi) = \max_{\tau} \left[ f(u(c), \phi) - \beta E^{RE} \sum_{s_{\tau+1}, \phi_{\tau+1}, \Phi_{\tau+1}} \right]
\]

(4.132)
Where RE now shows that the expectations are made rationally under the rational expectations hypothesis. But if the households does not know by how much the exchange rate is going to change in that case the households has to make expectations in a different way.

The importance of the expectations formation lies in the policy making process, the actual conduct of the monetary policy and the amount by which the exchange rate depreciates over the period of time. Let us look at a case when the exchange rate on average depreciates just 1% in each year. This level of depreciation is very small and the impact of this level of depreciation on the behavior of the households might not have any relevance at all. The household might be employed with government and the contract made by the syndicate with the government might guarantee the increase in salary for several years. In this particular case, if the increase in salary is greater than 1% per year, the change in the exchange rate cannot serve as a deterrent from debt for the households. However if the depreciation rate is greater than the increase in salary over time then we have a completely different setup. The rate of depreciation also plays are role, known or unknown to the households.

Now we are going to develop the model when the depreciation of the exchange rate is not known to the households. In that first time period once the exchange rate regime switch is announced the household does know what the average rate of depreciation going to be is. The households has to make expectations and the only way to make expectations is to have some probability distribution. This is the same probability distribution used in equation (4.115).

The household assumes the change of the exchange rate is going to have distribution N(µ, σ). This distribution is not correct and does not match the policy function distribution the central bank has. Here we are going to follow similar approach from Cogley and Sargent (2008).

Since the distribution is wrong, thus the expectations created based on that distribution are wrong as well. The only way for households to improve their distribution is to obtain the correct distribution and the only way for the household to obtain the correct distribution is through sampling. So every time when the period ends there is going to be another item added to the sample as shown through Kalman filter. In that case the transition equation we have been using before is now going to be changed,

\[
c_{t+1} = g(\tau_t, s_t, \phi_t, \theta_t)
\]

(4.133)

Where \(\theta\) represents the expected value of distribution of exchanges rate of the thus far collected observations of the changes in the nominal exchange rate. The parameter \(\theta\) is obtained from the Kalman filter through learning process described in the equations (4.115) and (4.116). Given this knowledge we can change the bellman equation to be

\[
V_t^*(\tau_t, s_t, \phi_t, \theta_t) = \max_c \left[ f(u(c), \Phi) - \beta E^\theta V_{t+1}^*(A_{s_{t+1}}, \Phi_{t+1}, \theta_{t+1}) \right]
\]

(4.134)
As we can see the bellman equation has now changed and several new properties have been added. The first property is that the bellman equation is now created with the Bayesian expectations because there is a superscript B.

The addition of the Bayesian expectations changes the whole process of the recursion. Under the rational expectations once the equation is obtained the households solve the dynamic programming problem and the solution is valid for every time period. With the Bayesian expectations that is not the case. Since the mean of the distribution of the exchange rate changes every period, the Bayesian households obtains the bellman equation every period and then solves the dynamic programming in each time period and not just once and for all like under the rational expectations. From this process comes the aversion towards high level of debt. Over time the households is going to obtain the correct distribution of the changes in the nominal exchange rate and the households and the central bank are going to have the same distribution leading to the rational expectations equilibrium. This is the reason why the pass through increased over time in Slovenia as shown in Jazbec, Coricelli and Masten (2004).

In the dissertation I have also stated that over time the pass-through effect is going to be 1, now we have mathematically shown why the pass through over time has to be 1 under variable exchange rate. The reason is quite simple, the participants learn the true model and cannot be fooled any more, and similar result was obtained in Lucas (1973). In Lucas (1973) we can see how the inflation output tradeoff is diminishing over time as the inflation accelerates, again the explanation for this is simple, the people learn the true model and cannot fooled. Regardless of the policy choice for δ over time the households are going to converge towards the rational expectations model.

This part of focused on the households, but as we have shown it is hard to separate households from other economic agents. We have seen how the choices the households make influence the government and the firm which are producing the goods the households consume.

What is important to emphasize is the model we have created here is a model, but in that model we have made some very strong points. The fundamental basis for those points is the initial choice of the exchange rate regime made by the central bank, once the policy is chosen, the households use the appropriate model and the rest is just the natural recounts of the model chosen.

We have demonstrated here the importance of the choice of the monetary policy, not the conduct of the monetary policy. The choice of the exchange rate regime determines the model the households are going to use. Once the model is chosen, the behavior of the households is simply logical and without any surprises. However for the model to be proved correct or disputed we have to wait for Part 5 when we are going to analyze the data.
4.4.5.1. Household’s consumption basket

The main difference between large and small open economy lies in the source of the goods which are consumed. By the source here I mean whether the goods are imported or domestically manufactured. We shall now reformulate the consumption function, based on the source of goods. Now we have the consumption function as:

\[ c = \lambda c + (1 - \lambda)c \]  
\[ (4.123) \]

The consumption of a household is split between two segments, domestic and foreign. The parameter \( \lambda \) has property \( 0 \leq \lambda \leq 1 \) and presents what fraction of the goods the household consumes is manufactured domestically and what fraction is imported. We have already analyzed this part when we looked at the utility function in part 4.4.1. In a small open economy the goods can be from domestic source \( \lambda c = c_d \) or from \( (1-\lambda)c = c_f \) a foreign source. Now the utility function in its parameter form looks like this\(^56\)

\[ u(c) = \left( \frac{c_f + c_d}{1 - \gamma} \right)^{1 - \gamma} \]  
\[ (4.124) \]

Again trying so set up a dynamic formulation of the problem the household is trying to solve is

\[ \max \sum_{t=0}^{\infty} \beta^t \left( \frac{c_f + c_d}{1 - \gamma} \right)^{1 - \gamma} \]  
\[ (4.125) \]

In Part 4.4.3 of the have stated that the households consume a certain basked of goods, however we have left open what are those goods and what is the structure of those goods in terms of the source of the goods. We are now going to return to this issue.

As we can see from the utility function we have divided the goods the households consume into two separate sets of goods, the domestically produced and the foreign produced goods. We have to understand what is the composition of the consumer basket and what determines the choices of the consumers.

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\(^{56}\) The choice of the functional form is coincidental, we are just illustrating an example and are not interested in the properties of the utility function. We could have used Barro Sala-i-Martin or Kimball’s function for that matter.
First we have to note that the smaller the economy the smaller is going to be the economies’ level of self-sufficiency. In the smaller the economy there is going to be more goods the economy cannot produce and is forced to import. In Mundell-Fleming model we have developed these kinds of imports were called the autonomous imports. The best example of this kind of goods are oil and oil derivatives. Most of the countries which we are going to latter analyze are not oil self-sufficient and they have to import oil.

There is also some set of goods which are unique to the country and are not produced anywhere else, so regardless of how small the economy is, some goods are always going to be domestically produced. Due to this fact the parameter $\lambda$ has the values $0 < \lambda < 1$ since it impossible for a small open economy to be completely self-sufficient just like it is impossible for the economy to import all of the goods and services which are used. So $\lambda$ can never be $0$ or $1$.

We are now going to analyze the choice of the households for a good which can be produced both in small open economy and it can be imported from the rest of the world. Let us take a representative good $x$, in the case of determining the price of goods $x$ we have the two different possibilities of real price

$$p_{f,x} = p_x^* e$$

$$p_{d,x} = p_{d,x}$$

(4.126)

(4.127)

The price of the domestic goods $x$ expressed in domestic currency $p_{d,x}$, on the other hand the price of the same good, but imported is priced as $p_x^* e$. Where $p_x$ is the price of the foreign goods in foreign currency and $e$ is the current real exchange rate. For simplicity $p$ is going to be real price to eliminate the inflation. These two formulas are valid for any time period in any exchange rate regime.

The reason why we use the real exchange rate is the fact that we have a rational expectations model, so the nominal disturbances are of no importance to the household when it comes to consumption, but when it comes to debt since the annuity is determined using the nominal exchange rate. Also under fixed exchange rate regime there is never a change in the nominal price of the exchange rate so we cannot use the nominal exchange rate to study changes in consumption. Under variable exchange rate we have constant changes in the nominal rate, therefore only the real disturbances will have an effect on the economic participants. We are also using the real exchange rate since the formula for the real exchange rate encompasses both domestic and foreign inflation.

Since the household is trying to maximize the utility and utility comes from consumption the household is trying to consume as much as it can, so given the budget constraint the household will try to buy as much of any good as possible. We shall assume the household is indifferent
between consuming domestic and foreign goods\(^{57}\). We have three basic cases of how the household shall choose between the goods:

- \( p_{d,s} = p_{s}^* e \) the household is indifferent between which good to consume
- \( p_{d,s} < p_{s}^* e \) the price of the domestic good is less, the household will choose the domestic good
- \( p_{d,s} > p_{s}^* e \) the price of domestic good is greater the household will choose the foreign good.

From this set up we can see that the main drive of the composition of the household’s basket of goods is going to be the real exchange rate\(^{58}\). In part 4.2.4 we have set up the household’s consumption basket as

\[
X = (x_1, x_2, x_3, \ldots, x_n) \tag{4.128}
\]

We are now going to modify this basket to be

\[
X = (x_{1d}, x_{2d}, x_{3d}, \ldots, x_{nd}, x_{1f}, x_{2f}, x_{3f}, \ldots, x_{nf}, x_{1f}, x_{2f}, x_{3f}, \ldots, x_{nf}) \tag{4.129}
\]

As we can see there are now three kinds of goods in the consumption basket. The goods with subscript \( d \) are domestic goods; the goods with subscript \( f \) are the foreign goods. As we have noted there is some numbers \( m \) and \( q \) for both the domestic and foreign goods respectively which represent the minimum of the domestic and foreign goods which have to be consumed. In the Mundell-Fleming model we are said these are autonomous imports and autonomous exports. The third group of goods is goods denoted with \( i \), these are the goods which are produced both domestically and can be imported. The consumption of this intermediate group of goods depends only on the price difference between the domestic and foreign goods. If the price of the foreign goods is cheaper the households are going to consume the foreign goods, if domestic goods are cheaper the households are going to consume the domestic goods. When the actual consumption basket is purchased there are only going to be two sets of goods the \( f \) and the \( d \) goods. So in terms of the \( i \) good the household is going to make a choice.

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\(^{57}\) The author is aware of the fact this assumption might not absolutely hold in real life, due to the patriotic and brand preferences, but as the model shall show this assumption will hold due to law of large numbers and in the long run.

\(^{58}\) This could be also adjusted for unobservable variables like patriotism and brand preferences, but this adjustment would not change the ultimate outcome.
of which good to consume, the domestic or the foreign. The number of i goods split between the d and f goods only depends on the real exchange rate.

We can now tie in the exchange rate with the structure of the consumption basket.

\[
 f(x_s) = \begin{cases} 
 x_i = x_d & \Rightarrow p_{x,d} < p_{x,f} \times e \\
 x_i = x_f & \Rightarrow p_{x,d} > p_{x,f} \times e 
 \end{cases} \quad (4.130)
\]

This relationship can be extended further. As long as the real exchange rate is appreciating there is going to be more and more demand for the imports. If the real exchange rate is depreciating the consumers are going to consume more and more of the domestically produce goods. Naturally, higher the consumption of the foreign goods, higher is the level of imports going to be.

The tie between the monetary policy and the structure of the consumption basket of the households here is simple. If the central bank chooses regime under which the central bank cannot control the real exchange rate and the real exchange rate is appreciating over time the households are going to change their consumption basket. As the real exchange rate is appreciating the substitution of domestically produced goods for foreign goods is going to increase. So over time the structure of the consumption set of the households is going to tilt more and more towards the side of the foreign goods. Naturally if the real exchange rate is depreciating the reverse is going to happen. The households are going to consume more and more of the domestic goods and the consumption set is going to have more and more of the domestically produced goods.

This change of the structure of the consumption basket is going to have two impacts on the economy. The first impact is going to be the impact on the imports. If the real exchange rate is appreciating there is going to be an increase in demand for imports since the households are consuming more and more if the foreign produced goods. This behavior is going to have a direct impact on the current account of the country. In case the central bank has the ability to diminish the real appreciation the increase in imports is not going to happen.

The second impact is even more significant. The producing firms in the economy are going to feel the changes in the real exchange rate in terms of income. If the consumers are opting for the foreign goods the income of firms is going to decrease and the firms are going to go out of business eventually. On the other hand if the real exchange rate is depreciating the consumers are going to increase the consumption of the domestic goods and this is going to increase the income of the resident firms and make their business more and more successful.

If the real exchange rate is appreciating the success of the firms is not going to be manifested only domestically, but it is going to spread. Since with the real depreciation of the exchange rate the domestic firms are going to be producing cheaper goods and will have competitive advantage to move into foreign markets.
Naturally if the real depreciation is going to happen the small open economy under stable exchange rate regime will have to have smaller rate of inflation then the rest of the world. The second way for the real depreciation to happen is if the central bank has chosen the variable exchange rate regime and can use the changes in the nominal exchange rate to offset the inflation and even cause real depreciation.

This “middle” group of goods is the group which opens room for domestic production and expansion. Fiscal policy could create programs to foster investments in production of these “middle” products. At the same time the actual number of the “middle” products which is being produced in the economy is clearly telling us what effect past economic policies had on the economy.

4.4.5.2. Exchange rate regime switches

We have developed a model of the household’s behavior and we have separated that model for two different exchange rate regimes, we have assumed the monetary policy is not going to change and that the households do not consider a change in the monetary policy when making their decisions. In this part we are going to discuss the implications of the exchange rate regime change.

The switch from stable to variable exchange rate regime is more “stressful” for the households since the households have to learn the true model. Because of introduction of the exchange rate risk the households will have to adjust their debt holdings. Increase in exchange rate implies decrease in consumption since the depreciation causes debt annuity to go up. Also there will be adjustment in obtain new debt to finance consumption.

Once there is a changes from variable to stable exchange rate regime the households switch their model as well. The change in the model is instantaneous and there is no need for the households to adapt in any way. With the change in the model, comes the change in the behavior.

The change of the exchange rate regime presents an interesting and unique test regarding the time consumption properties of the ex-socialist countries. In the Part 5 when we analyze the data it will be interesting to see what has happened to the loans in banks and the demand for the households loans after the regime switch. If the lending activity has increased, the consumption preferences of the households are more oriented towards the present. If the lending to households has remained the same, the time consumption preferences of the households are more towards the future.

In the next part we are going to look at the firms and we are going to see the economy through their eyes. We are not going to relate the choice of the exchange rate to the behavior of firms, but we are rather going to analyze how the change in the real exchange rate over time affects the firm and their business choices.
4.5. Firms

In this part we are going to look into the behavior of firms. First we are going to model the firms as profit maximizing economic participants and then we are going to see how the choice of the exchange rate regime affects the firms.

The firms are not going to be impacted by the choice of the exchange rate policy as directly as households have been. When we have modeled households we have seen once the exchange rate regime has changed, the stochastic component was introduced into the household’s model and their behavior was immediately altered. This will not happen in the model used for firms. Although one could argue if the firm is exporting or importing the change in the nominal exchange rate is going to have immediate effect on the firm’s income and/or costs, we are not interested in this kind of impact of the monetary policy. We are interested in is the impact of the monetary policy on the firm’s choice of business and how does the evolution of real exchange rate over time impact the firms. Because of this the monetary policy enters the firm’s model indirectly through the real exchange rate.

To be more precise we are interested in the choice of the business for firms, which branch of the economy the firms are going to be started. We are going to argue in the dissertation that the monetary policy is the one which government the sector choices of the firms. The sector choice from firms is important in our analysis because of following three reasons.

- **The first reason** is the number of workers. Industry is more labor intensive, so if the most of the firms in the economy are industry oriented the number of workers is going to be greater, so the overall employment in the economy is going to be greater. The level of employment has large impact on the structure of the government’s budget through government’s income.

- **The second reason** is the relationship between the firms and the government’s income. If the firms are trade oriented and their main business is the imports of goods and their subsequent sale the firms will have to pay two main taxes. The first tax is the VAT and the second tax is the income tax. However if the firms are in industry and are exporting, there is no VAT tax for the government.

- **The third and the most important reason** is the behavior of the new (start-up) firms under alternative exchange rate policies.

We are going to see how does the choice of the exchange rate regime impact the start-ups and their choice of which sector of the economy to be in? This particular problem will be modeled through the marginal entrepreneur.
4.5.1. Model of firm's behavior

The firms are profit maximizing economic agents. We have a representative firm. The firm is trying to produce or import some good x; this good is then sold at the price p. The modeling process is the same for both firms which are importing and selling goods or for the firms which are producing goods and then selling them in domestic or foreign markets. For the simplicity and terminology we are going to refer to all firms are producing firms, regardless of their actual business. For the production function we shall use the common production Cobb-Douglas function:

\[ f(y) = AK^\alpha L^{1-\alpha} \]  

(4.135)

Where A is the technology level which is for a small open economy given exogenously, for simplicity we are going to assume that the technology level is the same for all periods. K is capital and L is the labor.

The cost of production is the cost of labor, cost of input goods and the cost of new investments used for capital accumulation. This implies the profit function given the costs used in production (labor, materials and investments in capital) is:

\[ \pi_t = E(y * p) - nw - \left\{ E(c_d * p_d + c_f * p_f) \right\} - i \]  

(4.136)

Where y is the total of the goods produced; the goods are sold at price p minus the expenses. For the price p we are going to assume that is the net weighted price between the goods sold on the domestic market and the goods sold on the foreign markets. The firms also has costs of production c, this is the cost of materials used in production the cost is separated between the cost of goods bought on the domestic market and the cost of goods bought on the foreign market. The different costs are differentiated by the subscripts d for domestic and f for foreign. The i represents the cost of investments in each period. E are the expectations since the firms do not know how much income is going to get or what will be the real cost.

The capital stock over time evolves according to the following equation

\[ k_{t+1} = (1 - \delta)k_t + i_t \]  

(4.137)

Where k is capital stock in given time period and i is the investments made in each time period.
Labor evolves over time given the following equation

\[ L_{t+1} = \alpha L_t \]  

(4.138)

Where \( L \) is labor and \( \alpha \) is the change of labor at time \( t \) and \( \alpha \) can have value of \( 0 < \alpha < n \), where \( n \) is the upper limit of change in the labor in each time period. We are also going to assume that the wage \( w \) is set and it does not change over time.

The costs of the goods used in production are evolving over time

\[ f(e_t) = \beta e_{t-1} + \varepsilon \]  

(4.139)

The costs are going to depend on the changes in the real exchange rate \( e \) which is given stochastic over time with \( \varepsilon \) being the shock distribution. So the basic problem the firm is trying to solve in every time period is:

\[
\max V(Y) = \sum_{0}^{n} \beta^t \pi_t
\]  

(4.140)

Now we can set up the bellman equation for the problem:

\[
V(Y_t) = \max_{y, p, e, c, y} \min \left\{ (y^* p - nw - (c_d^* p_d + c_f^* p_f) - i) + \beta EV(Y_{t+1}) \right\}
\]  

(4.141)

The policy function for this problem is given with

\[
h(i^*, L^*, y^*)
\]  

(4.142)

The policy function represents the optimal choice the firm chooses for the optimal levels of investments, labor and production in order to maximize the profits given the dynamic programming problem.

The bellman equation is a stochastic equation and the shocks come from the changes in the real exchange rate. The policy function gives us the optimal choices the firm has to make in order to be profitable. The object of the firm is to maximize the profits and the variables
chosen have to serve that purpose. Not mathematically nor in real life it does not make any sense for the firm to choose set of variables which are not going to lead to profit maximization. Since the firm is trying to be maximize profits, a rational firm is going to calculate the future profits given the expected changes in the cost and income.

What would happen if the value of the value function is negative. This would mean the present value of the profits for the firm is negative and that the firm is not profitable. In the long run this is not an option for the firm and such firms would go out of business. The model we have developed here is valid only for firms which are capable of generating profits or at least having no net loss over the maximization period of time. The source of the diminishing profits in this model is the real exchange rate.

If the firm is able to solve the dynamic programming problem, the firm is capable of overcoming any adverse conditions during the period. If this is not the case, the firm has to go out of business. We now need to investigate what happens to the firms which are not able to solve the dynamic programming problem with adequate result.

### 4.5.2. Impact of the real exchange rate on firms

In the previous part of the dissertation we have analyzed the optimal behavior of “healthy firms” in the economy, the firms which are profitable. We have seen how the firms choose their level of labor, investments and production in order to maximize profits over time. Now we are going to investigate the firms which do not have the ability to be profitable over long periods of time. The fundamental question here is: what makes the firms not profitable? The profit equation in each time period is:

\[
\pi_t = \bar{E}(y^* p) - nw - \left\{ \bar{E}(c_d^* p_d + c_f^* p_f) \right\} - i
\]

(4.143)

The variables we have to investigate are:

- prices of the goods sold
- price of labor
- price of inputs
- cost of investments.

The price of labor is not a variable to be considered. The price of labor for any company in the economy is the same so we cannot consider the price of labor to be reason for the company’s demise. We have also assumed the price of labor is fixed and monetary policy cannot influence the price of labor.
Price on investments is a possibility. If the firm wants to grow or just keep the level of capital the same the firm will have need for investments. The price of investments is going to be determined by the cost of credit which the firm gets from banks. For the firm’s investments to be profitable the basic condition has to be met:

\[ r_i \geq r_c \]  

(4.144)

The return of the investment \( r_i \) has to be greater or equal to the cost of funding for that investment \( r_c \). Where \( c \) denotes the interest rate charged by the bank to the company, the cost of interest. Although this might present a possible problem for the firm in the case of small open economy it should not. We have assumed the economy is a small open economy with the free flow of capital. In case the firm cannot get financing domestically the firm can obtain financing outside of the country. As a matter of fact this possibility is valid also in cases when the financing is cheaper abroad then with the resident bank.

In case the firm does not have investments which are able to have greater return then the cost of financing the firm will go out of business, it does not seem plausible the cost of credit is the reason for the firms going out of business. Also the interest rates expenses for most firms represent relatively small fraction of overall costs.

The next possible reason is the price of goods sold and the cost of inputs. Both of these costs are tied to the exchange rate policy. If the real exchange rate is appreciating the foreign costs of production are going to be cheaper, but the domestic costs of production are going to increase. Reverse happens if the real exchange rate is depreciating. The cost of inputs for the firm is not going to depend on what is the direction of the real exchange rate, but what is the ratio of costs from domestic inputs and costs from foreign inputs. If the firm is producing just using the domestic inputs the changes in the real exchange rate are of no importance for that firm. If the firm is using only foreign inputs then the changes in the real exchange rate is going to present a significant impact on firm’s costs.

Another possible problem for the firm might the lack of sale (market for its goods), so it is not the costs of production, but the fact the firm cannot sell its goods which would make the firm not profitable. When we have analyzed households we have stated the households choose between the foreign and domestic goods which are perfect substitutes. The main force of the household’s choice is the price and the price is governed by the real exchange rate. It is the real exchange rate which will determine which “middle” goods are consumer: foreign or domestic.

The household’s choice of consumption has very large impact on the firms. If a firm is producing a good which has a perfect substitute in some foreign good, the only way the firm will be able to survive in the long run is if the firm has a competitive advantage. However if the real exchange rate is appreciating then the firm is going to lose the competitive advantage over time. In the end the only firms which are able to have positive profits are going to be firms which produce goods which do not have foreign substitutes. Domestic firms which produce goods that have foreign substitutes, under appreciating real exchange rate, are going
to go out of business because over time the households will consume more the more cheap foreign goods. This is the fundamental issue of any economic policy. The policies have to be designed so the effects of the policies will be increase in the production of “middle” goods: the goods which can be produced in the country, but are not because of bad economic policies.

**The success of firms in the model is tied to the changes in the real exchange rate, not to the exchange rate regime.** If the inflation in the small open economy is smaller than the inflation in the rest of the world then even under stable exchange rate the firms are going to gain that competitive edge. we have shown it is harder to have real depreciation with stable exchange rate. In next part we are going to look at the marginal entrepreneur. We are going to analyze the choice of business for the new startup firms.

### 4.5.3. Marginal entrepreneurs

The marginal entrepreneur is a person or a corporation who is deciding to start a business under the current exchange rate regime. We shall analyze the decision making process of the marginal entrepreneur and see how the choice of the exchange rate regime impacts the behavior of entrepreneurs and their business choices. A representative investor funding and would like to use the funding to start a new business. This investor would be an example of "marginal entrepreneur". One more business is going to be started in the economy. We assume our representative investor creates expectations rationally under the rational expectations hypothesis. The investor takes the exchange rate regime as given and exogenous.

In the model we have specified the foreign and domestic goods are perfect substitutes, so the only difference between then is the real price determined by the exchange rate. We are also assuming our marginal entrepreneur has the same model which we have developed in Part 4.5.1 of this dissertation. Our marginal entrepreneur is using the model in order to determine which choice of business, over long period of time, is going to produce the highest present value of profits. The marginal entrepreneur is taking a large number of business plans and is trying to find the business plan which is going to have the highest value of the equation of present value of profits:

\[
\max V(Y) = \sum_0^\infty \beta^t \pi , \tag{4.145}
\]

We are obviously not going to analyze all possible business plans the marginal entrepreneur might have but we are going to group them into two large groups. In a small open economy a potential "marginal" entrepreneur is faced with two options when opening a business:

- **Open a firm that is going to produce goods.**
Open a firm that is going to import and goods or production of services.

Given the information available to our potential business man, he has to create a business model and then predict the success of each of the above options. Once the model is created probability of success is assigned to each of the possible business endeavor. The probability for success of the importing business is \( p \) and the probability for success to the producing/exporting business is \( 1-p \). The probabilities we are talking about here are in essence the results of the policy function created by the solution of the bellman equation.

We shall not deal with a whole business model and all of the variables which enter the calculation, but with only with the real exchange rate, which is manifested through the price of goods sold. Since the restrictions on the model are such the firm has to be a profit maximizing firm and in the long run the real exchange rate is the only variable of interest. Because in the long run the only important variable is the real exchange rate.

Let us now assume the marginal entrepreneur starts an importing firm. He is importing the goods and then selling them on domestic market. If the real exchange rate is depreciating in the long run the goods that he is importing are going to lose competitiveness. Regardless of how competent he is in handling business affair or how much initially his imported goods are cheaper the domestic one. In the long run he is bust\(^{59}\). The value function is going to have a negative value. The opposite will happen in the case the real exchange rate is appreciating. In that case his imported goods are going to be cheaper over time and his business will be successful. So even if initially the profits might be negative, the firm will have the real exchange rate on its side and profits are going to improve as more and more consumers substitute imported goods for domestic ones.

The opposite example is just a mirror reflection. In case our marginal entrepreneur starts a producing business, if the real exchange rate is depreciating he will have this exogenous variable in his corner and over time the real exchange rate will work in his favor.

Our agent is rational and has a perfect foresight so he can create the future expectation of the current price of some good or the index of the real exchange rate in the future. Using the rational expectation model now we can present the equation:

\[
\Phi_t = \alpha + \beta \mathbb{E}[\Phi_{t+	au}|\Omega_t] + \epsilon_t,
\]  

(4.146)

The real exchange rate is a simple auto regression in a forward looking model. Where \( \Phi_t \) is the index from equation (4.21) and \( \epsilon \) is the error \( \mathcal{N}(0,\sigma) \). The current value of the real exchange rate index is an OLS parameter \( \alpha \) plus the expectations of the index in the next period. Following the basic assumption of the rational expectations the error variable is going to be on

\(^{59}\) However there is a caveat to this argument. In case he is importing something the economy can not produce this argument might not totally hold, but by law of large numbers analyzing the aggregate economy the argument is valid.
average 0 as stated and the parameters $\alpha$ and $\beta$ are not going to change over time. Solving the equation (4.146) forward we get the rational expectations equilibrium which is:

$$\Phi_t = \frac{\alpha}{1 - \beta}$$  

(4.147)

Rational agent can use the above technique to predict the development of real exchange rate over time. All our business man has to do is to create a forward projection of the equation (4.147) and he will have the answer to the future of the real exchange rate and what is his own future regarding the choice of business. Now that he has obtained the future price of his good or set of goods, he can go back to the model, put the values in the bellman equation, obtain the policy function and see the outcome of a particular business plan.

The monetary policy is determined by the central bank, and the central bank is under the commitment of monetary policy. Following the Lucas Critique the agent has no reason not to trust his model, since the model is trying to predict the changes in the real exchange rate under one exchange rate regime and the model does not try to test what will happen if the exchange rate regime changes.

The implications of the solution are clear. If the marginal entrepreneur obtains a result of a permanent real exchange rate appreciation over time he will chose to enter into importing business immediately. Over time more and more new, "marginal" business created will be oriented towards the imports of goods and there will be an economic wide substitution from a producing economy to an importing economy.

The second solution to the equation is when the real exchange rate depreciates over time. In this case the new business will be immediately a producing one. The reason is the fact that importing goods over time will become increasingly less and less competitive and households will substitute them for domestically produced goods. From this perspective an importing business, due to the real exchange rate is destined to fail and the new business company will immediately be a producing/exporting one. Over time there is going to be an economy wide switch from importing to domestically produce goods and economy will be an export oriented economy.

4.5.4. **Transformation of the economy from manufacturing into service economy**

Following the claims from Parts 3 and 4.5.3 we can see clearly what is going to happen under a particular exchange rate regime and how an exchange rate regime is going to impact the firms in the economy. The long run competitiveness of the firms and choice of the business to venture in, are determined by the real exchange rate.
When we have modeled the central bank we have paid attention to the ability of the central bank to control the real exchange rate regime. Given the mechanism of the conduct of the monetary policy the fixed exchange rate regime cannot answer to the real appreciation of the currency. With the flexible exchange rate regime the central bank does have the possibility to affect the real exchange rate.

Now that we have modeled the households and firms it is clear why we have stressed the real exchange rate so much. The real exchange rate, at least in the models developed in this dissertation, governs important choices in the economy. Because of the real exchange rate the households are going to consume cheaper goods. If the real exchange rate is appreciating and the goods have perfect substitutability the households are going to consume more and more of the foreign goods over time.

The increase in the consumption of foreign goods is going to have a large impact on the firms. The firms producing goods which have perfect substitutes in foreign counterparts are going to become more or less prosperous depending on the time development of the real exchange rate. If the real exchange rate is appreciating the firms are going to lose their competitive edge and eventually go out of business. If the real exchange rate is depreciating the firms are going to gain competitive edge over time.

As the firms are becoming more and more competitive and are taking more and more market share from their foreign counterparts the domestic market is going to become too small for those firms. Eventually they are going to expand into foreign markets. The expansion into the foreign markets is going to increase exports and increase GDP, but it will have an even more important impact and that is the increase in employment. New markets imply increase in capacity and with increase in capacity an increase in the employment is needed as well.

The real exchange rate depreciation is going to have an important impact on the marginal entrepreneur. Given the depreciation of the exchange rate the marginal entrepreneur is going to lean more towards opening of the manufacturing and exporting businesses. This will again have an impact on the employment in the economy.

The flip side of this coin is the case when the real exchange rate is appreciating. In case of real appreciation the firms which are producing and their products have perfect substitutes in imports are going to go out of business due to the loss of competitiveness. Over time households are going to substitute their products more and more for the imported goods which are cheaper. The producing firms, which are labor intensive, are going to go out of business which will cause massive layoffs and loss of jobs. However in their place firms oriented towards imports and trade are going to start.

The marginal entrepreneurs in case of appreciating exchange rate are going to start business which is going to be in services and trade. The economy is going to move from manufacturing toward services. The imports are going to rise and this will cause downward pressure on the GDP. Due to de-industrialization there is going to be a loss of jobs, but the new jobs are going to be created in sectors like services and trade.

We have presented an argument where the structure of the economy simply changes, some jobs are created and some jobs are lost as part of the natural economic process, but there is three caveats.
The first caveat is regarding the number of people which can be employed in the services and trade. The sector of trade and services has an upper limit on employment while manufacturing and industries do not. This is of major importance for the economy. Trade and services are limited by the fact that in the economy there is a limited amount of consumer, which is changing at some natural rate; this natural rate is the growth rate of the population. So there are only so many services which can be sold to a population at given time. The examples of this are numerous. One of this might be haircuts. In the economy, given the population the numbers of people are roughly going to have the same amounts of haircuts per year, so it is not that hard to calculate the optimal number of hairdresser per population. Same is with shops or malls. Given the size of the country and the number of population there is an optimally level of shopping malls per person or per square meter. Same goes for any other services.

The second caveat is in the response of the business towards economic recession and the effects economics policies can have given the employment structure of the economy. The services are very business cycle elastic and if there is an economic downturn the first sectors hit are going to be the ones which deal in services. These sectors are also relatively non responsive to the fiscal stimulus. But what is even more important, the sectors like trade and services have an upper limit on employment. This implies that where there is an economic downturn the creation of new jobs through fiscal policy is going to be hard. So the economy which is based on services and trade is going to have a much harder time exiting the economic downturn.

The third caveat is the sources of economic growth we have to consider. Economic growth cannot come just from consumption; at least some part of economic growth has to come from investments. Since the goods and services have mostly fixed investment based on just one time investments there is no need for future developments. Once a shopping mall has been built it is hard to envision its expansion. This is not the case with industry and factories. A factory always has an option, in case of increasing demand to expand the production, open and new factory and hire more workers. The capacity of a factory is only limited by the demand for its goods, while the capacity of trade is given by the number of people in the country and the size of the country.

In the end I will address some final concerns over the model. The first concern is the deficiencies in the model in terms of variables. The variables we have presented here are: the price for which the goods are sold and price of the inputs. One could argue this model in itself is deficient because there are no taxes and other elements of the fiscal policy. This is true. The reason for leaving out the implications of fiscal policy lies in the fact the objective of the thesis is to investigate the behavior under monetary policy not under different fiscal regimes. What remains the question is: can the monetary policy be offset by the fiscal policy? Or reverse can the negative trends in the monetary policy be offset with the fiscal policies? Keep in mind the purpose of the model created is to serve as an indicator of behavior and its relevance lies more in the ability to describe potential behavior not to encompass all possible solution.

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60 For extensive proof and analysis see Mesić and Vidaković (2011).
The second point is that the model is a long run model, but the long run is contingent on the speed of changes in the real exchange rate, the faster the speed of real exchange rate change (in one direction) the faster should be the effects predicted in the model.

The third one is that at no point in time in this part of the dissertation (Part 4.5) I have made any assumptions about the superiority of an exchange rate regime. In this part I have merely presented a general problem for any economy. It is quite clear that the superior exchange rate regime in the one which can keep the real appreciation at bay. Now given the explanations regarding the conduct of monetary policy under the two regimes we have presented it is hard to imagine how a stable exchange rate regime could be able to stop the real appreciation of the currency. The crux of the model has been made around the real exchange rate, so it is reasonable to expect that once we see the developments of the real exchange rate in the economy the data is either going to validate the model or not. Again here I leave an open point about the possible effects of the fiscal policy.

The ultimate test of the model and everything stated in this section of the dissertation will be made in Part 5 when we look at the data and see does the data match the assumptions about the economic behavior of firms we have made in this section.

4.6. Government

The government is an important economic participant in many economic models, however in our model of the monetary policy the government has been put on the fringes of the economic activity. We have in part 2.3.1 analyzed the behavior of the fiscal policy, but even then the focus of the analysis was in conjunction to the monetary policy. In this part we are going to try to see what kind of exchange rate regime the government prefers. We will also try to see is there is possibility that the government off-sets some of the negative elements tied to the monetary policy.

We are going to analyze what are the rolls of the government; here we are going to split the roles of the government into economic roles and non-economic roles. As presented in the chapter about transition in Part 2 of this dissertation, once the socialism was over the government went on a path of changes the question remains were all changed good? This brings us to the issue of non-economic role of the government. It is obviously clear that no economic policies, no matter how brilliant they are, can help an economy which does not have a functional judicial system. This is obvious, but in economic models the non-economic role of the government is seldom explicitly modeled, simply because it is too hard to quantify and it falls outside the realm of the economics science. But I feel some issues should be addressed. But our main focus will remain the effects of the choice of the exchange rate regime on fiscal policy.
4.6.1. Economic role of government

The economic role of the government is to: perform fiscal policy and makes economic transfers. The fiscal policy is manifested through the government spending and tax policies. The transfers are mostly pensions and salaries, but they also include social welfare and other transfers.

The fiscal policy in the small open economy has different effects than in the large economies. The best example of this difference is the effect of the government spending. Using IS-LM model we can easily see the increase in the government spending, increases the aggregate demand and then at the expense of the higher price level there is an increase in both nominal and real GDP. It is also assumed in the Keynesian models the increase in government spending is going to have a multiplier effect in the economy. So the 1$ spent will multiply in the economy and have more than 1$ increase in the GDP. This assumption in the small open economy does not hold from micro or from macro perspective. From the macro perspective the ineffectiveness of the government spending was already illustrated in the Mundell-Fleming model. As for the micro perspective all we have to do is ask ourselves: What if the government decides to build a hospital, but uses a foreign company? If the foreign company uses foreign materials and foreign labor in that case this government spending is going to have 0 effect on the GDP since the increase in the government spending G will be offset by imports in the end the government will have to hire doctors and that will just increase the transfer part of the budget. The new salaries will have to be funded either by higher taxes or by government deficit. There will be no increase in GDP due to the increase in government spending. In small open economy the effect of government spending is not determined by the marginal propensity to consume, but it has to be adjusted with the marginal propensity to import.

Additional problem is the government deficit. Large economies like USA, Japan, and Germany can assume there is always going to be a demand for their debt. A small open economy cannot absolutely assume the amount of debt which can be sold is infinite since most of the ability to sell debt is largely dependent on the credit rating of the country.

Even in this simple example we can see that the classical fiscal policy of just increasing the government spending is much more complex in the small open economy than it is in large economies. Because of this it is important to investigate fiscal policy in terms of the interaction with other variables. Not just spending. Another variable of importance to us is the income structure of the government’s budget, which tax contributes the most to the budget.

4.6.2. Non-economic role of government

The non-economic role of the government lies at the foundations of the country the government is going to build for its people and what kind of system the government is going to create. The process of transition has been very interesting in this particular aspect. Most of the economic models, this one included, look at the economic variables and then try to explain
the behavior of economic participants. The non-economic role of the government is often neglected, but still plays an important part in any economy.

In part 3.1.2 we have created a game theory transition model in which we have stated the policy maker implements policies to bring the country closer to their goals. We were rather vague in defining what the policies are. We are going to elaborate more on those policies now. So far in the dissertation we have dealt mostly with only one policy, the choice of the exchange rate regime. This is an economic policy, but there are many other non-economic policies which affect the economy just as well. These other policies might have even more impact on the economy than the actual fiscal or monetary policy. As I have stated there are some conditions in the models which are considered as given. These conditions are, but not limited to:

- Sufficient labor supply.
- There is a strong and clearly defined rule of law in the country, with the well-functioning judicial system.
- There is well established and functioning education system in the economy.
- The economy is open and there are no restrictions on any kind of mobility (capital, labor, goods).
- Political stability.
- Stable international relationship, free trade and uninhibited travel to and from the country.

All of the above stated conditions are being taken for granted in most economic models, including this one, but in real life these other non-economic policies might be just as important as the economic policies. For example three countries were immediately excluded because of the political reasons. Bosnia and Herzegovina is still reeling from the war turmoil from the 1990s. Serbia still has quite sanctions because of the lack of cooperation with the Court in Hague and problems with Kosovo. Macedonia even has problems with its very existence due to the name dispute with Greece. Although these three countries fit the economic bill of the countries we would investigate due to the non-economic actions of their government and their political situations there were excluded on the grounds that the political conditions have interfered with the economic policies. Bosnia and Herzegovina, Serbia and Macedonia were immediately excluded from the model, but that does not mean that all of the other countries we are going to analyze in Part 5 are as pure as the driven snow.

In the Part 4.5.4 we have stated that the real exchange rate is going to cause economic transformation from manufacturing to the service economy. We have labeled the real exchange rate as the sole reason why the industry is going to shrink in the economies with the appreciating exchange rate; however that might not be the case. Another very good reason for the decrease of the industrial activity might be tax policies and process of privatization.

The real exchange rate is going to work against the manufactures and over time their goods are going to become less and less competitive with the foreign goods, but this is in the long run.
There is a possibility the tax system pressures the manufacturers to go out of business. It is not hard to see a possibility where the manufactures in the small open economy have competitive advantage, but that competitive advantage gets taken away be the tax system. The decrease in the manufacturing can also be easily explained through the process of privatization which in some countries could have gone better.

In the list of non-economic pre-requisites we have also included a rule of law. In this model the rule of law was not incorporated, but the fact remains without rule of law there cannot be a well-functioning economy. Having a just and functioning legal system is something which is an absolute prerequisite for any economic activity. However it is hard to create a “what if” scenario for the rule of law. The answer to the question: *how would the economy look like if it had a better judicial system in the last ten years?* is well beyond this dissertation. Rule of law does not directly influence the consumption and choices of the households in terms of their consumption basket and preferences of debt, but it does influence the companies and through companies it influences the wage of workers. It is not a quantum leap to assume with a strong and defined rule of law the economy is going to have higher growth rates and higher standard of living.

Maybe the adverse data patterns in some countries are completely normal due to the elements which are not accounted for in the model and then the choice of the exchange rate regime just amplified the negative elements. The model we have presented here is a model with focus on the monetary policy; we start from the premise the choice of the monetary policy is significant for the economic behavior. However it is possible the initial assumption of the model is wrong. It is possible that the model has hidden and omitted variables because if the model was absolutely correct then it would not be a model, but a formula for the real world.

Following the line of argument, some economies are predetermined for some paths, we could go with the argument the bad monetary policy increases bad elements in the economy and dampens the positive elements in the economy; just as the good choice of the monetary policy creates more fruitful environment for the economic participants.

The only answer for this is in the data that is why we are going to test the data in two ways, for the change in behavior of economic agents and for the support of the model as it will be elaborated in Part 5 of this dissertation. We are going to come back to this argument in the conclusion of the dissertation as well.

### 4.6.3. Tax system and the preference of the exchange rate regime

In this part we are going to investigate what are the government’s preferences for the choice of the monetary policy, exchange rate regime and why. The government collects taxes and wants to collect as much taxes without causing severe disturbances in the economy. The main source of taxes for the government in this model will be the value added tax; this is a type of a tax which taxes the whole chain of production of a good, from the first link in the chain to the last user of the produced good. The object of taxation is the new value added to the product.
How does the monetary policy choice fit into taxation and does the choice of the monetary policy impacts the taxation of the government? The answer directly is no, however the indirect effect of the choice of the monetary policy to the ability of the government to tax are enormous, as shown in Zbašnik (2010).

When we analyzed the producers we have stressed the importance of the real exchange rate on the choice of the marginal producer. We have seen how, depending on the real exchange rate movements; over time we are going to see a restructuring in the economy away from the producers and towards the importers. So is the taxation of importer vs. taxation of exporters any different for the government? The answer to this question is a major one and here we are going to presents two views. The first view is the one presented in a textbook by Stanovnik (2008) where the answer to the question is no, the taxation of importers or exporters does not make any different to the government form the VAT perspective. The second one and also the one we are going to adhere to is yes, it makes all the difference to the government is the economy export or import oriented. This view was presented in Santini (2005, 2006, 2007) and is going to be mathematically developed now.

First we are going to look at the presentation by Stanovnik (2008 page 112) about the basis for the taxation under the VAT system. The basis presented in Stanovnik (2008 page 112) is here brought in full.  

**Stanovnik’s proposition: the basis for VAT taxation is C+Gc. Consumption from private entities plus consumption from the government, the imports are not relevant.**

We have to split the VAT taxation into two parts, taxation of the domestically produced goods and the taxation of the foreign produced goods. First we are going to develop the VAT basis of the domestically produced goods.

The taxable basis for the firms is:

\[ FD - In = \text{bruto FD} - Ib \]  

(4.148)

Where FD stands for factor income, In are net investments and Ib are gross investments. If we sum up all of the factor income from the private and public entities we are going to get GDP or gross domestic product. Following this we can write:

\[ \sum_i FD + \sum_j FD = GDP \]  

(4.149)

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61 The translation from Slovenian was made by the author.
So the sum of the factor income from the public sector and private sector will give us the gross domestic product of the nation. We can now expand the above equation to get

\[
\sum_i (\text{grossFD} - \text{I}_b) + \sum_j \text{FD} = \text{GDP} - \text{I}_b \tag{4.150}
\]

Where the first summation is the summation for the private entities and the second summation is the summation for the public sector. With the fact the summation of \( \text{I}_b \) across the economy represents the gross invests of the whole economy. The second summation is the presents, in approximation, the wages in the public sector (will be noted as \( \text{GW} \)), so now we can write the tax basis as:

\[
\sum_i (\text{grossFD} - \text{I}_b) = \text{GDP} - \text{I}_b - \text{GW} \tag{4.151}
\]

Now we can put into the equation the second part of the taxable basis and that is taxes on imports, the taxable basis of the customs department is \( U \) so now we can write the whole of the equation as:

\[
\text{basisVAT} = \text{GDP} - \text{I}_b - \text{GW} + U \tag{4.152}
\]

Now we have the whole of the tax basis in one equation. However we know that the GDP is defined as:

\[
\text{GDP} = \text{C} + \text{I}_b + \text{G} + \text{X} - \text{U} \tag{4.153}
\]

Where \( \text{C} \) is the final consumption, \( \text{I}_b \) are gross investments, \( \text{G} \) is government spending (no transfers), \( \text{X} \) is exports and \( \text{U} \) are imports. If we combine equation (4.152) \(^{62}\) with equation (4.153) we get VAT basis to be

\[
\text{basisVAT} = \text{C} + \text{I}_b + \text{G} + (\text{X} - \text{U}) - \text{I}_b - \text{GW} + \text{U} = \text{G}_c + \text{X} \tag{4.154}
\]

Where \( \text{G}_c \) is the government’s consumption. Since the exports \( \text{X} \) are not part of the VAT system of a country we have that the basis for the VAT taxation in the economy is \( \text{C} + \text{G}_c \). However this

\(^{62}\) Number of equations adjusted for this dissertation.
is a very general equation since some parts of the consumption can have 0 rate of VAT and some companies are not within the VAT system, but on the average the equation holds. QED.

The taxable basis presented in Stanovnik (2008) is rejected in the dissertation as deficient. The basis that I (following Santini 2007) will develop will show the taxable basis for a small open economy is in fact $C+Gc+U$ where $U$ is imports.

As it can be seen from the proof presented in Stanovnik (2008) the imports are not part of the VAT system and the government cannot gain from taxing the imported goods. From the proof we can conclude it might be in the interest of the government that as much of the goods are domestically produced and domestically consumed, since the exports do not bring any VAT taxation, but the amount of imports as elements of the taxed are completely irrelevant for the government since the imports are not VAT taxed.

This notion is strongly rejected. In order to be able to disprove the notion presented we are going to use two ways to prove our hypothesis. The first one is a verbal one and the second one a mathematical one.

Let us proceed with the verbal proof. We shall assume an island economy which has three participants. The first participant is the government. The government has only one function and that is to tax the consumption. The taxes are not used by government; they are just collected and then destroyed. The second participant is going to be importer. This importer imports goods for the third participant on the island and that is the consumer. The importer imports the goods by buying them on the other island and then selling them to the consumer. The third participant is the consumer and the consumer gets his utility from consumption. The goods are imported and delivered to the consumer. The consumer has to announce its future consumption one period in advance. Then the importer takes the order in time $t$ and delivers the goods to the consumer in time period $t+1$. The consumer has income. The income comes from the fact the consumer can print money. However there is a limit on how much money the consumer can print in any time period so every time period the consumer will print the maximum allowed in order to maximize his consumption. The cost of printing money does not exist and there are savings. It can be seen there is no production on the island and GDP is 0, since the printing of fiat money is not part of GDP. There is only one tax and that is the VAT tax, the VAT tax is imposed on consumption and it is included in the price of the goods consumed. As noted only goods consumed are the imported goods. Using this set up and following the proof by Stanovnik (2008) the VAT on this island is 0, since there is no GDP, however there is consumption so that has to be some taxation, but the consumption is the consumption of imported good. As we can see in this set up the proof presented in Stanovnik (2008) does not function since the government does tax consumption and does collect VAT, but on imported goods.

How does the island economy work? The object of the consumer is to maximize the consumption. So in time $t$ the consumer makes and order with the importer to obtain $x$ amount of imports to the purchased with $x$ amount of money produced and to be paid in time period $t+1$. In time period $t+1$ the importer delivers the goods and sells them at price $p$ to the
consumer. The consumer consumes the goods and makes an order for time period t+2. Once the importer receives the money he has the following profit calculation

\[ \pi = p - T - g \]  

(4.155)

Profit equals price of the goods sold minus taxes minus cost of goods bought. The taxes go to the government. As we have demonstrated here even with no domestic production and with all goods consumed come from imports the government gets its dues in for of a value added tax. The tax amount is cost of goods g times the tax rate t.

\[ T = p \times t \]  

(4.156)

We have now shown in our island economy which we have set up there is value added tax and it is on the importer goods.

This was the first element of the proof, a verbal one. Now we are going to show the error in the proof presented by Stanovnik (2008) in mathematical terms. First we are going to rewrite the formula for the GDP. The actual formula for the GDP is usually written as:

\[ UXGIb \quad CGDP \quad \]  

(4.157)

However that is not the formula for the GDP, the actual formula for the GDP is:

\[ GDP = C + Ib + G + X - U \]  

(4.158)

The gross domestic product, everything produced in one nation within one time period, of a nation is in fact the consumption of domestic goods \( C_d \) plus the consumption of foreign produced goods \( C_f \), plus the investments \( Ib \), plus the government consumption of both domestic \( G_d \) and foreign goods \( G_f \) plus exports since the exports are also produced in the country. However in the consumption elements we have consumption of goods which are not produced in our country so we have to take them out of the equation and the goods produced in the foreign country come via imports, that is why imports are negative in the formula for the gross domestic product. Using the GDP equation we have presented we see that the equation

\[ basisVAT = GDP - Ib - Gw + U \]  

(4.159)
As developed by Stanovnik (2008) contains the GDP, but the GDP equation is

\[ \text{GDP} = C_d + C_f + I_b + G_d + G_f + X - U \]  \tag{4.160}

Only the goods and services produced domestically are included in the equation. So we can now implement this equation in the (4.160) with the equation (4.159) and we get

\[ \text{basisVAT} = C_d + C_f + I_b + G_d + G_f + X - U - I_b - Gw + U = \]
\[ = C_d + C_f + G_d + G_f \]  \tag{4.161}

Now we get that the basis for the VAT includes domestic consumption by private and public sector and the imports. The equation still contains consumption, but consumption of goods produced both domestically and foreign.

We have now demonstrated both verbally by example and mathematically the basis for taxation using a VAT tax for the government has imports in it. Imports can get taxed by the government and they can be source of income for the government. The proof offered by Stanovnik was not wrong per se, but it was somewhat misleading since consumption C in GDP contains both domestic and foreign consumption. This is the point I try to make.

The example of the importance of the imports as the source of income for the government as tested by Santini (2007 page 134), in his book Santini demonstrates the importance of the imports on the government revenue and shows that without the taxation of the revenues the nation debt in Croatia would be several times higher since the government could not support its spending.

At the beginning of this section we have asked does the government have any preferences when it comes to the choice of the monetary regime? On the surface the government does not care which system the central bank implements since the government does not care about the movement of the exchange rate, unless it has foreign denominated debt. However once we dig into the structure of taxes we come up with strong government’s preference for the stable exchange rate system because of high consumption.

As we have demonstrated when we have analyzed the producers in case of the stable exchange rate system the marginal producer and over time the whole economy will move towards importing and trade, while in the case of the variable exchange rate system the marginal producer and over time the whole economy will move towards production and exports.

We have seen in our proofs the imports mean more revenue for the government and the exports mean less VAT revenue for the government. So in case the object of the government is...

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63 Professor Andrej Kumar pointed out the structure of the GDP in one of his lectures and indvertibly gave me an idea for this proof. Thank you.
to have as much tax revenues as possible the government will prefer the stable exchange rate regime since this system brings in the revenue from the imports.

### 4.6.4. Fiscal policy under alternative exchange rate regimes

In the previous part of the dissertation we have seen the government has a strong preference for the stable exchange rate regime since this regime brings higher tax revenues in the short run. Following this line of argument we are now going to fully model the behavior of the government, we are going to use the same dynamic tools which we have used in the previous parts.

Following the logic of the modeling we have used in the previous parts of the dissertation in this part we are also going to model the behavior of the economic agent under the stable exchange rate policy first and then under the variable exchange rate policy. We are going to assume the expectations are made rationally and that the government knows what will be the exchange rate in any future period since monetary policy and fiscal policy do communicate with each other. The government receives funds from two sources the taxes and new debt in the current period, so the BR (budget revenue) can be noted as

\[
BR_t = T_t + D_t - rB_{t-1}
\]  

(4.162)

Where \( T \) are taxes collected in the current time period, \( D \) is government deficit funded by issuing bonds and the \( rB \) is the amount of the outstanding debt which has to be paid off in the current time period. The expenditures of the government are pensions \( P \) and spending \( S \).

\[
BE_t = P_t + S_t
\]  

(4.163)

What the government wants over time is to maximize spending given the BR transition equation so we have

\[
V(P_t, S_t) = \max \left[ \sum_{0}^{e} f(P_t, S_t) - \sum_{0}^{e} rB_t \right]
\]  

(4.164)

The above value function states that the government wants to maximize the spending, but at the same time it is forced to pay off debt from the previous governments. It should be noted the government performs the optimization from 0 to \( e \) where \( e \) is the next election period. In creating this limited optimization period we have in fact introduced the moral hazard into the
calculation. In this particular model the government only cares to be elected for the next mandate. Following this the bellman equation for the government is

\[
V(P_s, S_t) = \max \left\{ f(P_s, S_t, t, D) + \beta V(BR_{t+1}, B_{t+1}) \right\} \tag{4.165}
\]

The small \( t \) represents the average tax rate in the economy. From the bellman equation (4.165) the government derives the policy function \( h(P^*, S^*, D^*, t^*) \) where the star values represent the optimal choice of the variables the government can control. It is easy to extend the model for the variable exchange rate regime. The budget revenues in any future period are now:

\[
BR_{t+n} = T_{t+n} + D_{t+n} - rB^B_{t+n} - (r + e^{c}_{t+n}) B^f_{t+n-1} \tag{4.166}
\]

Where superscripts D and R refer to domestic and foreign respectively, because we have separated the domestic part of the government debt and the foreign part of the government debt; \( e \) is the expected nominal exchange rate in the current period. By adding the expectations to the debt repayments of the foreign issued bonds we have again, just like with the households, introduced the hard budget constraint. So the augmented bellman equation is now

\[
V(P_s, S_t) = \max \left\{ f(P_s, S_t, D) + \beta EV(BR_{t+1}, B^D_{t+1}, B^f_{t+1}) \right\} \tag{4.167}
\]

With the variable exchange rate regime the government has to take into the expectations for the change of the nominal exchange rate. Given the fact the expectations are made rationally and the fiscal policy maker know what the exchange rate is going to be in any future period, just like the central banker, it is not hard for the government to understand how much funds it can ask from the rest of the world.

If the nominal rate of depreciation is more than the government can pay the foreign source of deficit is going to be limited. We see the variable exchange rate has the same preventive effect on the government as it had on the households.

The best way of getting out of this situation is never to get into it in the first place. Even of the stable exchange rate regime is chosen the government should strive towards the balance budget so that decrease in credit activity is not going to cause major disruptions in the functioning of the government.

4.6.5. Sources of fiscal revenue: the importance of credit
We are now going to investigate more the sources of revenue for the government and how does the revenue of the government ties in with the household's model. The equation for the revenue of the government was given as collection of taxes and new debt.

\[ BR_i = T_i + D_t - rB_{t-1} \quad (4.168) \]

Let us break down the revenue from taxes:

\[ BR_i = T_{\text{VAT}}basisVAT + T_{\text{cor}} (\pi^B + \pi^{\text{cor}}) + D_t - rB_{t-1} \quad (4.169) \]

The revenue comes from taxes from VAT with the rate \( T_{\text{VAT}} \), corporate tax \( T_{\text{COR}} \) and new debt minus the repaid debt. Now by using equations (4.161) which is he government basis for VAT with profit equations for firms and banks, which are equation (4.43) and (4.136) we are going to expand the government revenue to

\[
BR_i = T_{\text{VAT}}basisVAT + T_{\text{cor}} (\pi^B + \pi^{\text{cor}}) + D_t - rB_{t-1} = \\
T_{\text{VAT}} * (C_d + G_d + U) + \\
T_{\text{cor}} * \left\{ x_{t-1} + (\Lambda_t - \lambda) \right\} * \left\{ (r_t)_t \omega_t + (z_t^i)(1 - \omega_t) \right\} + \\
T_{\text{cor}} * \left\{ y * p - n w - (c_d * p_d + c_f * p_f) - i \right\} \\
\quad (4.170)
\]

So the government taxes come from corporate tax which we are assuming is the same for firms and banks and from the VAT from consumption. However we can do one more expansion and combine the equation (4.109) which is consumption under stable exchange rate regime and replace the \( C_d \), so now we get:

\[
BR_i = T_{\text{VAT}}basisVAT + T_{\text{cor}} (\pi^B + \pi^{\text{cor}}) + D_t - rB_{t-1} = \\
T_{\text{VAT}} * (w_t + \tau * S_{t-1} + \varphi_t - s_t - \kappa \Phi_t - G_d) + \\
T_{\text{cor}} * \left\{ x_{t-1} + (\Lambda_t - \lambda) \right\} * \left\{ (r_t)_t \omega_t + (z_t^i)(1 - \omega_t) \right\} + \\
T_{\text{cor}} * \left\{ y * p - n w - (c_d * p_d + c_f * p_f) - i \right\} \\
\quad (4.171)
\]

What the equation (4.171) does is to combine the VAT collected by the government and household credit. The more households consume on credit in each period the more VAT revenue will be collected. **This clearly ties in the credit policy with fiscal policy.** From this it is not hard to calculate how much of government’s revenue came from increase in household
debt. However the increase in government revenue is possible if and only if there is an increase in household debt and the model was created with the assumption the increase in debt comes under the stable exchange rate regime. Under variable exchange rate regime this is not possible.

The government taxes should be based on real economic activity: increase in production and increase in wages. What was demonstrated in this part is that the monetary policy can through stimulation of household debt increase fiscal revenue.

If the government is interested only in the next election cycle the choice of the exchange rate regime is more than obvious: the stable exchange rate regime. There are several reasons for the government to support the stable exchange rate regime. Stable exchange rate regime as the best economic drug there is.

Under the stable exchange rate regime the households have soft budget constraint and if the households have not reached their upper limit of debt the banks are willing them extend the credit. By extending the credit to the households, the banks are supporting the household’s life above their means and creating an illusion of prosperity based on credit. With credit obtained from the banks the households are spending and increasing the tax revenue from the VAT tax on imported goods. If at the same time this process is followed by the inflows of money into the economy and rise in foreign debt we are going to have the unholy trinity of economics.

- **Government** is going to be very happy due to high tax revenues from VAT on the imported goods financed by credit expansion.
- **Households** are going to be able to live above their means because of the soft budget constraint as long as the banks are willing to fund such high life.
- **Central bank** will have to sterilize the inflows of the money into the economy which will lead to the increase in the total reserves of the central bank and high domestic liquidity.

Everybody will be happy and point out the stability of the system. This particular set up is going to produce a lot of positive effects for the economy in the short run: stable currency, increasing foreign reserves, high tax revenues, ability to secure next election thought government spending and transfers and for the households high standard of living above their means.

It is easy to see why the stable exchange rate receives so much support from the politicians and get hailed and praised as a source of economic stability. Given the interactions we have presented in this model the reasons are more than obvious. But once the cycle is complete, once the inflows of funds into small open economy stop and the money starts to leave the economy, the households reach their upper level of debt, the government will be faced with a problem and significant decrease in revenues. However since the politicians in our model look only from election to election the optimal strategy is to go to the opposition for one or two election cycles until the economic problems blow over.
We could also extend the argument and look at the source of the funds for budget deficit. If the central bank has chosen the stable exchange rate regime the source of funds for deficit can be both in the country and outside of the country. Since the exchange rate is stable the government does not face the problem of the exchange rate risk once is issues foreign bonds. But if the central bank has chosen a variable exchange rate regime then the government has the exchange rate risk problem and is faced with the same hard budget constraint as are the households under the variable exchange rate regime.

The behavior of households and the behavior of the government is the same. Both households and government want to live as good as possible. Households want large consumption and government wants large enough budget to secure the electoral win. Under stable exchange rate regime both households and government are faced with soft budget constraint. Because of this the pursuit of desired life style and electoral wins are going to be completely open. The households are going to live the standard they want and the government will get all the funding it wants. However the problem arises when the credit boom comes to end, as it always does. Then both government and households are going to be faced with “hard reality which destroys the fairy tale”. When the lending comes to stop the household’s living standard is going to drop dramatically and so will the budgetary revenues.

4.6.6. Interaction of fiscal and monetary policy

The interaction of the fiscal and monetary policy is something we have to address here again. We have already noted under the variable exchange rate regime the central bank buys and sells the foreign currency when it wants to change the level of the nominal exchange rate. If the central bank chooses the stable exchange rate regime then the monetary operations of the central bank are performed when there are inflows or outflows of funds.

One of the main differences between the small open and large economies is in the fact in large economies the central bank buys and sells the government debt. This leaves the possibility for the government debt simply to be monetarized by the operations of the central bank. This relationship between fiscal and monetary policy does not exists if the central bank is only trading in the foreign currency.

The independence of the monetary policy lines in the ability of the central bank to make decisions when it feels such decisions are best appropriate. The independence of the monetary policy should not be ineptness of the monetary policy to see the state of the economy.

When we have modeled the central bank we have made the theoretical difference between the stable and variable exchange rate regime. The stable exchange rate regime is based on the premise that the exchange rate stability is going to bring the price stability, while the variable exchange rate regime is based on the premise the central bank should look at more variables then just the price stability. The model we have presented and the basic assumptions about the

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64 Quote taken from Guste Santini “kruta zbilja je uništila bajku”
economic behavior we have made in the model point to the conclusion the interaction of the monetary and fiscal policies are imposed by the choice of the exchange rate regime.

If the central bank chooses variable exchange rate regime then the central bank can use the exchange rate and the quantity of money in the economy to facilitate the fiscal policies and provide enough liquidity for the economy. If the central bank chooses stable exchange rate the quantity of money is determined by the capital flows in and out of the country. With the stable exchange rate regime the central bank is devoid of any connection with the real economy and that includes the fiscal policy as well.

The most important part in the relationship of monetary and fiscal policy is credit in the economy. The model we have set up clearly shows the issue of monetary policy in a small open economy is not just the issue of price stability but it is the issue of banks and their credit policy. Through this part of the dissertation we have tied the credit to all elements of the economy and have clearly demonstrated in the model there is a relationship between the choice of the exchange rate regime, credit and all other economic variables. But nowhere has this relationship come to its full strength like in the relationship between fiscal revenues and credit. This intricate relationship which was presented in the model between the fiscal policy, credit and choice of the exchange rate regime clearly points to the possibility there is more to the impact and importance of the monetary policy then just price stability.

* * *

This concludes the part of the dissertation in which we have modeled the economic agents. The economic agents were modeled under two exchange rate regimes. In the modeling process we have often, based on the theoretical assumptions of the model concluded that the variable exchange rate regime is superior to the stable exchange rate regime. Those claims were made based on the mathematical properties of the model.

In the end of this section of the dissertation we are not going to make a comprehensive summary of the model, instead we are going to do that in the next section of the dissertation and that is the data analysis. The next part of the dissertation is the most important part of the dissertation since it will provide us with the most answers to the most important question of all: is the model correct?
5. Data analysis

In this part of the dissertation, we are going to validate the claims made in other parts of the dissertation and test the model. The analysis will be split into two separate segments. The first part is going to be focused on the difference in the data between countries with stable and variable exchange rate regimes. The second focus is going to be on the relationship between the claims made in the model and the actual data.

The first data test is going to show if the model makes sense in its fundamental implication: various exchange rate regimes – different economic data. In the model, we have stated on numerous occasions that there is a difference in the behavior of the economic participants due to the different exchange rate regimes. If the data has similar properties in all countries regardless of the exchange rate regimes, then the model is not valid, and we cannot conclude that the difference in the exchange rate regimes leads to different economic behavior. So, we have to test if economies with different exchange rate regimes have different economic data properties. The purpose of this test is to test the validity of the claim that the change in the exchange rate regime changes the behavior of economic participants. This will be the hypothesis test. The second data test, if the model passes the first one, is going to be on the correlation between the claims made in the model and the actual data. In this test, we want to see if the model is correct. We can call this the model test. It is possible for the model to fail this test as well.

We are going to perform this dual test of purpose, since we need to validate two items, the main thesis and the model. The data is going to be analyzed per variable, not per country and not per economic participant. The data analysis will also be based on the behavior of the variables, not necessarily on the magnitude of variables. The mechanics of the analysis of the data are going to be done two fold. First, we are going to perform and intergroup analysis, we are going to compare the data from different exchange rate regimes. The object of this test is to see where the behavior of the data is different between the economies with different exchange rate regimes. Then, we are going to compare the behavior of the data in countries which have had exchange rate regime switch in order to detect the changes in the behavior of data once the exchange rate regime has been switched.

But before we move to the actual data analysis, we are going to make two side steps. First we are going to have a comprehensive overview of the model, just to repeat what was stated in the model and what does the model tell us about the behavior of economic agents. After the overview, we are going to assign to each country in our analysis an exchange rate regime based on the definitions of the monetary exchange rate regime we have made in Part 3 and Part 4.

5.1. Discussion and overview of the model

The initial assumption of the model and the main thesis of the dissertation is that a choice of the exchange rate regime is going to force economic agents to behave differently thus causing economic agents to have two different models, depending on the exchange rate regime chosen.
The main player in the model is the central bank. The central bank chooses the exchange rate regime. The choice is exogenous for economic participants, they cannot affect the choice, the economic participants just have to accept the choice and then optimize their behavior under the given exchange rate regime. Principally the central bank has the following two choices of the exchange rate regime, as we have defined it in our model.

**STABLE EXCHANGE RATE REGIME:** in this exchange rate regime the central bank has two options of what to do with the exchange rate. The first option is to keep the exchange rate fixed to some other currency or a basket of currencies. The second option is to keep the exchange rate in a range, essentially making the exchange rate time series a mean reverting series. The main characteristic of this regime is that over time the exchange rate “does not go anywhere” or that the exchange rate regime does not have a direction or a trend over time. In this regime the central bank maintains the stability of the exchange rate and does not actively use the exchange rate in order to affect the economy.

**VARIABLE EXCHANGE RATE REGIME:** in this exchange rate regime the central bank purposefully changes the exchange rate over time. The central bank in this exchange rate regime again has two options. The first option the central bank has is to keep the exchange rate fixed at some level and then move it in jumps in certain time periods. Or the central bank can allow free trade of the currency, but through the open market interventions in the currency market the central bank can increase the supply of the domestic currency and depreciate the currency over time. The main characteristic of this regime is that the central bank actively uses the exchange rate regime in order to influence the economy and the exchange rate data will show a trend.

Important point: in real life there might be a third possibility under the variable exchange rate regime and that is for the central bank to push the exchange rate in the appreciating direction. From the model point of view this policy does not make sense since the exchange rate appreciation is considered extremely negative for the economy. In the model we have not analyzed this possibility in a formal way. It is possible we encounter this regime in the data, if that does happen, economy with this exchange rate regime is going to be a very good control case.

Once the exchange rate regime is chosen the economic participants choose a model (behavior) and the rest is just a traveling along a preset path for the economy. The model we have created assumes once the exchange rate is chosen the rest of economic events are just a naturally economic occurrence.

### 5.1.1. Households

The choice of the exchange rate regime has a significant influence on the households. The stable exchange rate regime imposes a soft budget constraint on the households and gives the households an ability to obtain debt without the exchange rate risk. If the households have
preference toward the more consumption now rather than in the future, the households are going to obtain as much debt as they can and consume as much as possible in the shortest possible amount of time. However at one point in time this spending spree has to come to an end; since there has to be an upper limit of debt at which the banks are no longer willing to lend to the households. Once the spending spree is over the consumption of the households is going to fall rapidly. The soft budget constraint has multiple impacts on the economy. Due to availability of credit in the economy the households are going to have higher demand for loans from the banks. The banks, following their profit motives, are going to lend to households since there they can get higher interest rates. This change in the business strategy will lead to the change in the structure of the banking balance sheet since they are going to be lending more to the households and not to corporations.

The increase in the aggregate demand due to credit is going to increase the demand for imports as well. Higher demand for imports is going to have two major effects on the economy. The first effect is going to be the increase in the current account deficit, which is negative for economic growth. The second effect is going to be increase in the VAT tax collection providing the government with higher than normal inflow of revenue from taxes. The increase in the VAT income for the government is going to happen regardless what is the origin of the goods purchased.

In the variable exchange rate regime the reverse is true. The households do not have access to the easy credit since they are faced with the exchange rate risk. The banks, in order to protect themselves from the exchange rate risk, will transfer the exchange rate risk to the households. The exchange rate risk serves as a deterrent towards easy credit for households and serves as a hard budget constraint for the households as well. With the choice of the variable exchange rate the central bank in essence forces the households to live within their means. Lack of easy credit under the variable exchange rate regime also has adverse effect of the government since the government cannot get extra VAT revenue from the credit induced consumer spending.

5.1.2. Banks

The interaction of banks and households is very important in both exchange rate regimes. As shown in the model the bank’s credit to households also has major impact on government revenue. In essence the choice of the exchange rate regimes imposes the distribution of bank’s loans portfolio. The choice of the exchange rate regime imposes a budget constraint on the households. If the central bank chooses the stable exchange rate regime the banks are going to face large demand for loans from households. If the central bank chooses variable exchange rate regime, the banks will not be faced with such a high demand for loans from households.

This imposition of the structure of demand for loans will, determine the loans structure for banks and naturally have significant impact on firms. The banks are going to pursue the profit maximizing strategy. If faced with high demand for loans from households the banks are going to lend more to the households and less for firms. Due to this profit maximizing strategy the households are going crowed-out the firms from the loan market! High demand for loans is
also going to increase the interest rates for households as well. This high demand will make banks extremely profitable under the stable exchange rate regime.

The lack of credit for firms will force firms to accept higher interest rates making their business more difficult or it will force companies to seek funding abroad thus increasing the foreign debt. Although bank’s strategy to lend to households in the short run is going to be very profitable, this high profitability is going to come into question when the “spending spree” is over.

The higher demand for funds by both the households and government is going to have a major impact on the foreign debt. If the economy does not have enough credit to meet the demand the banks are going to import funds from the rest of the world causing higher foreign debt. The increase in the foreign debt does not have to come only from banks, but it can come from the government and firms as well, since the government and firms have the ability to get funds directly from abroad without the intermediation of the local banks.

If the economy has stable exchange rate regime the loans to households will raise and will ultimately become the major part of the bank’s credit portfolio. This is going to create an economic paradox, instead of savings equal investments in the economy the economy with a stable exchange rate regime is going to have savings equal to credit.

The variable exchange rate regime imposes hard budget constraint on the households and effectively dampens the households demand for loans leaving the room for lending to firms. Higher lending to firms will decrease the interest rates and create easier business conditions for firms. Decrease in credit demand will also keep the spending down and there will be no artificial increase in aggregate demand due to increase in credit. Variable exchange rate regime combined with decrease in credit also keeps down the demand for imports, import of capital (foreign debt) and inflationary pressures.

5.1.3. Government

The choice of the exchange rate regime on government has similar effect as it does on the households. If the exchange rate regime is variable the government will essentially be cut off from the nonresident funding and will be forced to live within its own means; from the taxes collected and debt obtained from the domestic market. If the exchange rate regime is stable the government will have open access to the nonresident, foreign sources of funding. This access will give the government ability to have as large of a budgetary deficit as it wants for as long as the foreigners are willing to purchase debt.

With stable exchange rate regime there will be no hard budget constraint and increase in household’s consumption, through credit, will increase the household’s purchases of imported goods. The purchase of imported goods is going to have positive impact on the government’s tax revenues since it will increase the collection of the VAT tax. Under the stable exchange rate regime the government will be able to collect the VAT tax from the credit induced consumer spending. This can also be called credit induced VAT. The lending to households
and spending on credit will artificially inflate the income of the government, so once the lending naturally stops the government is going to have a large budget gap.

If the objective of the politicians is to get reelected then it is fairly obvious which exchange rate regime is more preferable for the politicians. The larger the budget the more there is possibility to structure the budget towards voting groups’ demands. Also stable exchange rate regime gives the government the possibility to get nonresident funding and use deficit for pleasing the electorate.

The soft budget constraint is more preferred by both the government and the households. It allows households to live higher standard of living though credit and it allows the government to have higher revenues because of the taxation of the imported goods, however in the long run the debts have to be repaid by both the households and the governments.

The variable exchange rate regime exogenously imposes a hard budget constraint and forces the government to rely only on domestic sources of income and debt financing. Because of changes in the exchange rate the government will be reluctant to borrow in foreign currency. Since stable exchange rate imposes hard budget constraint on the households the government will also not be able to collect extra revenue from increase in household’s credit. Both the government and the households have very similar behavior under the exchange rate regimes which is not surprising since they both have revenues and try to maximize objectives: household's consumption, government re-election.

5.1.4. Firms

The choice of the exchange rate regime has direct and indirect impact on firms through households demand and real exchange rate. Under stable exchange rate the demand from households is initially going to increase, this increase will be caused by higher lending activity. However the choice of stable exchange rate regime does not give the central bank ability to control the real exchange rate. If there is a real exchange rate appreciating, the consumption maximizing households are going to buy goods which maximize their consumption. If there is a domestically produced goods with a perfect foreign substitute and there is a real exchange rate appreciation, over time the households are going to substitute their consumption of domestic goods for foreign. This substitution is going to decrease the income of domestic firms and they are going to become less and less competitive. The real exchange rate appreciation has impact on the firms participating in the foreign markets as well. With the real exchange rate appreciation the firms are going to become less and less competitive in the foreign markets. The lack of competitiveness due to the real exchange rate appreciation will cause firms to go under.

The combination of high consumer demand and destruction of competitiveness through real exchange rate appreciation is going to cause restructuring within the economy. The manufacturing firms which are producing goods which have perfect foreign substitutes will eventually go out of business because of the real exchange rate appreciation. The real exchange rate appreciation is going to erode the firm’s ability to compete over time; in the long
run if the real exchange rate is appreciating the firms which are exporting and competing in the foreign market are going to lose their market. However as some firms are going to go under the others are born. In place of the manufacturing firms the new firms will rise. Those firms will be more oriented towards the services and imports. With higher aggregate demand from households it is reasonable to expect most of the new jobs created are going to be in the areas of trade and services, if the economy is under the stable exchange rate regime.

The variable exchange rate regime allows the central bank to use the nominal exchange rate in order to fight the real exchange rate appreciation. If there is no real exchange rate appreciation the above described cycle will be broken. If the variable exchange rate regime and real appreciation is prevented the firms are not going to come under pressure from the foreign competition, the firms are also going to be more competitive in the foreign markets.

What is most important to note is, if the real exchange rate appreciation is prevented then the deindustrialization of the economy can be prevented. When the deindustrialization of the economy is prevented, the economy has the ability to create more jobs and will have higher robustness towards crisis. However this "prevention" is monetary based and cannot stop the process of possible illegal privatization and corruption.

5.2. Interaction of economic participants and data

We are going to have two flow charts just to be able to better visualize the changes in the economy with the imposition of exchange rate regime. In Table (1) we see the stable exchange rate regime, participants in the economy and their behavior once the exchange rate regime is imposed.

Table 1: Stable exchange rate regime

<table>
<thead>
<tr>
<th>Overall economy</th>
<th>Households</th>
<th>Banks</th>
<th>Firms</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in foreign debt</td>
<td>Increase in debt relative to income</td>
<td>Increase in demand for capital</td>
<td>Increase in competitiveness</td>
<td>Increase in overall output</td>
</tr>
<tr>
<td>Increase in trade deficit and public debt</td>
<td>Increase in budget constraint</td>
<td>Increase in demand for capital</td>
<td>Increase in competitiveness</td>
<td>Increase in overall output</td>
</tr>
<tr>
<td>Real exchange appreciation</td>
<td>Increase in demand for capital</td>
<td>Increase in demand for capital</td>
<td>Increase in competitiveness</td>
<td>Increase in overall output</td>
</tr>
</tbody>
</table>

In Table (1) we see the stable exchange rate regime, participants in the economy and their behavior once the exchange rate regime is imposed.
Just like with the stable exchange rate regime we see different behavior with the variable exchange rate regime in Table (2).

Table 2: Variable exchange rate regime

<table>
<thead>
<tr>
<th>Overall economy</th>
<th>Households</th>
<th>Banks</th>
<th>Firms</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small and stable foreign debt</td>
<td>Stable debt constraint</td>
<td>Stable lending to households</td>
<td>Increase in production</td>
<td>Stable spending with small deficit</td>
</tr>
<tr>
<td>Controlled public spending</td>
<td>Increase of consumption only through increase in income; not credit</td>
<td>Increase of lending to firms</td>
<td>Increase of stable competitiveness because of no real exchange rate appreciation</td>
<td>No credit induced VAT income</td>
</tr>
<tr>
<td>Real exchange depreciation</td>
<td></td>
<td>No or small importation of capital</td>
<td>Abundance of domestic credit</td>
<td></td>
</tr>
</tbody>
</table>

What we have made perfectly clear in this review of the model is that there is a strong interaction between the economic participants. From the model and from this little overview it is clear that we cannot just look at one economic agent and analyze the behavior of that economic agent under alternate exchange rate regime, but a comprehensive understanding of the participant’s interaction is needed. Different exchange rate regimes will cause different behavior of economic agents and different data properties.

The way the interaction goes about and the path of economic impact and economic causality is determined by the choice of the exchange rate regime. In the model we have seen how the households might want more or less loans from the banks; we have seen how the firms might be given a boost in the foreign market if the economy does not go through the real exchange rate appreciation. The interaction is there, but it is pre-determined by the choice of the monetary exchange rate regime. The behavior of economic participants is going to be reflected in the data. We can see the main implications of each exchange rate regime in following points.

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65 One of the main points of the Rational expectations revolution was that the macro economic models need a micro economic foundation.
Stable exchange rate regime:

- Appreciation of the real exchange rate
- Removal of the exchange rate risk opens door for increase of household’s debt
- Banks alter the structure of their credit portfolio more towards lending to households. Lending to households crowds out firms and increases interest rates.
- Firms cannot compete with the foreign competition.
- Increase in the government revenue due to the increase in the collection of VAT tax from imports and household’s credit induced spending.

Variable exchange rate regime:

- Foreign exchange rate risk forces households and government to adhere to the hard budget constraint.
- Banks lend more to firms.
- No surge in household credit.
- Real exchange rate appreciation prevented and stopped.
- Firms are more competitive on both domestic and foreign market.

Before we move to the actual data analysis there are still two things we have to do. First we have to see which countries we are going to analyze and then we have to see what their exchange rate regime choices were.

5.2.1. Countries to be analyzed

In this part we are going identify which countries we are going to use for our analysis and in the next part we are going to determine the exchange rate regimes which the countries have been using. When we have discussed economic modeling in Part 2.2 the main problem apostrophized was how to use the economic data. One issue which arose very quickly was the use of econometrics in the model. It is clear we cannot simply run regressions and then interpret the coefficients in order to draw conclusions. The model we have set up is not suitable for that kind of analysis and we are not interested in quantification of coefficients, but in the behavior of economic participants. So how are we going to analyze the data? First we need to finds suitable candidates for the analysis. The countries analyzed have to have similar origins. Their starting points in analysis, economic history, economic goals, have to be as close as possible. The countries have to have similar noneconomic characteristics: size, education of population, history. Due to this we have to pick from a pool of ex-socialistic countries. These countries had planned economies and then have undergone process of
economic transition from central planned economies to free market economies\textsuperscript{66}. Their economic goals are also the same. In this particular case we are going to assume that the economic goals are joining the EU and EMU.

These characteristics are shared by many ex-socialistic countries; however there is an issue of size and economic goals. For example Ukraine and Belarus maybe one day members of the EU and EMU, but they are currently not making any significant progress. Poland for example is too large in terms of economic size to be compared with a country like Slovenia of Croatia. Macedonia is a very suitable candidate but the problem with Macedonia is that the political strife over its name has made so much impact on its economic status that it would not be fair to state Slovenia and Macedonia have had same economic opportunities over the last two decades, also the proximity of Kosovo has significantly hindered Macedonia’s economic development. Even Croatia could be excluded from this analysis due to the war. But since all war operations were over by 1995 and the complete territorial integration was achieved by 1998 Croatia is included in our analysis.

Another important point in analysis will be the crisis which started in 2008. The crisis was fully felt in 2009 when most countries which we will analyze have experienced an economic downturn. The crisis of 2008 will also be an appropriate test how different exchange rate regimes have reacted to the economic crisis and what were the results.

The following countries were chosen:

- Bulgaria,
- Czech Republic,
- Croatia,
- Latvia,
- Lithuania,
- Estonia,
- Hungary,
- Rumania,
- Slovenia,
- Slovakia.

\textsuperscript{66} The difference was Yugoslavia which had worker’s self-management and not strict central planning. Ribnikar (1994).
Table 3: Countries used in our analysis


For some of these countries like Estonia, Slovenia and Slovakia the transition process is over. They are now part of the EU, EMU and NATO. These countries have ended the period of transformation from planned economies into free market economies; they have fully integrated themselves into the western economies and have become free market economies. Out of all the countries in our analysis Croatia is farthest away from the completion of the transition process since it is still not the member of the EU but the expected membership has a fixed date.

From the data we can see that most of the countries are similar in size, except for Romania which is an outlier, most other countries are between 50,000 and 100,000 square kilometers in size. The population is also close with outliers Estonia 1.3 million and Romania with 21.6 million. Economic data is also similar, although the GDP data is extremely different due to the sizes of the economy, the GDP per capital and GDP PPP per capital shows some similarities. It is important to contrast the data before the crisis (last year 2008) and period after the start of the crisis 2009, 2010, and 2011 as the last data point.

In 2008 Bulgaria had the smallest GDP per capita with EUR 4,949 and Slovenia has the highest GDP per capita with EUR 19,597 which is cca. four times higher. However once we look at the GDP PPP per capita the differences becomes much smaller. Bulgaria again has the smallest GDP PPP per capita with EUR 8,908, and Slovenia has the largest with EUR 21,273; including the PPP the difference is 2.38 times which is almost half less than if we were just using the nominal GDP per capita.
In 2011 the situation has not changed. Bulgaria still has the smallest GDP per capita of EUR 5,522 and Slovenia still the highest with EUR 19,023. The difference now is 3.44 times since Slovenian GDP per capita decreased because of the crisis. When we look at the GDP PPP per capita, now the smallest GDP PPP per capita is no longer Bulgaria, but Romania with EUR 9,683 and the largest is still Slovenia with EUR 22,208; so in spite of the crisis Slovenian GDP PPP per capita has actually increased during the crisis. The impact of crisis is clearly pronounced since Hungary, Latvia, Slovenia have a decrease in the nominal GDP per capita and Croatian is almost unchanged. Another impact of the crisis is the increase in unemployment rate in all countries.

Although the data presented is different and each country has its peculiarities, we can say that we have a relatively cohesive group. One more thing which is very important is that all countries have had similar past since they were all under some form of socialism of communism.

In our analysis after we have determined the exchange rate regime we are going to see what the data development for each country was. What we are most interested are two cases.

- **Case one**: a country has had an exchange rate regime switch. One of the fundamentals observatories which we are interested in is: was there a change in the behavior of economic data before and after the regime switch.
- **Case two**: behavior of data between countries with different and with the same exchange rate regime. We are also going to be analyzing the behavior of variables by comparing them in countries with different exchange rate regimes.

The analysis is going to be intergroup and intragroup. We are going to analyze the behavior of economic variables in one country, but with different exchange rate regimes and we are going to analyze the behavior of economic variables in several countries, but with different exchange rate regimes.

The quantitative techniques used in this part are going to be focused on determining the changes in the patterns of the data. As we have stated running a regression on the data and then comparing the coefficients in of no interest to us, but running a regression on two time periods with different exchange rate regime within the same country is of interest to us. We are interested in determining does the change in the exchange rate regime change the coefficients in the regression. We postulated: changes in exchange rate regime cause changes in economic choices; consequently changes in economic choices have to change the data and regression coefficients.

The data we are going to analyze is going to be the following variables:

- Loans to households
- Real exchange rate
- Inflation
- Consumption
• Fixed capital creation
• Imports
• Exports
• Income structure of GDP
• Economic growth
• Foreign debt
• Employment structure

Each of these variables will be compared between the countries with different exchange rate regimes and before and after the exchange rate regime change in countries where this is possible.

5.3. The choice of monetary policy in the analyzed countries

Before the analysis of the data we need to determine the exchange rate regimes based on the definitions we have provided in part 5.1. The data is not complete for some countries for all periods starting from 1990. The Croatian data starts in 1994, because of hyper inflation in the period 1990 – 1994 and at that time the currency unit in the Croatia was Croatian dinar, and not Croatia Kuna, similar problems are in other countries. The data is complete for all countries from 1994 with exception of Romania and Bulgaria with the data from 1995 and 1996 respectively. This pattern of missing data is similar for other variables as well. However the data period of 16 years if sufficient enough, because in quarterly units we have more than 60 observations and in monthly units we have more than 180 observations which is terms of the quantity of the data is more than enough to run regression needed to determine the exchange rate regime.

We see from Table (4) that for some countries the determination of the exchange rate regime is very simple. Using just visual approach we can see that: Bulgaria, Estonia, had fixed exchange rate regimes because the value of the currency does not change. The exchange rate in Bulgaria is fixed from 1998 until 2011 and in Estonia from 1999 until 2011. Even before the exchange rate was fixed in those countries the exchange rate changes were very small.

Next group of countries for the exchange rate determination are: Latvia, Croatia, and Hungary, in these three countries the exchange rate exhibits small volatility.

In Latvia the value of the Lats at the end of 1993 was 0.6 for 1 Euro and at the end of 2008 it was 0.71 for 1 Euro and at this value has remained for the rest of the time period. The low value was 0.56 and the high value was 0.71, mean for the series in the time period was 0.69 for 1 Euro. So the low point is 0.1 away from the mean and the high point is 0.05 away from the mean or in terms of percentages cca. 15% and cca 8%. So although the changes are small there is some volatility in the exchange rate. What is puzzling is the time of the changes. From 1993 to end of 1998 the exchange rate does not change at all, at the end of 1993 Lats is 0.67 and at the end of 1998 Lats is 0.66. Then in 1999 there is a sharp appreciation to 0.59; then
there is exchange rate stability up to 2001 and then from 2001 until the end of 2008 there is a depreciation since the Lats moves from 0.56 in 2001 to 0.71 at the end of 2008, almost a 30% depreciation. Further econometrics tests will be applied in order to determine the exchange rate regime in Latvia.

Table 4. Exchange Rate Changes in Analyzed Countries

<table>
<thead>
<tr>
<th>Year</th>
<th>New Bulgarian Lev</th>
<th>Croatian kuna</th>
<th>Czech Krona</th>
<th>Estonian Kroon</th>
<th>Hungarian forint</th>
<th>Latvian Lats</th>
<th>Lithuanian Litas</th>
<th>New Romanian leu</th>
<th>Slovak Koruna</th>
<th>Slovenian Tolar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td></td>
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<td>1992</td>
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<tr>
<td>1993</td>
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<td>1995</td>
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</tr>
<tr>
<td>1996</td>
<td>0.61</td>
<td>6.94</td>
<td>34.25</td>
<td>15.64</td>
<td>101.66</td>
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<td>11.35</td>
<td>3.50</td>
<td>30.34</td>
<td>177.26</td>
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<tr>
<td>1997</td>
<td>1.98</td>
<td>6.98</td>
<td>38.69</td>
<td>15.46</td>
<td>224.71</td>
<td>0.66</td>
<td>4.26</td>
<td>37.04</td>
<td>166.78</td>
<td>186.81</td>
</tr>
<tr>
<td>1998</td>
<td>1.96</td>
<td>7.29</td>
<td>35.19</td>
<td>15.62</td>
<td>252.39</td>
<td>0.66</td>
<td>4.87</td>
<td>37.48</td>
<td>166.58</td>
<td>188.81</td>
</tr>
<tr>
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<td>1.96</td>
<td>7.08</td>
<td>38.10</td>
<td>15.65</td>
<td>254.70</td>
<td>0.59</td>
<td>4.02</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2000</td>
<td>1.95</td>
<td>7.08</td>
<td>35.05</td>
<td>15.65</td>
<td>254.70</td>
<td>0.59</td>
<td>3.72</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2001</td>
<td>1.95</td>
<td>7.37</td>
<td>31.96</td>
<td>15.65</td>
<td>245.18</td>
<td>0.56</td>
<td>3.52</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2002</td>
<td>1.95</td>
<td>7.48</td>
<td>31.58</td>
<td>15.65</td>
<td>236.29</td>
<td>0.61</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2003</td>
<td>1.95</td>
<td>7.65</td>
<td>32.41</td>
<td>15.65</td>
<td>262.50</td>
<td>0.67</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2004</td>
<td>1.96</td>
<td>7.67</td>
<td>30.46</td>
<td>15.65</td>
<td>245.92</td>
<td>0.70</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2005</td>
<td>1.96</td>
<td>7.37</td>
<td>29.00</td>
<td>15.65</td>
<td>252.87</td>
<td>0.70</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2006</td>
<td>1.96</td>
<td>7.35</td>
<td>27.47</td>
<td>15.65</td>
<td>251.77</td>
<td>0.70</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2007</td>
<td>1.96</td>
<td>7.33</td>
<td>26.63</td>
<td>15.65</td>
<td>253.73</td>
<td>0.70</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2008</td>
<td>1.96</td>
<td>7.32</td>
<td>26.88</td>
<td>15.65</td>
<td>266.70</td>
<td>0.71</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2009</td>
<td>1.96</td>
<td>7.31</td>
<td>26.47</td>
<td>15.65</td>
<td>270.42</td>
<td>0.71</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2010</td>
<td>1.96</td>
<td>7.39</td>
<td>25.06</td>
<td>15.65</td>
<td>277.95</td>
<td>0.71</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
<tr>
<td>2011</td>
<td>1.96</td>
<td>7.53</td>
<td>25.80</td>
<td>1.00</td>
<td>311.13</td>
<td>0.70</td>
<td>3.45</td>
<td>37.18</td>
<td>166.21</td>
<td>171.54</td>
</tr>
</tbody>
</table>

Sources: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home, Statistical institutes of individual countries, central banks of individual countries

We have very similar stories in Hungary and Croatia. In Hungary from 1990 until 2000 we have a variable exchange rate regime. This can clearly be seen from the data. The forint moves from 83.77 for 1 Euro to 265.00 for 1 Euro at the end of 2000. The exchange rate depreciates by 216%. This is clearly a variable exchange rate regime. This can be seen from the data provided on Central bank of Hungary web site presented in Table (5) which shows when the depreciation has occurred and by which rates and in which time periods as determined by the central bank. Here we see the central bank is using a “jump” approach to the control of the exchange rate. The exchange rate is fixed for a time period and then the exchange rate jumps because the central bank has decided to depreciate the currency. From the Table (5) we can see the “jumps” are stochastic both in the size and in the time from one jump to the other. Then from 1995 there were daily devaluations of HUF.

It is clear now why we have paid so much attention to the definition of the exchange rate regime. If we look at the Hungarian changes in the exchange rate the exchange rate regime in time period from 1990 to 1995 is fixed, hard peg. However from time to time the central bank changes the exchange rate and devalues the exchange rate by certain percentage. So the exchange rate jumps, but after the jump the exchange rate is fixed again. What we are seeing in the actual conduct of the monetary policy is that the central bank is actively using the
exchange rate and adjusts the value of the exchange rate as needed, this is why we have labeled this exchange rate regime variable. As it can be seen from the Table (6), from 2000 the Hungary has the stable exchange rate regime with clearly stated upper and lower edges of the exchange rate bands. The exchange rate bands do change, the exchange rate fluctuates, but the exchange rate itself does not have any direction.

Table 5: Depreciation Rates for Hungarian Forint

<table>
<thead>
<tr>
<th>Date</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 January 1990</td>
<td>1.0%</td>
</tr>
<tr>
<td>6 February 1990</td>
<td>2.0%</td>
</tr>
<tr>
<td>20 February 1990</td>
<td>2.0%</td>
</tr>
<tr>
<td>7 January 1991</td>
<td>15.0%</td>
</tr>
<tr>
<td>8 November 1991</td>
<td>5.8%</td>
</tr>
<tr>
<td>16 March 1992</td>
<td>1.9%</td>
</tr>
<tr>
<td>24 June 1992</td>
<td>1.6%</td>
</tr>
<tr>
<td>9 November 1992</td>
<td>1.9%</td>
</tr>
<tr>
<td>12 February 1993</td>
<td>1.9%</td>
</tr>
<tr>
<td>26 March 1993</td>
<td>1.9%</td>
</tr>
<tr>
<td>7 June 1993</td>
<td>1.9%</td>
</tr>
<tr>
<td>9 July 1993</td>
<td>3.0%</td>
</tr>
<tr>
<td>29 September 1993</td>
<td>4.5%</td>
</tr>
<tr>
<td>3 January 1994</td>
<td>1.0%</td>
</tr>
<tr>
<td>16 February 1994</td>
<td>2.6%</td>
</tr>
<tr>
<td>13 May 1994</td>
<td>1.0%</td>
</tr>
<tr>
<td>10 June 1994</td>
<td>1.2%</td>
</tr>
<tr>
<td>5 August 1994</td>
<td>0.0%</td>
</tr>
<tr>
<td>11 October 1994</td>
<td>1.1%</td>
</tr>
<tr>
<td>29 November 1994</td>
<td>1.0%</td>
</tr>
<tr>
<td>3 January 1995</td>
<td>1.4%</td>
</tr>
<tr>
<td>14 February 1995</td>
<td>2.0%</td>
</tr>
<tr>
<td>13 March 1995</td>
<td>9.0%</td>
</tr>
<tr>
<td>16 March 1995–</td>
<td>1.9%  (rate of daily devaluation: 0.060%)</td>
</tr>
<tr>
<td>29 June 1995–</td>
<td>1.3%  (rate of daily devaluation: 0.042%)</td>
</tr>
<tr>
<td>2 January 1996–</td>
<td>1.2%  (rate of daily devaluation: 0.040%)</td>
</tr>
<tr>
<td>1 January 1997–</td>
<td>1.2%  (rate of daily devaluation: 0.040%)</td>
</tr>
<tr>
<td>1 April 1997–</td>
<td>1.1%  (rate of daily devaluation: 0.036%)</td>
</tr>
<tr>
<td>15 August 1997–</td>
<td>1.0%  (rate of daily devaluation: 0.033%)</td>
</tr>
<tr>
<td>1 January 1998–</td>
<td>0.9%  (rate of daily devaluation: 0.030%)</td>
</tr>
<tr>
<td>15 June 1998–</td>
<td>0.8%  (rate of daily devaluation: 0.026%)</td>
</tr>
<tr>
<td>1 October 1998–</td>
<td>0.7%  (rate of daily devaluation: 0.023%)</td>
</tr>
<tr>
<td>1 January 1999–</td>
<td>0.6%  (rate of daily devaluation: 0.020%)</td>
</tr>
<tr>
<td>1 July 1999–</td>
<td>0.5%  (rate of daily devaluation: 0.0163%)</td>
</tr>
<tr>
<td>1 October 1999–</td>
<td>0.4%  (rate of daily devaluation: 0.0133%)</td>
</tr>
<tr>
<td>1 April 2000–</td>
<td>0.3%  (rate of daily devaluation: 0.0098%)</td>
</tr>
<tr>
<td>1 April 2001–</td>
<td>0.2%  (rate of daily devaluation: 0.00654%)</td>
</tr>
<tr>
<td>1 October 2001–</td>
<td>No devaluation</td>
</tr>
</tbody>
</table>

4 June 2003– Shift of the central parity of the forint by 2.26%, with the currency’s ±15% intervention band remaining unchanged

Source: Central bank of Hungary www.english.mnb.hu
From the definitions we have set up and without any further econometric evidence we can conclude the Hungary had three exchange rate regimes: variable, stable, variable. Hungary had from 1993 to 2000 variable exchange rate regime and from 2000 until end of 2008 stable exchange rate regime. At the end of 2008 Hungary abandoned the stable exchange rate regime and moved to the variable exchange rate regime. This change in the exchange rate regime was not done because of smart changes in the economic policies, but because of the onslaught of the economic crisis. In time period 2008 – 2011 exchange rate depreciated by 16,6% and at the end of each year the exchange rate was higher than the previous year so there is a clear trend in the data which qualifies as the variable exchange rate regime.

### Table 6: Exchange Rate Band for Hungarian Forint

<table>
<thead>
<tr>
<th>Month</th>
<th>Upper limit</th>
<th>Lower limit</th>
<th>Central parity</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2009</td>
<td>295.12</td>
<td>255.31</td>
<td>280.72</td>
<td>Central bank of Hungary</td>
</tr>
<tr>
<td>February</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
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</tr>
<tr>
<td>December</td>
<td>280.72</td>
<td>255.31</td>
<td>280.72</td>
<td></td>
</tr>
</tbody>
</table>

Source: Central bank of Hungary www.english.mnb.hu
Croatia had a similar path of the exchange rate changes. At the end of 1994 the value of 1 Euro was 6.96 Kuna, however at the end of 1999 the value of 1 Euro is 7.68 for 1 Kuna, in terms of percentages this is 10% depreciation. In 2001 the exchange rate appreciated. In time period from 2001 – 2008 the exchange rate is around 7.35 level. There was a small 3% depreciation from end of 2008 to end of 2011. This depreciation is not sufficient to qualify as variable exchange rate and it can also be interpreted as part of the crisis and not a change in the monetary policy. Changes in exchange rate of Kuna might indicate two regimes; however the regimes are not as obvious as in Hungary and are ambiguous as in Latvia. So in case of Croatia and Latvia we will need further econometric testing.

We are now going to look at Slovakia and Slovenia. Here the exchange rate regimes are more than clear. Both countries have had variable exchange rate regime and then they have moved to the fixed rate regime because both countries were preparing for EMU. Slovenia joined the EMU at the beginning of 2008, hence there is 1 in the exchange rate value for 2008 and Slovakia joined the EMU at the beginning of the 2009. Slovenia clearly had the variable exchange rate regime before deciding to join EMU. The value of Tollar for 1 Euro was 76.2 at the end of 1990 and 239 when the parity was established. This is a depreciation of 210% in the time period of 12 years. Slovakia had the similar exchange rate regime. The Krona at the end of 1993 is 37.4 for 1 Euro and in 2000 it is 43.93 for 1 Euro, that is a depreciation of 18%. Then Krona sharply depreciates down to 30.13 where the parity is established until Slovakia joined the EMU.

Next we look at Czech Republic and Lithuania these two counties had exchange rate regime which were not predicted by the model. Czech Krona starts in 1993 with the value of 33.42 for 1 Euro, then until 1997 the Krona depreciates to 38.03 13.7% depreciation, however after that it is a downhill pattern in the next 11 years. By the end of 2008 Krona is at 26.88 for 1 Euro, a 29.31% appreciation. This appreciation continues during the crisis and in the period of 2008 – 2011 Krona appreciates even more, from 26.88 down to 25.88 or another 4% for total appreciation from 1994 in amount of 8.7 kronas or 25.21%. Lithuania follows a similar pattern as Czech Republic. Litas starts at 4.35 for 1 Euro at the end of 1993, depreciates to 5.26 by the end of 1995, which is 21% depreciation in two years, but after that, just like in Czech Republic it is all the way down for the Litas. The appreciation stops in 2002 when the exchange rate gets fixed at 3.45 Litas for 1 Euro and keeps this value for the rest of the period.

What we have in Lithuania and Czech Republic was not analyzed by the model. The model stated there are two exchange rate regimes, stable and variable. However it was implied that under the variable exchange rate regime the central bank deprecieres the currency. Policy where the central bank actually appreciates the currency was never considered. It was understood the currency appreciation would hurt the real exchange rate, hurt the exports and foster imports. The nominal currency appreciation would have more negative effects than the stable exchange rate. The model does not assume the policy makers would deliberately hurt the economy with the nominal appreciation. But what was neglected by the model was shown as a real policy in the data.

There are several ways to treat this occurrence. We can exclude the countries from the analysis, we can treat them as an outlier for the model, or we can put them into one of the groups of the regimes as we have defined. We are going to keep these two countries for our
analysis and we will not exclude them. The countries are going to be put into the stable exchange rate group. However when it comes to the actual data we are going to treat them separately to see into which category does the data puts them. We can call these two countries a control group.

As for Romania, it has a variable exchange rate regime for the whole period; however we do see some changes in the trend. From 1995 to 2003 we see clear exchange rate depreciation. Then from 2003 to 2006 there is a period of appreciation, but then in 2006, before the economic crisis the exchange rate continues to depreciate and in 2011 it is higher than 2003. So in spite of this brief period of appreciation there is a trend in the value of the exchange rate and we will put Romania into variable exchange rate for the whole period.

We now have to return to the exchange rate in Latvia and Croatia. We need to determine was there an exchange rate regime switch in those countries. To do this we are going to use econometrics. The econometric test we are going to run in order to determine was there a regime switch is the Chow test. The basic premise of the Chow test (Chow 1960) is to investigate was there a structural break in the data, something which has altered the economic pattern of the data creation. Chow test does not have the ability to tell us what is the reason there was a structural break in the data. This suits just fine, since we are assuming the reason for the structural break in the data was the change in the exchange rate regime in the country.

The mechanisms of the Chow test are rather simple. The actual test is done in the following way. The independent variable and independent variables are determined then a regression is run using the whole data set. Then the data set is split into two parts, before and after the suspected structural break. Then again two regressions are run; one using the data before the structural break and one regression is ran using the data after the structural break. Then the F-test is performed using the sum of squares from all three regressions.

Let us assume we have a regression with two independent variables and n+m=t time periods. We are going to assume that n is the time before the structural break and m is the time after the structural break. The n and m do not have to be the same. The regression using the t time periods is going to be

\[ y = \alpha + \beta_1 x + \beta_2 z \]  \hspace{1cm} (5.1)

We are going to run two more regressions which are going to be:

\[ y = \alpha^n + \beta_1^n x_1 + \beta_2^n z_1 \]  \hspace{1cm} (5.2)

\[ y = \alpha^m + \beta_1^m x_2 + \beta_2^m z_2 \]  \hspace{1cm} (5.3)
Superscripts indicate coefficients obtained using time periods. The null hypothesis for the chow test is:

$$\alpha^n = \alpha^m; \beta_1 = \beta_1^n; \beta_2 = \beta_2^m \tag{5.4}$$

In order to test this hypothesis the following F-test is performed

$$F \sim \frac{S - S_1 - S_2}{\frac{k}{S_1 + S_2}} \frac{N + M - 2k}{k} \tag{5.5}$$

Where $S$ is the sum of squares residual from each of the three regressions, $n$ and $m$ and the numbers of observation and the $k$ is the degrees of freedom. Using the appropriate $F$ distribution table the null hypothesis is tested and either accepted or rejected.

We are trying to determine was there a structural break in the exchange rate regime. In case of Croatia and Latvia we are going to use the ARMA regression. Using the monthly time series for the exchange rate we are going to have the following regression:

$$EX = \alpha + \beta_1 EX_{t-1} + \beta_2 EXMA_{t12} \tag{5.6}$$

Where the $EX$ is the exchange rate and the $EXMA_{t12}$ is the 12 month moving average of the exchange rate. The two time periods we are going to split the data into are going to be 1994 – 2000 and 2001-2008 for Croatia, for Latvia the first time period is going to be 1993-1999 and the second time period is going to be 2000-2008. The data after 2008 will not be used because in case of Latvia it is the same and in case of Croatia there was a slight depreciation which cannot be attributed to the actual change in the monetary policy. For Latvia the $F$ test is

$$F \sim \frac{0.029112 - 0.0196020 - 0.0059}{0.0196020 + 0.0059} \frac{0.001203}{0.000137} = 8.77 \tag{5.7}$$

The $F$ value we are going to base on the $F$ distribution with $k$ and $t-2k$. In our case that is 3 and 186. P value we have obtained is 0 to the 4th decimal clearly indicating that there was a structural break. Because of the results of the econometric test Latvia goes into the group of
countries with the exchange rate regime switch. So for Latvia there was first a variable exchange rate regime and then the stable exchange rate regime. The econometric test did show a regime switch, but we should note from 2004 the exchange rate of Lats has been very closely to 0,7 level for 1 Euro, indicating that there might have been a reversal back to the stable exchange rate regime.

If we look at the Graph (19) we can see that up to 1993 there is strong volatility in the exchange rate, after that there is stabilization of the exchange rate. Then the variable exchange rate regime starts with an appreciation of the exchange rate, then until 2004 there is exchange rate depreciation. However after the 2004 the exchange rate is stable, at least that is how it appears to be on the graph. In this example it becomes very clear why I am so reluctant to use econometrics. The econometrics are telling us there were two exchange rate regimes, but by looking at the data we can possibly see three: stable, variable then again stable. This is similar what we can see in the data for Romania. For now we are going to assume three exchange rate regimes: stable (with appreciation), variable and then again stable. However the true effect of the exchange rate regimes will be given in the data properties.

**Graph 19. Latvian Lats**

![Graph 19. Latvian Lats](source)

We are now going to perform the same calculation for Croatia, with the same regression setup, but in designated time periods. The calculation is now as follows:

\[
F \sim \frac{3}{0.215618 + 0.593208} - \frac{0.850245 - 0.215618 - 0.593208}{0.013807} = 2.69
\]  

\[(6.8)\]
Using the F distribution table for k=3 and 158 we get that the p value is 4.8%, which is just below a 5% significance level. In this particular case we are going to reject the null hypothesis and state that in Croatia there was also a regime switch, however the level of confidence is not as strong as in Latvia. Now we can go over the countries and their regimes as shown in the table below.

### Table 7. Regime Distribution per Country

<table>
<thead>
<tr>
<th>Year</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Slovenia</th>
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</table>

Sources: Author’s definition

The Table (7) presents us with the exchange rate regimes in each country. We have a colorful mixture of economies. We have economies with one exchange rate regime in the whole time period; we also have five economies which have changed their exchange rate regimes. Three have moved from variable to stable (Croatia, Slovakia, Slovenia), albeit for different reasons, while Latvia has moved from variable to stable exchange rate regime. Hungary moved from variable to stable and then back to variable.

### 5.4. Economic growth

The objective of most economic policies is to increase the living standard in the economy. This is measured by the real growth of the economy or by real growth of GDP per capita. Economic policies should be designed to promote economic stability and improve the living standards of its people. One such policy is the choice of the exchange rate regime. Because of this we are going to start our data analysis with the growth rates of our countries. The data used is from Eurostat, yearly change, constant prices previous year:
Table 8: Economic Growth per Country

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<td>4.3%</td>
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<td>8.3%</td>
<td>8.9%</td>
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</tbody>
</table>

Sources: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home, Statistical institutes of individual countries,

Table 9. Economic Growth Per period

<table>
<thead>
<tr>
<th>GDP real growth with index 100</th>
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</thead>
<tbody>
<tr>
<td>Bulgaria</td>
</tr>
<tr>
<td>1994</td>
</tr>
<tr>
<td>2009</td>
</tr>
<tr>
<td>2011</td>
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</tbody>
</table>

Sources: Author's calculation based on statistical data

First we will look at the growth rates before 2009, before the crisis. Here the data does not give a clear conclusion. Smallest accumulated growth is in Bulgaria stable exchange rate regime for the whole period. Largest economic growth is in Latvia and Hungary which both had regime switches. It is interesting to note that in both countries in the year of regime switch from stable to variable the GDP growth rate went negative. We cannot conclude, from the perspective of economic growth there is a regime preference.

The crisis period 2009 – 2011 is negative for all countries except Slovakia and somewhat Czech Republic since the index in Czech is almost unchanged. All other countries have had significant decreases, the largest being in Hungary. Looking at the whole period 1994 – 2011 the winners are: Slovakia, Estonia, Latvia, and Hungary.

What can we conclude from the data?

- Regime change in the middle of recession is negative since largest drop is in Hungary.
Economic growth can be achieved under both regimes and there is no clear distinction between the regimes. Smallest growth in Bulgaria, largest in Estonia, both under stable exchange rate regime.

Mixed regimes which move from variable to stable seem to produce the most growth and the most robust economies. Examples are Slovakia and Slovenia but they did not have stable exchange rate regimes, but moved into EMU which is different from the stable exchange rate regime which Hungary had before crisis.

Let us answer two questions which pertain to the hypothesis:

1. Does the exchange rate regime or a regime switch change the pattern of growth or induces growth? NO
2. What is the impact of this data on the “correctness” of the model? We need to look deeper into the details of the data.

The answer to the second question is very vague; but let us goes back to the model. The model does not imply that any exchange rate regime leads to higher growth, what model does imply is that under alternative regimes the source of growth is going to be different. Under the stable exchange rate regime the model implies the main source of growth is the increased consumption fuelled by the loans to the retail, however under the variable exchange rate the increase growth in fuelled by investments. Different sources of growth do not necessary mean different growth rates in the short run. In order to validate this claim we have to dig deeper into the data. Also policies which are beneficial for the economy in the long run might not have such positive impact in the short run: Basu Fernald and Kimball (2006) show that technological improvements might cause contraction in the short run, but are exceptionally positive for growth in the long run. This implies that if the economy decreases consumption, increases investments and improves the technological skills of the labor in the short run the economy can have smaller economic growth since the return on investments are not enough to offset the decrease in the consumption. Since the process of transition is complex and requires technological improvements it is possible we are seeing this kind of contraction in our economies as well.

The source of growth is probably the most important economic element in the long run since growth based on debt financed consumption is not sustainable. The economic implications of growth are enormous. Economic growth from investments and economic growth from consumption cannot be treated the same way, although in the data presented in the table above makes the sources of growth indistinguishable.

The relationship between economic growth and exchange rate regimes is weak and that is not surprising since exchange rate regime is a monetary variable and economic growth is real economic variable. The model does not necessarily imply the variable economic exchange rate regime leads to larger growth rates, but what is does imply is that it leads to more robust sources of growth and this still has to be investigated.
Right now the main conclusion is that the choice in the exchange rate regime or the switch in the exchange rate regime does not impact the growth rates of the economy, except if the economy is in recession like in case of Hungary. In latter parts of this chapter we will have to see does the choice of the exchange rate regime impact the sources of growth.

5.5. Real exchange rate

Next piece of data we will look at will be the real exchange rate (equation 4.21). We are going to compare the model with the data and then, based on the model, predict changes in other variables. The exchange rate is very simply set up as an index:

\[
\Lambda_t = \Lambda_{t-1} \left\{ 1 + e^{ex}_t - e^{im}_t + \left( \frac{E_{t-1} - E_t}{E_{t-1}} \right) \right\}
\]

\(\Lambda\) – value of index with initial value of 100.

\(e^{ex}\) - price change in country (percentage change or inflation) plus exchange rate appreciation minus the exchange rate depreciation in the period in percentages.

\(e^{im}\) - world inflation, in this case inflation in EU, in percentages.

\(E\) – nominal exchange rate

The index is designed so that real exchange rate appreciation means increase in the value of index and the real exchange rate depreciation means decrease in index. Two scenarios lead to real exchange rate depreciation: smaller inflation then in EU and nominal depreciation. However the two can offset each other as well. For effect of the real exchange rate investigated using similar approach see Flere (2004)

Euro stat does have a real exchange rate index with major trading partners however this index is based on real economic variables which are trading partners and can create possible distortions. For example a small open economy trades with only two economies: imports from one and exports to the other. In case the real exchange rate is constantly depreciation versus the economy where the small open economy is exporting and constantly appreciating versus the economy there small open economy is importing we will have that real exchange rate index is unchanged and it is no related with imports and exports and that is clearly not the case. This is the reason I have taken into consideration only EU and exchange rate vs. EU.

In Table (10) we have my calculations of the real exchange rate. However in order to be scientifically accurate I will present the Eurostat index as well presented in Table (11).
### Table 10: The Real Exchange Rate and Exchange Rate Regime Changes

<table>
<thead>
<tr>
<th>Year</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
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<td>204.3</td>
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Sources: Author’s calculation based on statistical data

### Table 11: The Real Exchange from Eurostat based on 41 trading partners

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<th>Hungary</th>
<th>Latvia</th>
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<td>2010</td>
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<td>124.9</td>
<td>142.4</td>
<td>190.3</td>
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</tr>
</tbody>
</table>

Sources: Eurostat

As it can be seen from the data both indices have similar directions and magnitudes, but the values are different because of different methodologies and starting points. For the purpose of the dissertation we are going to focus on the author’s index.
None of the countries were able to stop the real exchange rate appreciation regardless of the exchange rate regime choice. The degree of real exchange rate appreciation has varied from one country to the other.

The real appreciation is largest in the countries with the stable exchange rate regime since the largest appreciation is in Bulgaria and Lithuania. Romania was left out since there was a period of hyperinflation 1997 – 2001, after that period the real exchange rate depreciated. Because of this inflationary peculiarity Romania is not the best case to analyze since the inflationary conditions were not stable.

Exchange rate regime switches also lead to changes in the behavior of the real exchange rate. Switch from variable to stable immediately appreciates the real exchange rate. This is obvious in Croatia, Hungary, Latvia, Slovakia, and Slovenia.

Economies with the variable exchange rate regime have the ability to fight off the real appreciation, but not to stop it completely. Variables exchange rate in Slovakia and Slovenia were particularly effective since from 1997 – 2001 real appreciation in Slovakia is 13,1 points of index and in Slovenia in the period from 1996 – 2002 the index increased 11,2 points. Change in the regime immediately caused real exchange rate appreciation. After the exchange rate regime change from stable to variable we have the following changes

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Index change</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Croatia</td>
<td>2000 - 2011</td>
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<td>Hungary</td>
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<td>42.7</td>
<td>34.38%</td>
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<td>Latvia</td>
<td>2003 - 2011</td>
<td>36.7</td>
<td>29.75%</td>
</tr>
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<td>Slovakia</td>
<td>2001 - 2011</td>
<td>53.8</td>
<td>43.38%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>2002 - 2011</td>
<td>14.6</td>
<td>13.12%</td>
</tr>
</tbody>
</table>

Sources: Author's calculation based on statistical data

We see that changes from variable to stable exchange rate regime leads to strong real appreciation. Reverse also holds since after the switch from stable to variable exchange rate regime Hungary had 21,5 points (13%) real depreciation and same is true in Latvia. From 2000 – 2005 Latvia had 16,9 index points decrease (12%).

The above analysis has powerful implications and it serves as a contrast to the initial analysis. If we look at the whole period we see that all countries have had real exchange rate appreciation; however when we look intra countries and see the implications of exchange rate regime switches we come to the two following conclusions:

- Regime switch from variable to stable leads to strong real appreciation
- Regime switch from stable to variable can lead to real depreciation
The above conclusions are not surprising. Through the dissertation it was stated the variable exchange rate has more maneuverability and it gives the central bank more power over the control of the real exchange rate, the data tells us the variable exchange rate cannot prevent the real exchange rate appreciation, but it can slow it down or stall it. What the data also tells us is the importance of the regime switch. We see in Slovakia and Slovenia that variable exchange rate regime does not lead to real exchange rate depreciation, but a regime switch from stable to variable does lead to real exchange rate depreciation, just like a switch from variable to stable lead to real exchange rate appreciation.

Regarding the model and the data we have to conclude the real depreciation can be achieved with a regime switch from stable to variable exchange rate regime. The variable exchange rate regime by itself can keep real exchange rate appreciation at bay, but it cannot completely offset it. Under the variable exchange rate the real appreciation was less than under the stable exchange rate. So the model is partially correct. The real appreciation cannot be stopped, but the adverse effects of the real appreciation can be partially offset by the variable exchange rate regime and the effects can be annulled. We have to keep in mind the real appreciation might not be impossible to offset using the strategy of the variable exchange rate. **The data is telling us the real appreciation has occurred but the rate of the real appreciation was smaller for countries with the variable exchange rate regime. The model and the data both show variable exchange rate gives the central bank a tool to fight the real appreciation. The data also makes favorable a switch from stable to variable exchange rate regime.**

The reason why the regime switch from stable to variable causes depreciation and variable exchange rate regime by itself does was explained in the model. In case the economic participants do not have the same model as the central bank they do not know the rate of depreciation. In case of an exchange rate regime switch the participants will revert to using the Bayesian model and the participants will have to learn what model the central bank is using.

If there is a difference between the expected rate of depreciation and the actual rate of depreciation, this will be reflected in the real exchange rate. Greater depreciation then expected will devalue the real exchange rate. So the model can predict occurrences like ones in Latvia and Hungary.

### 5.6. Inflation

We did not deal directly much with the inflation in the model. In the model there was no explicit calculation how the prices are derived, except the assumption that under variable exchange rate the nominal appreciation will pass-through into inflation. The impact of inflation was mostly mentioned in the real exchange rate. Inflation was also postulated in Part 2 as something which can be decreased if the exchange rate is stable. In this part we are going to address the issue of inflation, but we are going to focus on two aspects:

- Do economies with stable exchange rate regime have smaller inflation or similar inflation to the economy with whom they have stabilized the exchange rate?
• What is the standard deviation of inflation under stable and variable exchange rate regimes?

First we are going to address what is in my view the great economic paradox and wrong definition: the objective of the central bank in respect to prices. It is stated: the objective of the central banks is to have price stability. What is price stability? If we just look at the words and take them at their linguistic meaning the price stability means the prices are stable, the prices do not change a lot, the prices do not oscillate. In mathematical terms the price stability can be low volatility of prices index. So price stability should be in the linguistic interpretation: prices do not change over time. This in last 100 years was not possible as it was shown in Graph (1). But it was possible in the past.

The central banks around the world do not pursue price stability since it is clearly impossible for prices not to change. What central banks do pursue is low inflation rate, now low inflation and price stability do not have to be the same thing. The country can easily have low inflation (average inflation under 2% for example) but have very high volatility of the inflation rate. The reverse can be true in case of the country with high inflation but with no volatility of the inflation rate. So at best the price stability can be: stable inflation rate.

As we have seen from the Part 2 of the dissertation the inflation is the 20th century phenomenon, there is no escaping the inflation. The only thing the central bank can do is try to keep the inflation under control. Price stability in terms of keeping the price level stable and having 0% inflation is impossible in the current economic system and setup. From this point it would make more sense to have the monetary policy goal of small and stable inflation rate. This means not only to have low inflation, but that the inflation rate itself does not have high volatility which is the theoretical implications of inflation targeting. In the Part 4.2 of the dissertation about the central bank we have offered ways for a small open economy to have a stable inflation rate over long period of time. We have tied this possibility with the assumption the pass-through is one-for-one and rate of nominal depreciation is known to both central bank and other participants in the economy.

One of the main assumptions about the stable exchange rate system is that stable exchange rate system is going to bring price stability and low inflation. This opinion is clearly stated in the Central bank of Lithuania’s web site and we have quoted it in Part 2 of this dissertation. We are now going to look at the countries with stable exchange rate and compare their inflation rates to the EU inflation rates. Here we are seeing very mixed results. In some countries the inflation rate is much higher than in the EU and in some countries the inflation rates is actually much lower than the EU.

Table (13) shows us the “pure” stable exchange rate regimes, economies which did not have exchange rate regime switches and have had stable exchange rate regimes for whole period analyzed: Bulgaria, Czech Republic, Estonia, Lithuania. Exchange rate stability did not bring low inflation to Bulgaria. Looking at the data we can see that Bulgaria has persistently much higher rates of inflation then the EU, for most part several percentage points higher inflation rates then the EU. The exchange rate stability did bring low inflation to Czech Republic, in some instances lower than in EU. Out of 15 years in the sample Czech Republic has smaller
inflation then EU in 7 years and what is most important in last 3 years of the crisis. Lithuania for in 2002 and 2003 actually has deflation. That is why the real exchange rate index actually depreciates in Lithuania in 2003. Similarly out of 17 periods in the sample inflation in Lithuania is smaller than EU in 5 periods.

The occurrence of smaller inflation then in EU brings a new light to the model. The use of the nominal exchange rate to offset the inflation rate was the prime tool in the model to offset the real exchange rate appreciation, but this might not be necessary be the only tool as long as the country can have lower inflation then the rest of the world. However as the data shows it is impossible to have a persistent deflation and persistently lower inflation then in EU, again shining light that variable exchange rate simply gives the central bank more tools to work with.

Table 13: Inflation in countries with stable exchange rate

<table>
<thead>
<tr>
<th>Year</th>
<th>CPI EU</th>
<th>Δ(Domestic - EU)</th>
<th>CPI EU</th>
<th>Δ(Domestic - EU)</th>
<th>CPI EU</th>
<th>Δ(Domestic - EU)</th>
<th>CPI EU</th>
<th>Δ(Domestic - EU)</th>
</tr>
</thead>
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<td>-</td>
<td>1.60%</td>
<td>0.00%</td>
<td>2.20%</td>
<td>-</td>
<td>2.20%</td>
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<td>0.60%</td>
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<td>2.00%</td>
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<td>-0.10%</td>
<td>0.10%</td>
<td>-0.10%</td>
</tr>
<tr>
<td>2003</td>
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<td>0.00%</td>
<td>0.10%</td>
<td>-</td>
<td>0.10%</td>
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<td>-0.10%</td>
</tr>
<tr>
<td>2004</td>
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<td>0.30%</td>
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<td>0.30%</td>
<td>-0.10%</td>
<td>0.30%</td>
<td>-0.10%</td>
</tr>
<tr>
<td>2005</td>
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<td>0.20%</td>
<td>-</td>
<td>0.20%</td>
<td>-0.10%</td>
<td>0.20%</td>
<td>-0.10%</td>
</tr>
<tr>
<td>2006</td>
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<td>0.10%</td>
<td>-</td>
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<td>-0.10%</td>
<td>0.10%</td>
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</tr>
<tr>
<td>2007</td>
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<td>0.00%</td>
<td>0.00%</td>
<td>-</td>
<td>0.00%</td>
<td>-0.10%</td>
<td>0.00%</td>
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</tr>
<tr>
<td>2008</td>
<td>0.50%</td>
<td>0.00%</td>
<td>0.20%</td>
<td>-</td>
<td>0.20%</td>
<td>-0.10%</td>
<td>0.20%</td>
<td>-0.10%</td>
</tr>
<tr>
<td>2009</td>
<td>0.20%</td>
<td>0.00%</td>
<td>0.10%</td>
<td>-</td>
<td>0.10%</td>
<td>-0.10%</td>
<td>0.10%</td>
<td>-0.10%</td>
</tr>
<tr>
<td>2010</td>
<td>0.10%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>-</td>
<td>0.00%</td>
<td>-0.10%</td>
<td>0.00%</td>
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</tr>
<tr>
<td>2011</td>
<td>0.50%</td>
<td>0.00%</td>
<td>0.10%</td>
<td>-</td>
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<td>-0.10%</td>
<td>0.10%</td>
<td>-0.10%</td>
</tr>
</tbody>
</table>

Sources: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home, Statistical institutes of individual countries, central banks of individual countries

Moving our analysis forward we can see that all three countries have increase in inflation from 2006 to 2008. this is not surprising at all since at the same time the inflation in EU increases as well. But what is obvious is the increase in inflation in these countries is much larger than the increase in inflation in EU. This is again normal, since the small open economy is subject to the supply side shocks and those shocks cause more volatility in small open economy then they do in large economy.

Looking at the data in Table (13) we can conclude the following:
Having stable exchange rate does not imply low inflation, simply because a supply side shock will have larger impact on small open economy than on the large economy.

Stable exchange rate in a small open economy does not automatically imply the inflation rate in the small open economy is going to mimic the inflation rate in large economy.

Small open economy is much more open to the supply side shocks (theoretically developed as early as Mundell-Fleming model)

The sources of inflation in small open economy might be completely different then the sources of inflation in large economies. Not only demand side driven, but also supply side.

We are now going to move to the analysis of other countries: Croatia, Hungary, Latvia, Romania, Slovakia, Slovenia all of which have mixed results as well presented in Table (14). For example in case of Slovenia, after the exchange rate regime switch the inflation rate goes down, same happens in Croatia, Hungary, Slovakia, but even with the exchange rate stabilization it is obvious the inflation rates are significantly higher than the inflation rates in EU. Hungary even with the exchange rate stability has several percentage points higher inflation then the EU, same goes for other countries as well.

We can immediately conclude the switch from variable to the stable exchange rate regime brings down the inflation rate. With the exchange rate regime switch from variable to stable the inflation rates have decreased across the board in the analyzed countries, but the inflation rates do not equal the inflation rates in EU, so again we see that stable exchange rate does not lead to inflation which is the same as in the country with whom the exchange rate was stabilized with.

We see economies with variable exchange rate have larger rates of inflation under variable exchange rate then under stable exchange rate. This is clearly the case in Slovakia, Slovenia and Hungary. Just as it is clear the switch from variable to stable exchange rate leads to the decrease in inflation. Again the clear example of this is Hungary with double digit inflation under variable exchange rate regime and single digit inflation under stable exchange rate regime. In the countries in the second group we can also see the increase in the inflation rates in 2006 and 2007. again showing that small open economy is open to outside supply side shocks since the inflation rates in 2006 and 2007 are much larger than the inflation rates in EU.

The overall data in this group has same properties as the data in the previous group. Some overall conclusions can be drawn:

- Exchange rate regime switch will change the inflation dynamics as predicted by the model.
- Switch from variable to stable exchange rate regime does not guarantee inflation same as in the country with whom the exchange rate is fixed, but it does lead to lower inflation rates in the medium term.
- Small open economy is much more prone to the supply side inflationary shocks.
We are now going to look at how the change in exchange rate regime altered the standard deviation of the inflation rate. This is done in order to determine the inflationary dynamics between the two regimes. We are going to try to determine if the countries with variable exchange rate regime have stable inflation.

Table 14: Inflation in Countries with Variable Exchange Rate and Regime Switch

<table>
<thead>
<tr>
<th></th>
<th>CPI EU</th>
<th>Δ(Domestic - CPI EU)</th>
<th>Δ(Domestic - CPI EU)</th>
<th>Δ(Domestic - CPI EU)</th>
<th>Δ(Domestic - CPI EU)</th>
<th>Δ(Domestic - CPI EU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CROATIA</td>
<td>2.40%</td>
<td>3.70%</td>
<td>1.30%</td>
<td>28.19%</td>
<td>25.79%</td>
<td>23.14%</td>
</tr>
<tr>
<td>HUNGARY</td>
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<td>3.40%</td>
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<td>23.60%</td>
<td>21.70%</td>
<td>11.13%</td>
</tr>
<tr>
<td>LATVIA</td>
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<td>3.80%</td>
<td>2.20%</td>
<td>18.50%</td>
<td>17.00%</td>
<td>6.40%</td>
</tr>
<tr>
<td>ROMANIA</td>
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<td>5.40%</td>
<td>4.40%</td>
<td>10.10%</td>
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<td>2.70%</td>
</tr>
<tr>
<td>SLOVAKIA</td>
<td>1.70%</td>
<td>3.40%</td>
<td>1.70%</td>
<td>11.40%</td>
<td>9.70%</td>
<td>3.00%</td>
</tr>
<tr>
<td>SLOVENIA</td>
<td>2.20%</td>
<td>5.90%</td>
<td>3.70%</td>
<td>10.00%</td>
<td>7.80%</td>
<td>1.70%</td>
</tr>
<tr>
<td>2001</td>
<td>1.90%</td>
<td>2.40%</td>
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<td>4.90%</td>
<td>3.20%</td>
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<tr>
<td>2002</td>
<td>2.20%</td>
<td>2.80%</td>
<td>0.60%</td>
<td>4.90%</td>
<td>2.70%</td>
<td>1.60%</td>
</tr>
<tr>
<td>2003</td>
<td>1.40%</td>
<td>2.10%</td>
<td>0.40%</td>
<td>5.00%</td>
<td>5.80%</td>
<td>3.90%</td>
</tr>
<tr>
<td>2004</td>
<td>2.20%</td>
<td>1.90%</td>
<td>-0.30%</td>
<td>5.50%</td>
<td>3.30%</td>
<td>7.40%</td>
</tr>
<tr>
<td>2005</td>
<td>2.70%</td>
<td>4.08%</td>
<td>1.90%</td>
<td>3.30%</td>
<td>1.20%</td>
<td>7.10%</td>
</tr>
<tr>
<td>2006</td>
<td>2.10%</td>
<td>2.20%</td>
<td>-1.0%</td>
<td>6.00%</td>
<td>9.40%</td>
<td>4.60%</td>
</tr>
<tr>
<td>2007</td>
<td>3.20%</td>
<td>5.40%</td>
<td>2.20%</td>
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<td>4.20%</td>
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</tr>
<tr>
<td>2008</td>
<td>2.20%</td>
<td>2.80%</td>
<td>0.60%</td>
<td>5.00%</td>
<td>1.20%</td>
<td>10.40%</td>
</tr>
<tr>
<td>2009</td>
<td>1.50%</td>
<td>1.60%</td>
<td>0.30%</td>
<td>5.40%</td>
<td>3.90%</td>
<td>-1.40%</td>
</tr>
<tr>
<td>2010</td>
<td>2.20%</td>
<td>1.70%</td>
<td>-1.0%</td>
<td>4.80%</td>
<td>1.90%</td>
<td>2.40%</td>
</tr>
<tr>
<td>2011</td>
<td>2.80%</td>
<td>2.10%</td>
<td>-0.80%</td>
<td>4.50%</td>
<td>1.20%</td>
<td>2.90%</td>
</tr>
</tbody>
</table>

Sources: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home, Statistical institutes of individual countries

From the Table (13) (14) and (15) we can see again we have mixed results. It is clear the exchange rate stability does not bring price stability. Countries with fixed exchange rate regimes (not just stable, but fixed) like Bulgaria, Czech Republic and Lithuania have much higher standard deviation of the inflation rate then EU. As a matter of fact Slovakia and Slovenia with variable exchange rate have smaller standard deviations than Estonia and Lithuania who have stable exchange rate. This clearly point to the fact stability of inflation is not guaranteed with stability of the exchange rate. As a matter of fact Slovenian and Slovakian data validate the model by showing it is possible to have stable inflation if the rate of devaluation is stable.

Let us look more closely at the Slovenian data. The inflation rate is very high under the variable exchange rate regime, around 8%, but it is very stable. Once the exchange rate regime switches to stable the inflation rates comes down, but the standard deviation of the inflation rate does not alter significantly. In case of Slovakia once the exchange rate has been stabilized the standard deviation of inflation actually goes up! So what does this mean? Croatia, Slovenia and Slovakia had higher inflation under variable exchange rate
regime, but better inflation stability. This possibility was predicted by the model. This clearly points out the source of inflation is not just the exchange rate and under stable exchange rate regime it cannot be the exchange rate, but something else.

| Table 15: Inflation in Countries with Variable Exchange Rate and Exchange Rate Regime Switch |
|---------------------------------|---------------------------------|----------|----------------|--------------------|----------------|----------------|----------------|----------------|--------------------|
| STANDARD DEV TOTAL              | EU CPI                         | BULGARIA | CROATIA        | CZECH             | ESTONIA          | HUNGARY         | LATVIA         | LITHUANIA       | ROMANIA            | SLOVAKIA          | SLOVENIA         |
| 0.53                            | 13.95                          | 1.34     | 2.39           | 7.72              | 7.30             | 5.99            | 8.59           | 35.76           | 2.65               | 3.47              |
| REGIME 1                        | 0.53                            | 0.84     | 7.76           | 1.08              | 3.03             |
| REGIME 2                        | 0.53                            | 1.48     | 2.08           | 1.80              | 2.79             |

Sources: Author’s calculation based on statistical data

In case of Croatia the regime change from variable to stable caused the standard deviation to increase. This observation is very interesting, especially when we look at Hungary where we have the opposite occurrence. In Hungary the change from variable to stable decreased standard deviation and the decrease was extreme, the standard deviation of inflation rate decreased more than three times. This points out that the causes of inflation are not the same in Hungary and in Slovenia.

In the literature it is mostly taken for granted the inflation is caused by changes in the nominal exchange rate, in small open economies it is implied the inflation is tied to the exchange rate, however using this simple statistic we see in cases of Hungary and Croatia the causes of inflation are not the same. If the causes of inflation were the same in Hungary and Croatia then the behavior of the standard deviation would be the same, but since they are not we have to conclude that inflation in one of these countries is not tied to the monetary policy and exchange rate at all. One of the explanations for inflation in Croatia was given by Gregurek and Vidaković (2008) where inflation is directly tied to the degree of monopoly in the economy.

The issue of inflation and inability of stable exchange rate regime to mimic the inflation is clear in correlation. The table below shows the correlation of inflation of individual countries with inflation of EU. From the data it is clear there is no correlation in the data. As a matter of cast Bulgaria and Czech Republic have negative correlation.

| Table 16: Correlation between EU inflation and observed countries |
|---------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Correlation between individual countries and EU inflation     | Bulgaria    | Croatia     | Czech Republic | Estonia | Hungary | Latvia | Lithuania | Romania | Slovenia | Slovakia |
| -0.24                                                      | 0.28        | -0.13       | 0.31         | -0.43     | 0.49     | 0.30       | -0.44      | -0.32     | -0.33     |

Sources: Author’s calculation based on statistical data

From the data regarding inflation it is now clear why we have used econometrics so little. Running regression only means that two variables are statistically connected through econometric techniques we are using; they do not have to have causation in real world. So practice of running regressions on data and then making conclusions without proper
understating of economics is potentially very dangerous and in this part we have seen why. The exchange rate stability does not lead to price stability, nor does the stable exchange rate guarantee the inflation rate is going to be the same in small open economy as in the large economies with whom the small open economy has tied its currency to.

The explanation the stable exchange rate is needed because of price stability (the reason for inflation is nominal devaluation) does not exist in the data. The data does not support having stable exchange rate regime because of price stability. What data also points is that the small open economies are much more open to the supply side shock so if a country has a stable exchange rate regime it has to determine what the cause of inflation is and how to act to prevent the increases in inflation.

This analysis brings us also back to the importance of the purpose of the monetary policy. The data shows us the purpose of the monetary policy cannot just be price stability and low inflation. When conducting monetary policy the central bank has to have deep understanding of processes in the economy and what are the causes of inflation. Just fixing the exchange rate and then blaming the inflation rate on everyone else in the economy is simply an act of cowardice. Monetary policy has to have a larger, broader view of the economy and argument for stable exchange rate as presented by Latvia’s central bank has been annulled by the data in this chapter.

5.7. Ratio of exports to imports

Imports and exports analysis will give us the ability to investigate what is the status of the economy in terms of openness, what is the impact of the regime switch and what exchange rate regime will give the economy better foundations. Also we will investigate what happened since 2008 and how did the crisis impact the imports and exports.

In our analysis we are going to look at the ratio of exports to imports. This is slightly unusual variable since it is usual to look at the current account deficit and surplus. When we look at the ratio of exports to imports we can see what the actual size of one over the other is and how much the economy is actually taking in vs. how much it is going out. Also looking at the ratio of imports to exports we can see how the economy is changing over time.

Model states the stable exchange rate regime will lead to real appreciation and this leads to more imports. However this ratio is not tied to the exchange rate regime per se, but rather is tied to the changes in the real exchange rate. We also have to investigate the effect of the exchange rate regime change on the ratio of exports to imports. Table (17) shows the data.

First we are going to look at the four countries with stable exchange rate regime: Bulgaria, Estonia, Lithuania and Czech Republic. Bulgaria has stable exchange rate regime in the period we are observing, the ratio is constantly decreasing up to 2008, clearly indicating the economy is more and more importing over time as the real exchange rate is appreciating. We can see

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67 As done by Croatian Central bank governor Željko Rohatinski who in 2008 stated: Central bank has done all it can it is now up to other participants in the economy to decrease inflation. www.hnb.hr
that in 1996 this ratio is at 110%, but by the end of the period we are observing the ratio is as low as 74%. Estonia is also another interesting case since it has stable exchange rate regime, but large oscillations in the ratio. The ratio goes from 83% in 1997 to 93% in 2001 then back down to 87% in 2003. The year 2007 and 2008 are the two largest extremes when the ratio goes from 85.4% in 2007 to 94.5% in 2008. In Estonia there is no clear direction like in Bulgaria, but the economy is not able to have more exports then imports. Similar pattern can also be found in Lithuania where the ratio oscillates a lot, but the economy is not able to have a single positive year until the crisis.

Table 17: Ratio of Exports and Imports

<table>
<thead>
<tr>
<th>Year</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Slovenia</th>
</tr>
</thead>
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<td>1995</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1996</td>
<td>110.1%</td>
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<td>90.0%</td>
<td>105.2%</td>
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<td>96.9%</td>
<td>87.2%</td>
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<tr>
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<td>83.4%</td>
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<td>97.9%</td>
<td>85.0%</td>
<td>103.4%</td>
</tr>
<tr>
<td>1998</td>
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<td>96.9%</td>
<td>76.4%</td>
<td>82.4%</td>
<td>97.9%</td>
<td>83.6%</td>
<td>103.4%</td>
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<tr>
<td>1999</td>
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<td>96.3%</td>
<td>78.8%</td>
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<td>94.6%</td>
<td>94.3%</td>
<td>103.4%</td>
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<tr>
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<td>100.0%</td>
<td>93.7%</td>
<td>97.7%</td>
<td>88.1%</td>
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<td>97.0%</td>
<td>93.8%</td>
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<td>95.9%</td>
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<td>90.0%</td>
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<td>94.1%</td>
<td>72.1%</td>
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<td>69.9%</td>
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</tr>
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</tr>
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<td>105.8%</td>
<td>913.5%</td>
<td>105.9%</td>
<td>97.9%</td>
<td>101.9%</td>
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<td>96.7%</td>
<td>107.6%</td>
<td>111.7%</td>
<td>108.1%</td>
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<td>97.4%</td>
<td>85.1%</td>
<td>104.8%</td>
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</tr>
<tr>
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<td>99.5%</td>
<td>108.3%</td>
<td>107.6%</td>
<td>110.2%</td>
<td>91.1%</td>
<td>99.0%</td>
<td>86.8%</td>
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</table>

Sources: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home, Statistical institutes of individual countries, author’s calculation

Czech Republic is again a case for itself. For the most part the ratio is close to 100% and after 2004 for the rest of the period it is above 100%. What is most interesting is the Czech Republic, the nominal exchange rate for Krona in the time period observed actually appreciates, the exchange rate moves from 38 for 1 Euro in 1997 to 26 for 1 Euro in 2008, real exchange rate index appreciates, but the ratio actually increases over time. The ratio moves from 91% in 1995 to 101% in 2004, this behavior completely contradicts the model. We have both nominal and real appreciation and yet in the data we see that the ratio of exports to imports is increasing, so exports are increasing at the faster rate than the imports and eventually become larger than the imports. There are two main possibilities why this has happened. The first possible explanation for this is the development and growth of tourism. Since tourism can be an export, but it is a service at the same time we would have a caveat inside the model. If tourism is the key for the growth of exports then the model is correct, since the economy has moved from manufacturing towards services. In order to check this
possibility we are going to look at the income side of GDP for Czech Republic per sectors and see which sector has most contributed to the economic growth. Using the Czech income GDP data from Czech Statistical institute we see that largest growth in the economy in time period 1990 – 2008 was in:

Table 18: GDP developments in Czech Republic

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D Electricity, gas, steam and air conditioning supply</td>
<td>1079%</td>
<td>2.28%</td>
<td>3.78%</td>
</tr>
<tr>
<td>E Water supply, sewerage, waste management and remediation activities</td>
<td>1039%</td>
<td>0.65%</td>
<td>1.06%</td>
</tr>
<tr>
<td>I Accommodation and food service activities</td>
<td>1209%</td>
<td>0.96%</td>
<td>1.93%</td>
</tr>
<tr>
<td>J Information and communication</td>
<td>2271%</td>
<td>1.03%</td>
<td>3.69%</td>
</tr>
<tr>
<td>K Financial and insurance activities</td>
<td>1222%</td>
<td>1.47%</td>
<td>2.79%</td>
</tr>
<tr>
<td>M Professional, scientific and technical activities</td>
<td>1344%</td>
<td>2.28%</td>
<td>4.59%</td>
</tr>
<tr>
<td>N Administrative and support service activities</td>
<td>1146%</td>
<td>1.04%</td>
<td>1.89%</td>
</tr>
</tbody>
</table>

Sources: Author’s calculation based on statistical data

From the above table we see all of the industries which had highest growth and we see how their increase in GDP contribution has increased mostly from services, but also services which can be exported so the model was correct, but only partially.

This analysis gives another light to the model. It clearly makes possible for the economy to resist real appreciation and to have increase in exports, but we see this was not done by the monetary variables, so the only explanation lies in the fiscal policy. In Part 4.6 we have stated the government has two main fronts of actions: the economic and noneconomic. The economic front is to create fiscal policies to improve the economic conditions, the noneconomic front is to have rule of law and create supporting services so that economic agents can function.

From the data we can see that in the case of Czech Republic the negative effects of the monetary policy were offset by the policies of the government. Although we have argued that such possibility is highly unlikely we can see that it is possible in case of Czech Republic. However it is not done in any other country with the stable exchange rate regime. One question remains: if the ratio is so good under the stable exchange rate regime, what would it be if the Czech had variable exchange rate regime? The case of the Czech Republic brings another point to light and that is the importance of the fiscal policies and even noneconomic policies of the government which to a large extent have be somewhat neglected by the model, but again given the data and the results the Czech case is more of an exemption then the rule.

Croatia has an improving ratio before the exchange rate regime switch then the ratio starts to deteriorate until the crisis. Hungary on the other hand also has a regime switch and the ratio actually improves after the move to stable exchange rate regime. The ratio then decreases slightly (in period 2001 - 2004) but then starts to improve and it hits 100% in 2006 and it actually increases from then on, also thought he crisis. Latvia follows an inverted V path, the ratio goes up and then it goes down. Just like the path of the real exchange rate in Latvia, the real exchange rate in time period 2001 to 2004 depreciates and the ratio improves, however once the real appreciation comes back the ratio deteriorates. In Romania, although there was the variable exchange rate regime, the changes in the nominal exchange rate were not enough
to stop the real appreciation and over time the economy imports more and more. In Croatia we see the switch in behavior after the switch in the exchange rate regime. The ratio is increasing under the variable exchange rate, but then starts to deteriorate under the stable exchange rate regime. Just like in case of Romania the ratio follows the changes in the real and nominal exchange rate.

In Slovakia and Slovenia the ratio is stable before the regime switch and then it makes a jump after the move from variable to stable exchange rate. This occurrence can be explained due to joining the EMU and expanding the markets. After the regime switch in Slovakia and Slovenia the ratio is mostly stable and close to 1.

We need to address the issue of the exchange rate regime switch. From the data we have two separate cases. In groups one there are Croatia and Latvia. In the other Group are Hungary, Slovakia and Slovenia. All these countries have had regime switch from variable to stable exchange rate regime, but from the data we see that in the first group the move was not successful and in the second group the move was successful. This clearly indicates possibility of optimal timing for the exchange rate move from variable to stable exchange rate regime. From the data we see that, apart from Czech Republic, stable exchange rate regime cannot secure increase in exports, however since the ultimate goal of all countries is to join EMU the exchange rate has to be fixed at one point in time. We see in the data that two economies have stabilized and exchange rate and failed, but three have stabilized and succeeded. Since the switch happened at different times it is obvious that there is an optimal point at which the economy can move from variable to stable exchange rate regime. From the data we also have the implication the optimal path for the economy is variable, then stable exchange rate regime.

We can see from the data the exports are more tied to the real exchange rate then to the choice of the exchange rate regime. However it is obvious the economies with the variable exchange rate which were able to offset the strong real exchange rate appreciation are in much better shape than the economies which have chosen stable exchange rate regime.

The table (19) gives us the effects of the crisis on imports and exports in time period 2008 – 2011. The table is calculated as index with starting value of 100. Immediately we can see the imports decreased in all countries except for Czech and are almost unchanged in Estonia and Hungary.

<table>
<thead>
<tr>
<th>2008 - 2011</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Slovenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>114,9</td>
<td>88,5</td>
<td>116,3</td>
<td>124,5</td>
<td>111,3</td>
<td>107,8</td>
<td>116,8</td>
<td>117,3</td>
<td>96,8</td>
<td>108,6</td>
</tr>
<tr>
<td>Imports</td>
<td>87,8</td>
<td>77,0</td>
<td>110,2</td>
<td>103,5</td>
<td>102,2</td>
<td>89,8</td>
<td>94,8</td>
<td>98,3</td>
<td>90,2</td>
<td>99,5</td>
</tr>
</tbody>
</table>

Sources: Author’s calculation based on statistical data

Exports on the other hand increased in all countries except Croatia and Slovakia. This effect of the crisis was the reason why the period 2008 – 2011 was left out from the previous analysis. It is clear the crisis had a significant impact on the ratio of imports and exports. It is the decrease in domestic credit fuelled demand which has caused decrease in imports and thus
improved the ratio of exports and imports. At the same time we can see that, except for Croatia in most countries the exports have increased in this time of crisis.

**Apart from the Czech experience we can conclude the model is correct in case of exports and imports and the countries with variable exchange rate regime have better structure of exports and import the economies which have stable exchange rate regime.**

### 5.8. Loans

The changes in the both nominal and real exchange rate have impact on the choice of the model for households, with strong emphasis on the exchange rate risk. Without the exchange rate risk the households will tend to increase their debt, while with the variable exchange rate the households will shun away from debt. The variable vs. stable exchange rate regime works as a strong vs. soft budget constraint for the households. The changes in the real exchange rate for the households are going to be manifested in their choice of consumption, but that was already covered in the previous part on exports and imports. In this part we are going to look at the choice of the exchange rate regime and the household’s choice of debt holdings.

In order to do this we are going to look at the percentage of the loans to retail in total lending of the banks. We could just look at the growth of loans to households over time, but then we would not know what the business strategy of the banks was. The actual percentage in the Table (20) shows the percentage of loans to households as part of lending to households and businesses, so we exclude lending to government. The model has clearly stated that under stable exchange rate regime, with the weak budget constraint, the household will tend to increase their debt holding in order to boost their consumption. Using the percentage of loans to households indicator we can kill two flies with one stone. First we can see is the lending to households increasing? Second we can see what business strategy the banks have been pursuing, are the banks lending more to firms or the households? This ratio is also going to confirm to us does the stable exchange rate regime lead to “crowding out” of firms by households.

What we clearly see from the Table (20) is that the loans to households, as part of the banking business, have increased in all of the observed countries. We can immediately see that the stabilization of the exchange rate regime has significant impact on lending to households. Once the economy changes from variable to stable exchange rate regime we see shift towards increase in lending to households. The best examples of this are Hungary, Latvia and Slovakia.

In Hungary the loans to households are continuously decreasing under variable exchange rate regime. The moment the exchange rate stabilizes the loans to households explode. This is the most obvious proof of the model. In Latvia we have similar results. First the loans as percentage are increasing under stable exchange rate regime. Then under variable exchange rate the lending to households is still increasing, but with decreasing rate. Then again once the exchange rate stabilizes the lending explodes. Similar pattern can be found in Romania as well. Once the exchange rate starts to appreciate the lending to households explodes.
Table 20: Loans to Households as Percentage Of The loans to businesses and households

<table>
<thead>
<tr>
<th>Year</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Slovenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>39.7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>35.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>32.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>29.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>26.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>23.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>20.4%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>17.6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>14.8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>12.0%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>10.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>8.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>6.7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>5.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>3.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>1.6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>0.9%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>0.2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>0.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: individual countries central banks

In Croatia we see the growth of loans for the whole time period, but the growth rate increases once the exchange rate stabilizes and what is extremely important is the fact that over 50% of loans in the banks are loans to retail. Slovakia is also a good example. The share of loans to retail changes by +11% under the variable exchange rate and then +30% under the stable exchange rate.

Naturally there are always exemptions to the rule and that is Slovenia where after the regime change the participation of debt to households in total banking loans actually goes down. The reason for that might be the high standard of living in Slovenia so the households do not tend to borrow in order to achieve the standard of living they prefer but could not afford. So there was no reason for Slovenian households to increase their debt to live the way they want to live since they were already at the desired standard of living. This result in Slovenia is actually quite expected and predicted by the model.

Another issue mentioned in the model is the crowding out effect and this is also clear in the data. Out of ten countries six have ratio above 50% (seven if we count Lithuania) which means the banks are lending more to households then they are lending to firms. This economically makes no sense since savings should equal investment, not credit. This statistic brings us again to the question of the purpose of the monetary policy and I have to ask: what is the point of monetary policy if banks are lending to households to increase their unsubstantiated consumption?

We are not looking at the ownership of banks at all or the currency structure, or the lending per loan category. We are just assuming in the model that if there is no exchange rate risk for the households and if the households have high present preference for consumption we are
going to see increase in the lending to households and that is exactly what we are seeing in the data. It is clear from the data the assumption of the model regarding the behavior of the households under alternate exchange rate regimes is correct. Model assumptions confirmed.

What we see is that the banks are not the great nemesis they are so often portrayed to be in the popular press as even foreigners which come to plunder the country. The banks are behaving just the way the model predicts they should behave. When there is high demand for loans the banks, as profit maximizing agents, will increase interest rates and will lend to the sector of the economy which is the most profitable. So the increase to lending to households under the stable exchange rate regime is not surprising at all. This pattern would occur regardless of who owns the banks.

This is the strongest proof that with the change of the monetary policy there is a change in the behavior of economic participants yet in the data.

5.9. Foreign debt

Another variable which goes hand to hand with loans to households is the foreign debt. The model predicts that under stable exchange rate the foreign debt is going to increase. There are three main reasons for increase in foreign debt under the stable exchange rate regime:

- The banks cannot fund the lending to households from primary sources of funds so they will borrow on the secondary market abroad.
- The firms are going to get crowded out by the households, so the firms are going to go abroad in order to get the need credit.
- If the interest rate in the small open economy is higher than the rest of the world, under stable exchange rate, the foreign investors are going to invest in the small open economy since they can get higher rate of return then in their home country.

In order to analyze the foreign debt we are not going to create any indicator, we are just going to look at the values in billion or Euros. From the Table (21) we can notice the foreign debt has increased in all countries in our sample when data is available. The model is proved correct when we look at the exchange rate regime changes.

Just as with the debt to households, the pattern under the stable exchange rate repeats itself. The foreign debt after the exchange rate stabilization explodes in Croatia, Hungary, Slovenia and Slovakia. Even the developed countries like Slovakia and Slovenia were not able to offset the increase in foreign debt once they switched to the stable exchange rate regime. In Croatia the foreign debt increases almost 4 times after the exchange rate stabilization; in Hungary over 3 times; in Slovakia 6 times and in Slovenia over 3 times. In countries with the stable exchange rate the foreign debt in just as rampant. In Estonia the foreign debt increases 15 times over time period of sixteen years. In Bulgaria four times in fourteen years.
In this case we have to say that the model is dead on in its prediction that stable exchange rate leads to increase in foreign debt. It is very important to look at the size of the debt, not just how many times it increased. If we look at Croatia and Slovenia when the data starts most of that debt is inherited from Yugoslavia. In Slovenia the total debt was 11.5 bln Euros at the end of 2002 and at the end of 2008 it was 39 billion Euros, that is 27.5 billion Euros of new net inflows into the country. For the economy the size of Slovenia this is enormous amount of money. But Hungary definitely takes the pot, over 90 billion Euros debt inflows through debt between 1999 and 2008 and just 27 billion before the regime change in 1999. The model is correct in all of its assumptions about foreign debt.

The implications of this foreign debt cannot be stressed enough. The economies with such large debt burden will never be able to have significant growth rates. Also large foreign debt makes countries highly susceptible to refinancing risk and re-pricing risk. This is clearly seen after 2008 when most countries have decrease or slight increase in foreign debt, with exception being Romania and Czech Republic where debt increased by more than 15% after the start of the crisis.

This is once again where the choice of the exchange rate as economic policy comes into play. We have seen that stable exchange rate leads to high foreign debt. When a policy maker chooses to have exchange rate stability, the policy maker has immediately chosen to burden his country with high levels of foreign debt.

The relation between the stable exchange rate and the increase in foreign debt cannot be ignored. Out of all the data we have seen thus far nothing illustrates strongly the fact that

<table>
<thead>
<tr>
<th>Year</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Slovenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>8.558</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.743</td>
<td>3.706</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>10.023</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.789</td>
<td>4.275</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>18.427</td>
<td></td>
<td></td>
<td></td>
<td>24.875</td>
<td></td>
<td></td>
<td>7.758</td>
<td>5.811</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>17.075</td>
<td>1.200</td>
<td>22.556</td>
<td></td>
<td>1.904</td>
<td></td>
<td></td>
<td>7.758</td>
<td>5.811</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>10.541</td>
<td>19.884</td>
<td>27.624</td>
<td>5.603</td>
<td>42.269</td>
<td>7.564</td>
<td>6.670</td>
<td>17.825</td>
<td>13.255</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>28.955</td>
<td>32.929</td>
<td>51.642</td>
<td>17.466</td>
<td>98.804</td>
<td>26.852</td>
<td>20.547</td>
<td>58.829</td>
<td>44.509</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>37.246</td>
<td>40.590</td>
<td>60.511</td>
<td>19.023</td>
<td>118.533</td>
<td>29.762</td>
<td>23.009</td>
<td>72.354</td>
<td>52.527</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>37.616</td>
<td>45.244</td>
<td>61.940</td>
<td>17.204</td>
<td>133.043</td>
<td>29.086</td>
<td>25.163</td>
<td>81.205</td>
<td>69.552</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>37.051</td>
<td>46.483</td>
<td>70.498</td>
<td>16.402</td>
<td>138.636</td>
<td>29.977</td>
<td>24.071</td>
<td>92.458</td>
<td>65.824</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>35.385</td>
<td>45.734</td>
<td>72.583</td>
<td>15.504</td>
<td>139.352</td>
<td>29.405</td>
<td>24.813</td>
<td>98.425</td>
<td>68.491</td>
<td></td>
</tr>
</tbody>
</table>

Sources: Individual countries central banks.
choice of the exchange rate regime is not just a simple thing for small open economy. With this data it is painfully clear the choice of the exchange rate regimes has profound impact on the whole structure of the economy. The choice of the exchange rate regime cannot be treated just like something that might impact the inflation but it is a choice which is going to have a profound and deep impact on the economy.

5.10. Structure of GDP

We are now going to move into the analysis of the structure of GDP. We are going to investigate both income and expenditure. We have already investigated the imports and exports and we have used a separate analysis of those two variables in order to be able to focus on effects of the regime and regime change on small open economies. Since there was a sharp decrease since the start of the crisis we have already demonstrated the fact the countries were over importing, but we have also shown that crisis was used by most countries to increase their exports.

In this part we are going to go deeper in to the analysis of the structure of GDP. In terms of the expenditure structure of GDP we are going to focus on consumption and gross fixed capital formation. The initial assumptions are that consumption should be smaller under variable exchange rate regime and that fixed capital formation should be smaller under stable exchange rate regime.

In terms of the income side of the GDP we are going to focus on particular economic sectors are the sources of economic growth in economies. Again under variable exchange rate regime we are expecting for manufacturing to be the driver of growth and under stable exchange rate regime the services should be the driver of economic growth.

5.10.1. Consumption

We have made clear that with the stable exchange rate there is going to be an increase in consumption of households due to the higher lending from banks. The consumption as part of the GDP is just the last link in the chain of economic behavior. If there is an increase in the lending to households and the credit is used for consumption we should see the rise in the consumption level over time for economies with stable exchange rate regime. We are looking at the household’s consumption of goods, regardless of the origins of those goods.

The data significantly differs from country to country. In Bulgaria and Romania the share of consumption is over 65% of the GDP while in Slovakia and Slovenia it is well below 60%. The percentage of consumption in the GDP is steady over time, but all countries have decreased the consumptions as part of GDP since the start of the crisis in 2008 except Czech,

---

68 We have also show that stable exchange rate regime might lead to lower, but not to stable inflation
Slovenia and Slovakia. In terms of the exchange rate regime switch and effects of the exchange rate regime switch on the data we have to conclude there isn’t one.

Looking at the Table (22) we can see large differences in consumption between the countries. Countries with higher GDP tend to have lower consumption (higher investments) and countries with lower GDP per capital tend to have higher consumption (lower investments). From this perspective it means that it is much easier for richer to remain rich, while the poor need to perform massive change in the consumption habits to get richer.

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Sources: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home, Statistical institutes of individual countries

The impact of the crisis is more than clear in the economies. The largest drop is in Bulgaria 6%, Estonia 4%, Slovakia 4% and the smallest changes are in Czech increase 2%, and Slovenia has an increase of 3%. Although there might not be a conclusive conclusion about the changes in the consumption and the effects of the crisis in terms of exchange rate regimes, there is one in terms of percentage of consumption and the crisis. The largest decreases came where the consumption was high (over 60% of GDP), while the smallest decreases (actually increases) came from where the consumption was low, under 55% of GDP. Extrapolating from this we see the economies with stable exchange rate regimes Bulgaria, Croatia, Estonia, Lithuania had significant decreases in consumption. This implies that economies with large consumption are more affected by the crisis, but also and this could be more important economies with large consumption are more prone to the crisis. Also decrease in consumption with the start of the crisis came from the decrease in leading to households.

We can now combine the changes in consumption with the changes in the GDP during the crisis which was Table (9), which we are going to put here again.
We see that economies with high consumption had the higher decreases in GDP like Bulgaria, Estonia, Lithuania, and Romania. But this is also a mixed bag since decrease in consumption in Hungary and Latvia does not follow the decrease in GDP. As for Slovakia and Czech it is clear what has happened: the economic crisis was offset by increase in exports. Overall countries which consume less are more robust when the crisis hits. All elements boil down that if the economy is strong before the crisis it will be able to resist the crisis, if it is not it will not be able to resist the crisis, as simple and obvious as this is, it is still the truth.

### 5.10.2. Investments in fixed capital

The fixed investments into new capital are another part of the model and indicator of the economic behavior. We are assuming if the economy is more exports oriented it will need higher level of capital in order to have enough manufacturing capacity. So we are expecting to see higher rate of investments under the variable exchange rate regime then under the stable exchange rate regime. In order to produce exports the countries need capital, so the model states we should see more new fixed capital creation in the countries with the variable exchange rate.

Again there are large differences between the countries in terms of how much of the GDP goes towards investments and that the portion of the investments in GDP is relatively stable in most of the countries in the sample, however there are some countries which are exhibiting an unusual volatility.

First there is extreme volatility of the investment rate, second there is decrease in investments with the start of the crisis. In comparison with 2008 every single country has lower investments in 2011. There is no conclusive connection between the investments and the exchange rate regime. Best example is Bulgaria where rates are between 8,1% and 34,1% of GDP. Also there is no connection between the regimes, again Bulgaria has the smallest average rate (average for the period for which the data exists) of 21,6% and highest average is in Estonia with 29,3%. Both countries have stable exchange rate regime.
If we look in the countries with exchange rate regime shifts we cannot see conclusive proof the exchange rate regime will switch the economic behavior and increase investments rate. This beckons the obvious question: is the model wrong? It is clear the predictions of the model did not come true in case of investments, but there are two caveats which have to be considered.

The first caveat is the issue of what is the investment for? The model states the variable exchange rate will increase manufacturing and not favor services, stable exchange rate regime should have the reverse, but both manufacturing and services need investments. Some services like telecommunications require massive investments into infrastructure. So in order to get more conclusive proof we will have to see the income structure of GDP and more importantly employment.

The second caveat is the fiscal policies. Behavior of investments in the economy is heavily depended on the fiscal policies. The answers why we are seeing this data might be in the tax structure of individual economy and within other fiscal policies which we have not explicitly modeled. Again the behavior of the Czech Republic is indicative that there might be something more in case of investments and exports then it meets the eye.

In the end we will conclude this particular indicator does not support the model, there are simply too many contradictory observations in the data for us to make any certain conclusions about the relationship of the exchange rate regime and investments. Same could be said about the regime change.

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Sources: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home, Statistical institutes of individual countries

Table 24: Fixed Investments as Percentage of the Capital
5.10.3. Income structure of GDP

We have investigated how the expenditure structure of GDP has changed over time and we have seen how did the change in exchange rate regime impact the characteristics of expenditure side of GDP, now we are going to turn our attention to the income side of GDP and see how the income side of GDP has changed over time. As usual we are going to investigate what is the main contributor to GDP under specific exchange rate regime and how did the exchange rate regime switch impact the changes in the GDP contribution. The methodology which we are going to use is the standard statistical methodology of particular industries which is repeated in the table below.

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<tr>
<td>Real estate activities</td>
<td>L</td>
</tr>
<tr>
<td>Professional, scientific and technical activities</td>
<td>M</td>
</tr>
<tr>
<td>Administrative and support service activities</td>
<td>N</td>
</tr>
<tr>
<td>Public administration and defense; compulsory social security</td>
<td>O</td>
</tr>
<tr>
<td>Education</td>
<td>P</td>
</tr>
<tr>
<td>Human health and social work activities</td>
<td>Q</td>
</tr>
<tr>
<td>Arts, entertainment and recreation</td>
<td>R</td>
</tr>
<tr>
<td>Other service activities</td>
<td>S</td>
</tr>
<tr>
<td>Activities of households as employers and producers for own use</td>
<td>T</td>
</tr>
</tbody>
</table>

Sources: Author's calculation and individual countries statistical institutes

Since some economies do not have the data for all items we are going to use condensed methodology which is available for all economies. Table (26) presents condensed methodology. In this condensed methodology is a logical summation. Agriculture is based off the land so it is due to natural resources and those are a given to an economy with only minor possible improvements. Mining, Manufacturing, Energy and Water are all part of production and are strictly economic variables, not given by nature like agriculture. Other combined items like G, H, I, or M, N, or O, P, Q or R, S, T, U all present some logical grouping. What we are interested in this part is how the group B, C, D, E developed over time versus G, H, I: production of goods vs. production of services.
First we are going to look at the general trend in the data. In order to save space and not present 10 years Table (27) is a condensed table with three years; 1995 which we consider the starting year, 2008 the year before the crisis and 2011 the year of crisis. From this table we look to extrapolate general trend.

For most economies the largest item is production, which is mostly above 20% of GDP. But what is more interesting for us is how the structure of GDP has changed of the years. Table (28) presents the changes in GDP between 1995 – 2008 to investigate how the transition has affected the structure of GDP and then changes between 2008 – 2011 to investigate how the crisis has affected the structure of GDP.

From the data we see that in all economies the importance of agriculture has decreased and construction as part of GDP has increased in all countries, except for Czech Republic. As for production (B, C, D, E) we have a mixed bag, from increase in Czech, Slovakia to decrease in Croatia of -9,2%. Another important category is J (Information and communication) which points to the importance of IT during the IT revolution which we had in 1990s. Some countries took advantage of this possibility like Bulgaria and Czech, while in Latvia and Lithuania we have a decrease.

Looking at the available data we can immediately analyze countries with stable exchange rate regime for the whole period: Bulgaria, Czech Republic, Estonia, and Lithuania. Again in this analysis the complete outlier is the Czech Republic which has increase in production of goods (B, C, D, E) and decrease in production of services (G, H, I). However other three countries have all decrease in production of goods and increase in production of services, which
supports the model. As for the period of crisis 2008 – 2011 the only clear variable is the decrease in construction for all countries except for Romania.

Table 27: Contribution of each industry to GDP

<table>
<thead>
<tr>
<th>Industry</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech *</th>
<th>Estonia</th>
<th>Hungary *</th>
<th>Latvia</th>
<th>Lithuania **</th>
<th>Romania</th>
<th>Slovakia *</th>
<th>Slovenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14.7%</td>
<td>6.0%</td>
<td>4.0%</td>
<td>5.8%</td>
<td>8.5%</td>
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<td>6.3%</td>
<td>4.8%</td>
<td>4.3%</td>
<td></td>
</tr>
<tr>
<td>B.C.D.E</td>
<td>23.4%</td>
<td>38.7%</td>
<td>42.3%</td>
<td>25.4%</td>
<td>25.4%</td>
<td>18.6%</td>
<td>23.7%</td>
<td>29.1%</td>
<td>40.0%</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>5.0%</td>
<td>5.0%</td>
<td>10.1%</td>
<td>6.7%</td>
<td>5.1%</td>
<td>6.8%</td>
<td>6.6%</td>
<td>7.2%</td>
<td>8.2%</td>
<td></td>
</tr>
<tr>
<td>G.H.I</td>
<td>18.8%</td>
<td>18.8%</td>
<td>13.6%</td>
<td>21.9%</td>
<td>17.6%</td>
<td>28.9%</td>
<td>26.6%</td>
<td>23.8%</td>
<td>17.3%</td>
<td></td>
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<td>J</td>
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<td>2.2%</td>
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<td>3.1%</td>
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</tr>
<tr>
<td>K</td>
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<td>3.6%</td>
<td>2.6%</td>
<td>2.2%</td>
<td>4.4%</td>
<td>3.1%</td>
<td>2.9%</td>
<td>2.0%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>1.9%</td>
<td>8.7%</td>
<td>4.3%</td>
<td>11.1%</td>
<td>7.5%</td>
<td>8.6%</td>
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<td>6.6%</td>
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<td>7.0%</td>
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<td>O.P.Q</td>
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<td>11.6%</td>
<td>9.0%</td>
<td>14.8%</td>
<td>19.0%</td>
<td>17.0%</td>
<td>17.7%</td>
<td>14.4%</td>
<td>10.6%</td>
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<tr>
<td>R.S.T.U</td>
<td>1.6%</td>
<td>1.3%</td>
<td>1.9%</td>
<td>2.6%</td>
<td>4.3%</td>
<td>2.9%</td>
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<td>1.9%</td>
<td>2.7%</td>
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</tr>
</tbody>
</table>

Table 28: Differences in Contribution of each industry

Sources: Author’s calculation and individual countries statistical institutes

Sources: Author’s calculation and individual countries statistical institutes
Now we are going to look at the countries which had regime switch we are going to look at Croatia, Hungary, Slovakia and Slovenia. The table (29) shows what was the difference between each items of GDP under variable and stable regime. The table (28) shows what the effects of crisis in selected economies were. In three economies after the regime switch we have a decrease in production of goods (B, C, D, E) and increase in production of services (G, H, I) while in Slovakia the contribution of production is the relatively the same for both goods and services. This crisis brings the reversal of this trend for all economies except for Slovenia. So we have again three out of 4 cases.

| Variable to stable | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
| Croatia           | -1.6% | -5.4% | -2.7% | 2.4% | -0.7% | 1.3% | 0.4% | 2.9% | -3.9% | 0.4% |
| Crisis            | 0.1%  | -2.0% | -2.3% | 1.4% | -0.2% | 0.6% | 0.7% | -0.5% | 1.1%  | 0.0% |

| Variable to stable | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
| Hungary           | -2.2% | -1.7% | -0.1% | 1.3% | 0.2% | 0.9% | -0.2% | 1.9% | 0.3%  | -0.3% |
| Crisis            | 0.3%  | 1.4%  | -0.5% | 1.8% | 0.5% | 0.6% | 0.6% | -0.1% | -0.3% | -0.1% |

| Variable to stable | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
| Slovakia          | -0.6% | 0.3% | 2.4% | -0.6% | 0.7% | 1.2% | -1.9% | 0.9% | -2.6% | 0.2% |
| Crisis            | -1.0% | -4.1% | 0.0% | -5.3% | 0.5% | 9.1% | 0.2% | -6.6% | 1.0% | 1.0% |

| Variable to stable | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
| Slovenia          | -0.8% | -3.6% | -3.9% | 1.9% | 0.3% | 0.0% | -0.3% | 0.4% | -1.3% | -0.3% |
| Crisis            | 0.0%  | -0.6% | -3.0% | 0.2% | 0.3% | 0.7% | 0.5% | 0.3% | 1.8%  | 0.2% |

Sources: Author's calculation and individual countries statistical institutes

From the data it is clear we are dealing with different economies, which might have had similar starting points but in the last 20 years have developed their own characteristics, in spite of the fact today all economies are in similar positions in global affairs. Apart from Czech Republic which is a constant outlier we see stable regimes decrease production of goods and increase production of services. We also see a regime switch from variable to stable does the same. In the end we conclude stable regimes are not favorable for production, but are favorable for services. Regime switches from variable to stable also favor production of services versus production of goods.

5.11. Employment

The last variable which we are going to investigate will be the employment structure of the economies and what are the effects of the regime switch. The data does not exist for all countries and there is one methodological issue with Croatia. In case of Croatia the data
includes workers employed in agriculture and craftsmen, because of this the summation of percentages is 100% only in case of Croatia, while it is not for other countries.

Table 30: Sector employment: Services

<table>
<thead>
<tr>
<th>Year</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Slovenia</th>
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</table>

Sources: Author’s calculation and individual countries statistical institutes

Table 31: Sector employment: Industry

<table>
<thead>
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<th>Year</th>
<th>Bulgaria</th>
<th>Croatia</th>
<th>Czech</th>
<th>Estonia</th>
<th>Hungary</th>
<th>Latvia</th>
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</table>

Sources: Author’s calculation and individual countries statistical institutes

In all countries the employment in services has increased just like in all countries the employment in industry has decreased. From the perspective of our model this is to be
expected since all of the economies have had real exchange rate appreciation. However is this data result of how correct the model is or there are some other factors in the economy as well? It certainly is that the model can explain a part of the shift in employment, but not the entire shift in employment.

Another significant reason for this structural change is the fact that last 20 years have seen significant increase in productivity and new service technologies like IT and communications. These new technologies opened new jobs, but also decreased the need for labor in production.

Because of the lack of data econometric testing is possible only in Hungary, Slovakia and Slovenia. Using the Chow test for structural breaks and following formula:

$$\text{Emply}_{\text{serv}} = \alpha + \beta_1 \text{Emply}_{\text{serv}-1} + \beta_2 \text{Emply}_{\text{serv}}MA_4$$  \hspace{1cm} (5.9)

Where $\text{Emply}_{\text{serv}}$ is employment in services we get that for all three countries there is a structural break at 5% significance. Hence there is a connection between regime change and employment in services. When the economy moves from the variable to stable exchange rate regime the employment in services increases as the model has predicted and econometrics has confirmed. Clearly there is a connection between the exchange rate regime, real exchange rate and employment.

Another point we have to investigate is the labor participation rate which is given in the Table (32). From this table we can see does the change in the exchange rate regime alter the number of people which are in the work force.

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Sources: Author’s calculation and individual countries statistical institutes
The values in the table represent the people who are in the workforce (employed plus unemployed) as the percentage of the total population. We can see that for the most part the participation rate is the same in all countries cca 50% indicating the exchange rate regime does not affect the labor participation rate. Also, the changes in the exchange rate regime do not change the participation rate. The model does not address the issue of the participation rate, so inattentive of the participation rate in terms of the model is neutral.

### 5.12. Government

We now will look at the government and the effects of the exchange rate regime choice on the government. The model tells us we should see two, somewhat contradictory data sets. In terms of the government deficit economies with the variable exchange rate should have lower deficits and the total government debt should be lower. Under stable exchange rate regime we should see lower deficits, but significant increase in government debt. The logic behind this conclusion which is not intuitive lies in the debt financed revenues. If the households obtain more debt the government revenues should increase, but when the inflow of funds stops government will have to finance their spending with more debt.

The exchange rate regime switch from variable to stable should lead to smaller deficits because of the increase in the debt fueled consumption.

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Sources: *Individual countries statistical institutes*
We can see from the data clearly that exchange rate switch from variable to stable leads to lower deficits. Croatia, Latvia, Slovakia, Slovenia all exhibit decrease in the total government deficit after the switch from the variable to stable exchange rate regime. The decrease in deficit is due to the increase in VAT revenues funded with consumer loans, since those countries also exhibit increase in lending to retail at the same time. But from the data we cannot conclude variable exchange rate regime leads to lower deficits because we have large differences in the data. For example Hungary and Croatia have lower deficits under variable exchange rate regime, but Slovenia does not.

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<td>45.6%</td>
<td>41.2%</td>
<td>6.0%</td>
<td>80.8%</td>
<td>42.6%</td>
<td>38.5%</td>
<td>33.3%</td>
<td>43.3%</td>
<td>47.8%</td>
</tr>
</tbody>
</table>

Sources: Individual countries statistical institutes

Here we have a mixed bag again. Countries with stable exchange rates like Estonia and Bulgaria have exceptionally low government debt. In case of Bulgaria the debt is decreasing throughout the period and in case of Estonia it is in single digits. Overall most countries do not have high debt levels, except for Hungary and in all countries the debt has increased during the crisis, again except for Estonia.

In terms of the model prediction the model is correct that stable exchange rate regime will bring more revenues to the government and lower deficit rates, but when it comes to the total size of debt the model is not valid.
5.13. Model and the data

We have come to the end of the analysis of the data. The connection between the model and the data is twofold. With some variables the model is completely correct, foreign debt, household’s debt, employment in services. Other variables do not exhibit changes like consumption as part of the GDP.

If we wanted to characterize the model it would have to be characterized as heavily monetarist. The largest emphasis lies on the monetary policy and the impact the monetary policy has on the behavior of economic participants. Fiscal policy and other non-monetary elements of economy in the model are seen as elements which are going to eventually bend towards the direction chosen for them buy the monetary policy. In most cases in terms of variables this is correct the only example where this is not correct is Czech Republic which is in most cases contrary to the model.

The issue of the Czech Republic clearly demonstrates the deficiencies in the model but it also demonstrates it is possible effect the fiscal policy can have on the economy. Czech Republic is a clear example it is possible to have real exchange appreciation (and nominal!) but at the same time to maintain strong economy. However the success of the Czech Republic is not a positive example, but more a warning since this is the only country which has succeeded in this strategy. All other with stable exchange rate regime have failed. So the possibility of building a strong economy with just fiscal policies should not be taken as something which can be done, but as something which should be combined with variable exchange rate regime. However even with all the economic success Czech Republic was not able prevent surging foreign debt. Looking at the data there are two basic conclusions:

- Variable exchange rate regime is more preferable.
- There is an optimal point in time when to move from stable to variable exchange rate regime.

On the examples of Slovenia and Slovakia it is clear they were able to build stable and strong economies under variable exchange rate regimes and then the switch from variable to stable exchange rate regimes did not start negative trends. The opposite examples of regime switching in wrong time are clearly Croatia and Hungary. Latvia and Romania are on the other hand countries which have used exchange rate as a policy tool, but they moved between appreciation and depreciation of the currency and analyzing the model it seems the better strategy would be to just actively depreciate the currency. The data presented shows that variable exchange rate has some power to stop real appreciation, growth of foreign debt, destruction of production, but in the end we have not seen an economy which has the ability to complete off-set all the negative trends. The obvious conclusion is that the best option is to have a coordination of monetary and fiscal policies which are going to fight against these negative trends, as predicted in the Mundell-Fleming model.
6. Conclusion

The usual question in economics is: what is the importance of money and does money have any impact on real economy. In a small open economy this question is extended to the choice of the exchange rate regime. It is not just the money in one country, but also money in another country.

The dissertation tried to look at the impact of the choice of the monetary policy in a small open economy. The dissertation argues the purpose of the monetary policy cannot be just the keep prices stable; the purpose of the monetary policy is to guide the economy through various points of the business cycle. The monetary policy should be used to actively participate in the economy and the best way to do this is to control the bank's credit policy through regulation and make sure negative trends in the economy are immediately spotted and possible prevented. However most central banks in small open economies we have analyzed did not have such a broad view. For some the only purpose of the central bank is to keep the prices stable and this can be done though exchange rate stability.

In this conclusion I would like to do three things. Look at the data and see does the model correspond to the data. Look at the main hypothesis of the dissertation and see where they correct and in the end offer a reflection on monetary policy.

6.1. Model and the data

The Table (35) presents what were the variables analyzed, what are the implications of the model and what are the results from the data. What we can see is that the model is correct in terms of monetary variables like: loans, foreign debt, and inflation. The model does not fare so well when it comes to the real economic variables like crisis robustness, ratio of imports and exports, consumption, investments. This to some extent is not surprising, the main focus of the model is on the monetary variables and the model tries to analyze the possible implications the monetary variables could have on real variables. The main disadvantage of the model is fiscal policy and the effects the fiscal policy can have on variables. However the fiscal policy has very little effect on foreign debt, households' debt, inflation.

The summation of the results: the model is correct in eight out of fourteen variables, and for one variable is only partially correct. The model is incorrect in following variables: consumption, investments, ratio of imports and exports, crisis robustness, government debt. All these variables are real economic variables, not monetary variables which are to be expected. The model is long term model and the current crisis which took its full effect in 2009 might be an appropriate test for the model, however such long term data is not available.
## Table 35: Data and the model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model prediction</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic growth</td>
<td>Largest economic growth will be in economies with variable exchange rate regime.</td>
<td>Data confirms this assumption since the largest growth was in Slovakia, then in Latvia and Hungary which had regime switches. MODEL CORRECT</td>
</tr>
<tr>
<td>Crisis robustness</td>
<td>Economies with variables exchange rate regime will be more resistant to crisis.</td>
<td>No clear conclusions in terms of exchange rate regime or regime switches. MODEL NOT CORRECT</td>
</tr>
<tr>
<td>Real exchange rate</td>
<td>Economies with variable exchange rate should be able to off-set the real exchange rate appreciation.</td>
<td>Every economy has had real exchange rate appreciation. However economies with variable exchange rate regime have had lower rates of appreciation. MODEL PARTIALLY CORRECT</td>
</tr>
<tr>
<td>Inflation</td>
<td>Stable exchange rate regime is no guarantee of low inflation rate.</td>
<td>No economy has even remotely close inflation with EU. MODEL CORRECT</td>
</tr>
<tr>
<td>Price stability</td>
<td>Stable exchange rate does not lead to stable inflation rate.</td>
<td>No correlation in the data. MODEL CORRECT</td>
</tr>
<tr>
<td>Ratio of exports to imports</td>
<td>Economies with variable exchange rate regime should have higher ratio of imports to exports.</td>
<td>The data does not support this assumption. In some economies, after the switch from variable to stable exchange rate regime, the ratio improves and the highest ratio is in economy with stable exchange rate regime. MODEL INCORRECT</td>
</tr>
<tr>
<td>Loans</td>
<td>Higher level of households loans will be under stable exchange rate regime. There will be an increase in lending after switch from variable to stable exchange rate.</td>
<td>The data clearly shows higher level of loans under stable regimes and clear increase in lending to households after switch from variable to stable exchange rate regime. MODEL CORRECT</td>
</tr>
<tr>
<td>Foreign debt</td>
<td>Economies with variable exchange rate regime should have smaller foreign debt and a switch from variable to stable will increase foreign debt.</td>
<td>Economies with variable exchange rate regimes have smaller foreign debt and switch from variable to stable exchange rate regime increases foreign debt. MODEL CORRECT</td>
</tr>
<tr>
<td>Consumption</td>
<td>Economies with stable exchange rate regime should have higher consumption levels.</td>
<td>The data varies and economies with stable exchange rate regime have both highest and lowest consumption. MODEL INCORRECT</td>
</tr>
<tr>
<td>Investments in fixed capital</td>
<td>Economies with variable exchange rate regime should have higher levels of investments.</td>
<td>The rates of investment vary from all economies and all regimes. MODEL INCORRECT</td>
</tr>
<tr>
<td>Production of goods vs. production of services</td>
<td>Economies with variable exchange rate regime will produce more goods than services. Regime switch from variable to stable will be good for production of services.</td>
<td>Stable exchange rate regimes favour production of services as does switch from variable to stable exchange rate regime. MODEL CORRECT</td>
</tr>
<tr>
<td>Employment</td>
<td>Economies with stable exchange rate regime will open more jobs in services than in production of goods. Same will occur when there is a regime switch from variable to stable exchange rate regime.</td>
<td>Econometrically tested the data does show that switch from variable to stable exchange rate regime favours increase in jobs in services vs. jobs in production of goods. MODEL CORRECT</td>
</tr>
<tr>
<td>Labour participation rate</td>
<td>Variable exchange rate should increase employment. Switch from variable to stable exchange rate should also decrease the labour participation rate.</td>
<td>There are no changes in the data over time, over the exchange rate regimes or due to the exchange rate regime switch. MODEL INCORRECT</td>
</tr>
<tr>
<td>Government deficit</td>
<td>Stable exchange rate regimes will have lower deficits because of higher revenues due to increase in debt fuelled consumption.</td>
<td>Stable exchange rate regimes have lower deficits and switch from variable to stable exchange rate regime lowers deficit. MODEL CORRECT</td>
</tr>
<tr>
<td>Total debt</td>
<td>Variable exchange rate regime should lead to lower government debt.</td>
<td>There is no clear indication in the data that variable exchange rate leads to lower government debt. MODEL INCORRECT</td>
</tr>
</tbody>
</table>

Sources: Author
The model did well in the data, the data in which the model did not do so well just points to the fact there are two sides in economic policy monetary and fiscal. The Table (35) clearly points to the effects of the exchange rate regime choice on the monetary variables, but at the same time the Table (35) points that there is power to the responsible government and that in spite of the stable exchange rate it is possible to have a responsible government like in the case of Estonia or Bulgaria.

6.2. Main hypothesis

In this part we are going to review the hypothesis from Part 1 of the dissertation and see were they correct. We are going to start with the main hypothesis:

The main thesis of the dissertation is: Choice of exchange rate regime is a fundamental choice for small economy with significant effects on all economic participants. When a central bank chooses a particular exchange rate regime in effect the central bank chooses a certain economic set-up which will have significant impact on the behaviour and choices of the participants in the economy. Stability or variability of the exchange rate will have an impact the participants in the economy through FX risk. Economic participants will behave differently if there is FX risk (variable exchange rate regime) and if there is no FX risk (stable exchange rate regime). The choice of exchange rate regime will lead to distinct differences in the economic characteristics for economies which have stable exchange rate regime and economies which have variable exchange rate regime. CONFIRMED

Just from Table (32) and Part 5 of the dissertation we clearly see there are variables (mostly monetary) variables which behave differently under different exchange rate regimes. So the main hypothesis the exchange rate regime will change the behavior of economic participants is confirmed.

The hypothesis for the households were

**Households**

**H1:** The behaviour of the exchange rate plays fundamental role in the decisions making process for the household and the choice of the amount of debt the household is willing to hold. CONFIRMED

**H2:** If the household is faced with a depreciating exchange rate, the household will be credit averse and will create consumption plans with minimum debt holding. CONFIRMED

**H3:** If the household is faced with stable exchange rate households will create consumption plans which are more skewed towards present consumption and will increase their debt holdings in order to achieve those plans. CONFIRMED
Although it might seem H2 and H3 are the same thing, but from a different point of view, we had to make a clear distinction regarding the choices the households will make under each exchange rate regime. In the end from the data all hypothesis were confirmed.

In case of firms there were following hypothesis:

**Firms**

**H1:** Different exchange rate regimes will create different economic environments for firms. In different economic environments firms will chose different business options in terms of service or production and different structures of employment. **CONFIRMED**

**H2:** Under stable exchange rate regime firms will be more oriented towards services and trade, while under variable exchange rate regimes firms will be more oriented towards production. **CONFIRMED**

**H3:** Variable exchange rate regime will have higher level of employment and higher level of labour participation. **NOT CONFIRMED**

When it comes to the model, data and hypothesis relating to firms the model could not take the economic transition into full extent and that is the reason H3 was not confirmed. The process of transition was not analyzed, the monetary policy was analyzed. The other two hypotheses H1 and H2 were confirmed through econometric tests. Changes in the exchange rate regime from variable to stable do lead to higher employment in services.

In case of banks there were following hypothesis:

**Banks**

**H1:** Banks as profit maximizing companies which will give loans to sectors of economy from which the banks can generate highest income. This implies the sector distribution of loans in the banks’ balance sheet will be based on the assumption of what is most profitable for banks, not what is optimal for the economy. **CONFIRMED**

**H2:** Under stable exchange rate banks will lend more to households then the firms. Under variable exchange rate regimes banks will lend more to firms. The banks will have different sector distribution of credit under different exchange rate regimes. **CONFIRMED**

**H3:** Economies with stable exchange rate regime will have higher foreign debt then under stable exchange rate regime. **CONFIRMED**

Considering banks are significantly influenced by the monetary policy it is not surprising all hypothesis predicted by the model were confirmed by the data.

In case of government there were following hypothesis:
Government

H1: Fiscal policy will have different deficit plans under different exchange rate regimes. If the exchange rate is stable the government deficit will be higher than under variable exchange rate. Variable exchange rate limits foreign borrowing for the government and serves as deterrent against high deficits. NOT CONFIRMED

H2: Government receives revenue from household’s consumption through VAT. Higher consumption funded by credit growth will artificially inflate government’s VAT receipt in the period of credit boom. When the credit booms stops there will be a significant decrease in VAT receipts. CONFIRMED

H3: Because of receipts from credit funded consumption and possibilities to get funds from foreign markets the fiscal policy will prefer stable exchange rate over variable exchange rate. INCONCLUSIVE

The government set of hypothesis was the weakest from the perspective of the model. The model only analyzed how the government will behave under alternate exchange rate regimes, but it did not take into account any explicit fiscal policies. Just like in case of firms there is one hypothesis H1 which is not confirmed, H2 hypothesis was confirmed and H3 is inconclusive. The model predicts stable exchange rate regime should be more preferable for the government, but there is no way to check that.

In the end we will look at the central bank. In case of central bank there were following hypothesis:

Central bank

H1: Central bank chooses the exchange rate regime. The choice of the exchange rate regime sets economy on a particular path. CONFIRMED

H2: Change in the exchange rate regime will change the decision making process of participants in the economy. Since the participants will behave differently under different exchange rate regimes there is going to be a clear difference in behaviour of certain economic variables under different exchange rate regimes. Exchange rate regime switch will cause a structural break in the economic data. CONFIRMED

H3: Economies with stable exchange rate regime will have higher level of foreign debt. Switch of exchange rate regime from variable to stable will lead to increase in foreign debt. CONFIRMED

H4: Central bank is more able to control inflation under variable exchange rate regimes then under stable exchange rate regime. CONFIRMED

There is no doubt from the data that different choices of the exchange rate regimes cause economic participants to behave differently.
6.3. Reflection on monetary policy

In the end I would like to move the discussion into more of a philosophical plane and that is to try to determine is the choice of the monetary policy all there is to the process of transition. The analysis of various indicators and various countries in our sample shows some economies did very well under the stable exchange rate regime, while others continued to have very favorable economic results after they have moved from variable to stable exchange rate regimes. Let us look at the logical argument first:

- The Economy is in bad shape because the economy has bad exchange rate regime choice (stable).
- The Economy is in bad shape and exchange rate regime is only making it worse.

Or if we look from the bright side

- The Economy is doing great because the central bank choose the right exchange rate regime choice (variable)
- The Economic is doing great and the monetary policy is helping.

Natural question is what the difference is between these two points of view? In essence it is the chicken and the egg argument. It is my view the exchange rate regime choice is not an almighty tool, but it is an enhancer in case of some policies, this was also shows clearly in the data. The optimal policy is: first variable then stable exchange rate regime.

Having a variable exchange rate regime will not automatically guarantee a favorable economic outlook, but it could help with some economic indicators. From the data sample it is clear it is possible to have good economy with stable exchange rate regime, but only one country has managed to do that. What is extremely interesting and what the model and the data have shown beyond reasonable doubt, is the change of behavior of the households and increase in foreign debt under stable exchange rate regime. If we completely neglect all other policies these two results clearly warrant attention from policy makers.

Monetary policy like all things has two simple options: do the right thing or do the easy thing. Fixing the exchange rate and then stating the stable exchange rate is the only and best way is the easy thing, but as the model had assumed and the data has proved choice of the stable exchange rate regime it is not the right thing. Taking rains and guiding economy through hard times and trying to create an economy which will be prosperous for times to come is hard, but it is right.

If anything in the dissertation I have tried to present monetary policy as something much more than a mechanism of controlling inflation. Monetary policy has profound impact on economic
activity, the decisions of monetary policy are not clear cut and simple, this is the reason why it is hard to conduct monetary policy and even harder to make the right calls.

All of the policy choices have been made and all of the results are in the past. The dissertation has tried (and in some succeeded) to explain the consequences of choices made.
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