

# ESSAYS ON MONETARY, FISCAL AND MACROPRUDENTIAL POLICY NEXUS IN INDONESIA : AN EMERGING MARKET CASE

A Dissertation

Presented to the Faculty of the Graduate School

of Cornell University

in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

by

Danny Hermawan Adiwibowo

May 2014

ESSAYS ON MONETARY, FISCAL AND MACROPRUDENTIAL POLICY  
NEXUS IN INDONESIA : AN EMERGING MARKET CASE

Danny Hermawan Adiwibowo, Ph.D.

Cornell University 2014

This dissertation is a collection of three essays about public policy coordination. Although the subject and the issues analyzed in each essay are different, the bottom lines are similar, namely evaluating empirical performance of New Keynesian approach in explaining the economic variables behavior in emerging economies. Literatures for this approach are extensive but mostly focused on developed countries and researches on emerging countries are still in beginning stage. Therefore, these essays are an effort to narrow that gap

First chapter, as a starting point, develops of simple calibrated closed economy approach in the spirit of Bernanke et al. (1999) where financial intermediaries, entrepreneurs and households are subject to credit constraint as well as default probability; including real and nominal rigidities, thus both monetary and macro prudential policies can play a role to minimize those frictions and rigidities. We find that with the introduction of a macro prudential rule such as dynamic capital requirement and loan-to-value rules would help in reducing macroeconomic volatility and improving social welfare. However, the effects of macro prudential regulations tend to be modest and numerically much smaller than those achieved when the central bank implements monetary policy rules that are close to the optimal one. Given the situation in Indonesia, that macro prudential regulator will be under an independent financial supervisory body, as long as that regulator has an objective to minimize the volatility of

credit/GDP to avoid the buildup of excessive risks, macro prudential policies become quantitatively more important.

The second chapter based on premise that monetary policy has played a prominent stabilization role in many countries during the global financial crises, but fiscal policy has been seen as either sub-optimal or less effective. There has been renewed interest in fiscal policy in small open economies such as the UK and European periphery where austerity took place amidst low inflation and accompanied by internal or external imbalances. In an emerging economy, a larger expected share of nonRicardian agents and extent of real and nominal rigidities would be expected to create a larger potential role for fiscal policy in macro-economic stabilization and strengthening the resilience of the economy. Since we focused on monetary and fiscal policy only, there is no financial friction here but instead we developed a small open economy model. The model is estimated for the Indonesian economy, using a Bayesian approach to explore the role of fiscal policy in the existence of nonRicardian households. The model also features sticky prices and wages, nonRicardian agents and tax distortions to explore (i) the potential role for fiscal policy in stabilization, and (ii) monetary policy and fiscal policy interaction more generally. We found that fiscal policy does contribute to macroeconomic stabilization in Indonesia with its counter-cyclical policy in terms of fiscal expenditure and a tax response to debt that ensures solvency. However, fiscal policy should thanks to a large estimated share of nonRicardians households because they create an important role for fiscal policy, while price and wage rigidities and distortionary taxes are not. The fiscal debt also plays an important shock absorber role, allowing active fiscal stabilization and absorption of exchange rate valuation effects on the stocks of debt and reserves.

In the third chapter, we assessed the problem of large and persistent global imbalances in the recent years that have changed the behavior of capital flows across countries, particularly in the emerging market. After the global financial crisis in the late 2000s, the emerging market has experienced massive capital inflows due to the strong countercyclical policy in the advanced economy. These inflows lead to excessive credit growth and booms in asset prices in the emerging market, including Indonesia. In general, this massive global financial cycle has amplified the business cycle and one of the options to deal with the so-called enhanced trilemma is focus on the excessive leverage and credit growth as well as some forms of capital control such as tax on non-core liabilities. Therefore, in this chapter, we combine the model from the first and second chapters, mainly the macro prudential policy and non Ricardian households issue, and develop a New-Keynesian DSGE model for a small open economy, and estimate it for the Indonesian economy. The parameter estimation process uses Bayesian approach to explore the role of macro prudential policy and tax in non-core liabilities as one form of the capital control policy. Therefore, with those policy options, this research explores the potential role of each policy to mitigate the massive amplification of the domestic business cycle and finding an optimal policy choice

© 2014 Danny Hermawan Adiwibowo  
ALL RIGHTS RESERVED

## **BIOGRAPHICAL SKETCH**

Danny Hermawan Adiwibowo was born in Jakarta, Indonesia. He attained his Bachelor of Economics degree from University of Indonesia in 1994, Master of Arts in International and Development of Economics from Yale University in 2002 and pursuing PhD degree in Regional Science at Cornell University since 2009. Prior to joining Yale and Cornell he was an economist at Bank Indonesia who awarded full scholarship to attend those two schools. During his master study at Yale, he took summer job as analyst at Solomon Smith Barney, New York and while preparing for PhD proposal at Cornell he took a summer program at London School of Economics, London in 2011 and fellowship program as visiting economist at Macro Prudential Department, Bank for International Settlements at Basel, Switzerland in 2012 He is married to Khozanah Kun Safitri with three daughters: Nadzifa Alifia, Raina Rahmi and Keianna Anjani His research interest is mainly macro and monetary economics, financial market and regulation as well as their impact to regional economy and income distribution. Finally, He received his Ph.D. program in Regional Science at Cornell University in May 2013.

I dedicate this disertation to Mama and Papa to My Soulmate, Fitri my angels,  
Difa, Raina and Kei2 and to Bank Indonesia, who made this journey possible

## ACKNOWLEDGEMENTS

First and above all, praise to Allah SWT, for His blessings and guidance during my academic journey to complete this doctoral degree and indeed throughout my life. Apart from the efforts of myself, the success of this journey depends largely on the encouragement and guidelines of many others. I take this opportunity to express my gratitude to the people who have been instrumental in the successful completion of this dissertation.

I would like to express my utmost gratitude to my mentor, Professor Iwan Jaya Azis, who introduced me to Cornell and helping to shape my decision to pursue this PhD program back in Indonesia. He always believes in me and continues to provide invaluable insights about bridging academic and policy issues. Together with his wife, Erina Azis, they deliver continuous support not only on my research but also on many other aspects of life in Ithaca. My special thanks go to my chairperson and Director of our program, Professor Kieran Donaghy, for his invaluable guidance and support during my study. Many thanks also go to my advisors committee, Professor Eswar Prasad and Professor Ravi Kanbur for their kindly accepting to serve on my committee. Both of them are tremendous mentors and my inspiration to write this dissertation. Professor Prasad always challenged me with up-to-date issues and introduced me to his valuable networks from policy-making and academic circles while Professor Kanbur always gave me insights on how to put my dissertation down to earth. I also want to thank you all for letting my defense be an enjoyable moment, and for your brilliant comments and suggestions, again, thank you. I also thank Professor Yuri Mansury for his invaluable computational inputs and Ms. Tina Nelson as well as the rest of administrative office of Regional Science Department for the logistics and administrative supports

During my dissertation research, I received many supports from several policy maker institutions. From IMF, I thanks Dr. Ayhan Kose from Research Department, Dr. Camillo Tovar from Western Hemisphere Department and Dr. Pau Rabanal from Institute for Capacity Development. From Bank for International Settlements in Basel, I thank my supervisors Dr. Kostas Tsatasaronis, my colleagues and seniors Dr Stefan Avdjief, Dr. Andrew Filardo, Dr. Leonardo Gambarcotta, and Dr. Madhusudan Mohanty for their invaluable supports and discussions during my summer fellowship. Deep appreciations also go to Dr. Anella Munro form RBNZ and Dr. Hugo Vega from Central bank of Peru for their technical supports. My educational path would have been very rough without the supports and opportunities given from my office colleagues before I came to Cornell and during my study period. I am heartily thankful to Dr. Hartadi A Sarwono, Dr. Halim Alamsjah, Dr. Perry Warjiyo, Dr. Iskandar Simorangkir, Dr. Harmanta Parikesit and Dr. Endy Dwitjahjono for their constant support and and help . I would like to express my deepest gratitude to Bank Indonesia's Human Resource Department and New York office staffs for their support and attention during our stay in US. I would like to offer special thanks to Mr. and Mrs. Lucky Fathul, Mrs. Kusumaningtuty, Mr. Dicky Kartikoyono, Mr. Donny Juwono and Ms. Retnoningsih. I am particularly grateful for the inspiration given by Dr. Wimboh Santoso in writing the third chapter. Discussion with him has been very insightful. I received generous support from Aan Mayani, Pandri Rama, Myrna Savitri, Oki Hermansyah and other office mates in terms of data and references. My deepest appreciation goes to Mr. Nanang Hendarsyah, Mr. Priyanto Nugroho, Dr. Wahyu Nugroho, Dr. Bambang Pramono, and Dr. Indra Astrayuda for their support and encouragement as well as resourceful discussions. Special thanks go to Ms Iss Savitri, Mr. Agus

Firmansyah and Mr Emil Ranakusuma and families for their hospitality during my visit to DC.

Members of Regional Science also deserve my sincerest thanks, their friendship and assistance has meant more to me than I could ever express. I could not complete my work particularly the first two years and during the proposal preparation without invaluable friendly assistance from Dr. Zevi Azzaino, Mr. Triadi Sumin and Dr. Alvin Sumin, Dr. Nur Ain, Dr Nij Tosirin and Dr Sutee Anantsuksomsri, Dr. Supree Simsaran, Dr. Scarlett Zhuo, Dr. Sandy Ye and Dr. Hee Hwa Min. I also thanks Alexander Mc Grath and my office roommates Woosung Kim and Dafeng Xu for their support and friendship during finishing of my dissertation.

The unconditional love and support from my family has always been my encouragement and enables me to face all the burden and obstacles to finish this journey. I am forever indebted to both my parents, Krishna Hidayat Adiwibowo and Sri Rahayu for their endless love and values to my life. I owe them everything and wish I could show them just how much I love and appreciate them. I hope this work makes you proud. Heartfelt thanks to my beloved wife, Khozanah Kun Safitri whose love and encouragement allowed me to finish this journey and for all of her immeasurable dedications, for being with me in thick and thins throughout this endeavor. I owe a very important debt to my beautiful daughters, Difa Alifia, Raina Rahmi and Keianna Anjani, which drives me to give my best. I cannot imagine a life without their love and blessings. Words cannot express how grateful I am to my mother-in law; Bahierah Kabir and my brothers and sisters; Armand Rahadian, Indri Martini, Baihaqi Dipabuana, Nurul Farihah and Fairuz Rahani and their families for the unconditional supports and prayers that sustained me thus far. I consider myself the luckiest in the

world to have such a supportive family, standing behind me with their love and support.

Lastly, thanks to all Indonesians in Ithaca who become our family here. Our memorable moments with you has been one that I will cherish forever. Special thanks to The Azzainos, The Sumins, The Waluyos and The Mohsins who always been a great support and help during our stay in Ithaca.

Ithaca, May 2014

## TABLE OF CONTENTS

Biographical Sketch . . . . .	iii
Dedication . . . . .	iv
Acknowledgements . . . . .	v
Table of Contents . . . . .	ix
 <b>1 Chapter 1 : Monetary and Macprudential Policy Interaction : Balance Sheet and Lending Regulation</b>	 <b>1</b>
1.1 Introduction . . . . .	1
1.2 The Model . . . . .	5
1.2.1 Household . . . . .	5
1.2.2 Entrepreneurs . . . . .	7
1.2.3 Capital Producer . . . . .	9
1.2.4 Aggregation . . . . .	10
1.2.5 Financial Contract . . . . .	10
1.2.6 Bank . . . . .	14
1.2.7 Retailers . . . . .	16
1.2.8 Monetary Policy . . . . .	17
1.2.9 Macprudential Regulation . . . . .	17
1.2.10 Fiscal Policy . . . . .	19
1.2.11 Aggregate Equilibrium . . . . .	19
1.3 Parameter Calibration . . . . .	20
1.4 Second Moment Comparison and Model Fit . . . . .	21
1.5 Impulse Response Functions . . . . .	22
1.6 Policy Impacts on Business Cycle Stabilization . . . . .	25
1.7 Optimal Policy Mix . . . . .	26
1.8 Conclusion . . . . .	27
Appendix A . . . . .	31
Appendix B . . . . .	31
Appendix C . . . . .	31
 <b>2 Chapter 2 : Monetary Policy and Fiscal Role under the existence of Non Ricardian Household</b>	 <b>31</b>
2.1 Introduction . . . . .	31
2.2 Monetary and Fiscal Policy Framework in Indonesia . . . . .	35
2.3 The Model . . . . .	37
2.3.1 Household Decisions . . . . .	38
2.3.2 Aggregation . . . . .	43
2.3.3 Final Goods Firms . . . . .	44
2.3.4 Intermediate Goods Producing Firms . . . . .	45
2.3.5 Importing Firms . . . . .	47
2.3.6 Monetary Policy . . . . .	49
2.3.7 Fiscal Policy . . . . .	49

2.3.8	Aggregate Equilibrium . . . . .	53
2.3.9	External Sector : Balance of Payment . . . . .	54
2.4	Model Solution and Estimation . . . . .	54
2.4.1	Calibrated Parameters . . . . .	55
2.4.2	Estimated Parameters: Priors . . . . .	55
2.4.3	Estimated Parameters: Posterior Means . . . . .	56
2.5	Impulse Response Functions : Baseline . . . . .	57
2.6	Optimal Stabilisation Policy Experiments . . . . .	60
2.6.1	Can fiscal policy play a stabilisation role? . . . . .	60
2.6.2	Mixed Policy and Stabilisation role . . . . .	64
2.6.3	Summary of Findings . . . . .	66
<b>3</b>	<b>Chapter 3 : Macroprudential Policy and Capital Control : an emerging market issue</b>	<b>93</b>
3.1	Introduction . . . . .	93
3.2	Stylized Facts on Increasing Non-Core Liabilities and Reversal Risk in Emerging Economies . . . . .	97
3.3	Model and Model Features . . . . .	101
3.3.1	Model Features . . . . .	101
3.3.2	Model . . . . .	105
3.4	Model Solution and Estimation . . . . .	117
3.5	Impulse Response Function . . . . .	118
3.6	Impact of Policy Choices on Social Welfare . . . . .	120
3.7	Conclusion . . . . .	122
	Annex 3.1 . . . . .	126
	Annex 3.2 . . . . .	155

## CHAPTER 1

### CHAPTER 1 : MONETARY AND MACROPRUDENTIAL POLICY INTERACTION : BALANCE SHEET AND LENDING REGULATION

#### 1.1 Introduction

In the wake of the global financial crisis that hit the US and European economies in the late 2000s, there is an emerging consensus that macroeconomic models and policy should be redesigned (CIEPR, 2011). Therefore, policy makers have set financial stability and price stability as their primary objective. One of the follow-ups is to formulate and execute macro-prudential policy along with monetary policy.

While monetary policy with its price stability objective is associated with a single instrument, macro-prudential policy has many instruments on both the balance sheet and the lending contract side. Some balance sheet regulations are capital requirement, reserve requirements, and foreign exchange position limit. Some lending contract are loan to value (LTV) ratio and debt to income (DTI). The possible combinations of monetary policy and macro-prudential policy have also led to a large and growing model-based literature that explores the stabilizing role of macro-prudential policy in the presence of financial friction. (Zhang, 2009, Suh, 2011, Quint and Rabbanal 2011) From a Keynesian perspective, financial friction, nominal and real rigidities, and distortions are central to business cycle dynamics and associated with allocative inefficiencies. This is particularly true of emerging markets and in this case, monetary, fiscal and macro-prudential policy can be used to reduce those inefficiencies (Hammond et al, 2009) However, the question is whether the effectiveness of those policies

depends on how strong the frictions and rigidities are. Examples of frictions and rigidities include asymmetric information, incomplete markets, moral hazards and the borrower's attitude toward risk. Moreover, a rise of inter-market borrowing will lead to an increase in risk exposure of individual financial institution and that risk will be transmitted to the whole financial system (Angelini, 2011)

The next question is the coordination issue between monetary policy and macro-prudential policy, mostly from the time series dimension of macro prudential policy. The first part of this question is on how macro-prudential policy affects the existing transmission mechanism such as the credit channel of monetary policy. The next question is whether macro prudential policy has an adverse effect on the price stability goal from monetary policy, particularly for inflation targeting country such as Indonesia.

Accordingly, this research will assess two scenarios: monetary policy alone without macro-prudential policy and the combination of both monetary and macro-prudential policy. Assessment criteria for this "tango" are the volatility of household consumption, output, inflation rate, asset price, household and business lending, and bank capital. Additionally, to find the optimal policy combination, we will minimize the loss function from household utility based on the assumption that the basic goal of every public policy is to optimize social welfare.

This paper redefines the financial accelerator concept from BGG by having an integrated financial contract in which banks and borrowers share a systemic risk. Negative shocks will lead to increasing default risks, thus influencing both firms and bank balance sheets. This differs from the BGG approach where firms

constantly repay their bank loans regardless of any shock. Furthermore, unlike the BGG approach, this paper includes a financial contract between households and banks. Additionally, bank capital dynamic also gives rise to credit supplies friction. These sources of friction will interact and reinforce each other, giving more pro-cyclical force to the economy. This new perspective provides a clearer picture of emerging market financial systems than the BGG approach.

With this new perspective, we study the interaction between monetary and macro-prudential policies in stabilizing the business cycle of emerging markets, particularly Indonesia. The model includes: (i) a closed economy, (ii) two sectors (consumption goods which are non-durable and housing goods that are durable), and (iii) two types of agents (saving household and borrowing household) such that there is a credit market.

The model includes a financial accelerator concept on the borrowing household and business/entrepreneur side, such that the volatility of housing and capital prices affects the value of borrowing collateral on both agents and leads to the possibility of default. In the case of default, collateral is accrued and adding up to bank equity capital. As such, it functions as a buffer to absorb the unexpected shocks from aggregate variables. Furthermore, both monetary and macro prudential policy follow a set of rules, including a standard Taylor rule, a capital requirement rule and an LTV ratio rule. Both types of policy share a common loss function from household utility representing the emerging market social welfare. The model is parameterized and calibrated using Indonesian data.

To give a broader context, Asian countries are considered as an early runner of macro-prudential regulations, thus measures on managing credit cycles

are not a new phenomenon. The 1997 crisis was the starting point when most authorities in Asia collectively begun enforcing macro- and micro prudential regulations as a supplement to their existing monetary policy. One example is a loan and credit management on the property market. The objective of these macro-prudential measures has also been to prevent other systemic risks such as a credit crunch, following the 1997 crisis. In practice, however, most of those policy measures are performed by discretion and yet have become a built-in stabilizer (Borio, 2007)

In Indonesia, the instrument that is often used is capital adequacy requirement where Bank Indonesia (hereafter BI) changes the risk weighting of bank asset classes to respond to the post-crisis credit crunch<sup>1</sup>

Another macro-prudential regulation is the adjustments of Reserve Requirements associated with LDR, meaning the higher LDR leads to relatively lower reserves. Similar with changes in risk weights, adjustments of Reserve Requirements is to encourage lending to the private sector (Utari et al, 2012)

Although those measures are already in practice, there are still several issues about macro prudential policy in need of further research. The first issue is the level of pro-cyclicality of the financial system. Compared to its Asian fellow, pro-cyclicality in Indonesian financial market is relatively higher owing to the fact that bank is still the main source of financing, thus disruption to the supply of bank credit is transmitted to the private sectors. Moreover, since the role of foreign bank branch offices in the domestic economy are increasingly significant, any changes in country risk assessment from their head office is di-

---

<sup>1</sup>For example, in 2006, BI relaxed several regulations for banks to encourage lending after oil price crisis in 2005 such as the reduction of asset risk weight for small business credit to 85%, mortgages down to 40%, and credit to employee/retiree to 50%.

rectly translated into branch offices pro-cyclical behavior. A Second issue is the institutional change where Indonesian government separated the banking supervision function from BI into financial supervisory authority (hereafter OJK). Therefore, micro prudential and macro prudential policy will be disentangled from the central bank, leaving the monetary policy as a single tool as of 2014.

Therefore this model also incorporates the high pro-cyclicality of Indonesian financial system and imposing a joint loss function for both policy from both institutions, representing the importance of strong coordination between monetary policy and macro prudential regulation.

## 1.2 The Model

### 1.2.1 Household

There are two types of households: Saving households (thus denoted by subscript  $s$ ) which are more patient about their future consumption *forward-looking* and have access to capital markets. Their budget constraint is:

$$\begin{aligned} C_{t,s} + P_t^H I_t^{H,s} + \frac{B_t}{P_t} + D_t + e_t + T_{t,s} \\ \leq R_{t-1}^N \frac{B_{t-1}}{P_t} + R_{t-1}^D D_{t-1} + R_{t-1}^e e_{t-1} + w_t N_t^s + Div_t^f + Div_t^e \end{aligned} \quad (1.1)$$

Saving households receive wage income, income from risk-free assets, real return on deposits and bank capital, and dividends from bankers and entrepreneurs. They spend their income on consumption  $C_t^s$ , investment in housing,  $I_t^{H,s}$ , holdings of risk-free assets, real bank deposits, real bank equity capital and lump-sum tax.

Both Saving and Borrowing Households maximize the present value ( $j = s, b$ ) of expected utility which is derived from non-durable goods consumption  $C_{t,j}$ , Housing goods consumption  $H_{t,j}$  and leisure ( $= 1 - N_{t,j}$ ). Borrowing households have lower discount factor ( $\beta_b^t < \beta_s^t$ ) than saving household, representing borrowing household less patient behavior about their future consumption. Difference in time preference parameter is inspired by the seminal paper by Laocaviello (2005) that models the financial friction between these types of household. Thus, saving household always save and borrowing household always borrow around the steady state due to this time parameter distinction. Other strong assumption is that agents stay in each group forever :

$$\max E_0 \sum_{t=0}^{\infty} \beta_j^t \{ \log C_{t,j} + (1 - \gamma \epsilon_t^\gamma) \log H_{t,j} + \varphi \log(1 - N_{t,j}) \} \quad (1.2)$$

subject to the above budget constraint

Borrowing households is assumed to use housing goods as collateral against their borrowing, while default will occur when the value of the collateral drop below the debt obligation that is set upon borrowing agreement. Thus the foreclosure risk is represented by the integral part  $\int_0^{\varpi_{t-1}^{H,b}} \omega P_t^H H_t^b f(\omega) d\omega$ , an amount that borrowing household have to surrender to bank equity capital. The remaining part is fraction of borrowing household that survive from default and pay all their debt from previous period.

$$C_t^b + P_t^H [I_t^{H,b} + \int_0^{\varpi_{t-1}^{H,b}} \omega P_t^H H_t^b f(\omega) d\omega] + [1 - F(\varpi_{t-1}^{H,b})] R_{t-1}^{LH} L_{t-1}^{LH} + T_t^b \leq w_t N_t^b + L_t^H \quad (1.3)$$

The lump sum taxes paid by Borrowing households,  $T_t^b$ , are the same as those paid by Saving households.

### 1.2.2 Entrepreneurs

Entrepreneurs produce intermediate goods using constant returns to scale technology. They use capital and labor from households, entrepreneurs and bankers as follows :

$$Y_t = A_t K_{t-1}^{\alpha_k} N_t^{\alpha_n} N_{t,e}^{\alpha_{ne}} N_{t,f}^{\alpha_{nf}} \quad (1.4)$$

where  $\alpha_k + \alpha_n + \alpha_{ne} + \alpha_{nf} = 1$ . The main reason to put the labor from entrepreneurs and bankers into production function is to ensure that entrepreneur net worth and bank equity capital will be non-zero around steady state. Another reason is to mimic an emerging market structure, that entrepreneurs and bankers contribution to the economy, in terms of aggregate output, are still very small.

Thus the marginal product of capital  $K_t$  is

$$z_t = mc_t \cdot \alpha \left( \frac{Y_t}{K_{t-1}} \right) \quad (1.5)$$

followed by marginal product of labor from household, entrepreneurs and bankers respectively

$$w_t = mc_t \cdot \alpha_n \left( \frac{Y_t}{N_t} \right) \quad (1.6)$$

$$w_{t,e} = mc_t \cdot \alpha \left( \frac{Y_t}{N_{t,e}} \right) \quad (1.7)$$

$$w_{t,f} = mc_t \cdot \alpha \left( \frac{Y_t}{N_{t,f}} \right) \quad (1.8)$$

Here, for simplification, labor supply for both the entrepreneurs and the bankers will be fixed at 1

The balance sheet structure for entrepreneur will be

$$W_t = \nu V_t + w_{t,e} \quad (1.9)$$

where entrepreneur net worth  $W_t$  is equal to retained earnings  $\nu V_t$  with real wage from entrepreneurs  $w_{t,e}$ . The fraction  $(1 - \nu)V_t$  is the dividend that goes to saving household every period.

The entrepreneur earning  $V_t$  is the project return net of the borrowing expenditures

$$V_t = \int_{\varpi_{t-1}^{H,b}}^{\infty} \omega R_t^K q_{t-1} K_{t-1} f(\omega) d\omega - (1 - F(\varpi_{t-1}^{H,b})) R_{t-1}^{LB} L_{t-1}^{LB} \quad (1.10)$$

where  $\omega$  is a unit mean, idiosyncratic shock experienced by the individual entrepreneur after project has started where  $\int_0^{\infty} \omega dF(\omega) = 1$  and  $\varpi^b$  is the default threshold.  $\int_{\varpi_{t-1}^{H,b}}^{\infty} \omega R_t^K q_{t-1} K_{t-1} f(\omega) d\omega$  denotes the payoff for entrepreneur in case of the value of the project is at least as big as the borrowing amount as collateral. However in the case of default when there is a negative shock that ( $\omega < \varpi^b$ ), the project will be accrued by the bank and add up to the bank equity capital. Finally the  $(1 - F(\varpi_{t-1}^{H,b})) R_{t-1}^{LB} L_{t-1}^{LB}$  part denotes the "default survival" debt repayment that matures on each period.

### 1.2.3 Capital Producer

At the beginning of each period, the capital producer purchases  $I_t$  amounts of consumption goods at a price of one and turns them into the same amount of new capital. Transformation costs arise during the process and at the end of the period they resell new

capital to entrepreneurs at price  $q_t$ . The law of motion for capital stock is given by

$$K_t = I_t + (1 - \delta)K_{t-1} \quad (1.11)$$

The capital producer optimization is defined by

$$\max_I (q_t - 1)I_t - f\left(\frac{I_t}{K_{t-1}}\right)K_{t-1}$$

where  $f(\dots)$  is a simple quadratic form of

$$f\left(\frac{I_t}{K_{t-1}}\right) = \frac{\chi_k}{2} \left(\frac{I_t}{K_{t-1}} - \delta\right)^2 K_{t-1}$$

and the first order condition resulted in capital price

$$q_t = 1 + f'\left(\frac{I_t}{K_{t-1}}\right) \quad (1.12)$$

### 1.2.4 Aggregation

Aggregate variable can be derived by summing up saving and borrowing household such as

$$I_t^H = I_{t,s}^H + I_{t,b}^H \quad (1.13)$$

$$N_t^H(S) = N_{t,s}^H + N_{t,b}^H \quad (1.14)$$

where  $N_t^H(S) = N_t^H(D)$

### 1.2.5 Financial Contract

In the literature about financial friction that developed way long before the current financial crisis are the seminal paper by Bernanke in 1999, where financial frictions between household and firm through bank have been incorporated into a general equilibrium framework. In this approach, frictions come from the fact that loan monitoring is costly that drives an external finance premium concept between the lending and the risk free rate. The recent version of this BGG approach was Kannan et al, 2009 assessing macroprudential policy impact to advanced economy. Second mainstream was introduced by Kiyotaki and Moore, 1997(henceforth KM), extended by Iocaviello, 2005 and the recent study by Angelini, 2011 where financial frictions is modeled through collateral constraint.

The contracts in this model were inspired by Suh, 2011 and Zhang, 2009

which used the refined BGG mechanism. While the line of KM does not model default probability of the borrower, Suh and Zang have modeled the default probability through an idiosyncratic shock and compare it to the default threshold level. Secondly, there exist bank equity capital that function as capital buffer that absorbs the unexpected shocks in aggregate variables. With the ex-ante and ex-post default threshold, there will be a forecast discrepancies for either capital or housing price resulted from those aggregate shocks. That forecast error is translated into gain or loss on bank capital, thus functioning bank capital as the buffer stock. Differs from Suh, this model tried to compensate the markup regulation from macroprudential rule violation to bank capital as well as on the funding rate. Therefore the mechanism is differs from pure BGG approach.

### **Entrepreneur Business Loan**

We begin with entrepreneur loan contract. At the beginning of each period  $t$ , the loan demand for individual entrepreneur  $i$  is determined by the gap between his investment project and his endowment in terms of net worth

$$L_t^{B,i} = q_t K_t^i - W_t^i \quad (1.15)$$

where  $\varpi_t^{i,a}$  is the ex-ante threshold idiosyncratic level that determines default probability of an entrepreneur.

Then the gross repayment amount will be equal to expected project return such as

$$R_t^{LB} L_t^{LB} = \varpi_t^{i,a} E_t R_{t+1}^K q_t K_t \quad (1.16)$$

therefore the entrepreneur will maximize his expected return net with debt payback

$$E(V_{t+1}) = \int_{\varpi_t^{i,a}}^{\infty} \omega E_t R_{t+1}^K q_t K_t f(\omega) d\omega - (1 - F(\varpi_t^{i,a})) R_t^{LB} L_t^{LB} \quad (1.17)$$

subject to contract constraint where entrepreneur should provide the same expected return to the bank as its funding cost for the project

$$R_t^f (q_t K_t^i - W_t^i) = (1 - F(\varpi_t^{i,a})) R_t^{LB} L_t^{LB} + (1 - \mu) \int_0^{\varpi_t^{i,a}} \omega E_t R_{t+1}^K q_t K_t f(\omega) d\omega \quad (1.18)$$

$\mu$  is the monitoring cost from BGG approach that represents "costly state verification". This problem arises between the entrepreneur and bank and bank will incur this cost in the case of default.

From the above optimization problem we can derive the external finance premium concept that resembles the BGG financial accelerator mechanism as follows :

$$\frac{E_t R_{t+1}^K}{R_t^f} = S\left(\frac{q_t K_t}{W_t}\right) \quad (1.19)$$

where  $S$  is increasing in  $(\frac{q_t K_t}{W_t})$ , thus implying that the external finance premium term  $\frac{E_t R_{t+1}^K}{R_t^f}$  is also increasing in the net-worth ratio leverage ratio, representing financial accelerator mechanism in the model. For example, when a positive shock improves the net-worth of entrepreneur, his improving balance sheet condition enables him to further increase his investment with lower premium.

From 1.16 the return from business loan  $R_t^{LB}$  is  $\frac{\varpi_t^{i,a} E_t R_{t+1}^K q_t K_t}{L_t^{LB}}$  and since for period t+1, ex-post productivity threshold  $\varpi_t^b$  will be

$$\varpi_t^b = \frac{R_t^{LB} L_t^{LB}}{R_{t+1}^K q_t K_t} = \frac{\varpi_t^a E_t R_{t+1}^K}{R_{t+1}^K} \quad (1.20)$$

## Household Loan

Household loan contract use the similar refined BGG mechanism as of entrepreneur loan contract. With an an idiosyncratic housing price shock  $\omega^{H,i}$  that hits an individual borrowing household  $i$  every period. Default will happen if the value of housing as collateral is less than the household loan contract, when the idiosyncratic shock is less than a cutoff level  $\varpi^{H,i}$

The household loan contract can be defined as :

$$R_t^{LH} L_t^{H,i} = \varpi^{H,i,a} E_t P t_{t+1}^H H_{t+1,b}^i \quad (1.21)$$

where the expectation term  $E_t P t_{t+1}^H H_{t+1,b}^i$  is the is the expected value of the housing collateral from the borrowing household. Thus, similar with entrepreneur, bank will set the value of the loan contract equal to the expected return from borrowing household, which is

$$\begin{aligned} & (1 - F(\varpi_t^{H,i,a})) R_t^{LH} L_t^{LH} + (1 - \mu^H) \int_0^{\varpi_t^{H,b}} \omega E_t P t_{t+1}^H H_{t+1,b}^i f(\omega) d\omega \quad (1.22) \\ & = (R_t^f + v + Q(ltv_t - \overline{ltv}_t)) L_t^{H,i} \end{aligned}$$

We assume that  $R_t^{LH}$  and  $\varpi_t^{H,a}$  are set to satisfy 1.21 and 1.22, given  $L_t^{H,i}$  and  $E_t P t_{t+1}^H H_{t+1,b}^i$ .

Noting that there are a markup  $v$  in household loan contract which assumed the the proceed from this markup goes into saving household as dividend income, and the regulatory markup  $Q(ltv)$  that capture loan to value ratio violation above the LTV rule. In this case, borrowing household has to pay an additional regulatory penalty in terms of higher interest payment, for taking higher LTV ratio above the target LTV set by macroprudential regulator.

### 1.2.6 Bank

There is a bank as a homogeneous intermediary agent with a standard balance sheet : In the liability side consists of two channels of financing: deposits and equity capital. Its asset side consists of business and household lending. One of the feature here that is bank funding rate decision ( $R^f$ ) charged to household and entrepreneur is determined by adding a regulatory markup to the actual funding rate, which is a weighted average of the deposit rate ( $R^D$ ) and the return on bank capital ( $R^e$ )<sup>2</sup>. The additional term of regulatory markup try to capture the restriction imposed on the banking sector by the regulatory authority, as a function of the difference between the required capital ratio and the actual capital ratio

$$R_t^f = \kappa_t R_t^e + (1 - \kappa_t) R_t^D + s(\bar{\kappa}_t - \kappa_t) \quad (1.23)$$

where the actual capital ratio  $\kappa_t = \frac{e_t}{L_t}$  is the weight factor between the deposit rate ( $R^D$ ) and the return on bank capital ( $R^e$ ) and the bank funding rate ( $R^f$ ) is

---

<sup>2</sup>this structure captures bank interest rate rigidities phenomenon in Indonesia. On the counter deposit rate is relatively flexible following the benchmark risk free rate (Bank Indonesia Certificate) but the funding rate is relatively rigid.

an increasing function of regulation markup  $s(\bar{\kappa}_t - \kappa_t)$ . Violation over capital ratio regulation will be translated into the higher bank funding rate that reflect banks managerial decision upon the regulator corrective measure

Bank capital,  $e_t$ , where  $e_t = L_t - D_t$ , owned by saving households, and functions as a buffer stock to absorb the discrepancies between expected returns and actual returns from both borrowing household and business lending. It gets accumulated when the actual return from the capital price or the housing price is not lower than the expected return upon which the loan contract for either entrepreneur or borrowing household is written, and deaccumulated vice versa. Also, it is assumed that fraction of bank capital is paid off to saving households as dividends. This is similar to a transversality condition that prevents bank capital from being over accumulated as well as representing wealthy saving household (income polarity in the emerging market). The law of motion for the bank capital is given as follow :

$$\begin{aligned}
e_t = & (1 - \phi)e_{t-1} \\
& + (1 - F(\varpi_t^{H,i,a}))R_{t-1}^{LH}L_{t-1}^{LH} + (1 - \mu)\int_0^{\varpi_t^{H,i,a}} \omega P_t^H H_{t-1,b}^i f(\omega) d\omega \\
& + (1 - F(\varpi_t^{H,i,a}))R_{t-1}^{LB}L_{t-1}^B + (1 - \mu)\int_0^{\varpi_t^{H,i,a}} \omega R_t^K q_{t-1} K_{t-1} f(\omega) d\omega \\
& - R_{t-1}^f (L_{t-1}^{LB} + L_{t-1}^{LH}) + w_{t,f} + \epsilon_t^e
\end{aligned} \tag{1.24}$$

with  $\epsilon_t^e$  as the exogenous shock in bank equity capital. The above equation can be rewritten by collecting the c.d.f and loan type as follows :

$$\begin{aligned}
e_t &= (1 - \phi)e_{t-1} + w_{t,,f} \\
&+ ((F(\varpi_{t-1}^{H,a}) - F(\varpi_{t-1}^{H,b}))R_{t-1}^{LH}L_{t-1}^{LH} + (1 - \mu)\int_{\varpi_{t-1}^{H,a}}^{\varpi_{t-1}^{H,b}} \omega P_t^H H_{t-1,b}^i f(\omega) d\omega \\
&+ ((F(\varpi_{t-1}^a) - F(\varpi_{t-1}^b))R_{t-1}^{LB}L_{t-1}^B + (1 - \mu)\int_{\varpi_{t-1}^a}^{\varpi_{t-1}^b} \omega R_t^K q_{t-1} K_{t-1} f(\omega) d\omega \\
&+ \epsilon_t^e
\end{aligned}$$

so that the forecast discrepancies of the collateral value for both entrepreneur and borrowing household can accumulate or deaccumulate bank equity capital. For example when the realized value or ex-post value of  $R_t^K$  or  $P_t^H$  is lower than its expected value or ex-ante value, we will have  $(\varpi^b > \varpi^a)$  for entrepreneur or  $(\varpi^{H,b} > \varpi^{H,a})$  for saving household, consequently  $((F(\varpi^a) - F(\varpi^b) < 0)$  or  $((F(\varpi^{H,a}) - F(\varpi^{H,b}) < 0)$  respectively, thus bank equity capital will be deaccumulate, vice versa.

## 1.2.7 Retailers

Following Calvo (1983), differentiated retailer firms set prices in a staggered fashion. Each firm resets prices with probability  $(1-\theta)$  each period, while a fraction  $\theta$  index prices to last period's inflation. Firms that do not optimize at time  $t$  index prices to a geometric average  $\Gamma_{p,t}$  of last period's inflation and the inflation target:

$$\Gamma_{p,t} = \Gamma_{p,t-1} (1 + \pi_{t-1})^{\gamma_H} (1 + \bar{\pi})^{1-\gamma_H}$$

where  $\gamma_H$  is the share of nonoptimising firms that index to past inflation. A firm resetting its price in period  $t$  optimizes the present value of expected profits

subject to the dynamics of aggregate inflation and demand from final goods producers

$$\max E_t \sum_{k=0}^{\infty} \theta_p^k \Lambda_{t+k} [Y_{t+k} P_{i,t}^* - MC_{t+k} Y_{t+k}]$$

$P_{i,t}^*$  represents the price chosen by a firms that repotimises at time  $t$ . The first order condition for optimal price setting in period  $t$  is:

$$E_t \left( \sum_{k=0}^{\infty} \theta_p^k \Lambda_{t+k} Y_{i,t+k} P_{i,t}^* \Gamma_{p,t+k} - (1 + \lambda_{p,t+k}) MC_{t+k} \right) = 0$$

This setup leads to the following inflation dynamics:

$$\beta E \pi_{t+1} = \pi_t - (1 - \beta \theta) \frac{1 - \theta}{\theta} mc_t + \epsilon_t^\pi \quad (1.25)$$

where  $mc_t$  is the log deviation of real marginal cost from steady state, and  $\epsilon_t^\pi$  is an iid cost push shock.

In steady state the price is set as a markup over marginal cost. In the limit where all firms reoptimise ( $\theta = 0$ ), the price is set equal to marginal cost.

### 1.2.8 Monetary Policy

Monetary policy is assumed to follow a Taylor-type rule that is sensitive to inflation above target and to the log deviation of output from steady state,  $y_t$ :

$$R_t^N = \rho_r R_{t-1}^N + (1 - \rho_r) \left[ \varphi_\pi \hat{\pi}_t + \varphi_y \hat{Y}_t \right] + \epsilon_t^R \quad (1.26)$$

### 1.2.9 Macroprudential Regulation

The regulatory authority, either central bank or separate financial supervisory body sets the target capital requirement ratio  $\bar{\kappa}_t$  and target Loan to-Value ra-

to  $\overline{ltv}_t$ , according to rules that systemically react to observable macro variables such as output, credit, or housing prices.

### Capital Requirement Regulation

The functional form of regulatory markup for capital requirement is

$$s(\bar{\kappa}_t - \kappa_t) = \nu_a^\kappa ((\exp[\nu_b^\kappa (\bar{\kappa}_t - \kappa_t)/\kappa]) - 1) \quad (1.27)$$

$$\bar{\kappa}_t = \rho_\kappa \bar{\kappa}_{t-1} + \varphi_Y^\kappa \hat{Y}_t + \varphi_L^\kappa \hat{L}_t \quad (1.28)$$

### Loan-to-Value Regulation

$$Q(ltv_t - \overline{ltv}_t) = \nu_a^H ((\exp[\nu_b^H (ltv_t - \overline{ltv}_t)/\overline{ltv}]) - 1) \quad (1.29)$$

$$\overline{ltv}_t = \rho_{ltv} ltv_{t-1,r} - \varphi_{PH}^{ltv} \hat{P}_t^H \quad (1.30)$$

where  $\nu_a$  is the level of intervention and  $\nu_b$  is the level of responsiveness of macroprudential regulation<sup>3</sup>

The target capital requirement ratio and target LTV ratio function are linear in log-linearized terms, similar to Taylor-rule type monetary policy, and are

---

<sup>3</sup>An exponential function allows regulator to impose heavier penalty based on the deviation from the rule and minus one is intended to avoid penalty in the intercept region when the deviation from the rule is zero.

allowed to have some degree of policy inertia since in practice, capital requirement and LTV target are relatively rigid.

The concept of dynamic capital requirement is adopted from the counter-cyclical capital buffer concept in Basel III that bank should conserve capital in good times that can be used in bad times. Since the common reference point for taking buffer decision is the behavior of the credit to GDP, credit and GDP variable enter the equation rule in log linear form, meaning bank is required to accumulate more capital during credit boom or good economic cycle, vice versa.

### 1.2.10 Fiscal Policy

Fiscal Policy is simply clears the market by balancing government expenditure  $G_t$  which is financed by lump-sum taxes from both households  $T_{t,s}$  and  $T_{t,b}$ , as well as risk-free assets issuance  $B_t$  purchased by saving household

$$G_t = T_{t,s} + T_{t,b} + B_t \quad (1.31)$$

### 1.2.11 Aggregate Equilibrium

Market clearing conditions for final goods is written as

$$\begin{aligned} Y_t/s_t = & C_{t,b} + C_{t,s} + q_t I_t + P_t^H I_t^H + G_t \\ & + \mu \int_0^{\varpi_{t-1}^b} \omega R_t^K q_{t-1} K_{t-1} dF(\omega) \\ & + \mu \int_0^{\varpi_{t-1}^{H,b}} \omega P_t^H H_{t,b}^i dF(\omega) + \varsigma_t \end{aligned} \quad (1.32)$$

Note that the last two terms on the right-hand-side of the equation correspond to monitoring cost and regulatory penalty where  $\varsigma_t$  denotes the terms representing the resource usage by regulatory penalties.

### 1.3 Parameter Calibration

Several parameter value are chosen from several new Keynesian literatures in Indonesia such as monetary-fiscal interaction as in Hermawan, Munro (2008), and financial friction as in Tjahjono (2010) and Harmanta, et al (2012), including the quarterly discount factor, frisch-labor supply elasticity, capital share, depreciation rate, and steady state share of consumption and investment expenditure from total output.

In the production sector, the share of capital, labor, entrepreneur labor, and banker labor in the Cobb-Douglas production function is chosen to be 0.30, 0.68, 0.01, and 0.01, respectively, in line with the fact that the Labor intensive industry still dominates Indonesian economy, particularly low-income labor.

Table 1.1: Calibrated Parameter

	value	Description		value	Description
$\beta$	0.99	Discount factor, savers	$\nu_c$	0.0071	Markup in household lending
$\beta_b$	0.98	Discount factor, borrowers	$\rho_A$	0.85	Autocorrelation, productivity
$\gamma$	0.9	Weight of housing in the utility	$\rho_\gamma$	0.95	Autocorrelation, housing demand
$\varphi$	2	Weight of labor in the utility	$\rho_G$	0.8	Autocorrelation, fiscal policy
$\alpha_k$	0.30	Weight, capital in the production	$\rho_r$	0.85	Autocorrelation, monetary policy
$\alpha_n$	0.68	Weight, households' labor in the production	$\rho_\kappa$	0.9	Autocorrelation, Capital Requirement
$\alpha_e$	0.01	Weight, entrepreneurs' labor in the production	$\rho_{ltv}$	0.9	Autocorrelation, target LTV ratio
$\alpha_f$	0.01	Weight, bankers' labor in the production	$\phi_\pi$	1.5	Monetary policy response to inflation
$\delta$	0.025	Capital Depreciation	$\phi_H$	0.1	Monetary policy response to output gap
$\nu$	0.973	Entrepreneur profit retention rate	$SE_G$	0.004	SE, government spending shock
$\sigma$	0.44	SD, idiosyncratic shock, business	$SE_r$	0.0003	SE, monetary shock
$\sigma_H$	0.13	SD, idiosyncratic shock, housing price	$SE_e$	0.0045	SE, bank capital shock
$\phi$	0.035	Bank dividend rate	$SE_a$	0.0063	SE, productivity shock
$\psi_k$	4	Capital adjustment cost	$SE_\gamma$	0.0011	SE, housing demand shock
$\frac{I^H}{Y}$	0.03	Housing investment / output	$\nu_a^I$	0.0025	Degree of regulatory intervention, CRR
$\frac{G}{Y}$	0.17	Government spending / output	$\nu_b^I$	25	Degree of regulatory sensitivity, CRR
$\mu$	0.09	Default cost, business	$\nu_a^H$	0.0025	Degree of regulatory intervention, LTV
$\mu^H$	0.15	Default cost, household	$\nu_a^H$	25	Degree of regulatory sensitivity, LTV

Table 1.2: Steady State Ratio

Variable	Steady state ratios	Calibrated Value
$\frac{C}{Y}$	Consumption output ratio	0.64
$\frac{I}{Y}$	Investment output ratio	0.20
$\frac{I^H}{Y}$	Housing investment output ratio	0.03
$\frac{G}{Y}$	Government expenditure output ratio	0.13
$\frac{L^B}{L^H}$	Business - consumer lending ratio	3.5
$\frac{L^H}{Y}$	Consumer lending output ratio	0.25
$R$	Deposit rate	4

## 1.4 Second Moment Comparison and Model Fit

In the model fit part, we present the standard deviation of some of the key variables from data., as well as their counterpart from the calibrated model. In the table 4, the first row represents the data and the second row is the unconditional moments from the calibrated model, both in percentage terms. Particularly for credit data, loan for entrepreneurs is represented by the total of working capital and investment credit, while the housing loan is represented by consumer

loan. The model does reasonably well in capturing macro variables such as consumption and real GDP. However, model volatility outperform the volatility of prices and quantities, such as inflation and credit, despite the assumption of different degree of nominal rigidities, indexation and different standard deviation of shocks. Apparently, structural changes following the Asian crisis has lead to the less pronounced business cycle for the later time period. On the other hand, high persistence of CPI inflation and the procyclicality of financial market in Indonesia are still relatively hard to fit.

Table 1.3: Second Moment Comparison

$\Delta \log C$	0.96
model	(1.16)
$\Delta \log Y$	1.67
model	(1.95)
$\Delta \log \pi$	0.24
model	(0.30)
$\Delta \log L_b$	11.81
model	(8.39)
$\Delta \log L_h$	2.19
model	(1.89)

## 1.5 Impulse Response Functions

Impulse Response functions (hereafter IRF), shown in Appendix A, evaluate the effects of macroprudential policy on several domestic economy variables such as Consumption, Investment, GDP, Policy rate, Housing price, Consumer loan, Business loan, Inflation rate, and Bank capital. First comparison scenario is between baseline policy with only monetary policy against capital regulation policy which is a tango policy of monetary policy and capital regulation policy.

Next scenario is policy comparison between monetary policy and loan to value ratio.

A one standard deviation productivity shock from baseline scenario implies a rise in consumption, investment and GDP as well as decline on inflation rate. Consumption increase leads to housing demand increase thus housing price also rise due to exogenous housing supply. From financial system, central bank respond low inflation with declining policy rate which further reduces the cost of fund. Therefore both both business and consumer lending increase. On the contrary, from monetary policy and macroprudential capital regulation scenario, capital requirement respond to increase in both business and consumer credit. Accordingly credit expansion stabilize more quickly than in baseline scenario, thus higher bank capital is also required as a "buffer in the good time" scenario. Consequently, consumption, investment and GDP is still increase but relatively stable than baseline scenario. The tango between monetary and macroprudential policy resulted in lower policy rate, meaning macroprudential policy helps easing the burden on monetary policy to stabilize the business cycle.

A one standard deviation on bank capital shock implies a direct shock to financial system such as an increasing amount of non-performing loans. This shock leads to a loss on bank capital. With more restricted equity capital, banks tend to shrink their loan to business and households. The credit crunch will further deteriorate the economy, particularly consumption and investment, GDP and inflation. As a result, central bank help the economic recovery by sharply lowers interest rate. On the other hand, when monetary policy interact with countercyclical capital requirement scenario, banks are allowed to accumulate less capital. Therefore, decline in both business and consumer lending are more

moderate and the impact to the recessionary pressure to macro variables is relatively less severe. This result confirms the strong procyclicality of financial system in Indonesia where bank is the major financing source for private sector and financial shock will have big impact to the business cycle.

A one standard deviation productivity shock from monetary and macroprudential loan to value regulation scenario implies similar countercyclical power to the economy as of capital requirement scenario. In this case, dynamic LTV rule is successful in stabilizing housing price upon a productivity shock with two quarters lag. Stronger regulation from dynamic LTV rule dampens household lending expansion and the rise in housing price. It is noticeable that there is regulatory arbitrage - a substitution of credit from the regulated consumer lending to the less regulated business lending. As a result, business lending is higher than in the baseline model. In this case, a segmented regulation to some extent can amplify the volatility of other markets by regulatory arbitrage behavior. Two suspected forces drive this arbitrage behavior. First, the cost of fund for business lending becomes relatively cheaper than consumer lending. Secondly, bank capital is higher with LTV rule, which leads to more loanable fund for bank to facilitate more lending.

An exogenous housing demand shock is interpreted as a decline in the housing price or durable goods. The housing price drop leads to lower LTV rule, dampening the negative impact from household default. The fall of housing prices is mainly absorbed by lower bank capital from default events. Another result of lower LTV is the increasing consumer loan but since the appetite for new housing investment falls, demand for business loan also decreasing, signaling another regulatory arbitrage.

## 1.6 Policy Impacts on Business Cycle Stabilization

The following section identifies the stabilization effect from the baseline scenario, comparing with the policy mix scenario (appendix B). The first comparison is between monetary policy alone and a combination between monetary policy and the countercyclical capital requirement. The numbers in the first table are standard deviation decompositions of consumption, output, inflation, housing price, business lending, household lending and bank capital. It is observed that the policy mix reduces the volatility of consumption, investment, GDP, housing prices, particularly business and consumer lending. The important finding is the relatively neutral impact of this policy mix to inflation rate. Therefore, this type of policy mix is considered to be the optimal policy for business cycle stabilization.

The second comparison is between monetary policy alone and the policy mix between monetary policy and an LTV rule, as presented in the second table. In terms of the achieving its objective, an LTV rule is able to stabilize housing price and credit to consumer. However, the regulatory arbitrage behavior occurs and creating more volatile credit to business. This volatility leads to more swing on business cycle, notably investment, GDP and inflation rate. This result strongly suggests that policymakers need to be aware of the possibility of regulatory arbitrage when implementing a segmented regulatory measure. Moreover, there is a possibility of conflict with monetary policy objective in terms of managing inflation.

## 1.7 Optimal Policy Mix

The next question is about the optimal policy mix between monetary policy and macro prudential policy. The criteria to achieve the optimal combination of policy parameters are by maximizing a welfare gains. For the welfare measure, we use the average households' utility between the saver and borrower household to equally capture welfare from all households

To find the optimal parameter value, we adopt grid search method and we restrict the parameter value bounded to an empirically consistent range such as Taylor principle for Taylor rule. Therefore, the range for monetary policy parameters is between 1.2 to 3 and 0 to 1 for inflation gap and output gap parameter respectively. Particularly for macro prudential policy parameters, their values are bounded between 0-2 ranges. The grid size is 0.2 and there are three scenarios and three regimes.

In the Baseline scenario, only monetary policy performs using the calibrated parameters that is 1.5 and 1 respectively and no macro prudential instruments in this scenario. The Optimal scenario is similar with the previous scenario where only monetary policy performs but using the optimal parameters from grid search. Lastly, the Optimal Mix scenario is the optimal monetary and macro-prudential policy parameters combination with grid search.

In the Stable regime, business cycle is characterized only by productivity shock without any disruption from financial market or asset price, followed by Normal regime where business cycle are characterized by productivity shock, decrease in bank capital and drop in housing demand. The magnitude in those two regimes follows the calibrated baseline model. In the Volatile scenario, the

magnitude of shocks from normal scenario are doubled, meaning more volatile productivity, banking and housing shocks

The result in table 2, Appendix C suggests the optimal policy combinations and welfare gains for each regime. For the stable scenario where only the productivity shock drives the business cycle, optimal scenario where monetary policy follows a strong Taylor principle (3 for inflation gap and 0.2 for output gap) is the optimal policy with 0.088% relative welfare gain. However, for normal scenario when bank capital and housing demand shocks jointly add the procyclicality of the business cycle, then the policy mix between hawkish monetary policy and macro prudential policy is the optimal policy with welfare gain of 0.678%. Finally, for volatile scenario where all shocks from previous scenario are doubled meaning stronger procyclicality of business cycles, more aggressive policy mix is the optimal policy, although the welfare gain is slightly lower than normal scenario. From this assessment, monetary policy will perform optimally under cycle from inflationary shock but when financial and asset shocks exist, policy mix with macro prudential policy is the optimal policy.

## 1.8 Conclusion

Based on a simple calibrated DSGE model, we can model unique feature of Indonesia as the prototype of emerging market model. Financial friction do plays an important role since banking activities still dominate the Indonesian economy, mainly through middle-class household financing followed by corporations financing, although the share of the latter is smaller empirically. We also introduced rule based countercyclical macro prudential policy that does func-

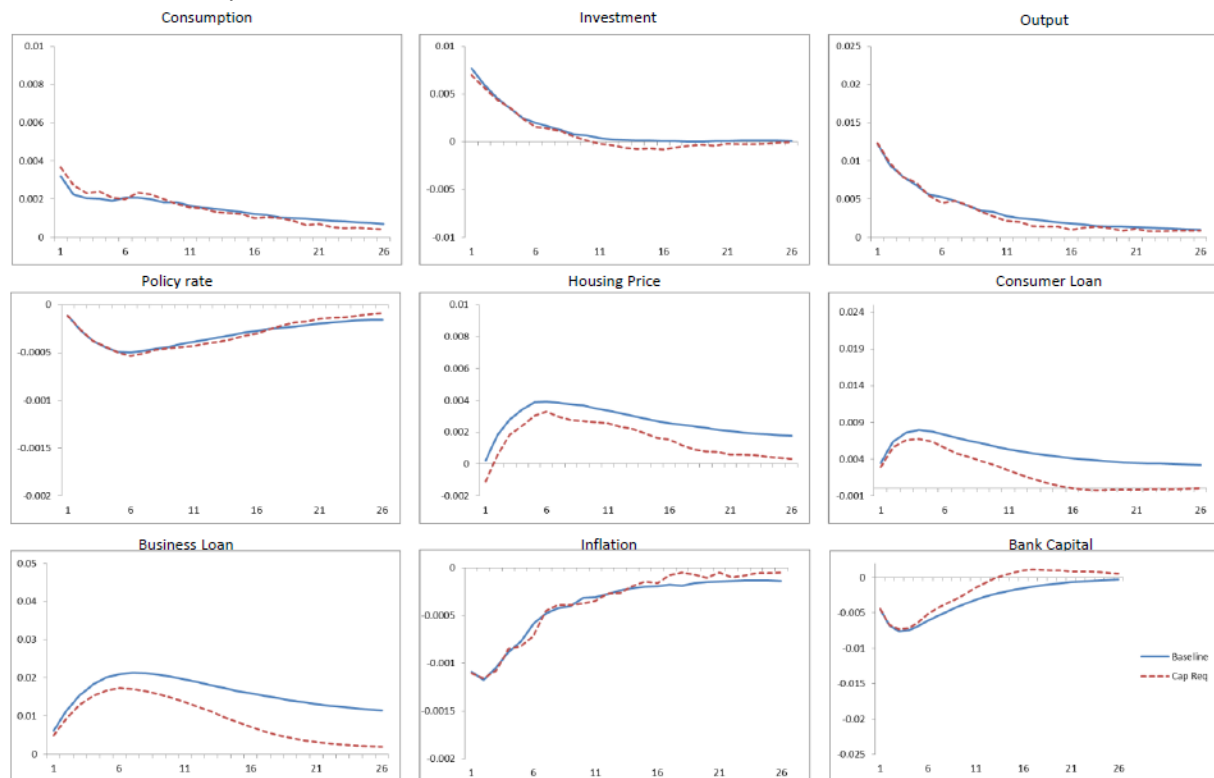
tion as an additional automatic stabilizer for Indonesian economy, together with monetary policy. The first macro prudential policy instrument is the countercyclical capital requirement ala Basel III, which directly influencing both households and corporate financing, can lower credit and output volatility, and relatively effective against bank capital shocks but relatively neutral to inflation. Other countercyclical instrument is LTV ratio, however, with massive bank liquidity; bank can do regulatory arbitrage by financing other unregulated credit market. In this model, under strict LTV scenario, bank financing goes to finance corporate credit. Empirically, although the growth of corporate financing is lower than the one of households but the level or the magnitude is higher thus casts regulators another important challenge. Another important feature in this model is the exponential penalty function to any violation from the macro prudential rule. It implies that general enforcement of macro prudential rule is preferable than case by case or discretion. In addition, it is important to have a common loss function to ensure the optimal interaction between monetary and macro prudential policy. Policy recommendation from this research is to assign monetary policy solely to inflation stabilization and macro prudential policy solely to credit and asset price stabilization. However, with extra volatility or countercyclical power, aggressive monetary and macro prudential policy and the asset side tend to decrease welfare gain. Therefore, in the third chapter, we will model an open economy with global banking glut and flight to quantity to assess the possibility of additional policy instrument

## Appendix A

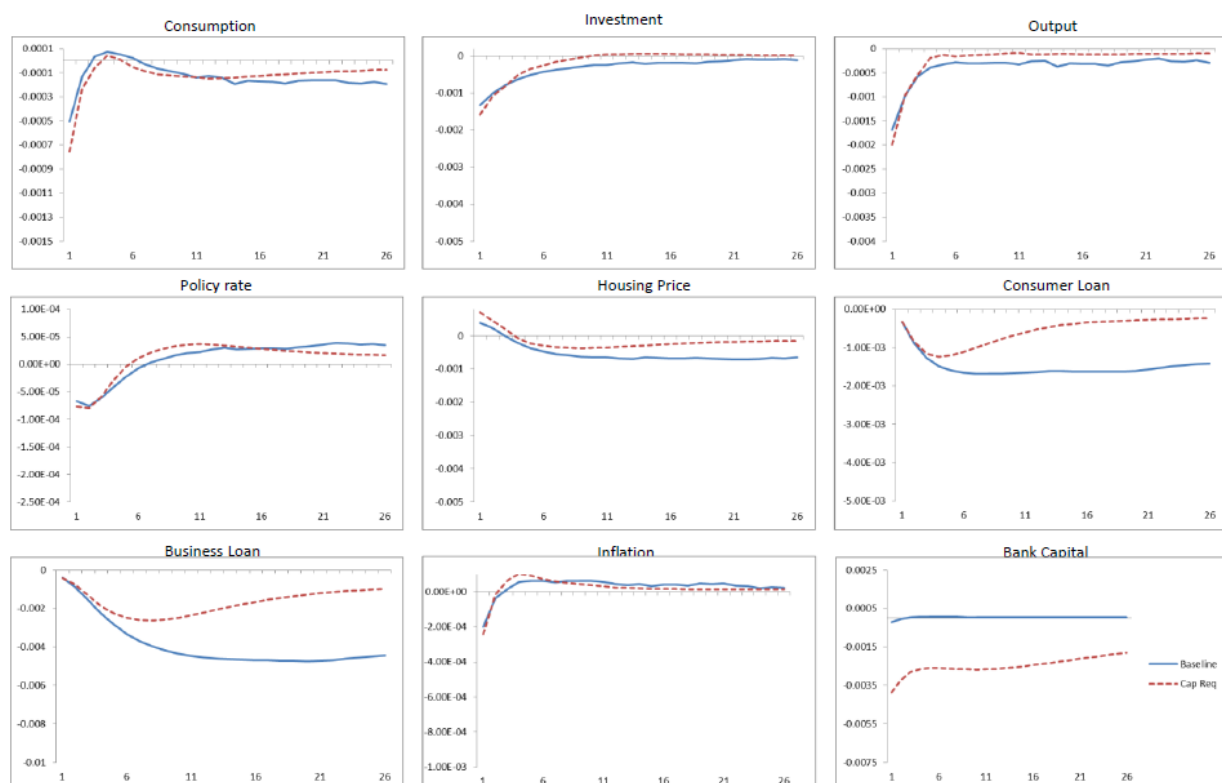
### Impulse Response Function

Baseline (Monetary Policy) and Cap req (Policy Mix – Monetary Policy and Capital Requirement)

Positive Productivity shock

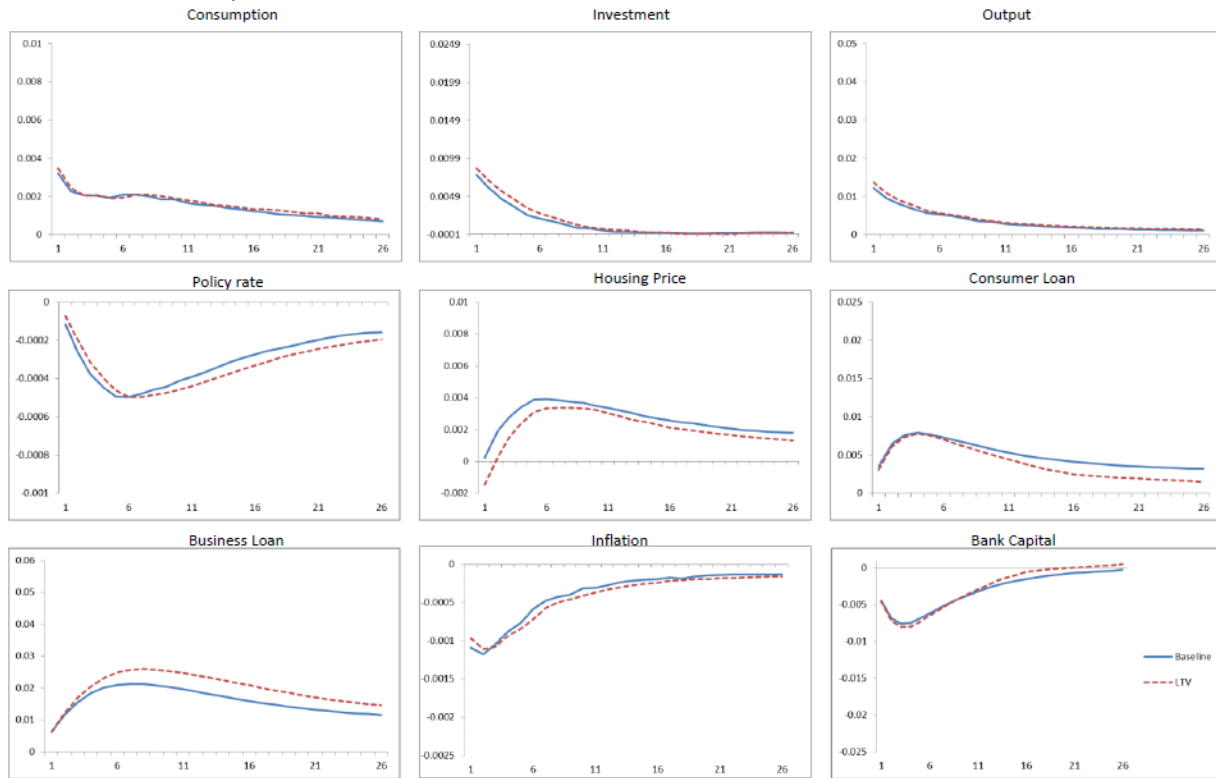


Negative bank capital shock

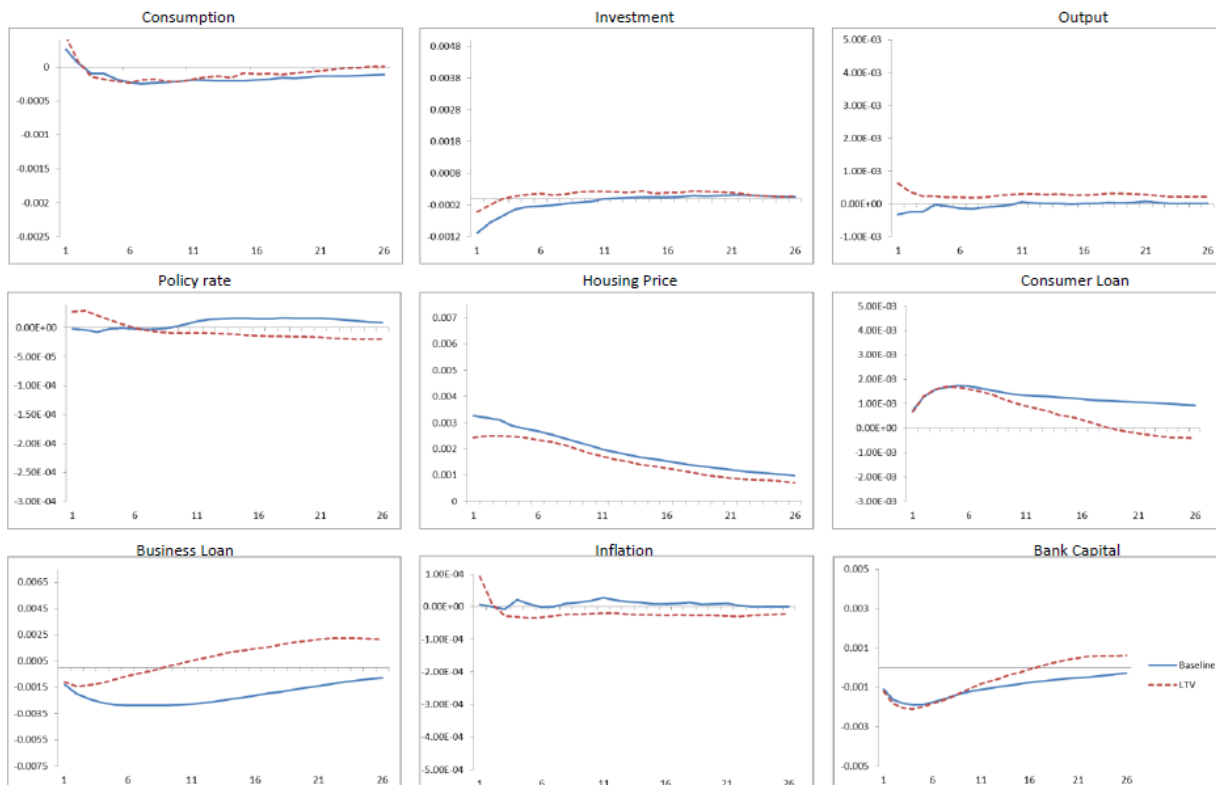


## Baseline (Monetary Policy) and LTV (Policy Mix – Monetary Policy and Loan to Value ratio)

### Positive Productivity Shock



### Negative Housing Demand Shock



Appendix B  
Policy Impacts on Business Cycle Stabilization

Baseline and Capital requirement policy mix

Variable	Baseline	Cap Req	change
C	0.0092	0.008	-13.04%
I	0.0125	0.0096	-23.20%
Y	0.0246	0.0204	-17.07%
pi	0.0027	0.0027	0.00%
P_h	0.0207	0.0139	-32.85%
R_n	0.0018	0.0017	-5.56%
L_b	0.107	0.0432	-59.63%
L_h	0.0346	0.0142	-58.96%
e	0.0277	0.0209	-24.55%

Baseline and LTV policy mix

Variable	Baseline	LTV	change
C	0.0092	0.0094	2.17%
I	0.0125	0.0142	13.60%
Y	0.0246	0.0267	8.54%
pi	0.0027	0.0029	7.41%
P_h	0.0207	0.0153	-26.09%
R_n	0.0018	0.002	11.11%
L_b	0.107	0.1301	21.59%
L_h	0.0346	0.0231	-33.24%
e	0.0277	0.0244	-11.91%

## Appendix C

### Optimal Policy Mix

Three Regimes: Stable, Normal, Volatile

Three Scenarios: Baseline, Optimal, Optimal Mix

Policy Regime	Shocks	Policy Parameter					Welfare	Gain
		Monetary		Macroprudential				
		$\phi\pi$	$\phi y$	$\phi l$	$\phi y$	$\phi ph$		
Baseline	Stable	1.5	0.1	-	-	-	-130.8698	-
	Normal	1.5	0.1	-	-	-	-131.0121	-
	Volatile	1.5	0.1	-	-	-	-131.2036	-
Optimal	Stable	3.0	0.2	-	-	-	-130.9847	0.088%
	Normal	3.0	0.6	-	-	-	-131.0146	0.002%
	Volatile	3.0	0.6	-	-	-	-131.2122	0.007%
Optimal mix	Stable	3.0	0.2	0.4	0	0.2	-130.8726	0.002%
	Normal	3.0	0.2	2.0	0	0.2	-131.8998	0.678%
	Volatile	3.0	0.6	2.0	0	2.0	-131.9302	0.554%

## CHAPTER 2

### CHAPTER 2 : MONETARY POLICY AND FISCAL ROLE UNDER THE EXISTENCE OF NON RICARDIAN HOUSEHOLD

#### 2.1 Introduction

The financial crisis that hit the U.S. and European economies in the late 2000s changed the overall perspectives on the importance of monetary policy and fiscal policy interaction on coping with the impact of sluggish world economy on a domestic economy. The role of monetary policy in macroeconomic stabilisation is well accepted. However, the role of fiscal policy is less well understood. In a Neoclassical world there is little scope for stabilising fiscal policy; while in a Keynesian world fiscal policy may play a substantial role.

From a Neoclassical perspective, business cycles are seen as optimal responses to shocks, to a first approximation, and rigidities and distortions are not central issues. If there were inefficiencies that created a role for fiscal policy, fiscal policy would still be largely impotent since infinitely lived Ricardian households would smooth their consumption through the effects of a rise in government spending by saving and borrowing<sup>1</sup>. If anything, a rise in gov-

---

<sup>1</sup>In a standard New-Keynesian model, the assumption of all households are forward looking and able to smooth consumption by exchanging physical or financial assets, called Ricardian type of household. That household behavior has amplify the negative wealth effect. As a result, household consumption becomes a function of permanent rather than current disposable income. Therefore "Ricardian equivalence" holds and fiscal policy becomes ineffective.

However, there is growing skepticism that the whole Ricardian assumption represents a good approximation to reality, mostly in the emerging economy. Empirically, consumption seems to track current income more closely than predicted by standard representative-agent and overlapping-generations models ( e.g., Hall, 1978, and Campbell and Mankiw, 1989). In the light of this research, we follow the work of Mankiw (Mankiw, 2000) that emphasized the need to build a new type of model for analyzing the effects of fiscal policy on macroeconomic stabilization. Such type of model should allow for heterogeneity of a particular form: some

ernment spending would have a small wealth effect, leading to a small fall in consumption.

From a Keynesian perspective, rigidities and distortions are central to business cycle dynamics and business cycles are associated with allocative inefficiencies. In such a world fiscal policy can be used to reduce such inefficiencies. The effectiveness of fiscal policy, however, depends on the existence of distortions and rigidities such as limited access to credit that leads to non Ricardian or poor household behaviour (e.g., consumption out of current income rather than lifetime income, as in the IS-LM model). In the presence of such rigidities, a rise in government spending would lead to an increase in income and therefore consumption.

The empirical evidence, based on Vector Auto Regressive (VAR) model, tends to support the Keynesian perspective: a rise in government spending is associated with a rise in consumption in some studies, and a small and insignificant effect in others, but rarely with a fall in consumption (Gali and Monacelli, 2005).

From a practical perspective most economists support the use of automatic fiscal stabilisers, suggesting a role for fiscal policy. Gali (2005) presents evidence that fiscal policy in OECD countries has become more countercyclical over time, which he interprets as evidence of an active role for fiscal policy. There has been renewed interest in fiscal policy in the Euro area due to the limits of monetary policy at the country level. There has also been renewed interest in inflation targeting countries have found that low and stable inflation outcomes can be

---

households should act in an optimizing, fully forward-looking manner, while others ought to follow a simple rule of thumb that renders consumption smoothing impossible or so called Non-Ricardian households. Mankiw argues that such form of heterogeneity can be easily reconciled with stylized facts at both the micro and macro level (Coenen-Straub, 2005)

accompanied by substantial internal imbalances on the UK (Leith and Wren-Lewis, 1999) or external imbalances for the case of New Zealand (Buckle and Drew, 2006). Such imbalances suggest that monetary policy alone may not effectively stabilise the economy and a potential role for fiscal policy. In this paper we explore the potential role for fiscal policy in an emerging economy. Fiscal policy may be important for stabilisation in emerging economies, if less developed markets are associated with allocative inefficiency, or if a lack of access to credit by poor households or undeveloped retail credit markets mean more widespread nonRicardian consumption behaviour.

While monetary policy is generally associated with a few instruments, fiscal policy has more potential instruments on both the expenditure side and revenue side, which will have different effects. For example, a temporary increase in VAT is more likely to affect private consumption decisions as it directly affects prices (Wren-Lewis, 2002). Moreover there is a broad set of rigidities and distortions that create a potential role for fiscal policy. The possible combinations of rigidities and fiscal instruments has led to a large and growing model-based literature that explores the stabilising role of fiscal policies in the presence of sticky prices, sticky wages, tax distortions, non-Ricardian consumption behaviour (Gali, et al 2007), monetary union (Gali and Monacelli 2004, Schmitt-Grohe and Uribe 2004, Benigno and Woodford 2003), the valuation of nominal government liabilities (Leeper and Yun, 2005), and economic openness (Gali and Monacelli, 2004).

Fiscal-monetary interaction may be especially relevant where the net fiscal position is large, so that monetary policy has a larger effect on fiscal debt service costs, or where the fiscal position has a large currency mismatch<sup>2</sup> so that mon-

---

<sup>2</sup>Even if the net fiscal position is zero, in a country with a significant domestic currency debt

etary policy effects on the exchange rate affect fiscal flows. If monetary policy has a large effect on fiscal flows, monetary policy may be undermined through political pressure to avoid undesirable effects on the fiscal position. Similarly, where reserves holdings are large and the carry cost and valuation effects fall on the central bank's balance sheet, monetary policy may be undermined by a desire to protect the integrity of the monetary authority's balance sheet.

This paper extends the analysis of fiscal monetary interaction in Coenen and Straub (2005) to a small open economy setting and to an emerging economy environment to find the optimal policy mix between monetary and fiscal policy in Indonesia. There are three scenarios; first is the baseline scenario, followed by the assumption of "all Ricardians" and the third is "mixed" policy, where we assign the policy parameters from the all Ricardians scenario to the baseline economy, representing the impact of misguided policy to an economy. In general setting the small open economy features are important for macroeconomic stabilisation because of the shock absorber roles of the exchange rate and the currency account and the importance of foreign shocks to the domestic economy. Open economy features may also be important in assessing the effect of monetary policy on fiscal flows via exchange rate fluctuations and the wedge between domestic and foreign interest rates, a channel has become increasingly relevant in Asia as reserves positions have increased. The small open economy DSGE model features both Ricardian and non Ricardian agents, sticky prices

---

and offsetting foreign currency reserves holdings, the carry cost of the interest rate mismatch and the effect of exchange rate fluctuations on both the net position and interest receipts may still be relevant. Sterilised intervention in the foreign exchange market, where accumulation of foreign currency reserves is sterilised by equivalent issuance of domestic currency government debt, will create a mismatched position. In practice, sterilisation need not be complete in the presence of financial deepening or productivity growth that puts downward pressure on inflation. Moreover, sterilisation may be achieved through an interest rate instrument or other monetary instruments such as reserves ratios. In this case, the central bank will generally need to sell domestic securities, and the relationship between debt issuance and reserves accumulation is likely to be weaker.

and wages, distortionary taxation, a capital accumulation process and open trade and financial accounts, sticky domestic prices and wages and imperfect passthrough from import costs to domestic prices. The fiscal position includes foreign currency reserves and domestic and foreign currency debt. Fiscal policy is conducted through lump-sum taxes that respond to fluctuations in fiscal expenditure fluctuations and to the debt gap, and through expenditure that may be pro- or countercyclical. Monetary policy is conducted through a Taylor-type rule. The model is estimated with Indonesian quarterly data and used to explore (i) the potential stabilisation role for fiscal policy, and (ii) the interaction between fiscal and monetary policy.

The rest of the paper is set out as follows. Section 2 provides a brief overview of the monetary and fiscal policy framework in Indonesia. Section 3 sets out the model. Section 4 discusses the data and estimation/calibration for three scenarios. Section 5 discusses the impulse response functions, emphasising the effect of monetary policy on the fiscal accounts and the effect of fiscal policy on the economy for baseline scenario. Section 6 explores monetary-fiscal interaction through optimal stabilisation policy experiments for three scenarios. Section 7 concludes.

## **2.2 Monetary and Fiscal Policy Framework in Indonesia**

Prior to 1999 monetary policy in Indonesia targeted base money. The early stage of Inflation targeting was adopted in 1999. Initially a variety of instruments were used and by 2005 an interest rate corridor had been established for effective control over the overnight interest rate.

In 2003 Indonesia passed a fiscal responsibility act (Law No 17 on State Finance, 2003), which stipulates that the fiscal debt should not exceed 60 per cent of GDP and the fiscal deficit should not exceed 3 per cent of GDP. In year 1995-6 Indonesia's fiscal debt varied from about 25 per cent of GDP to 35 per cent of GDP, all of which was in foreign currency. The debt increased sharply during the Asian crisis as the domestic currency sharply depreciated. In 1999 about half of the debt was converted to domestic currency debt, a share that has been sustained since. From a peak of almost 90 per cent of GDP in 2000, the fiscal debt has subsequently fallen sharply to less than 40 per cent of GDP through a combination of a smaller fiscal deficit, and nominal growth.

The domestic currency, Rupiah, was floated in 1997 and initially depreciated sharply – by over 60 per cent in real terms – recovered about a third of that by the end of 1998 and has since appreciated gradually. While the central bank actively intervenes in the foreign exchange market, the scope of this is small compared to many Asian countries. Indonesia has a stock of foreign currency reserves of about 14 per cent of GDP which is modest compared to China (about 45 per cent), India (about 25 per cent), Korea (28 per cent) and Singapore (about 100 per cent).

Reserves are held on central bank's balance sheet. The central bank issues central bank securities to sterilise intervention and so pays domestic interest rates, but receives lower foreign currency interest rates on reserves. Although the stock of reserves is modest, interest earnings cover only about half of interest costs, leading to an intrinsic loss on the central bank's balance sheet. Apart from balance sheet risks, this will potentially undermines monetary policy as a rise in interest rates may deteriorate the central bank's balance sheet through

upward pressure on the exchange rate which reduces the domestic currency value of both the stock of foreign reserves and the associated income. The ongoing losses also potentially undermine monetary policy by requiring ongoing government financing and creating the incentive to run an easier monetary policy. Ultimately, the cost of reserves holdings is a fiscal cost that will eventually find its way to the fiscal accounts through lower seigniorage transfers from the central bank or through central bank recapitalisation.

The cost of reserves has been handled in a variety of ways in different countries including increasing central bank capital or setting up contingency funds to absorb gains and losses, and absorbing the carry cost through noninterest bearing fiscal deposits at the central bank. In Indonesia, the offsetting effect of exchange rate fluctuations on foreign currency fiscal debt which is, for now, larger than reserves holdings, provides a rationale for natural transfers to reduce volatility on both central bank's account and the government accounts.

In Indonesia, the carry cost of holding reserves has been handled in a variety of ways including extraordinary items and crystalising revaluation gains on the stock of foreign currency reserves associated with currency depreciation. There is also a small foreign currency revaluation reserves for absorption of foreign exchange losses. Ultimately more of the carry cost will need to be borne by the budget through lower seigniorage payments or new central bank capital.

## **2.3 The Model**

The model is an small open economy Dynamic Stochastic General Equilibrium model in the spirit of Christiano, Eichenbaum, and Evans (2005) and Smets and

Wouters (2003). The domestic economy and fiscal setup is based on Coenen and Straub (2005) which builds on an earlier version of Gali, Lopez-Salido and Valles (2007). The model is extended to account for currency denomination of the fiscal debt, foreign currency reserves holdings and open trade and financial accounts. The economy is made up of two types of representative households – Ricardian households that smooth consumption intertemporally and non Ricardian (Rule of Thumb) households that consume only current income and receive transfer in terms of subsidy from government, domestic producers, importing firms, foreign exchange traders, a monetary authority and a fiscal authority. Domestic prices and wages are sticky and passthrough from import costs to domestic prices is imperfect. Investment adjustment costs are an important real rigidity in the model. The fiscal debt has a domestic currency component financed by Ricardian households and a foreign currency component financed by nonresidents. Tax revenue is raised through distortionary income, consumption and payroll taxes and a lump sum taxes that is responsive to the debt gap and the fiscal balance. Government expenditure may respond to the output gap.

### 2.3.1 Household Decisions

There are two types of households: Ricardian households which are *forward-looking* and have access to capital markets, where they can trade a full set of contingent securities and buy and lease physical capital. Their budget constraint is:

$$\begin{aligned}
& (1 + \tau^c)C_t^r + I_t^r + \frac{B_t^{d,r}}{P_t} + (1 + i_{t-1}^*)\Theta \frac{\varepsilon_t B_{t-1}^{P,r}}{P_t} \\
= & (1 - \tau^d) \left( \frac{W_t N_t^r}{P_t(1 + \tau^w)} + \frac{D_t^r}{P_t} + R_t^K U_t K_t^r \right) + \tau^d \delta K_t^r - \frac{T_t^r}{P_t} \\
& + (1 + i_{t-1}) \frac{B_{t-1}^{d,r}}{P_t} + \frac{\varepsilon_t B_t^{P,r}}{P_t}
\end{aligned} \tag{2.1}$$

Ricardian households receive wage income, rental income from capital assets, dividends from firms and the returns on domestic currency bond holdings. They spend their income on consumption  $C_t^r$ , investment in new capital,  $I_t$ , holdings of domestic currency government bonds,  $B_t^{d,r}$ , debt service on private foreign currency debt  $\varepsilon_t B_t^{P,r}$  and taxes. Taxes are levied on consumption, income and firms' payrolls at fixed rates  $\tau^c$ ,  $\tau^d$  and  $\tau^w$ . There is also a nondistortionary lump sum tax  $T_t^r$  that varies over time.

Ricardian Households maximise the present value of expected utility which is derived from consumption  $C_t^r$ , and leisure ( $= 1 - N_t^r$ ):

$$\max E_t \sum_{k=0}^{\infty} \beta^k \left\{ \log (C_{t+k}^r - h C_{t+k-1}^r) - \epsilon_{L,t+k} \frac{N_{t+k}^r{}^{1+\zeta}}{1+\zeta} \right\} \quad (2.2)$$

subject to the above budget constraint, and the law of motion of capital:

$$K_{t+1} = (1 - \delta) K_t^r + \epsilon_{I,t} \Upsilon \left( \frac{I_t}{I_{t-1}} \right) I_t, \quad (2.3)$$

where  $\epsilon_{L,t}$  is an AR1 labour preference shock,  $\zeta$  is the inverse elasticity of labour supply,  $P_t$  is the price level,  $i_t$  is the domestic nominal interest rate,  $W_t$  is the nominal wage,  $K_t^r$  is the capital holdings of the Ricardian household,  $R_t^K$  is the real rental cost of capital,  $U_t$  is the utilisation rate of capital,  $D_t^r$  are the dividends paid by Ricardian household owned firms, and  $\varepsilon_t$  is the nominal exchange rate.  $T_t^r$  is lump sum taxes, and  $\tau^c$ ,  $\tau^d$  and  $\tau^w$  are income, consumption and payroll taxes respectively. In the capital accumulation equation,  $\delta$  is the rate of depreciation and  $\Upsilon \left( \frac{I_t}{I_{t-1}} \right)$  is an investment adjustment cost function that alters the efficiency through which investment is transformed into productive capital and  $\epsilon_{I,t}$  is an AR1 investment-specific shock.  $\Upsilon(\cdot)$  is a convex function with properties  $\Upsilon(1) = 1$ ,  $\Upsilon'(1) = 0$  and  $\Upsilon''(1) = -v < 0$ . A risk premium proportional to

the ratio of the net external position to steady-state output,  $\Theta = (1 + \phi_{rp} \frac{IP_t}{P_t Y_t})$  is paid on foreign currency borrowing.

The first order conditions for the Ricardian household's problem are:

$$E_t \left\{ \Lambda_{t,t+1} \frac{P_t}{P_{t+1}} \right\} = \frac{1}{1 + i_t}, \quad (2.4)$$

$$\frac{Q_t}{P_t} = E_t \left\{ \Lambda_{t,t+1} \left[ (1 - \tau^d) \frac{R_{t+1}^K}{P_{t+1}} + \tau^d \delta + \frac{Q_{t+1}}{P_{t+1}} (1 - \delta) \right] \right\} \quad (2.5)$$

$$Q_t = \frac{P_{I,t} - E_t \left\{ \Lambda_{t,t+1} Q_{t+1} \epsilon_{I,t+1} \Upsilon'_{t+1}(\cdot) \left( \frac{I_{t+1}}{I_t} \right)^2 \right\}}{\epsilon_{I,t} \left( 1 - \Upsilon_t(\cdot) - \Upsilon'_t(\cdot) \frac{I_t}{I_{t-1}} \right)} \quad (2.6)$$

$$(1 - \tau^d) \frac{R_t^K}{P_t} = \Psi'(U_t) \quad (2.7)$$

$$\frac{1 + i_t}{(1 + i_t^*) \Theta_t} = \frac{E_t \left\{ \Lambda_{t,t+1} \frac{P_t}{P_{t+1}} \frac{\epsilon_{t+1}}{\epsilon_t} \right\}}{E_t \left\{ \Lambda_{t,t+1} \frac{P_t}{P_{t+1}} \right\}}. \quad (2.8)$$

where  $\Lambda_{t+1} \equiv \beta \left( \frac{C_{t+1}^r - hC_t}{C_t^r - hC_{t-1}} \right)^{-1}$  is the stochastic discount factor for real 1-period ahead payoffs, and  $Q_t$  is the real shadow value of capital in place in equation (2.5) which is equal to the replacement cost of capital in equation (2.6).

Equation (2.4) equates the marginal rate of substitution between current and delayed consumption to the discounted real interest rate. Equation (2.5) equates the consumption cost of an additional unit of capital (Tobin's q) with the value of installed capital. The latter is equal to the rental value plus the undepreciated

stock that carries over to the next period. Equation (2.6) equates the shadow cost of capital to the marginal cost of the extra unit. The latter is the consumption cost, net of the reduction in future adjustment costs, both adjusted for the marginal efficiency with which investment is transformed into capital (denominator).<sup>3</sup> Equation (2.7) implies equal rates of capital utilisation across households, and equalises the cost of increasing capacity utilisation to the production benefit. Equation (2.8) is the Uncovered Interest Parity (UIP) condition: which equates the expected discounted domestic currency returns on holding domestic and foreign bonds. Abstracting from covariance terms, this can be rewritten as:

$$\frac{1 + i_t}{(1 + i_t^*) \Theta_t} = E_t \left( \frac{\varepsilon_{t+1}}{\varepsilon_t} \right) \quad (2.9)$$

$i_t^*$  represents the unobserved foreign cost of capital that makes UIP hold, given domestic interest rate developments and the risk premium  $\Theta_t$ . The foreign cost of capital,  $i_t^*$ , is assumed to follow an AR1 process subject to UIP shocks. It combines both price (an unobserved combination of foreign interest rates), risk premia and capital flow effects that are reflected in exchange rate fluctuations.

A share  $\omega$  of households is assumed not to have access to capital markets and so can neither save nor borrow and does not invest in capital. As a result these nonRicardian households cannot behave in a forward-looking consumption smoothing manner. Instead they consume all of their labour income net of taxes and transfers according to the following budget constraint:

$$(1 + \tau^c) C_t^{nr} = \frac{(1 - \tau^d)}{(1 + \tau^w)} \frac{W_t}{P_t} N_t^{nr} - \frac{T_t^{nr}}{P_t} \quad (2.10)$$

The taxes paid (or transfers received) by nonRicardian households,  $T_t^{nr}$ , are

---

<sup>3</sup>See Medina, Munro and Soto (2007).

the same as those paid by Ricardian households. Non-Ricardian households have substantially lower incomes than Ricardian households due to the absence of capital income.

### Labour Supply and Wage Setting

Each household provides a differentiated labour service. Following Erceg et al (2000), households set wages in a staggered fashion. Wages are renegotiated with probability  $(1-\theta_w)$  each period, while a fraction  $\theta_w$  of households index wages to either last period's wage inflation or the central bank's inflation target according to the following rule:

$$\Gamma_{w,t} = \Gamma_{w,t-1} \left( \frac{W_{t-1}}{W_{t-2}} \right)^{\gamma_w} (1 + \bar{\pi})^{(1-\gamma_w)} \quad (2.11)$$

where  $\gamma_w$  is the share of non-optimising households indexing to last period's wage inflation.

A household resetting its wage in period  $t$  will maximise utility (2.2) with respect to the real wage, and taking into account aggregate wage dynamics (2.11) and the demand for its differentiated labour service,  $i$ :

$$N_{i,t+k} = \left( \frac{W_{i,t}^*}{W_{t+k}} \right)^{-\lambda_w} N_{t+k}$$

where  $W_t^*$  represents the wage chosen by the optimising household at time  $t$ . and the parameter  $\lambda_w = \frac{1+\mu_w}{\mu_w}$ , where  $\mu_w$  is the steady state wage markup. The renegotiating household solves the following problem:

$$\max E_t \left\{ \sum_{k=0}^{\infty} \theta_w^k \Lambda_{t+k} \left[ \frac{(1-\tau^d)}{(1+\tau^w)} \frac{\Gamma_{t+k}}{P_{t+k}} \frac{W_t N_{i,t+k}}{C_{t+k}} - \epsilon_{L,t+k} \frac{N_{i,t+k}^\zeta}{1+\zeta} \right] \right\}$$

The first order condition for that optimization problem sets the discounted marginal utility of income from an additional unit of labour equal to the expected discounted disutility of the additional labour effort:

$$E_t \sum_{k=0}^{\infty} \theta_w^k \beta^k N_{i,t+k} \left[ \frac{(1 - \tau^d)}{(1 + \tau^w)} \left( \frac{\Gamma_{w,t+k} W_{i,t}^*}{P_{t+k}(1 + \lambda_w)} \right) - \epsilon_{L,t+k} N_{t+k}^\zeta \right] = 0 \quad (2.12)$$

This lead to the following dynamics for the real wage:

$$\begin{aligned} (1 + \beta)wr_t &= \beta E_t wr_{t+1} + wr_{t-1} \\ &+ \frac{(1 - \beta\theta_w)(1 - \theta_w)}{\theta_w(1 + \zeta^{\frac{1+\mu_w}{\mu_w}})} (\zeta n_t - c_t + \epsilon_{L,t} - wr_t) \\ &+ E_t \pi_{t+1} + \gamma_w \pi_{t-1} + (1 - \beta\gamma_w) \pi_t \end{aligned}$$

where  $wr_t$  is the log of the real wage.

In the limit where all households renegotiate ( $\theta_w = 0$ ), this condition (2.12) reduces to the condition that the real wage equals the marginal rate of substitution between consumption and leisure, inclusive of all taxes:

$$\frac{(1 - \tau^d)}{(1 + \tau^w)} \frac{W_t}{P_t} = (1 + \tau^c) \epsilon_{L,t} \frac{(N_t)^\zeta}{C_t}$$

### 2.3.2 Aggregation

Aggregate consumption, labour input and lump sum taxes/transfers are weighted averages of the optimising and non-Ricardian households:

$$C_t = \omega C_t^{mr} + (1 - \omega) C_t^r$$

Investment, capital, bonds and dividend receipts of the Ricardian household are adjusted for the Ricardian share to give aggregate per capita values:

$$\begin{aligned} I_t &= (1 - \omega)I_t^r, & K_t &= (1 - \omega)K_t^r, & D_t &= (1 - \omega)D_t^r \\ B_t^d &= (1 - \omega)B_t^{d,r}, & B_t^P &= (1 - \omega)B_t^{P,r}, \end{aligned}$$

Labour input is equal as both Ricardian and non-Ricardian households meet demand given the wage set by Ricardian households.

$$N_t = N_t^{nr} = N_t^r$$

and lump sum taxes are assumed to be equal across households.

$$T_t = T_t^{nr} = T_t^r$$

### 2.3.3 Final Goods Firms

Differentiated intermediate goods are combined using a constant elasticity of substitution (CES) aggregator of *home* and *foreign* goods to form consumption and investment goods,

$$\begin{aligned} C_t(j) &= \left[ \gamma_C^{1/\psi_H} (C_{H,t}(j))^{\frac{\psi_H-1}{\psi_H}} + (1 - \gamma_C)^{1/\psi_H} (C_{F,t}(j))^{\frac{\psi_H-1}{\psi_H}} \right]^{\frac{\psi_H}{\psi_H-1}} \\ I_t(j) &= \left[ \gamma_I^{1/\psi_H} (C_{H,t}(j))^{\frac{\psi_H-1}{\psi_H}} + (1 - \gamma_I)^{1/\psi_H} (I_{F,t}(j))^{\frac{\psi_H-1}{\psi_H}} \right]^{\frac{\psi_H}{\psi_H-1}} \end{aligned}$$

where  $\psi_H$  is the elasticity of substitution between *home* and *foreign* goods and  $\gamma_C$  and  $\gamma_I$  define their respective weights in consumption and investment, where investment is much more import intensive than consumption. The optimal composition of the bundles is obtained by minimizing its cost. This minimization problem determines the demands for *home* and *foreign* goods by the

household,  $C_{H,t}(j)$ ,  $C_{F,t}(j)$ ,  $I_{H,t}(j)$ ,  $I_{F,t}(j)$  respectively, which are given by

$$C_{H,t}(j) = \gamma_C \left( \frac{P_{H,t}}{P_t} \right)^{-\psi_H} C_t(j), \quad I_{H,t}(j) = \gamma_I \left( \frac{P_{H,t}}{P_t} \right)^{-\psi_H} I_t(j), \quad (2.13)$$

$$C_{F,t}(j) = (1 - \gamma_C) \left( \frac{P_{F,t}}{P_t} \right)^{-\psi_H} C_t(j), \quad I_{F,t}(j) = (1 - \gamma_I) \left( \frac{P_{F,t}}{P_t} \right)^{-\psi_H} I_t(j), \quad (2.14)$$

where  $P_{H,t}$  and  $P_{F,t}$  are the price indices of *home* and *foreign* goods, and  $P_{C,t}$  and  $P_{I,t}$  are the price indices of the consumption and investment bundles, defined as:

$$\begin{aligned} P_{C,t} &= \left( \gamma_C P_{H,t}^{1-\psi_H} + (1 - \gamma_C) P_{F,t}^{1-\psi_H} \right)^{\frac{1}{1-\psi_H}} \\ P_{I,t} &= \left( \gamma_I P_{H,t}^{1-\psi_H} + (1 - \gamma_I) P_{F,t}^{1-\psi_H} \right)^{\frac{1}{1-\psi_H}} \end{aligned}$$

Similarly, home goods are exported and used as an input into a foreign consumption good. The foreign demand for home goods is:

$$X_t = \gamma^* \left( \frac{P_{H,t}}{\varepsilon_t P_t^*} \right)^{-\psi_F} Y_t^*(j) \quad (2.15)$$

where  $\psi^*$  is the foreign elasticity of substitution between *home* and *foreign* goods and  $\gamma^*$  is the steady state share of domestic goods in foreign GDP.

### 2.3.4 Intermediate Goods Producing Firms

Intermediate goods are produced using constant returns to scale technology:

$$Y_t = \epsilon_{a,t} K_t^\alpha N_t^{(1-\alpha)} - \Phi \quad (2.16)$$

and their profit maximisation setting is :

$$\pi^{IG} = \epsilon_{a,t} K_t^\alpha N_t^{(1-\alpha)} - W_t N_t - R_t^K K_t - \Phi \quad (2.17)$$

where  $\Phi$  is a fixed cost of production chosen to ensure zero profits in steady state, and  $\epsilon_{a,t}$  represents a transitory technology shock. Taking the rental cost of capital and real wage as fixed, cost minimisation implies the following rate of substitution between capital and labour:

$$\frac{K_t}{N_t} = \left( \frac{\alpha}{1-\alpha} \right) \left( \frac{W_t}{P_t R_t^K} \right) \quad (2.18)$$

Real marginal cost is given by:

$$MC_t = \frac{1}{\epsilon_{a,t}} \left( \frac{R_t^K}{\alpha} \right)^\alpha \left( \frac{W_t}{P_t} \frac{1}{1-\alpha} \right)^{1-\alpha} = \frac{R_t^K}{\alpha (1+\phi) Y_t / K_t} \quad (2.19)$$

[where  $\phi = \Phi/Y$  is the ratio of fixed cost to steady state GDP.]

Following Calvo (1983), differentiated intermediate goods firms set prices in a staggered fashion. Each firm resets prices with probability  $(1-\theta_H)$  each period, while a fraction  $\theta_H$  index prices to last period's inflation. Firms that do not optimise at time  $t$  index prices to a geometric average  $\Gamma_{p,t}$  of last period's inflation and the inflation target:

$$\Gamma_{p,t} = \Gamma_{p,t-1} (1 + \pi_{t-1})^{\gamma_H} (1 + \bar{\pi})^{1-\gamma_H}$$

where  $\gamma_H$  is the share of nonoptimising firms that index to past inflation. A firm resetting its price in period  $t$  optimises the present value of expected profits subject to the dynamics of aggregate inflation and demand from final goods producers (equation 2.13) and foreign consumers.

$$\max E_t \sum_{k=0}^{\infty} \theta_p^k \Lambda_{t+k} [Y_{t+k} P_{i,t}^* - MC_{t+k} Y_{t+k}]$$

$P_{i,t}^*$  represents the price chosen by a firms that repotimises at time  $t$ . The first order condition for optimal price setting in period  $t$  is:

$$E_t \left( \sum_{k=0}^{\infty} \theta_p^k \Lambda_{t+k} Y_{i,t+k} P_{i,t}^* \Gamma_{p,t+k} - (1 + \lambda_{p,t+k}) MC_{t+k} \right) = 0$$

This setup leads to the following inflation dynamics (check):

$$\pi_{H,t} = \frac{\beta}{(1 + \beta\gamma_H)} E_t \pi_{H,t+1} + \frac{\gamma_H}{(1 + \beta\gamma_H)} \pi_{H,t-1} + \quad (2.20)$$

$$\frac{(1 - \beta\theta_H)(1 - \theta_H)}{(1 + \beta\gamma_H)\theta_H} (mcr_t - p_{H,t}) + \eta_{H,t} \quad (2.21)$$

where  $mcr_t$  is the log deviation of real marginal cost from steady state, and  $\eta_{H,t}$  is an iid cost push shock.

In steady state the price is set as a markup over marginal cost. In the limit where all firms reoptimise ( $\theta_H = 0$ ), the price is set equal to marginal cost. The domestic firm also satisfies export demand at the price  $P_{H,t}$ .

### 2.3.5 Importing Firms

We introduce local-currency price stickiness in order to allow for incomplete exchange rate pass-through into import prices in the short-run. Competitive importers use CES technology to combine a continuum of differentiated imported varieties to produce a final *foreign* good  $Y_F$ . This good is consumed by households and used for assembling new capital goods. The optimal mix of imported varieties in the final *foreign* good defines the demands for each of them. In particular, the demand for variety  $z_F$  is given by:

$$Y_{F,t}(z_F) = \left( \frac{P_{F,t}(z_F)}{P_{F,t}} \right)^{-\epsilon_F} Y_{F,t}, \quad (2.22)$$

where  $\epsilon_F$  is the elasticity of substitution among imported varieties,  $P_{F,t}(z_F)$  is the domestic-currency price of imported variety  $z_F$  in the domestic market, and  $P_{F,t}$  is the aggregate price of import goods in this market.

Each importing firm has monopoly power in the domestic retailing of a particular variety. Each firm resets prices with probability  $(1-\theta_F)$  each period. Firms that do not optimise at time  $t$  index prices to a geometric average  $\Gamma_{F,t}$  of last period's inflation and the inflation target:

$$\Gamma_{F,t} = \Gamma_{F,t-1} (1 + \pi_{t-1})^{\gamma_F} (1 + \bar{\pi})^{1-\gamma_F}$$

where  $\gamma_p$  is the share of nonoptimising firms that index to past inflation. Therefore, when a generic importing firm  $z_F$  receives a signal, it chooses a new price by maximizing the present value of expected profits:

$$\max_{P_{F,t}(z_F)} E_t \left\{ \sum_{i=0}^{\infty} \Lambda_{t,t+i} \phi_F^i \frac{\Gamma_{F,t}^i P_{F,t}(z_F) - \mathcal{E}_{t+i} P_{t+i}^*(z_F)}{P_{C,t+i}} Y_{F,t+i}(z_F) \right\},$$

subject to the domestic demand for variety  $z_F$  (2.22) and the updating rule for prices. For simplicity, we assume that  $P_t^*(z_F) = P_t^*$  for all  $z_F$ .

In this setup, the optimal path for imported inflation is given by a New Keynesian Philips curve with indexation. In its log-linear form, imported goods inflation has both a forward and backward looking component and depends on the marginal real import cost.

$$\begin{aligned} \widehat{\pi}_{F,t} = & \frac{\beta}{1 + \beta\gamma_F} E_t \{ \widehat{\pi}_{F,t+1} \} + \frac{\gamma_F}{1 + \beta\gamma_F} \pi_{F,t-1} \\ & + \frac{(1 - \beta\theta_F)(1 - \theta_F)}{\theta_F(1 + \beta\gamma_F)} [r\widehat{e}r_t - \widehat{p}r_{F,t}] \end{aligned}$$

Changes in the nominal exchange rate are passed through gradually into prices of imported good sold domestically. Therefore, exchange rate pass-through will be incomplete in the short-run. In the long-run firms freely adjust their prices, so the law-of-one-price holds up to a constant.

In the steady state the price is set as a markup over marginal cost real import cost. In the limit where all importing firms re-optimize ( $\theta_F = 0$ ), pass-through is complete and  $P_{F,t} = e_t P_t^*$ .

### 2.3.6 Monetary Policy

Monetary policy is assumed to follow a Taylor-type rule that is sensitive to inflation above target and to the log deviation of output from steady state,  $y_t$ :

$$i_t = \varphi_i i_{t-1} + (1 - \varphi_i) [\varphi_\pi \pi_{t+1} + \varphi_y \hat{y}_t] + \epsilon_{r,t} \quad (2.23)$$

where  $\epsilon_{r,t}$  is an AR1 process.

### 2.3.7 Fiscal Policy

The nominal net fiscal position is defined as foreign currency reserves,  $Z_t$  less domestic and foreign currency fiscal debt,  $B_t^d$  and  $B_t^f$ :

$$NFP_t \equiv \varepsilon_t Z_t - B_t^d - \varepsilon_t B_t^f \quad (2.24)$$

While reserves are held by the central bank, they are viewed here as a fiscal asset: ultimately the costs or benefits of reserves holdings will show up in the fiscal accounts through higher/lower seigniorage transfers, or recapitalisation of the

central bank. The domestic debt is assumed to be held by households and the foreign debt is assumed to be held by non residents. Current expenditures, debt repayment, and reserves accumulation are financed through tax revenue, new borrowing and earnings on foreign reserves according to the following budget constraint:

$$\begin{aligned}\varepsilon_t Z_t - B_t^d - \varepsilon_t B_t^f &= (1 + i_{t-1}^*) \varepsilon_t Z_{t-1} - (1 + i_{t-1}) B_{t-1}^d \\ &\quad - (1 + i_{t-1}^*) \Theta_t \varepsilon_t B_{t-1}^f + F B_t\end{aligned}\quad (2.25)$$

where  $i_t^*$  is the nominal interest rate on foreign bonds, and  $F B_t$  is the primary fiscal balance (tax income less expenditures).

Note that foreign currency borrowing is at a premium  $\Theta(\frac{\varepsilon_t(B_{G,t} + B_t^P - Z_t^f)}{P_t Y_t})$  over the foreign interest rate, while foreign currency reserves earn the risk free foreign interest rate. In steady state, the domestic and foreign borrowing costs are equal ( $i = i^* - \phi_{rp} \frac{IIP}{PY}$ )<sup>4</sup> according to the UIP condition. As long as the net fiscal position is negative, there is a carry cost on foreign currency reserves proportional to the risk premium. Note also that accumulating reserves through sterilised intervention does not affect the risk premium. To illustrate the currency valuation effects and carry cost, the fiscal budget constraint (2.25) can be rewritten:

$$\begin{aligned}NFP_t &= (1 + i_{t-1} NFP_{t-1}) + F B_t \\ &\quad + \left[ - (i_{t-1} - i_{t-1}^*) + \left( \frac{\varepsilon_t}{\varepsilon_{t-1}} - 1 \right) i_{t-1}^* + \left( \frac{\varepsilon_t}{\varepsilon_{t-1}} - 1 \right) \right] \varepsilon_{t-1} Z_{t-1} \\ &\quad + \left( i_{t-1} - i_{t-1}^* + \phi_{rp} \frac{IIP_{t-1}}{P_{t-1} Y_{t-1}} \right) \varepsilon_{t-1} B_{t-1}^f \\ &\quad - \left( \frac{\varepsilon_t}{\varepsilon_{t-1}} - 1 \right) \left( i_{t-1}^* - \phi_{rp} \frac{IIP_{t-1}}{P_{t-1} Y_{t-1}} \right) \varepsilon_{t-1} B_{t-1}^f\end{aligned}\quad (2.26)$$

$$- \left( \frac{\varepsilon_t}{\varepsilon_{t-1}} - 1 \right) \varepsilon_{t-1} B_{t-1}^f \quad (2.27)$$

---

<sup>4</sup> $\phi_{rp}$  is positive and the net international investment position is negative.

where the second lines shows the carry cost and the currency valuation effects on the interest flows and stocks respectively for reserves, the third line shows the interest wedge on foreign currency debt which is zero in steady state, the last two lines show the currency valuation effects on the stock and flow of foreign currency debt. In steady state, all revaluation effects are zero, and  $i = i^* - \phi_{rp} \frac{NFP}{PY}$  so that the fiscal balance must cover interest payments on the net fiscal position plus the steady state carry cost of reserves. In the model setup the carry cost exists in steady state because UIP works between the domestic interest rate and a foreign rate plus risk premium, whereas reserves earn the risk free foreign rate.

In a country with foreign currency debt greater than reserves such as Indonesia, reserves accumulation will reduce the effects of exchange rate fluctuations on the fiscal position. However any remaining mismatch will lead to fluctuations on the fiscal accounts, and because of the impact of fiscal fluctuations on nonRicardian households, deficit stabilisation may not be an attractive policy. Depreciation of the domestic currency deteriorates the net fiscal position, but by less than it would in the absence of reserves.

The fiscal balance is:

$$FB_t = \tau^d \left( \frac{1}{(1 + \tau^w)} W_t N_t + D_t + P_t R_t^K U_t K_t - \delta P_t K_t \right) + \tau^c P_t C_t + \tau^w W_t N_t + T_t - P_{H,t} G_t \quad (2.28)$$

Fiscal policy is defined by  $B_t^d$ ,  $B_t^f$ ,  $Z_t^f$ ,  $G_t$  and  $T_t$  so four of the five need to be defined by fiscal rules. First, the ratio of reserves to steady state GDP is assumed

to follow an AR(1) process, subject to "reserve accumulation shocks". Reserves shocks are not included in the UIP equation and so do not have a direct effect on the exchange rate. Intervention can be sterilised through the interest rate rule, through a rise in domestic currency fiscal debt.

$$\frac{\varepsilon_t Z_t}{P_t Y} = \left( \frac{\varepsilon_{t-1} Z_{t-1}}{P_{t-1} Y} \right)^{\rho_z} \left( \frac{\varepsilon Z}{PY} \right)^{1-\rho_z} e^{\eta_{z,t}} \quad (2.29)$$

Second, we assume a portfolio rebalancing rule that keeps the share of foreign currency debt stable:

$$\frac{\varepsilon_t B_t^f}{B_t^d} = \frac{\chi}{1 - \chi} \quad (2.30)$$

where  $\chi$  is the foreign currency share of fiscal debt.

Third, the ratio of  $G_t$  to GDP is defined by a simple fiscal rule:

$$g_t = \rho_g g_{t-1} + \varphi_{gy} y_t + \eta_{g,t} \quad (2.31)$$

where  $g_t = (G_t - G) / Y$  and  $y_t$  is the log deviation of output from steady state. The fiscal authority adjusts expenditure gradually back to the steady state level in response to expenditure shocks  $\eta_{g,t}$  and may play an active stabilisation role through the output gap term. If  $\varphi_{gy}$  is zero, fiscal expenditure follows a passive AR1 process. If  $\varphi_{gy}$  is negative, fiscal expenditure will be countercyclical. At  $\varphi_{gy} = -1$ , fiscal expenditure fully offsets the output gap.

Finally, taxes are adjusted in response to deviations of debt and government spending from their steady state levels relative to GDP:

$$t_t = \varphi_{tb} b_t + \varphi_{tg} g_t \quad (2.32)$$

where  $\varphi_b, \varphi_g > 0$ ,  $t_t = (T_t/P_t - T/P)/Y$  and  $B_t = (\varepsilon_t B_t^f + B_t^d)/P_t Y - (B^f + B^d)/PY$ .<sup>5</sup> Under this rule, government expenditure shocks will be financed through a combination of a taxes (as  $\varphi_g$  approaches unity a rise in  $G_t$  will be financed by a rise in taxes) and debt (as  $\varphi_g$  approaches zero a rise in  $G_t$  will be financed by debt). The coefficient  $\varphi_b$  ensures a feedback response to debt above steady state and must be large enough to ensure solvency.

The steady state level of debt/GDP will be determined by several factors including the steady state level of taxes  $T/PY$  and spending  $G/Y$ , steady state growth and inflation, and the steady state carry on reserves.

### 2.3.8 Aggregate Equilibrium

Domestic firms satisfy demand for home goods:

$$Y_t = C_{H,t} + I_{H,t} + G_t + X_t$$

Similarly, importing firms demand for imports:

$$M_t = C_{F,t} + I_{F,t}$$

Nominal GDP is:

$$P_{Y,t}Y_t = P_t C_t + P_{H,t}G_t + P_{I,t}I_t + P_{H,t}X_t - e_t P_t^* M_t$$

---

<sup>5</sup>This simplifies the log linear representation. and defines these variables as percent of steady state GDP.

### 2.3.9 External Sector : Balance of Payment

Combining the households' budget constraints, the fiscal budget constraint, the definition of profits and the resource constraints we get the nominal balance of payments identity:

$$\varepsilon_t Z_t - \varepsilon_t (B_t^f - B_t^P) = \varepsilon_t (1 + i_{t-1}^*) Z_{t-1} - \varepsilon_t (1 + i_{t-1}^*) \Theta (B_{G,t-1}^f + B_{t-1}^P) + P_{X,t} X_t - P_{H,t} M_t \quad (2.33)$$

The change in the external position is equal to the current account: the investment income account and the trade balance. Note that the private sector is assumed to have no external assets or liabilities, so that the investment income account is the net flows associated with fiscal debt and reserves.

The real exchange rate is defined as:

$$RER_t = \frac{\varepsilon_t P^*}{P_t} \quad (2.34)$$

## 2.4 Model Solution and Estimation

We use Dynare<sup>6</sup> for model solution and estimation. Posterior parameters are estimated using a Bayesian approach (DeJong, Ingram, and Whiteman, 2000). We set prior distributions  $\mathbf{p}(\theta)$  for the parameters based mainly on their theoretical bounds and previous studies, but including country specific circumstances where relevant. We include in the model measurement equations that relate observed variables to model variables. Data for observable variables  $\mathcal{Y}^T$  is used to form a joint posterior distribution  $\mathbf{p}(\theta | \mathcal{Y}^T)$  by updating the prior distribution

---

<sup>6</sup>See [www.cepremap.cnrs.fr/dynare/](http://www.cepremap.cnrs.fr/dynare/).

based on the likelihood function  $L(\theta \mid \mathcal{Y}^T)$  using Bayes' theorem.

$$\mathbf{p}(\boldsymbol{\vartheta} \mid \mathcal{Y}^T) = \frac{L(\boldsymbol{\vartheta} \mid \mathcal{Y}^T) \mathbf{p}(\boldsymbol{\vartheta})}{\int L(\boldsymbol{\vartheta} \mid \mathcal{Y}^T) \mathbf{p}(\boldsymbol{\vartheta}) d\boldsymbol{\vartheta}} \quad (2.35)$$

An approximated solution for the posterior distribution is computed using the Metropolis-Hastings algorithm. The posteriors are the last 50% of two chains of 100,000 draws each.

### 2.4.1 Calibrated Parameters

To simplify the estimation procedure, some parameters are calibrated. These are shown in Table 2.1. Values are chosen based on observed aggregate ratios and tax rates, to give reasonable steady state values, and to be consistent with the DSGE literatures.

### 2.4.2 Estimated Parameters: Priors

We choose priors based on regularities of Indonesian data, and the DSGE literature. These are shown in Tables 2.2 and 2.3. For the share of rule of thumb consumers, we choose a fairly flat prior centered on 0.5. The prior for the risk premium parameter is chosen to be consistent with a steady state risk premium of about 4 per cent per annum. Priors for Calvo parameters are centered on 0.75 and price and wage indexation parameters on 0.5.

### 2.4.3 Estimated Parameters: Posterior Means

Posterior mean estimates are shown in Tables 2.4 and 2.5. for the three estimation periods and the distributions for the inflation target period are shown in Figure 2.2. The parameter estimates are reasonably robust across periods despite potential nonlinearities associated with the 1997-8 Asian crisis and changes such as the exchange rate float in 1998, adoption of inflation targeting in 1999 and the change in the foreign currency denomination of debt from 100% before the crisis to about 50% afterwards.

Posterior parameter estimates are all reasonable relative to estimated models for other countries, although in a few cases, parameters are not well identified as seen in Figure 1. This includes. the risk premium parameter  $\phi_{rp}$ , the fixed cost of production,  $\phi$ , the capacity utilisation parameter,  $\psi$ , the Calvo parameters, and the monetary policy response to inflation  $\varphi_{\pi}$ . The Calvo parameters will have an important effect on the results of our monetary policy experiments.

The share of nonRicardian consumers, an important parameter for our model is estimated at 67 percent and is well identified. This compares to calibrated values of 0.5 for the Euro area (Muscatelli and Tirelli, 2005), 0.37 for the US, (Gali et al,2007), and estimates of 0.25 to 0.35 for the Euro area (Coenen and Straub, 2005). The share of nonRicardian agents falls slightly over time.

The habit parameter is low for the baseline scenario and increases markedly in the ricardians scenario, implying ricardians household ability to smooth their consumption more than nonricardians. The risk premium parameter is lower for more recent periods. The investment adjustment cost parameter  $v$  which is changes the curvature of the investment adjustment cost function increases in

the ricardians scenario, along with the increasing investment.

While the Calvo parameters are not well identified, indexation is estimated to be highest for imports (three quarters of non-optimising firms index to past inflation), followed by home goods (about half index to past inflation) and lowest for wages (only about a third index to past inflation). Price indexation is lower for ricardians scenario.

The estimated monetary policy parameters imply a fairly standard Taylor rule, although the response to inflation is not well identified in the ricardian scenario. The estimated fiscal policy parameters imply strongly countercyclical government expenditure, a small tax response to debt, and mainly debt financing of fluctuations in expenditure in the baseline scenario. However, this countercyclical policy is even stronger for ricardians scenario as response for the crowding out effect of government expenditure to GDP.

Across the scenarios, monetary policy parameters relatively stable implying a conservative role of monetary policy guarding against both inflation and output. on the other hand, fiscal parameters are relatively dynamic for the role as a countercyclical agent.

## **2.5 Impulse Response Functions : Baseline**

Impulse Response functions are shown in Appendix B.

A one standard deviation *monetary policy shock* implies a rise in the central bank securities interest rate. This shock depressed aggregate demand, both consumption and investment. The exchange rate appreciates which reduces the

cost of investment goods, in particular, somewhat offsetting the fall in investment. Fiscal expenditure is countercyclical and so increases to partly offset the fall in output. The rise in expenditure is partly financed by an increase in debt (the net fiscal position worsens, despite the exchange rate appreciation which reduced the value of foreign currency debt) and partly by a rise in taxes. The rise in taxes is protracted and depresses nonRicardian consumption for a protracted period. Ricardian households reduce consumption briefly.

A one standard deviation *fiscal policy shock* implies an increase in the government spending /GDP ratio which directly increases GDP. The increase in government expenditure is partly financed by debt (the net fiscal position decreases) and partly financed by a protracted rise in taxes. The latter depresses nonRicardian consumption for a considerable period. In contrast, Ricardian consumption falls briefly and then rises above trend after about 8 quarters. The fall in consumption puts downward pressure on inflation. The monetary policy response to the output gap (tightening) dominates the monetary policy response to inflation (easing), and the interest rate rises, putting upward pressure on the exchange rate.

A one standard deviation *reserves accumulation shock* implies an increase in the reserves/GDP ratio. The increase in reserves is financed partly by an increase in debt and partly by a rise in taxes. Overall the net fiscal position improves (it is not fully financed by debt) which reduces the risk premium. The rise in taxes depresses nonRicardian consumption and GDP. The fall in demand puts downward pressure on inflation. The monetary authority responds to the fall in output and inflation by reducing the interest rate and the exchange rate depreciates. The fiscal authority responds to the fall in output by increasing

government spending which adds to inflation.

An exogenous exchange rate depreciation is interpreted as *a rise in the cost of foreign capital*. The exchange rate depreciation leads to an improvement of the trade account – the export response is strong ( $\psi_F$  is 1.75) and final goods firms substitute away from imported goods - which dominates the fall in consumption and investment. In response to the rise in GDP, government spending falls allowing a cut in lump sum taxes. The fall in taxes leads to a rise in nonRicardian consumption. While the value of the foreign currency debt increases, this is largely offset by an increase in the value of foreign currency reserves and fluctuations in the net fiscal position are dominated by the effects of expenditure and tax receipts.

We also include impulse responses for *a combined government spending and cost push shock* to domestic prices as a proxy for subsidy removal. The impulse responses are very similar to a pure price shock. This is because the fall in government expenditure is mainly absorbed in lower debt, rather than taxes, and so has a small effect. The increase in prices reduces the real wage which depresses nonRicardian consumption. The nominal interest rate rises in response to the higher inflation and so the nominal exchange rate appreciates. However the real interest rate does not rise because of the effect of the falls in government expenditure and nonRicardian consumption on the output gap. So the real exchange rate does not rise.

## 2.6 Optimal Stabilisation Policy Experiments

### 2.6.1 Can fiscal policy play a stabilisation role?

As was seen in the impulse response functions, a rise in government expenditure leads to a fall in consumption (particularly nonRicardian consumption) and downward pressure on inflation. In this section we use a standard quadratic loss function to (i) look at the optimal values for fiscal and monetary policy parameters, (ii) ask whether fiscal policy can/does play a stabilising role; (iii) if so, ask which factors (e.g. nonRicardian households, sticky prices and wages, and distortionary taxation) give fiscal policy a stabilisation role, and (iv) explore the interaction of monetary and fiscal policy parameters.

We assume a standard loss function :

$$Loss = \sum_0^{\infty} \pi^2 + 0.5y^2$$

where  $y$  is the percent deviation from steady state and  $\pi$ , and  $r$  are percentage deviations from steady state. This type of loss function approximates welfare in a small New Keynesian model as discussed in Rudebush and Svensson (1999) and Woodford (2003). There are good reasons why it may not approximate welfare in this model, including debt and capital stocks, open economy features and nonRicardian agents. Ideally, the analysis would be done in a second order model, however this was beyond the scope of this paper. We view the standard loss function as a general approximation of a policy-maker's objec-

tive function: to achieve both inflation and output stability. However, we also present figures showing the effect of the policy parameters on consumption to reflect the importance of consumption in welfare ie. utility, in a 3 equation New Keynesian model GDP is equal to consumption, and potential poverty considerations associated with nonRicardian agents who have lower incomes and cannot use credit to smooth consumption intertemporally. Because exchange rate volatility is also an often cited concern for policy makers in an open economy, we present figures showing the effect of policy parameters on exchange rate volatility.

Gali and Gertler (2007) argue that the output gap term should be the deviation from the flex price equilibrium, rather than the deviation of steady state. In this model with a high estimated share of nonRicardian agents, however, flexible domestic prices and wages, in particular, imply volatility in nonRicardian consumption and therefore output. So while, in theory, we would like to push the economy toward an efficient flex price adjustment path rather than all the way to steady state in a small model with Ricardian agents, here it would mean pushing the economy to a more volatile path. Therefore we stick to the deviation from steady state.

We also carry out stochastic simulations and for a range of values of each policy parameter we plot the loss function for each scenario. We also plot the variances of inflation, GDP, consumption and the real exchange rate. Because of uncertainty about the form of the welfare function, the results presented should be interpreted with a good degree of caution, especially in terms of optimal parameter values. What we aim to achieve in this section is a better understanding of the types of tradeoffs faced by policy makers relative to variables of interest.

Figure 3 show the results for the *monetary policy response to inflation*,  $\varphi_\pi$ . Losses are smaller for the ricardians scenario. For the other two scenarios, losses increase rapidly as the parameter approaches unity, by which point the model becomes indeterminate consistent with the Taylor Principle where the nominal interest rate should be increased at least one-for-one with inflation to prevent a drop in the real interest rate. For the ricardian scenario, the Taylor principle appears to be less binding. This may reflect both a fall in price indexation and stronger countercyclical fiscal policy for the ricardians. In this scenario losses are not very sensitive to this parameter. Estimated values are in the range 1.7 to 1.8, but not well identified, compared to a minimum standard loss function at 1.9 to 2.8. However, the model suggests that a policy maker concerned with consumption or real exchange rate volatility, would prefer a relatively weak response to inflation ( $\varphi_\pi$  of about 1.2) while keeping to the Taylor Principle.

The result for the *monetary policy response to the output gap*  $\varphi_y$  is shown in Figure 4. The results for the baseline and mixed periods show a minimum loss at a value for  $\varphi_y$  of about 0.8. For the ricardian scenario the minimum loss is at a value higher than normally considered practical. The estimated values are more moderate than a standard loss function would suggest. A policy maker concerned with consumption volatility would also prefer a strong interest rate response to inflation. However, in an open economy, concern for exchange rate volatility would suggest a more moderate response to avoid excessive movement.

The results for the *interest rate smoothing parameter*  $\rho_r$  is shown in Figure 5. Losses are not very sensitive to this parameter until it approaches unity at which point the nominal interest rate follows a random walk. Its effect on consumption

is similar. Thus, real exchange rate volatility is minimised as well.

The result for *the tax response to debt*  $\varphi_{tb}$  is shown in Figure 6. The loss function is not very sensitive to this parameter except at values close to zero, at which point the debt solvency condition is not met in the case explosive debt. The estimated values show a weak response to debt. A policy maker concerned with consumption volatility would want to respond only weakly to deviations of the debt from steady state – enough to keep the debt in check, but effectively use it as a shock absorber. This is consistent with the literature which suggests that fiscal policy should respond to the debt gap to ensure solvency, but that debt should only be brought back to target gradually. However, at very small values, the debt becomes volatile, and because of its effect on the risk premium, this leads to exchange rate volatility. Therefore there is a tradeoff between consumption and real exchange rate stability.

The result for *the tax response to fiscal expenditure*  $\varphi_{tg}$  is shown in Figure 7. This parameter determines the degree to which fluctuations in fiscal expenditure are financed by an increase in taxes. The estimated values are small, suggesting a high degree of debt financing, consistent with rising losses with tax financing. This result reflects the effect of movements in lump sum taxes of nonRicardian household income and consumption. Thus it is efficient to use the debt as a shock absorber, and vary taxes only a little. In contrast, real exchange rate volatility increases with greater debt financing because fluctuations in debt increase exchange rate volatility through the risk premium, but this is still relatively weak.

The *fiscal expenditure response to the output gap*  $\varphi_{gy}$  is the active fiscal stabilisation instrument. The loss function (Figure 8) achieves a minimum at a value

well below what might be considered practical. (At a value of -1, the output gap is fully offset by government expenditure). Estimated values are a more modest range of -0.7 to -1, but still suggesting a substantial fiscal stabilisation role. As can be seen, a policy maker would prefer a more modest countercyclical response with  $\varphi_{gy}$  in the range of -0.3 to -0.6, representing their concern with consumption volatility that is closer proxy to a welfare measure than output volatility or real exchange rate volatility.

In Figures 9 and 10, we consider monetary policy in the absence of active fiscal stabilisation (i.e.  $\varphi_{gy}=0$ ). In this single policy tango situation, the increases are mostly due to higher GDP volatility. If fiscal policy were to become solely concerned with good housekeeping, leaving stabilisation to monetary policy alone, monetary policy could achieve a better outcome through a less aggressive response to inflation and a more aggressive response to the output gap, and less interest rate smoothing referring to less aggressive policy in general. However, the outcomes are never as good as in the case where fiscal policy is active.

## 2.6.2 Mixed Policy and Stabilisation role

Let us consider the scenario when monetary and fiscal policy behave as if the economy is assumed to be all ricardian households, while in reality the share of non ricardian households is 62% as estimated from baseline scenario. Therefore, all policy parameters are taken from all-ricardian scenario, but the economy is based on baseline scenario. This scenario is called mixed, representing a misguided policy measures, however practically some countries may adopt this policy when their statistic offices publish incorrect poverty information, ei-

ther from poverty line calculation or political pressures to show government achievement for lowering poverty rate.

Figures 3 to 8 also show the loss function for stabilisation using mixed policy scenario, together with baseline and ricardian scenario. As can be seen, mixed policy scenario creates bigger loss to the economy, simply because policy under all-ricardian assumption is relatively more aggressive than baseline policy. For instance, fiscal expenditure response to the output gap  $\varphi_{gy}$  under all-ricardian scenario is -1.1, compare to -0.73 under baseline scenario. Under baseline scenario, any shock associated with economic overheat will be responded by trimming government expenditure or tax increase to reduce consumption. For example, subsidy reduction will trigger a drop on people purchasing power. That drop is reflected at real wages and weaken the consumption of non ricardian household. Under mixed policy, an example for aggressive fiscal policy is subsidy removal, which further worsen the purchasing power thus consumption of non ricardian household. Therefore, the policy of eliminating subsidy should be carried out in a cautious way. Although monetary can provide an optimal countercyclical response by raising interest rate, the direct impact of subsidy removal will be the declining consumption of the poor household for an extended period of time. Considering that poor household consumption is also one representative of public welfare, a public policy is only appropriate if it emphasized efforts to optimize public welfare, as reflected in public consumption dynamics. One of important argument is the reality that subsidy on domestic agricultural products is still maintained, even in several advanced country such as US and European union.

### 2.6.3 Summary of Findings

We find that fiscal policy can *and does* play a stabilising role in Indonesia. Government expenditure is estimated to be countercyclical. A tax response to variations in expenditure is undesirable because expenditure is playing an active stabilisation role and because non-Ricardian income and therefore consumption is directly affected by variations in taxes. Taxes respond to debt above target, by enough to ensure solvency, but to only gradually return debt to steady state. Therefore the fiscal debt plays an important shock absorber role facilitating countercyclical policy while avoiding large fluctuations in taxes which would lead to volatility in non-Ricardian consumption. Estimated fiscal and monetary policy parameters look sensible in terms of the variance tradeoffs in the model.

The features in our model that could give fiscal policy an active stabilisation role are a large estimated share of non-Ricardian households 67 per cent of households, price and wage rigidities, and distortionary taxes. Of these, only non-Ricardian agents are found to be important. Therefore, optimal policy measure should consider this type of household. Exclusion of the non-Ricardian households will result in sub-optimal policy toward optimising social welfare.

In the absence of active fiscal policy, monetary policy would give the best outcomes, in terms of a standard loss function, by being less responsive to inflation and more responsive to the output gap.

The size of the stocks of debt and reserves have little effect on macrostabilisation outcomes, within reasonable limits. Fluctuations due to exchange rate valuation effects are absorbed into the debt, which is fine as long as the tax response to debt is large enough to ensure solvency. While the size of the reserves

stock has little effect on stabilisation dynamics, it is, of course, still important for financial stability considerations.

In the model foreign reserves accumulation is contractionary and leads to a depreciation even in the absence of a direct effect on the exchange rate. However fiscal expenditure is a more effective instrument for influencing the exchange rate. An increase in reserves depreciates the exchange rate by considerably less than an equivalent cut in government expenditure. Countercyclical fiscal policy helps to reduce real exchange rate volatility. At the end, a policy tango is superior to monetary policy alone.

Table 2.1: Calibrated Parameters

	Description	Calibrated Value
$\beta$	subjective discount rate	0.99
$\alpha$	capital share	0.38
$\delta$	depreciation rate	0.025
$\mu_H$	steady state markup (home goods)	0.3
$\mu_F$	steady state markup (imports)	0.3
$\mu_W$	steady state markup (wages)	0.3
$G$	steady state gov't spending/GDP	0.88
$B$	steady state fiscal debt/GDP	0.30
$Z$	steady state reserves/GDP	0.10
$\chi$	foreign curr. share of fiscal debt	0.50
$\tau^c$	consumption tax rate	0.10
$\tau^d$	income tax rate	0.10
$\tau^w$	payroll tax rate	0.075

Table 2.2: Priors

	Parameter	Distribution	Mean/ Mode	StdDev/ Deg. Free
$\omega$	share of nonRicardian consumers	Beta	0.5	0.2
$h$	habit parameter	Beta	0.5	0.2
$\phi_{rp}$	risk premium parameter	Gamma	0.008	0.003
$\zeta$	inverse elasticity of labour supply	Gamma	2	0.75
$\phi$	fixed cost of production	Beta	0.3	0.1
$v$	investment adjustment costs	Gamma	3.0	1.5
$\psi$	cap. util. parameter	Gamma	0.2	0.075
$\psi_H$	home goods demand elasticity	Gamma	1	0.5
$\psi_F$	export demand elasticity	Gamma	1	0.5
<i>Price &amp; wage parameters</i>				
$\theta_H$	Calvo parameter home goods	Beta	0.75	0.15
$\gamma_H$	indexation: home goods	Beta	0.5	0.2
$\theta_F$	Calvo parameter imports	Beta	0.75	0.15
$\gamma_F$	indexation: imports	Beta	0.5	0.2
$\theta_w$	Calvo wage parameter	Beta	0.75	0.15
$\gamma_w$	wage indexation parameter	Beta	0.5	0.2
<i>Policy parameters</i>				
$\rho_r$	Interest smoothing parameter	Beta	0.8	0.1
$\varphi_\pi$	MP: inflation response	Normal	1.7	0.15
$\varphi_y$	MP output response	Normal	0.5	0.05
$\rho_g$	Fiscal smoothing parameter	Beta	0.85	0.1
$\varphi_{gy}$	FP: expenditure response to y	Normal	0	0.5
$\varphi_{tb}$	FP: tax response to debt	Beta	0.5	0.2
$\varphi_{tg}$	FP: tax response to expenditure	Beta	0.5	0.2

Table 2.3: Priors

	Parameter	Distribution	Mean/ Mode	St Dev/ Deg Free
	<i>AR1 coefficients:</i>			
$\rho_a$	technology shock	Beta	0.85	0.1
$\rho_g$	fiscal shock	Beta	0.85	0.1
$\rho_I$	investment adj	Beta	0.85	0.1
$\rho_L$	labour preference	Beta	0.85	0.1
$\rho_{i*}$	foreign cost of capital	Beta	0.85	0.1
$\rho_{y*}$	foreign demand	Beta	0.80	0.1
$\rho_z$	reserves shock	Beta	0.75	0.15
	<i>Shock standard deviations:</i>			
$\sigma_a$	technology shock	Inv Gamma	0.07	2
$\sigma_g$	fiscal expenditure shock	Inv Gamma	0.1	2
$\sigma_I$	investment adj shock	Inv Gamma	0.1	2
$\sigma_L$	labour pref shock	Inv Gamma	0.1	2
$\sigma_r$	monetary policy shock	Inv Gamma	0.02	2
$\sigma_{y*}$	foreign demand shock	Inv Gamma	0.1	2
$\sigma_{i*}$	foreign cost of capital shock	Inv Gamma	0.1	2
$\sigma_p$	price cost push shock	Inv Gamma	0.04	2
$\sigma_w$	wage cost push shock	Inv Gamma	0.01	2
$\sigma_z$	reserves accumulation shock	Inv Gamma	0.4	2

Table 2.4: Posterior Estimates

	Parameter	Baseline Scenario	Ricardians Scenario	Mixed Scenario
$\omega$	share of nonRicardian consumers	0.67	0.10	0.67
$h$	habit parameter	0.15	0.59	0.10
$\zeta$	inverse elasticity of labour supply	0.90	0.99	0.89
$\phi_{rp}$	risk premium parameter	0.0090	0.0077	0.0089
$\phi$	fixed cost of production	0.31	0.30	0.29
$v$	investment adjustment costs	0.57	0.83	0.38
$\psi$	cap. util. parameter	0.17	0.23	0.14
$\psi_H$	home goods demand elasticity	0.77	0.99	0.58
$\psi_F$	export demand elasticity	1.90	1.92	1.86
<i>Price &amp; wage parameters</i>				
$\theta_H$	Calvo Parameter home goods	0.83	0.78	0.90
$\gamma_H$	indexation: home goods	0.73	0.55	0.75
$\theta_F$	Calvo parameter imports	0.71	0.74	0.81
$\gamma_F$	indexation: imports	0.49	0.36	0.48
$\theta_w$	Calvo wage parameter	0.75	0.76	0.84
$\gamma_w$	wage indexation parameter	0.11	0.15	0.09
<i>Policy Parameters</i>				
$\rho_r$	MP: interest smoothing	0.86	0.87	0.87
$\varphi_\pi$	MP: inflation response	1.87	1.68	1.68
$\varphi_y$	MP output response	0.45	0.48	0.48
$\rho_g$	Fiscal smoothing parameter	0.72	0.72	0.72
$\varphi_{gy}$	FP: expenditure response to y	-0.73	-1.10	-1.10
$\varphi_{tb}$	FP: tax response to debt	0.25	0.12	0.12
$\varphi_{tg}$	FP: tax response to expenditure	0.20	0.13	0.13

Table 2.5: Posterior Estimates

	Parameter	Baseline Scenario	Ricardians Scenario	Mixed Scenario
	<i>AR1 coefficients:</i>			
$\rho_a$	technology shock	0.59	0.52	0.62
$\rho_I$	investment adj	0.80	0.68	0.85
$\rho_L$	labour preference	0.96	0.92	0.99
$\rho_{i*}$	foreign cost of capital	0.86	0.65	0.86
$\rho_{y*}$	foreign demand	0.86	0.78	0.86
$\rho_z$	reserves shock	0.86	0.89	0.87
	<i>Shock standard deviations:</i>			
$\sigma_a$	technology shock	0.12	0.08	0.11
$\sigma_g$	fiscal expenditure shock	0.08	0.10	0.08
$\sigma_I$	investment adj shock	0.21	0.22	0.15
$\sigma_L$	labour pref shock	0.09	0.10	0.08
$\sigma_r$	monetary policy shock	0.0084	0.0061	0.0081
$\sigma_{y*}$	foreign demand shock	0.29	0.30	0.28
$\sigma_{i*}$	foreign cost of capital shock	0.029	0.032	0.028
$\sigma_p$	price cost push shock	0.023	0.020	0.022
$\sigma_w$	wage cost push shock	0.0039	0.0036	0.0034
$\sigma_z$	reserves accumulation shock	0.21	0.13	0.20

Figure 2.1: Priors and Posteriors Distribution

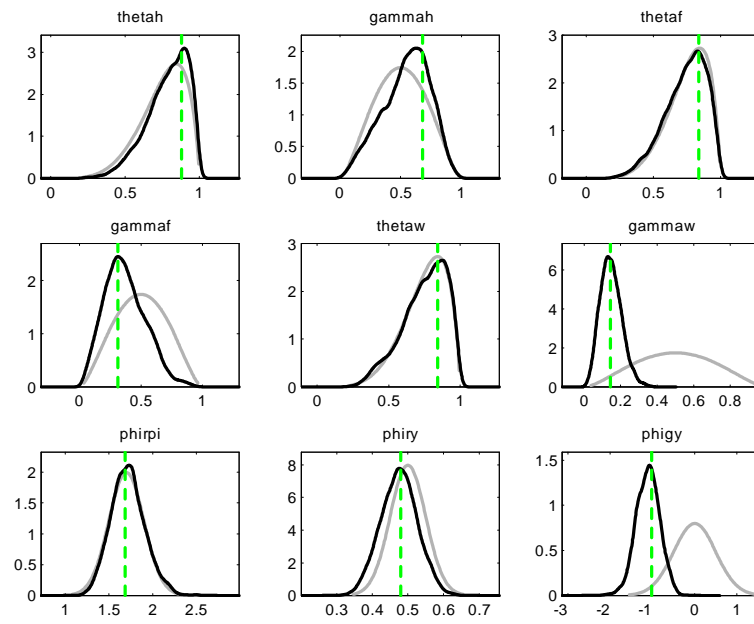
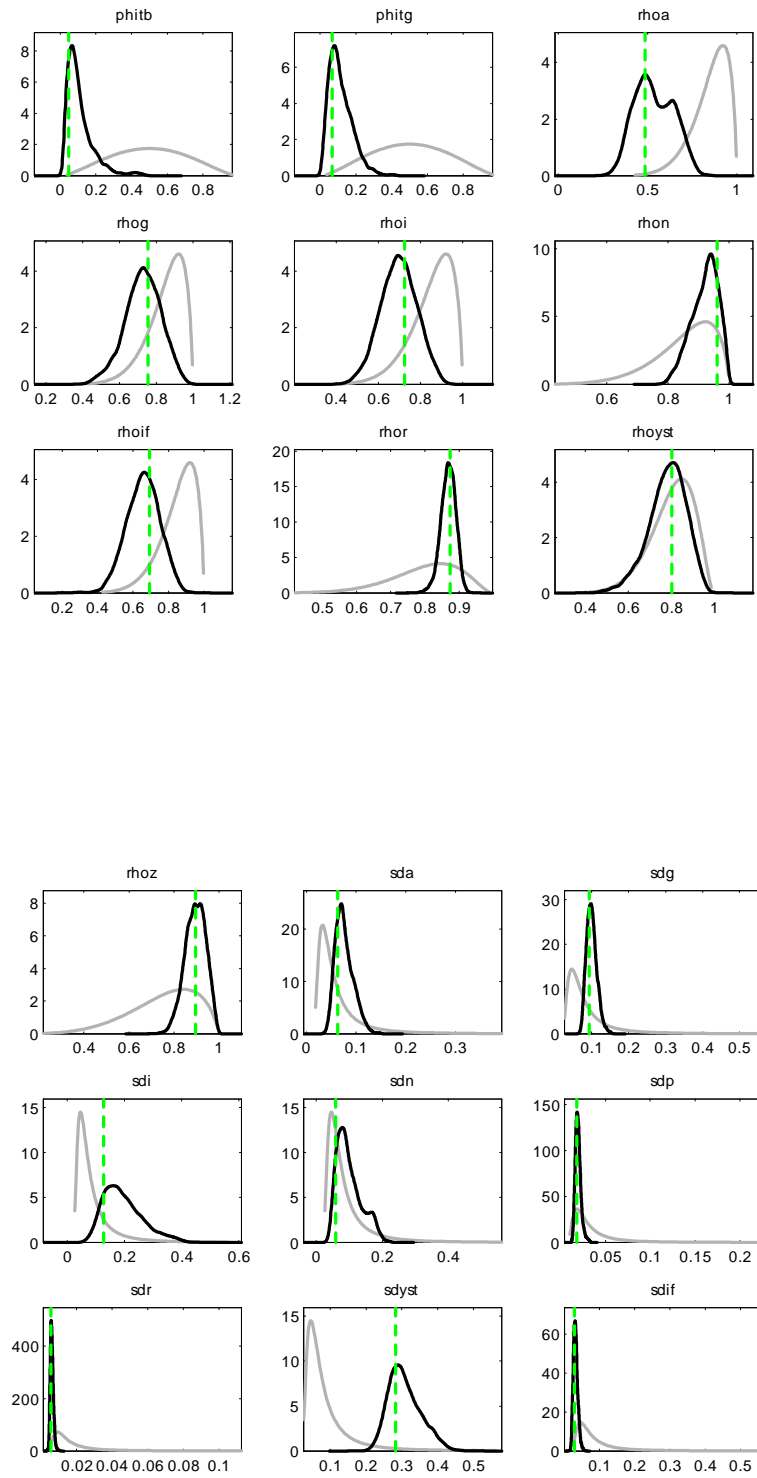


Figure 2.2:



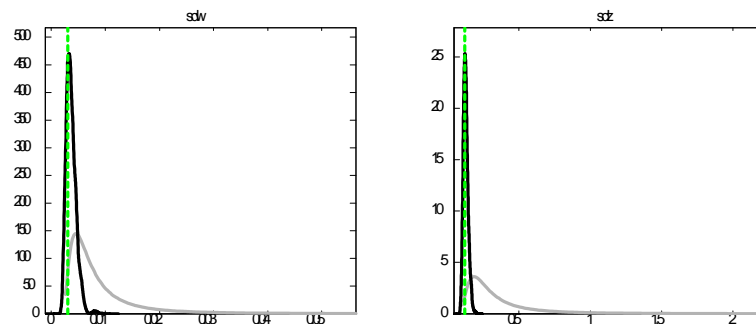


Figure 2.3: Monetary response to Inflation

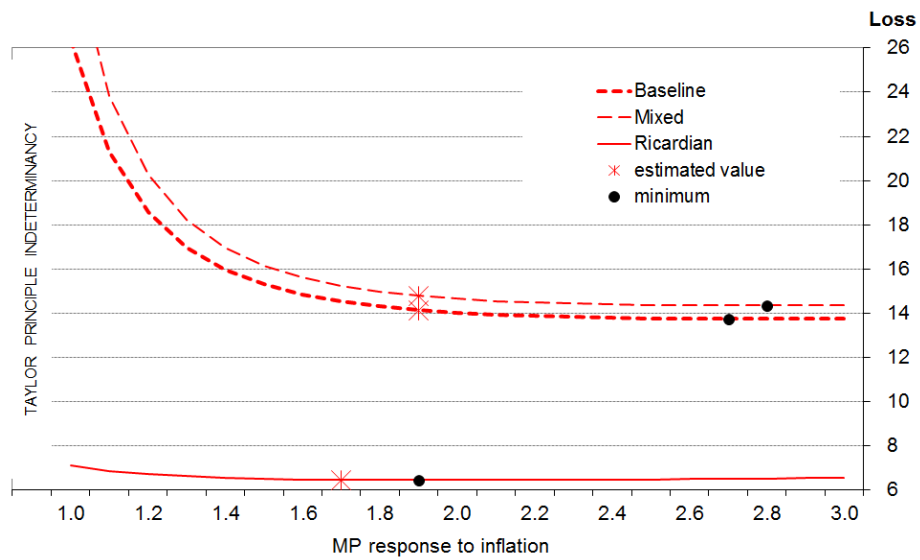


Figure 2.4:

Figure 2.5: Monetary Policy Response to the Output Gap

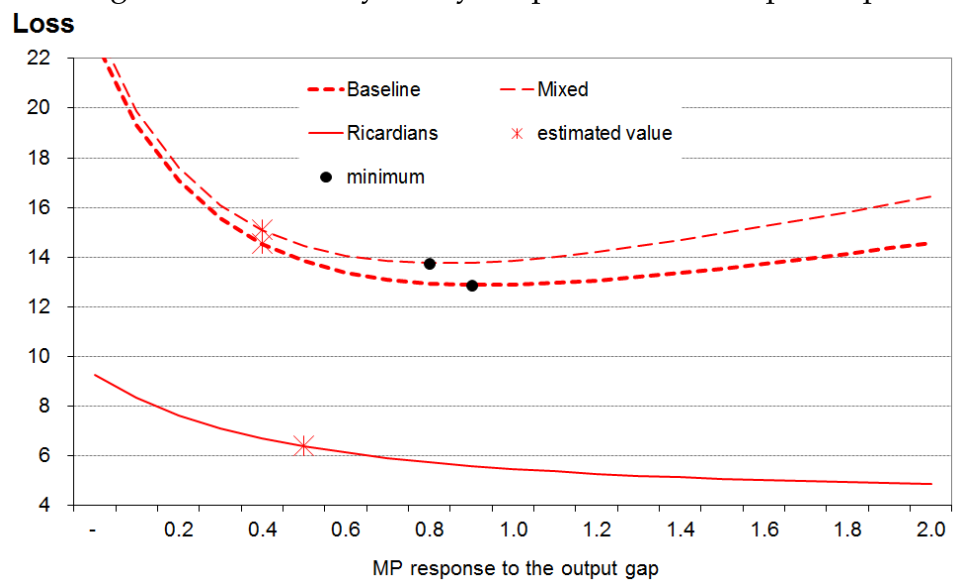


Figure 2.6: Interest rate Smoothing Parameter

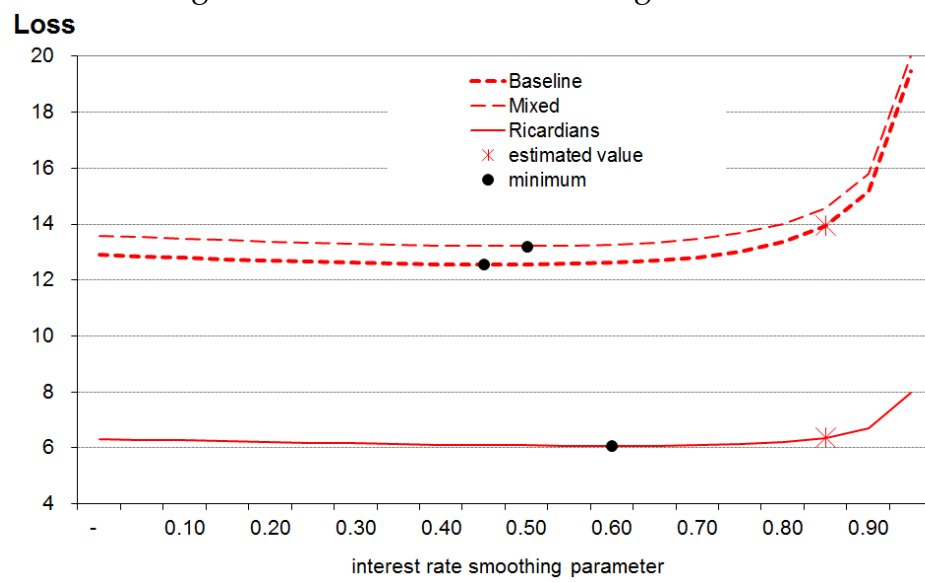


Figure 2.7: Tax response to Debt

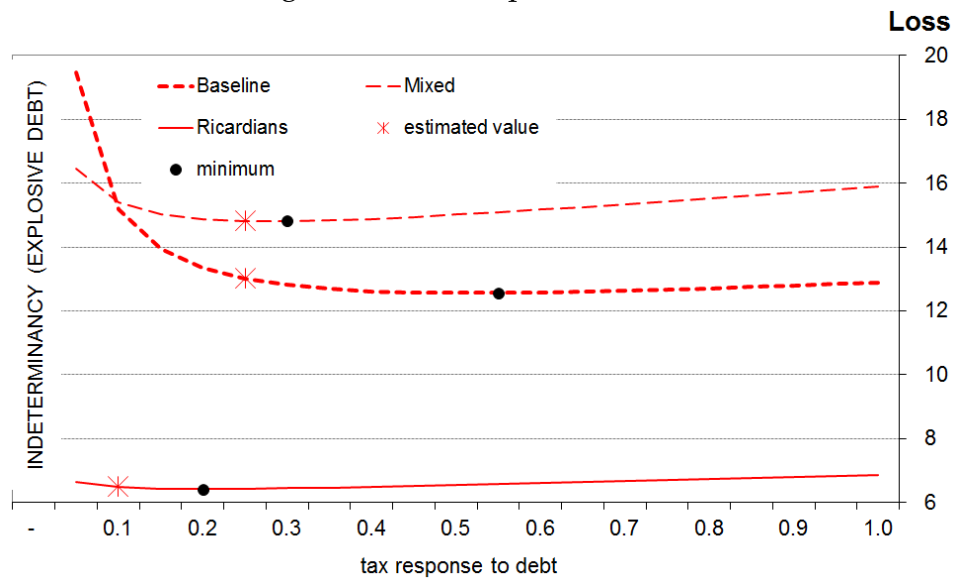


Figure 2.8: Tax Response to Govt Expenditure

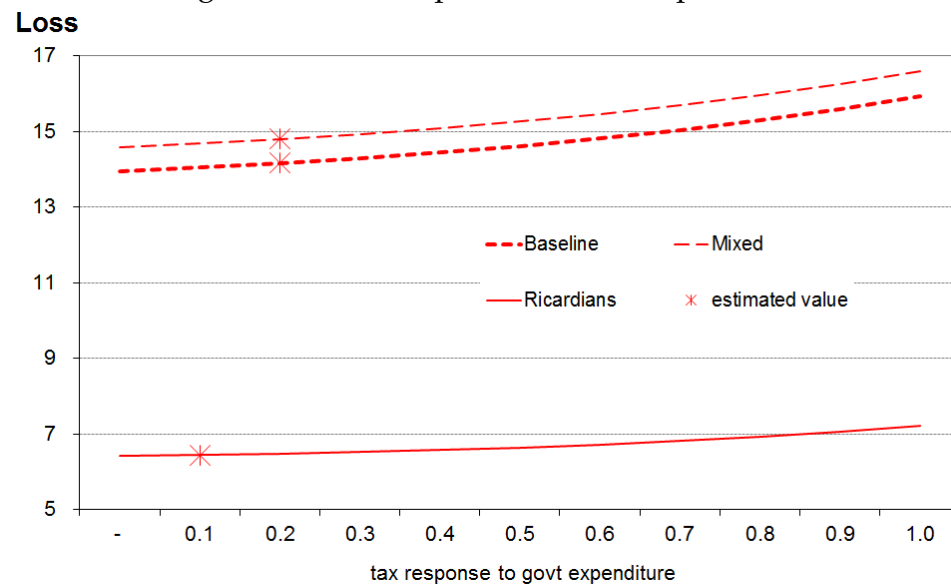


Figure 2.9: Government Expenditure Response to the Output Gap

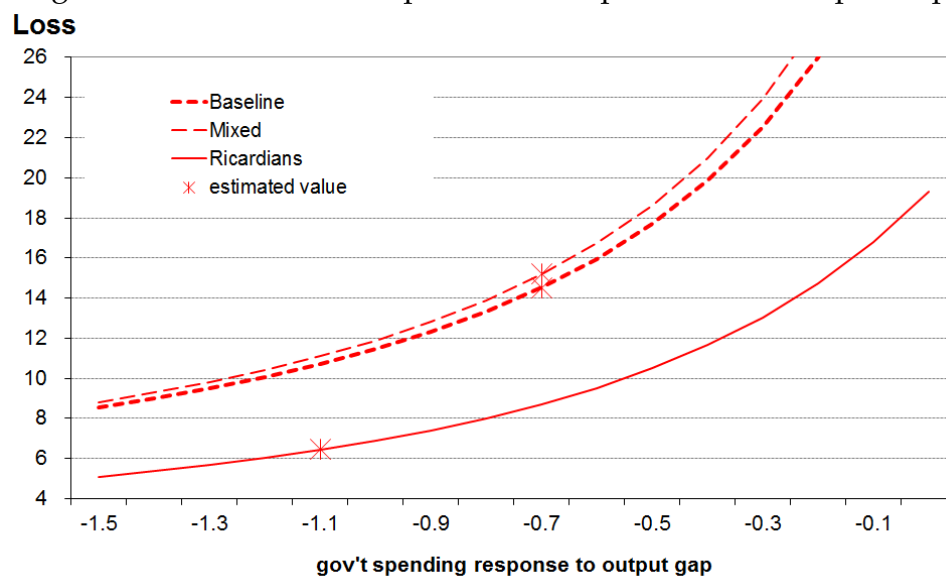


Figure 2.10: Shift in Loss Function in Absence of Fiscal Stabilisation ( $\varphi_{gy} = 0$ )

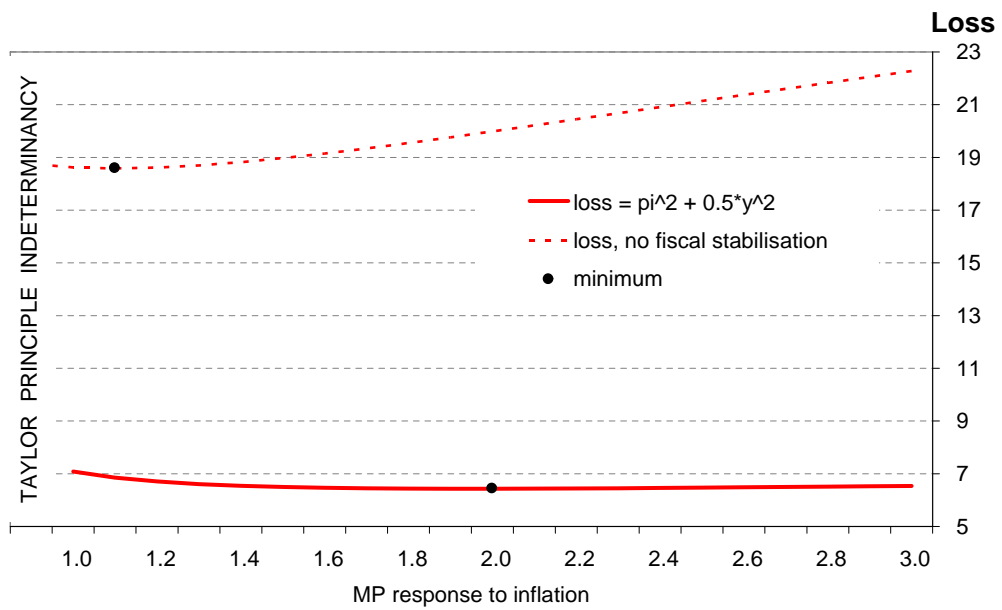


Figure 2.11: Shift in Loss Function in Absence of Fiscal Stabilisation ( $\varphi_{gy} = 0$ )

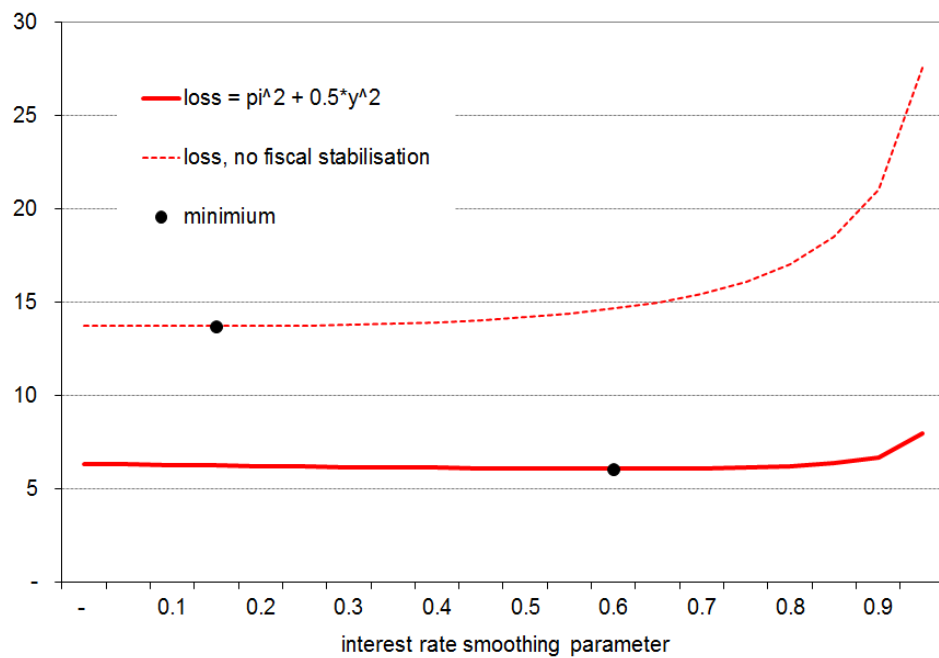


Figure 2.12:

## Impulse Response Functions : Baseline

Figure 2.13: Response to a 1 Std Dev Productivity Shock

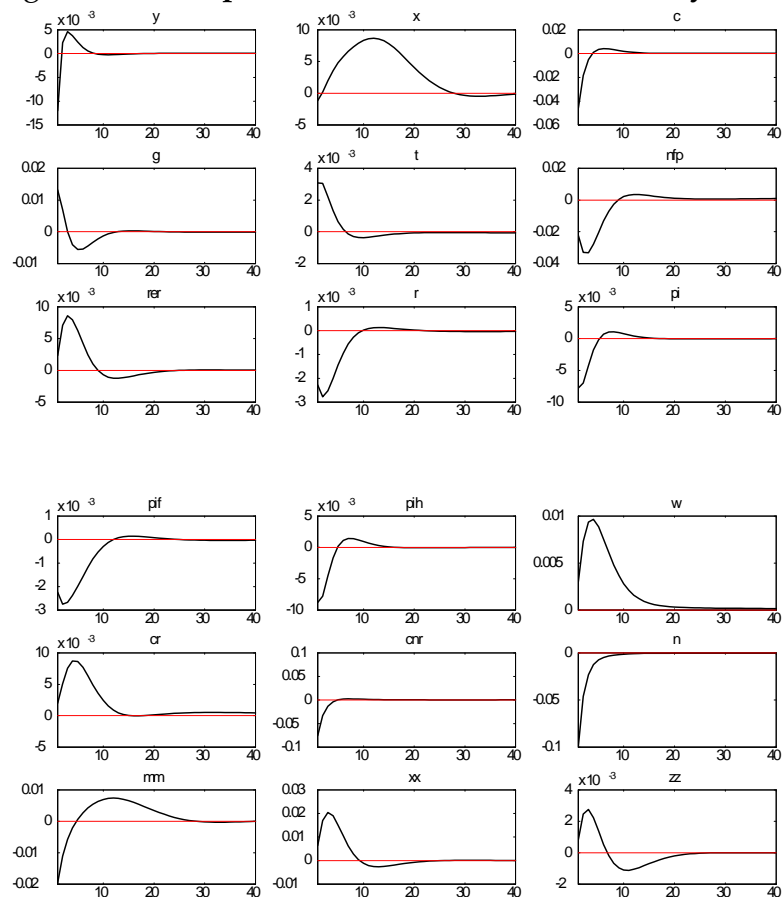


Figure 2.14: Response to a 1 Std Dev Gov't Spending Shock

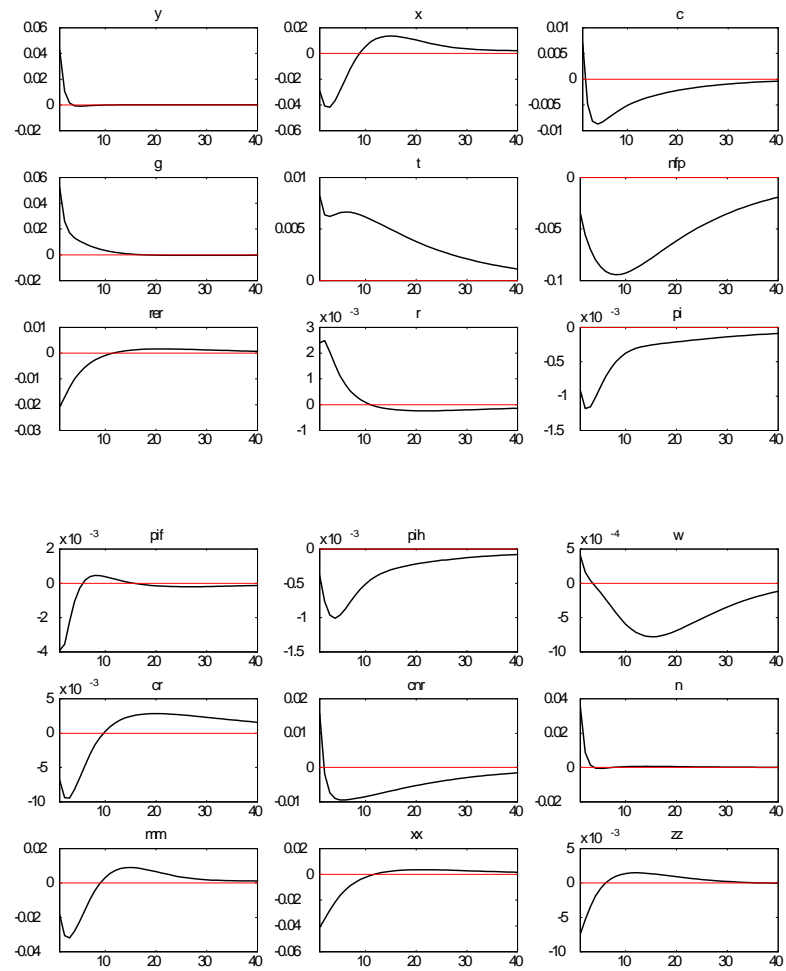


Figure 2.15: Response to a 1 Std Dev Investment Cost Shock

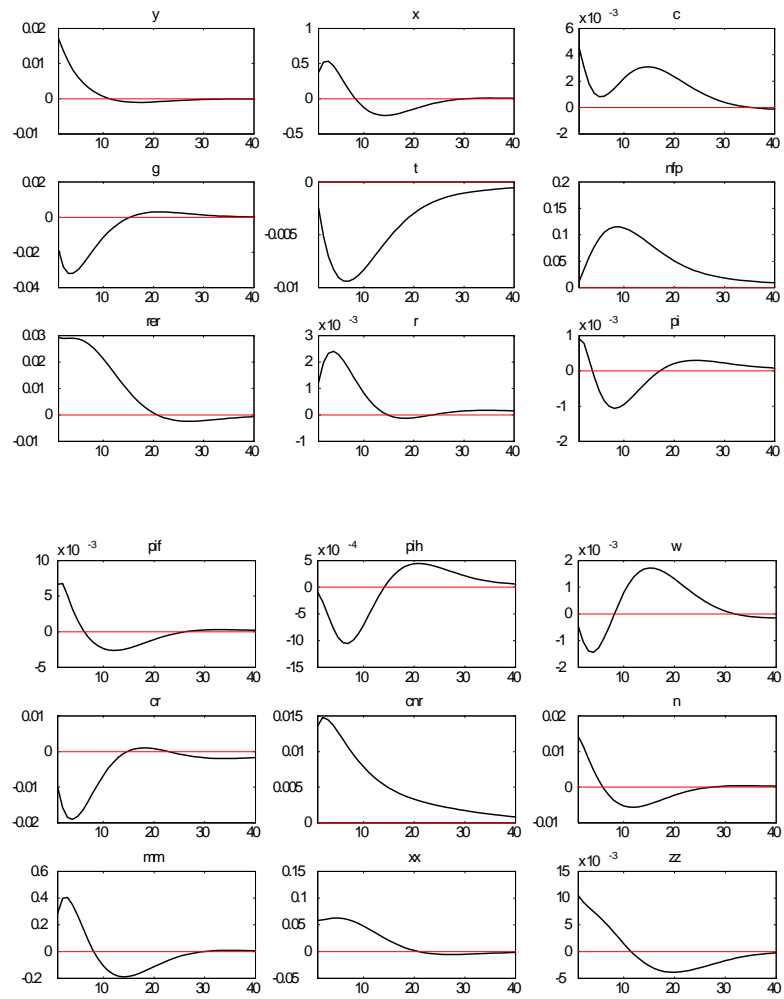


Figure 2.16: Response to a 1 Std Dev Foreign Cost of Capital Shock

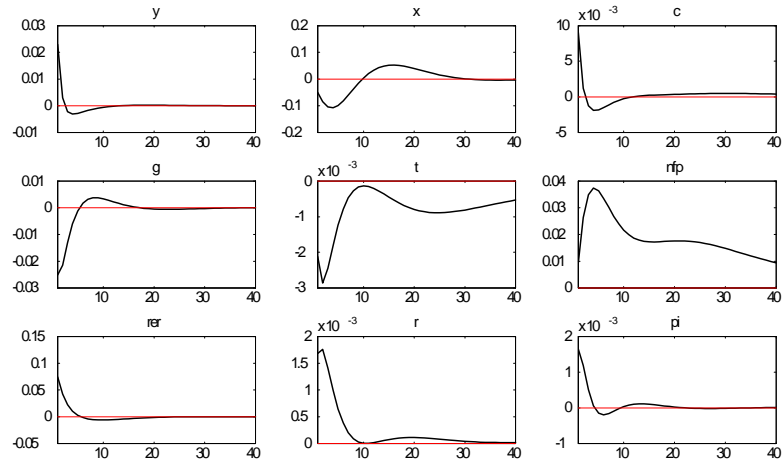


Figure 2.17:

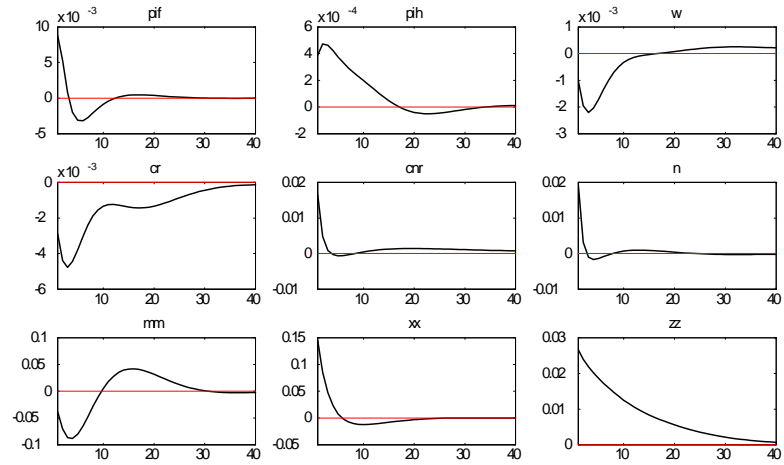


Figure 2.18: Response to a 1 Std Dev Labour Preference Shock

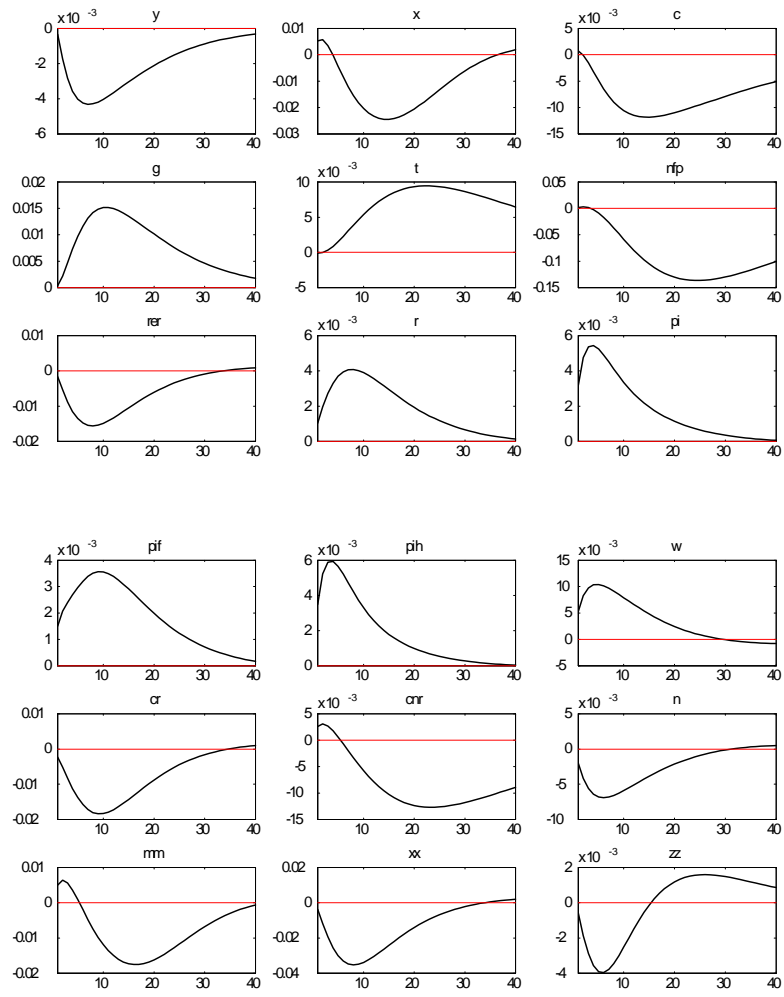


Figure 2.19: Response to a 1 Std Dev Cost Push Shock

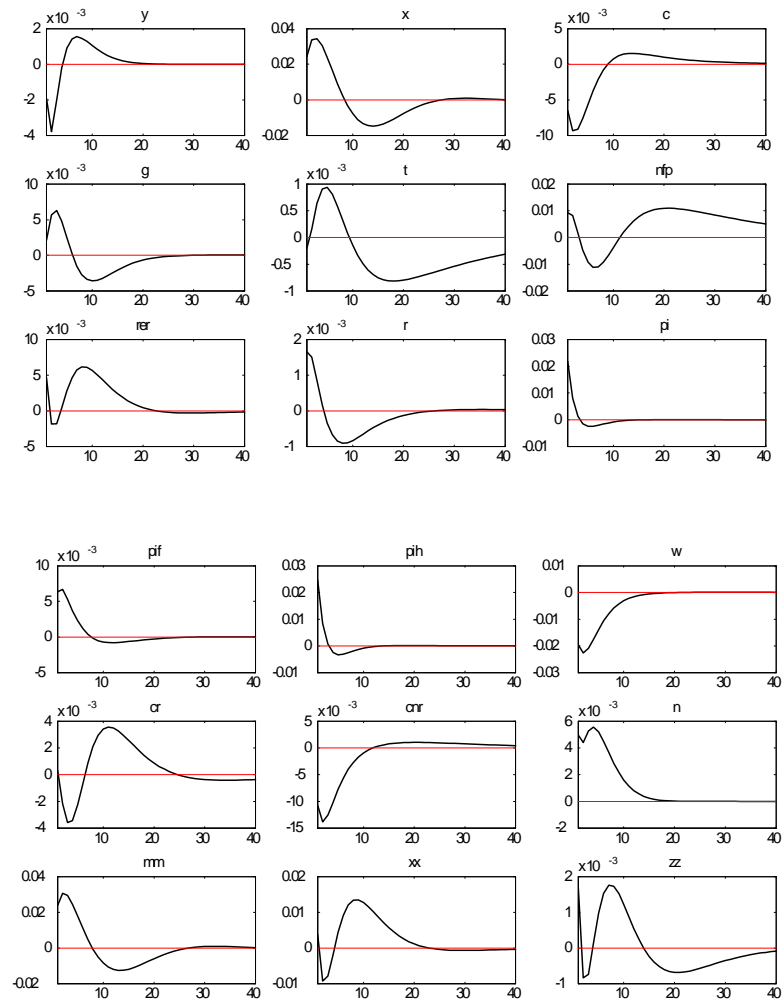


Figure 2.20: Response to a 1 Std Dev Monetary Policy Shock

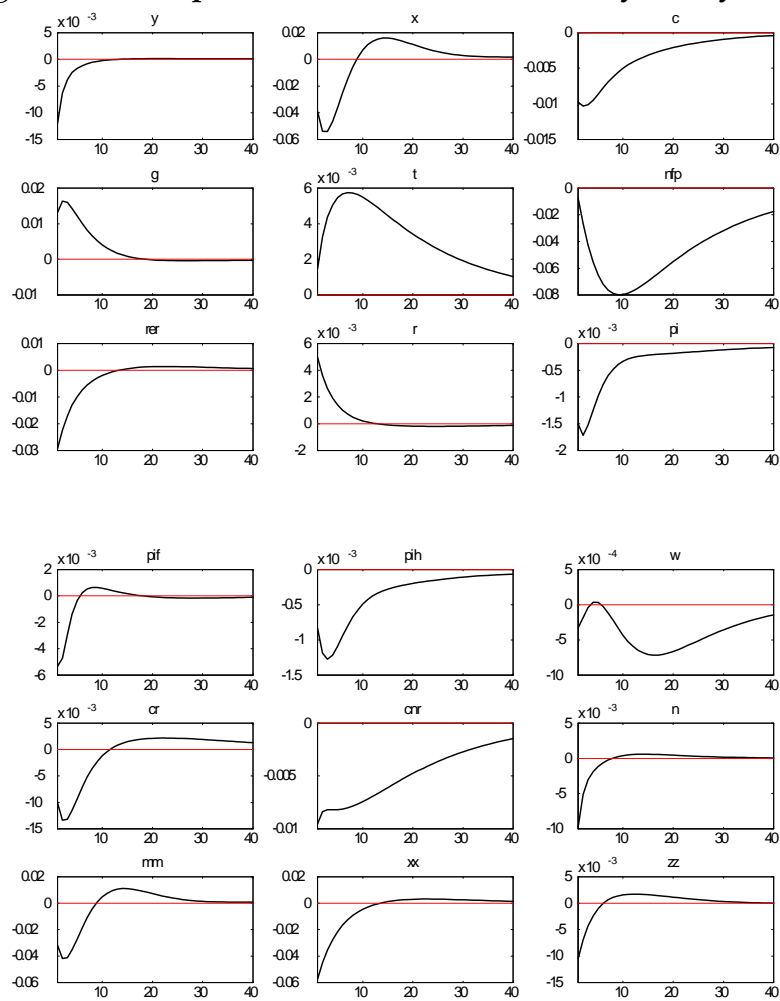


Figure 2.21: Response to a 1 Std Dev Wage Shock

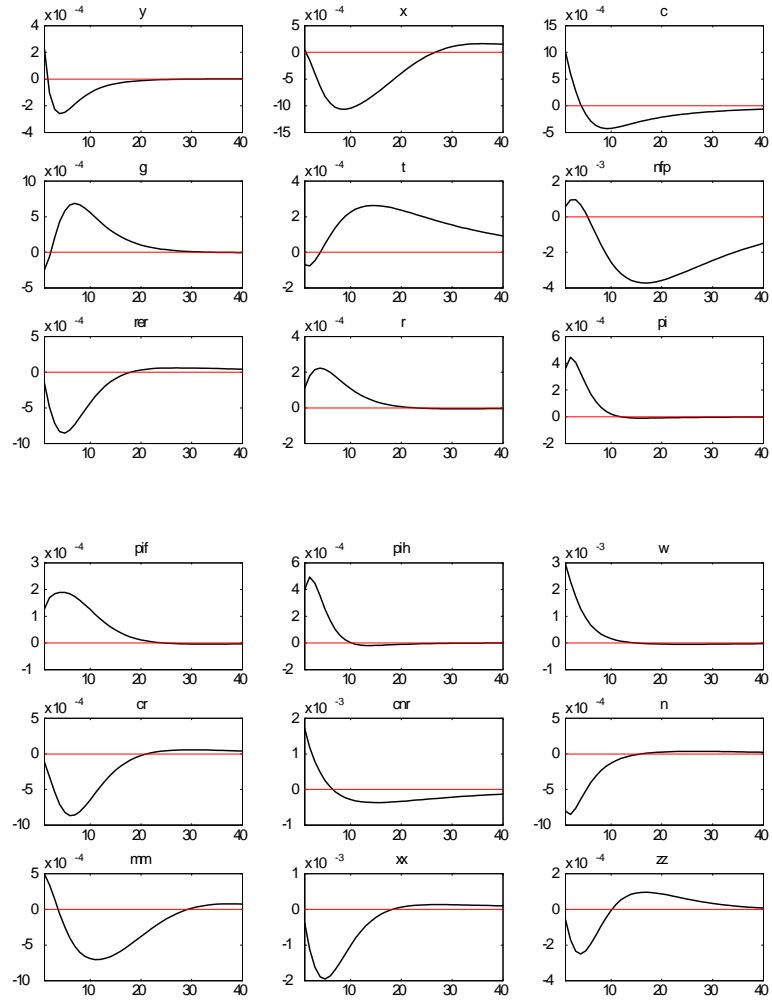


Figure 2.22: Response to a 1 Std Dev Foreign Demand Shock

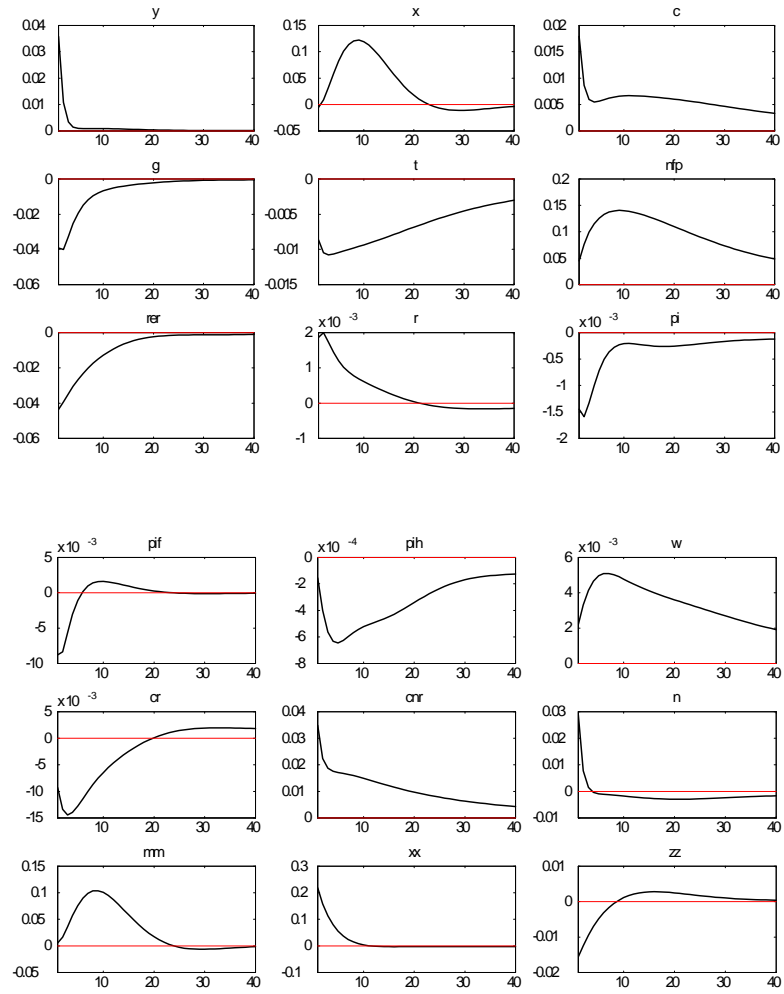
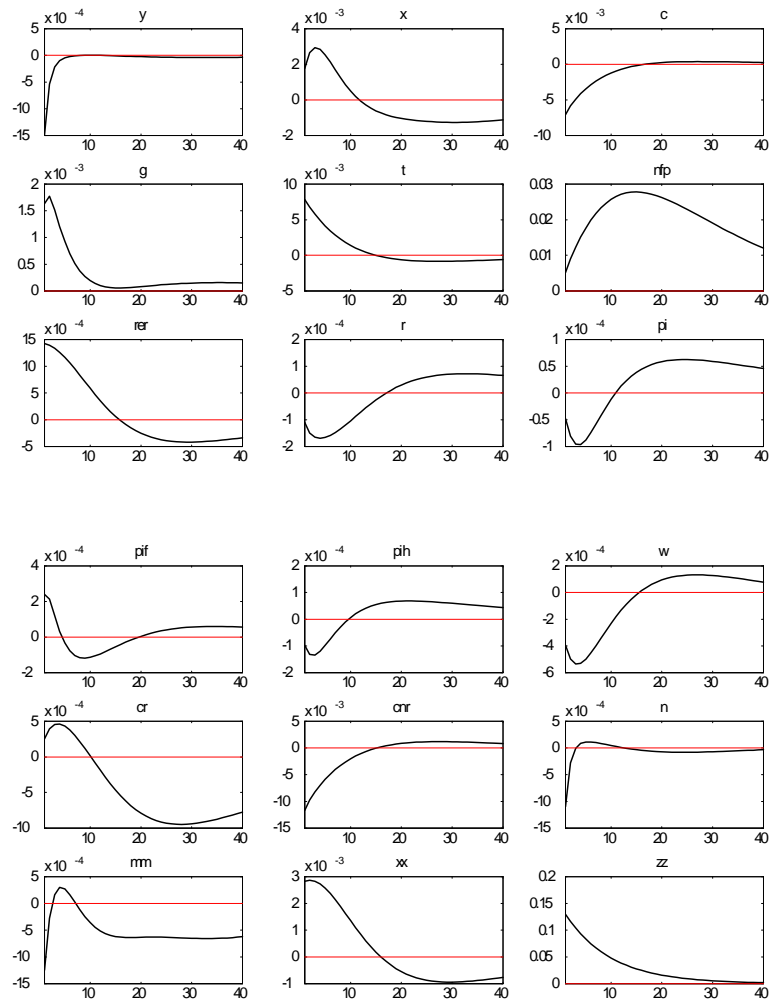
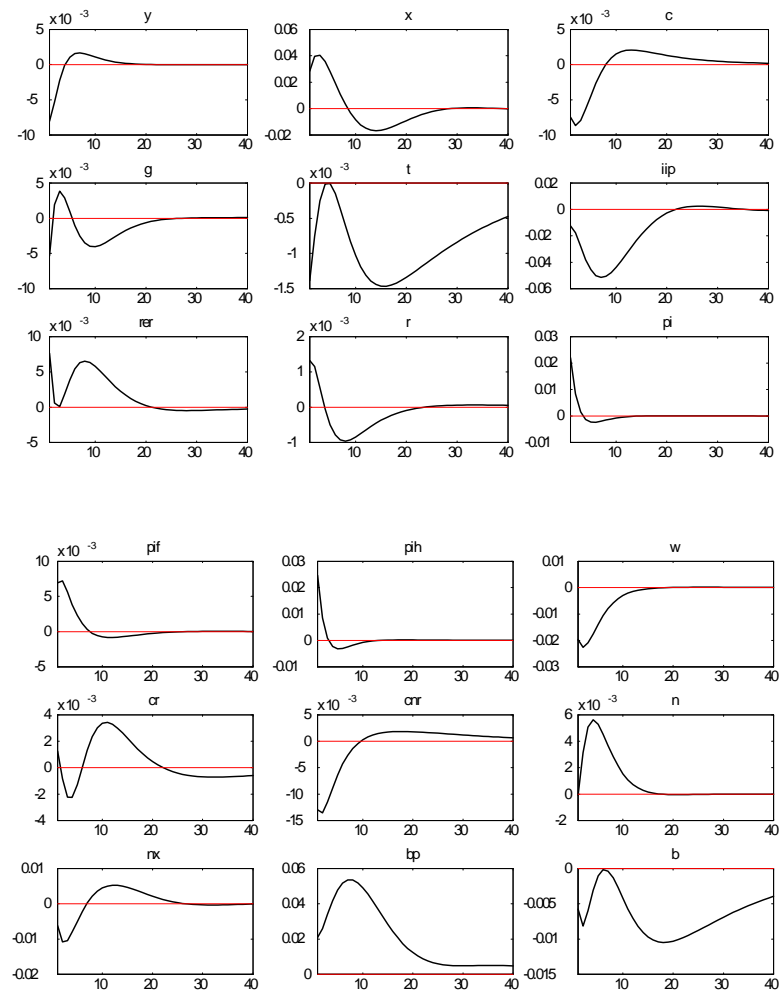


Figure 2.23: Response to a 1 Std Dev Reserves Accumulation Shock



**Figure 2.24: Response to Subsidy Removal (Combined Cost Push and Fiscal Shock)**



## CHAPTER 3

### CHAPTER 3 : MACROPRUDENTIAL POLICY AND CAPITAL CONTROL : AN EMERGING MARKET ISSUE

#### 3.1 Introduction

What is the challenge for the monetary and macro prudential policy in an emerging economy when it become a small open economy during the global economic turmoil? As a price taker, emerging economies are becoming subject of the volatility of world interest rates and prices, in particular in the case of high reliance on international trade. From financing channel, domestic saving rigidity problem in the emerging economies has led to high dependency on foreign investment, both direct and portfolio investment. Particularly, foreign portfolio investment flows tend to amplify the pro-cyclical power of domestic business cycle. This massive pro-cyclicality of business cycle tends to complicate policy maker in the emerging economy to conduct their countercyclical policies.

One component of foreign portfolio investment is the cross-border bank lending activities, mainly from banking industry in developed economies to banking industry in emerging economies. From the origin, deeper financial globalization and integration in the developed economies since 1990s, has led to stronger competition for new market and profitability. Furthermore, the development of financial intermediation alternative such as capital market and bond market has created fiercer competition among developed economies banks. On the other hand, as the recipient, emerging economies banks have grown rapidly due to the massive financial liberalization and deregulation program since the late 1980s. Along with this liberalization of capital account and combined with

taming barriers to entry to financial market , has created new investment opportunity to developed economies banks as an alternative to their local or regional market.

In terms of literature collections on the determinants of cross-border bank flows to emerging markets in periods of crises, they only have gained a little attention so far. Earlier works are the combination of the traditional push, pull factors with financial stress indicators, and highlighted the importance of common lender effects (Rijckeghem and Weder, 2003). Heid et al (2004) confirms such effects at the micro level and found that a sudden increase in risk aversion plays a fundamental role in explaining cross-border lending in Europe. Study from the World Bank (2008) showed that tensions in the global interbank market were associated with lower growth of bank loans during the current global financial crisis. McGuire and Tarashev (2008) establishes a link between cross-border loans and measures of bank health in host countries. Buch et al (2009) examined the relationship between macroeconomic shocks and international banks' foreign assets. They find that temporary overshooting and subsequent adjustment over several quarters characterized bank responses.

However, the notion of managing these international capital flows, particularly the cross-border loans to mitigate its negative impact to the economy has just received attention lately. One strand of recent theoretical literature examines whether prudential capital controls are desirable from the perspective of improving the overall domestic welfare of an emerging market economy when there are booms and busts in capital flows (Korinek (2010), Korinek (2011), Jeanne and Korinek (2010a)). They find that the optimal policy is the Pigouvian tax on capital inflows that make private market participants internalize

their contributions to systemic risk in order to restore the efficiency of the decentralized market equilibrium. Bianchi (2011) quantifies the optimal tax in a dynamic model of a small open economy calibrated to Argentina. He finds that the relationship between the capital flows cycle and the optimal tax is highly nonlinear. Shin (2010a) and Perotti and Suarez (2011) proposed to use a tax on banks' non-core liabilities as a tool for prudential regulation and such a tax was introduced in Korea in August 2010. From the policy perspective, The rationale for government management of capital inflows, and whether there is a need for international rules of the game for those policies, have been identified as important issues for the G20 discussions after the crisis, and IMF has produced several analytical papers on those issues (IMF, 2011; Ostry et al., 2011). Finally, panel of experts from CIEPR (Prasad, et al, 2012) showed that the pro-cyclical nature of cross-border lending type flows has given rise to serious economic and financial instabilities thus effective regulations of this cross-border banking activity is essential for domestic and global financial stability in a highly financially integrated world

The IMF document identifies three periods of rapid capital inflows in recent decades: 1995Q4–1998Q2, a period associated with the Asian financial crisis; 2006Q4–2008Q2, which is associated with the credit boom that led to the Global Financial Crises; and 2009Q3–2010Q2, the aftermath of the crisis. In the first two capital inflows periods, the roles of cross-border bank lending were less than 20%. However, cross-border lending role surged during the period leading up to the Lehman bankruptcy and its immediate aftermath (Azis and Shin, 2012).

Therefore, the changing nature of the global imbalances since the mid-1990s is evident in those different stages of capital inflows. However, the last episode

of capital inflows, leading up to the Global Financial Crises and the immediate aftermath of the Lehman Brothers bankruptcy in September 2008 is strongly characterized by increasing bank-led flows to the emerging economy. Permissive liquidity conditions in the US where wholesale market were transmitted via the global banking system to the rest of the world, including emerging Asia.

This first wave of global liquidity manifested itself in the expanded balance sheets of banks resulting from increasing non-core liabilities that facilitated loans and risk-taking behavior. Even non-financial institutions took on the attributes of financial firms, which is known as "financialization," as they increased the size of their balance sheets relative to sales-generating activities, and therefore contributed to the massive pro-cyclicality of business cycle. The currency appreciations impact further fueled capital flows into emerging economies particularly Asia, as borrowers' balance sheets were strengthened.

The second wave of global liquidity commenced in 2010, resulted from series of US Quantitative Easing (QE) policy as well as asset purchase policies of advanced economy central banks. A massive amount of capital inflows surged into emerging Asian markets searching for higher yield known as flight to quantity event. As a result, the region's capital markets across the board experienced a boom as governments seized upon the availability of low-cost financing through the bond market. The share of foreign ownership in local currency bond markets rose, as did banks' sovereign bond holdings. The issuance of international securities by both governments and private corporates in emerging economies also increased rapidly amid super-low interest rates.

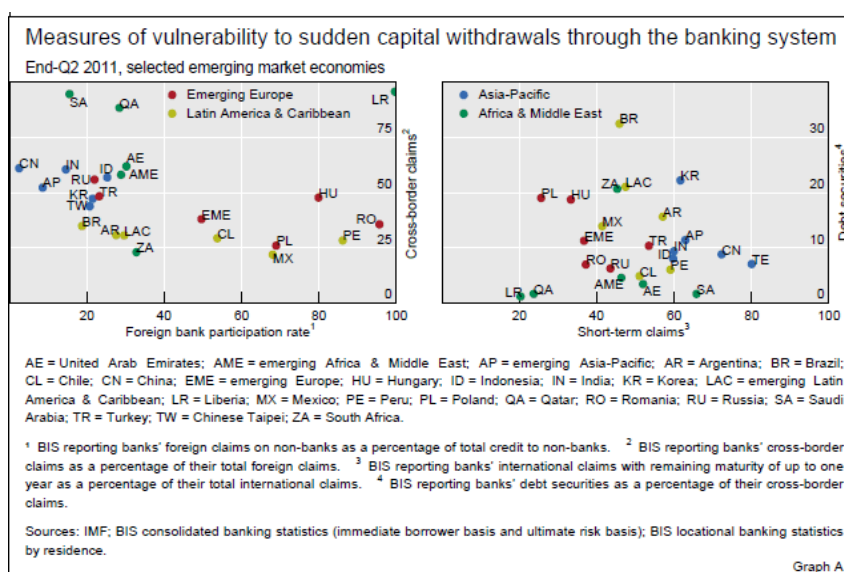
Rising bank led inflows or non-core liabilities since the first wave of capital flows to emerging Asia post Lehman were highly pro-cyclical and constituted

an important transmission channel of global liquidity shock to the this region. This bank led inflows has strengthen the domestic financial cycles. Together with domestic business cycles, they reduced the effectiveness of both emerging Asia's fiscal and monetary policy. Therefore, macro prudential policy takes the important role with more targeted policy and various instruments. Form the first chapter, macro prudential policy is considered superior over monetary policy in handing financial and asset price shocks. However, in that chapter, both instruments, LTV and Countercyclical capital are on asset side. Therefore, in this chapter, we introduce one instrument on the liabilities side, which is tax on non-core liabilities. It imposes a levy on bank led inflows to discourage arbitrage investment such as carry trade

### **3.2 Stylized Facts on Increasing Non-Core Liabilities and Reversal Risk in Emerging Economies**

Unusually strong cyclical and policy differences between advanced and emerging economies, and a gradual shift in portfolio allocation towards emerging markets, have led to capital flows into emerging economies since the start of this global financial crisis in the of mid-2009 (GFSR,2010, WEO, 2011). According to BIS report in 2011, out of emerging economies, Asia-Pacific region appears to be the most exposed area to the sudden capital flows withdrawals through the banking system. Using data as of June 2011, close to two-thirds (63%) of all international claims on residents of that region had a remaining maturity of less than one year (Graph A, right-hand panel). In addition, cross-border claims represented more than half (52%) of all foreign lending to the area (Graph A,

left-hand panel).



This rapid resumption of capital inflows, which are large in the historical context, has posed risks to macroeconomic and financial stability, and to address these risks, policy makers have turned their attention to the use of macroprudential measures, as a complement to monetary policy.

Experience has shown that macroeconomic stability is not a sufficient condition for financial stability. For example, prior to the crisis, global financial imbalances were built up in advanced economies resulted from the chronic current account deficit. However, the global financial crisis has created a massive global financial cycle, including the massive deleveraging from financial intermediaries in US and Europe. On the other hand, the expansionary global monetary condition and strong domestic consumption have spurred a credit boom, notably in Asia. In general, a credit boom, particularly to unproductive sector such as consumer credit is often accompanied by more risk taking behavior that lead to the relaxation of credit standard. Moreover, the economic risk is

heightened if the credit boom is driven by non-core liabilities such as borrowing beyond retail or deposits. This shift of composition of assets and liabilities, particularly towards non-core components, indicate more bank's risk-taking behavior, which also encourages them to increase their leverage over the economic cycle. This trend is now evident in Asia, where individual country scatterplots of level changes of assets and liabilities show a greater slope for non-core liabilities and assets (between 0.52 and 1.02) versus core liabilities and assets (between 0 and 0.41). After the global financial crisis, non-core liabilities appear to be growing faster than core liabilities in selected Asian economies, particularly in the emerging ones. The rapid growth can be explained by the fact that at present, the size/level of non-core liabilities in these economies continue to be small (e.g. low level-high growth), which places them at a less vulnerable position when compared to an economy exhibiting a high level-high growth pattern such as South Korea.

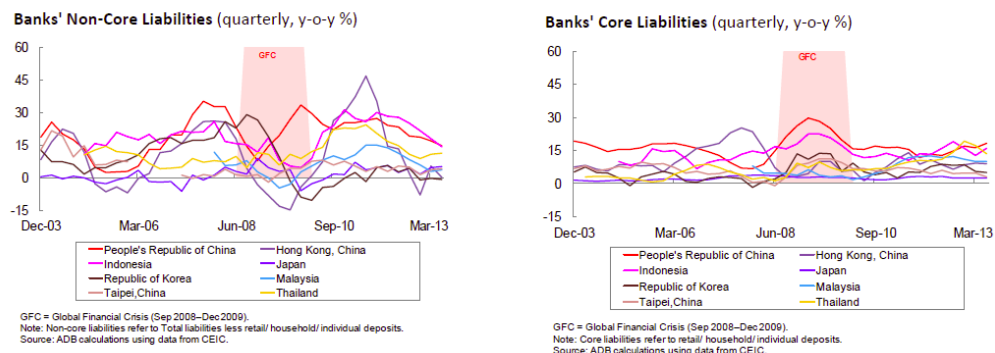


Figure 3.1: Bank's Core and Non-Core Liabilities in Asia

Therefore, the idea of capital control to mitigate their volatility emerging economies has gained renewed interest amidst the policy debate. This global financial crisis has ignited this control as the crisis prevention tool. Historically, few emerging economies such as Malaysia, Brazil, Chile, and Columbia had

used capital controls back in the 1990s, as a crisis-management tool. However, after the recent crisis, the motivation is more to prevent another crisis, not only to manage them.

For example, Brazil introduced a 2-percent tax on all capital inflows except FDI in late 2009. Subsequently the rate was increased to 6 percent in the late 2010 for bond finance, and the tax was extended to cover derivatives. In November 2009, Taiwan also introduced a ban on capital inflows for time deposits and in June 2010, Korea introduced tax on non-core liabilities. In practice, the currency forward and derivative positions of Korean banks and branches of foreign banks are limited to only 50 percent of their equity. In its financial market, Korea also imposed 14 percent withholding tax on foreign investors 'earnings from treasury bonds'.

In late 2010, Thailand has removed an exemption for foreigners on a 15 percent tax on income earned on domestic bonds. Similarly, Indonesia also introduced a relatively modest measure during that period, mainly through a compulsory one-month minimum holding period on a domestic currency monetary instrument known as central bank certificate or SBI.

Accordingly, from different degrees of intensity as well as the variety of instruments of capital control across emerging economies, there are several important questions related to the use of such controls, particularly the economic rationale and the most appropriate circumstances. That issue will be covered in the conclusion section.

### **3.3 Model and Model Features**

#### **3.3.1 Model Features**

Recent domestic boom and bust cycles are mainly characterized by asset price cycles namely stock and housing. Stock market capitalization in the emerging economy is relatively lower than the advanced one and affected few upper percentile of the society in the economy. However, the story of the global economic crises following the housing boom in the advanced economy showed that cycle in the housing price is deeper and structural. Seemingly consistent uptrend in the housing price cycle has also activates risk taking channels, where the financial intermediary overlooked the increasing value of housing as the mortgage collateral and less concern with the ability-to-repay from creditors. This cycle is worsen with the increasing inflows to bank's balance sheet in terms of non-core liabilities, where bank's balance sheets size increased relative to their business-as-usual activities. The great contraction itself, stemming from housing bubble eruption has cornered monetary and fiscal policy to their limit. It also questioned the effectiveness of DSGE model since it assumes the efficient financial market and the absence of agency problems (Gali and Gertler, 2007). This approach has been challenged for its inability to capture real time bubbles and insufficient tail-events mechanism to capture the severity of recession (Krugman 2009)

## **Global Banking Glut and Flight to Quantity**

The notion of the global banking glut was brought by Shin (2011) that is associated with the cross-border banking activities in Europe where excess saving in core countries (Germany, France) found their ways to periphery countries (Spain, Ireland) and inflates the property price in the periphery countries. However, in a wider perspective, the cross-border banking activities to emerging economies provide explanation for the large appreciation in emerging currency as well as the stock market and housing market booming. These capital inflows induced these emerging economies to experience capital surpluses, which was offset by current account deficit.

Flight to quantity motive also justifies the global banking glut phenomenon that global imbalances spillover to emerging economy following the global economic crises. However, unlike the global banking glut, this hunger for higher yield case increases the appetite for higher return assets in emerging economies. It was mainly driven by the loss in developed economy stock market following the abrupt bust in US mortgage market

This paper thus, tries to address those hypotheses that put more pro-cyclical business cycles as well as the tail-events that amplify the crisis that standard models failed to generate. One salient feature is the prominent role of housing investment. Combined with the mortgage lending mechanism, they form a bundle for collateral constraint following Kiyotaki and Moore (1997). Having this separate investment motive besides housing consumption enables us to capture housing investment boom on top of housing consumption, due to the excessive risk taking as well as the possibility of credit crunch in mortgage lending activities.

Combining open economy and financial friction should explain the dynamics of cross-border banking in terms of non-core liabilities, including the distributive impact among household classes as well as the saving-portfolio/risk premium shocks. With this open economy setting, we can measure the spillovers and the repercussion of trade and financial channel to domestic economy.

### **Distribution Impact**

In this research, households classes are disaggregated into debtors, savers and liquidity constraints household or non-Ricardian households. The latest represents fraction of households that do not have access to financial intermediary activity as well as financial market. On the contrary, the first one represents fraction of households that take out mortgage contract to finance their housing investment. This corresponds to risk taking channels where bank concern more to the housing value rather than payback ability of this household class. The objective of having these three types of households is to measure the distribution impact of several economic and policy shocks. With the increasing capital flows to the emerging asset market, it is suspected that increasing asset value owned by Ricardian household widened income disparity. Therefore, to find the optimal policy, we use comparison between Ricardian and non-Ricardian household consumption dynamic.

Another difference with the first chapter of this essay is that we focus more on credit to household than corporate, based on empirical reasoning that loans provided by Indonesian banks are mostly mortgage loans while corporations are able to utilize equity and bond issuance as well as their own funding from retained earnings (Bank Indonesia Financing Survey, 2005).

The rest of the paper is set out as follows. Section 2 provides a brief stylized facts about the development of Indonesian banking sector with respect to the accumulation of non-core liabilities. Section three sets out the model description. Section 4 discusses the data and estimation strategy. Section 5 discusses the impulse response functions, emphasizing the effect of certain shocks associated with the previously mentioned hypotheses, are able to emulate the stylized fact of emerging economy, particularly Indonesia. Section 6 conducts the optimal policy with respect optimal social welfare and the last section concludes.

To support this goal, the DSGE model we use in this chapter is a combination of first and second chapter, although there are some differences. First, unlike in the first chapter model where capital and insurance markets are regarded as being perfect (see Gali et al. (2007)), we allow for financial frictions in the form of collateral constraints on borrowers with high rates of time preference following Kiyotaki and Moore (1997), Iacoviello (2005) and Monacelli (2007). In addition, we expand the household into three types so that we can retain the financial friction between the savers and borrowers as well as the financial inclusion impact from the non-Ricardian type of household. Another feature is to allow for bubbles, following Bernanke and Gertler (1999). The term "bubbles" is used loosely to denote temporary but persistent deviations of asset prices from fundamental values due, for example, to noise traders, herd behavior or waves of optimism or pessimism. Our strategy for identifying bubbles empirically is similar to the approach by Chirinko and Schaller (2001), using GMM estimation to check the existence of stock market bubble in Japan. The closest work to this research is Ratto et al (2010) which evaluates various competing explanations about the recent boom bust cycle in the US economy.

### 3.3.2 Model

We assume a small open economy that produces goods which are imperfect substitutes to goods produced in the rest of the world. Households engage in international financial markets and there is near perfect international capital mobility. There are three production sectors, a final goods production sector as well as investment goods producing sector and a housing construction sector. We further separate households into Ricardian households which have full access to financial markets (savers), another Ricardian households facing a collateral constraint on their borrowing (borrowers) and nonRicardian or liquidity constrained households which do not engage in financial markets. And there is a monetary and fiscal authority, both following rules based business cycle stabilization policies.

#### Households

**Ricardian - Saver Household** Ricardian households have full access to financial markets. They hold domestic government bonds( $B_t^{Gr}$ ) and bonds issued by other domestic and foreign households( $B_t^r, B_t^{F,r}$ ), real capital ( $K_t$ ) used in the final goods production sector as well as the stock of land ( $Ld_t$ ) which is still available for building new houses. In addition they hold a stock of deposits ( $D_t$ ) with a financial intermediary who provides loans to credit constrained households. The household receives income from labor, financial assets, rental income from lending capital to firms, selling land to the residential construction sector plus profit income from domestic firms owned by the household (final goods  $Pr_t^j$ , residential construction  $Pr_t^H$  and financial intermediaries  $Pr_t^B$ ). We assume that Ricardian households owned the domestic firms. Income from labor is taxed

at rate  $t_t^W$ , and consumption is taxed at rate  $\tau^c$ . In addition households pay lump sum taxes  $T_t^{LS,r}$ . We assume that income from financial wealth is subject to different types of risk. Domestic bonds and interest income from deposits yield risk-free nominal return equal to it. Domestic and foreign bonds are subject to (stochastic) risk premium linked to net foreign indebtedness. An equity premium on real assets arises because of uncertainty about the future value of real assets. The optimization given by maximizing the objective function

$$\max E_t \sum_{k=0}^{\infty} \beta^{r,t} U(C_t^r, 1 - L_t^r, H_t^r) \quad (SS.1)$$

followed by the intertemporal budget constraint

$$\begin{aligned} & (1 + \tau^c) p_t^C C_t^r + p_t^I I_t + p_t^H (1 + t_t^C) I_t^{H,r} + p_t^H (1 + t_t^C) I_t^{HLC,r} + (B_t^{G,r} + B^r + D_t) \\ & + rer_t B_t^{F,r} \\ = & (1 + r_{t-1}) (B_{t-1}^{G,r} + B_{t-1}^r + D_{t-1}) + (1 + r_{t-1}^F) (1 - \Psi(.)) rer_t B_{t-1}^{F,r} + \\ & ((1 - t_t^k) i_{t-1}^K + t_t \delta^k) p_{t-1}^I K_{t-1} + (1 - t_t^W) w_t L_t^r + \frac{\gamma_w}{2} \frac{\Delta W_t^2}{W_{t-1}} + p_t^L J_t^{Land} \\ & + \sum_{J=1}^H \text{Pr } j - \text{Pr } - \text{Pr } B + T_t^{LS,r} \end{aligned} \quad (SS.2)$$

The dynamic in the housing and land market takes the similar form as the law of motion on capital such as :

$$J_t = K_t - (1 - \delta^K) K_{t-1}$$

$$J_t^{H,r} = H^r - (1 - \delta^H) H_{t-1}^r$$

$$J_t^{Land} = Land_t - (1 + g_t^L) Land_{t-1}$$

However, one strong assumption, is that land is the only scarce factor and every period the land value increase with the rate of  $g_t^L$ . Therefore, capital and house value will depreciate with different pace of  $\delta^K$  and  $\delta^H$  respectively.

Other characteristics of Ricardian household are the ability to invest on another housing  $I_t^{H,r}$  besides their residential housing  $J_t^{H,r}$ . Therefore, the feature to capture market inefficiency in emerging market is the convex adjustment cost related to household investment decision, both on capital and housing market.

$$I_t = J_t \left[ 1 + \frac{(\gamma_K + u_t^I)}{2} \left( \frac{J_t}{K_t} \right) \right] + \frac{(\gamma_I)}{2} (\Delta J_t)^2 \quad (SS.3)$$

$$I_t^{H,r} = J_t^{H,r} \left[ 1 + \frac{(\gamma_H + u_t^H)}{2} \left( \frac{J_t^{H,r}}{H_t^r} \right) \right] + \frac{(\gamma_{IH})}{2} (\Delta J_t^{H,r})^2 \quad (SS.4)$$

The Lagrangian is constructed in real terms, while all price variables are stated as a relative value over the GDP deflator.

The first order conditions for the Ricardian household's problem are:

$$\frac{U_{C,t}^r}{U_{C,t-1}^r} = \beta^r (1 + i_t - \pi_{t+1}^c - \Delta t_{t+1}^c) \quad (SS.5)$$

$$\left[ (\gamma_K + u_t) \left( \frac{J_t^K}{K_{t-1}} \right) + (\gamma_I \Delta J_t^K) \right] = E_t \left\{ \Lambda_{t,t+1} \left[ \frac{1}{(1 + i_t - \pi_{t+1})} \Delta J_{t-1}^K \right] + \frac{\xi_t}{p_t^I} - 1 \right\} \quad (SS.6)$$

$$\frac{\xi_t}{p_t^I} = E_t \left[ \frac{1}{(1 + i_t - \pi_{t+1}^I + u_t^I)} \frac{\xi_{t+1}}{p_{t+1}^I} (1 - \delta^K) \right] [(1 - t_t^K) i_t^K + t_t^K \delta^K] \quad (SS.7)$$

$$(\gamma_H + u_t^H) \left( \frac{J_t^{H,r}}{H_{t-1}^r} \right) + = \Psi'(U_t) \quad (SS.8)$$

$$\frac{1 + i_t}{(1 + i_t^*) \Theta_t} = \frac{E_t \left\{ \Lambda_{t,t+1} \frac{P_t}{P_{t+1}} \frac{\epsilon_{t+1}}{\epsilon_t} \right\}}{E_t \left\{ \Lambda_{t,t+1} \frac{P_t}{P_{t+1}} \right\}}. \quad (SS.9)$$

**Ricardian - Borrower Households** Debtor households are still considered as Ricardian households because of their ability to access financial market, in terms of borrowing. They have a higher rate of time preference to represent their impatient behavior ( $\beta_c < \beta_r$ ) and facing a collateral constraint ala Kiyotaki Moore (1997) on their borrowing  $L_t$ .

The Lagrangian problems are given by

$$\max E_t \sum_{t=0}^{\infty} \beta^{c^t} U^c(C_t^c, 1 - N_t^c, H_t^c) \quad (SS.10)$$

followed by the intertemporal budget constraint equation

$$\begin{aligned} & -E_0 \sum_{t=0}^{\infty} \lambda_t^c \beta^{c^t} (p_t^c C_t^c + p_t^H J_t^{H,c} - L_t + (1 + r_{t-1}^L) L - w_t N_t^c + T_t^c - DEF_{t-1}) \\ & -E_0 \sum_{t=0}^{\infty} \lambda_t^c \zeta_t^c \beta^{c^t} (H_t^c - J_t^{H,c} - (1 - \delta^H) H_{t-1}^c) \\ & -E_0 \sum_{t=0}^{\infty} \lambda_t^c \psi_t \beta^{c^t} ((1 + r_t^L) L_t - \chi^c p_t^H H_t^c) \end{aligned} \quad (SS.11)$$

where  $\chi^c$  = loan to value ratio

Consumption, thus equal Euler form as follows :

$$U_{C,t}^c = E_t \frac{(1 + r_t^L)^{\beta^c}}{(1 + (1 + r_t^L)\psi_t)} \frac{p_t^c}{p_{t+1}^c} U_{C,t+1}^c \quad (SS.12)$$

therefore the discount factor is  $d_t^c = \frac{(1 + (1 + r_t^L)\psi_t)}{(1 + r_t^L)} = E_t \frac{U_{C,t+1}^c}{U_{C,t}^c}$

and their residential investment purchase is

$$p_t^H = \frac{U_{H,t}^c}{U_{C,t}^c/p_t^c} \frac{1}{1 - \psi_t(1 - \delta^H)\chi_t^c} + E_t d_t^c \frac{(1 - \delta^H)}{1 - \psi_t(1 - \delta^H)\chi_t^c} p_{t+1}^H \quad (SS.13)$$

Consumption and residential investment from borrower households are affected by the collateral constraint. A tighter constraint lead them to shift consumption from current to future and reducing residential investment by increasing shadow capital costs of  $\psi_t(1 - \chi_t^E)$ . Higher LTV reduces the impact of credit tightening on residential investment, since in this case an increase in the capital stock makes investment valuable for the household by increasing its borrowing capacity.

**Non-Ricardian household** The last type of households is assumed not to have access to financial market and capital market, thus they can neither save nor borrow from bank and does not invest in capital. In terms of housing, it is assumed that they live in non-permanent housing, built in an unclaimed land. Therefore, there is no house purchasing or investment activity for them. As a result, non-Ricardian households do not behave in a forward-looking manner

and consume all of their wage payment as well as receiving subsidy according to this optimization problem as follows :

$$\max E_t \sum_{t=0}^{\infty} \beta^t U^c(C_t^c, 1 - N_t^c) \quad (SS.14)$$

with corresponding non inter-temporal budget constraint such as

$$p_t^e C_t^e = w_t N_t^e + T_t^e \quad (SS.15)$$

The subsidy  $T_t^e$  received by non-Ricardian households is similar as those taxes paid by Ricardian households. They have substantially lower income than Ricardians households due to the absence of financial and capital income.

There is a joint utility function for each type of labor  $i$ . It is assumed labor are distributed equally over Ricardians and non-Ricardians with their respective population weights. Wage is set by optimizing a weighted average of the utility functions of these households. The wage rule is the weighted average of the marginal utility of leisure equal to a weighted average of the marginal utility of consumption times the real wage of these three types of households, adjusted for a wage mark up

$$\frac{s^c U_{s^c - N^c, t}^c + s^r U_{s^r - N^r, t}^r + s^e U_{s^e - N^e, t}^e}{s^c U_{c, t}^c + s^r U_{c, t}^r + s^e U_{c, t}^e} = \frac{w_t}{p_t^c} \eta_t \quad (SS.16)$$

where  $\eta_t$  is the wage mark up factor, with wage mark ups fluctuating around  $1/\theta$  which is the inverse of the elasticity of substitution between different varieties of labor services. The consumption wage is set as a mark up over the

reservation wage. The reservation wage itself is a ratio of the marginal utility of leisure to the marginal utility of consumption. If this ratio is equal to the consumption wage, the household is indifferent between supplying an additional unit of labor and spending the additional income on consumption and not increasing labor supply.

**Intermediate Goods Producer** Intermediate goods producer use a Cobb Douglas production function with Capital ( $K_t$ ) and Labor ( $L_t$ ) as inputs

$$Y = K_t^{1-\alpha} N_t^\alpha Z_t^{Y\alpha} \quad (SS.17)$$

where  $N_t = \left[ \int_0^1 N_t^{i \frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}}$ , following a Dixit-Stiglitz, CES aggregator to get the aggregate labor supplied by individual households  $i$ .  $Z_t^{Y\alpha}$  is an economy wide shock and  $\theta$  is the degree of substitutability of labor. This intermediate goods producers issues shares at price  $q_t$  as well as  $S_{t-1}$  number of shares. Eventually it pays profits  $prf$  to the saver households as the owner. We derive profits from producer cash flow. Based on first chapter, we assume that intermediate goods producer is subject to default on his bank loan ( $def_{t-1}$ ) to finance their operation.

$$\begin{aligned} prf.S_{t-1} = & (Y_t - wN_t) - p_t^I J_t + (1 + r_{t-1}^L) L_{t-1} - (1 - s) def_{t-1} \\ & - (1 + r_{t-1}^D) D_{t-1} - L_t \\ & + D_t - \phi(D_t - ldr L_t)^2 + q_t \Delta S_t \end{aligned} \quad (SS.18)$$

The value of the firm ( $V_0$ ) maximization of intermediate goods producer is

as follows :

$$\begin{aligned} Max.V_0 = & E_0 \sum_{t=0}^{\infty} \prod_{j=0}^t (1 + r_{t+j}^E) [pr f_{t+j} S_{t-1+j}] \\ & - E_0 \sum_{t=0}^{\infty} \lambda_t \beta^t [K_t - J_t Z_t^J - (1 - \delta) K_{t-1}] \end{aligned} \quad (SS.19)$$

In this framework, the bank collects core liabilities as the form of deposits  $D_c$ , and non-core liabilities  $D_{nc}$ . It transform them into loans  $L_t$ . In this case, a regulator set such a constraint such that total deposits between core and non core liabilities cannot exceed a fraction ( $ldr$ ) of total loans. Furthermore  $Z_t^J$  is an investment specific technology shock.

From that maximization problem we can derive optimal physical capital

$$p_t^I = Y_{K,t} + E_t \frac{(1 - \delta)}{(1 + r_t^E)} p \frac{Z_t^J}{Z_{t+1}^J} \quad (SS.20)$$

as well as optimal bank capital such as

$$(1 - ldr) = \frac{((1 + r_t^L) - (1 + r_t^D)ldr)}{(1 + r_t^E)} \quad (SS.21)$$

in these optimal conditions, both physical and bank capital are multiplied by a stochastic discount factor  $\frac{1}{(1+r_t^E)}$ . Thus, the value of the firm of the intermediate goods producer is equal to the share price  $q_t$  and the outstanding shares  $S_{t-1}$ . Therefore, return on equity of this producer is profit  $pr f$  plus capital gain and the required return on equity is

$$(1 + r_t^E) = \frac{pr f_t + E_t q_{t+1}}{q_t} \quad (SS.22)$$

**Retail sector** The retail sector or retailers, purchase wholesale goods and sell them to households as consumption, in a monopolistically competitive market. They face a quadratic price adjustment costs as one of the nominal rigidities in this economy and in a symmetric equilibrium where inflation dynamics is given by a standard New Keynesian Phillips curve as follows :

$$\pi_t = \beta E\pi_{t+1} + \frac{1}{\gamma} \frac{mc_t^{ws}}{P_t} \quad (SS.23)$$

Standard new Keynesian approach strictly follow a taylor type rule, however, in this research, we allow some degree of discrepancies using a discretionary parameter  $z_t^M$ . The monetary authority sets interest rates based on a Taylor rule and responds to a certain degree of interest rate smoothing, the annual consumer price inflation, the annual growth rate of output and discretionary policy as follows :

$$i_t = \tau i_{t-1} + (1 - \tau)\tilde{r} + \pi_t^T + \frac{\tau_\pi(\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3} - 4\pi)}{4} + \frac{\tau_y(y_t + y_{t-1} + y_{t-2} + y_{t-3} - 4y)}{4} + z_t^M \quad (SS.24)$$

**Rest of the World (RoW)** Modeling countries inter-relation requires a greater detail of agents behavior such as two countries model ala IMF GIMF model. Another simplification is to model only parts of the economy. In this case, we model that the RoW is a service economy and the ouput is produced using only labor. Also, that service economy production is subject to permanent shocks to technology. RoW households receive income from service production and they save in the form of RoW and Indonesian currency denominated government

bonds  $B^F$ . Furthermore, their discount factor is subject to a stochastic shock  $\beta_t^W = \beta^W Z_{C,t}^{\text{row}}$ . Eventually, They maximize an intertemporal utility function which yields the following decision rule for consumption

$$U_{C,t}^{\text{row}} = E_t \left( (1 + r_t^w) \frac{p_t^W}{p_{t+1}^W} \beta_t^W U_{C,t+1}^{\text{row}} \right) \quad (SS.25)$$

Two features of this model, global banking glut and flight to quantity, are also presented in the section. The global banking glut shock stemming from negative shock to  $Z_{C,t}^{\text{row}}$  and the portfolio allocation decision yields the interest parity condition, where  $rer_t$  is the real exchange rate as follows :

$$(1 + r_t^w) = (1 + r_t^w) Z_t^{B^F} E_t \left( \frac{rer_{t+1}}{rer_t} \right) \quad (SS.26)$$

where  $Z_t^{B^F}$  is the stochastic risk premium between Indonesian and the RoW assets. Moreover, flight to quantity represented by an increase in the demand for higher yield Indonesian assets would be indicated by a fall in  $Z_t^{B^F}$

In aggregating the model, we assume an identical CES function between households and corporations between Indonesia as the small open economy and the rest of the world. This CES function applies for all types of goods for both consumption and investment,  $A^i \in \{C^i, I^i\}$  such as :

$$A^i = \left[ (1 - s^M - Z_t^M)^{\frac{1}{\sigma}} A^{d^i \frac{\sigma^M - 1}{\sigma^M}} + (s^M + Z_t^M)^{\frac{1}{\sigma^M}} A^{f^i \frac{\sigma^M - 1}{\sigma^M}} \right]^{\frac{\sigma^M}{\sigma^M - 1}} \quad (SS.27)$$

where  $s^M$  is the share parameter, subject to a shock  $Z_t^M$ , while  $A^{d^i}$  and  $A^{f^i}$  are the index of demand for a continuum of differentiated goods produced in

Indonesia and the RoW. Also, a share  $s$  from total defaults  $def$ , representing default on non-core liabilities, are born by household creditors from the rest of the world. Finally the stock of net foreign assets is :

$$B_t^F = (1 + r_{t-1}) B_{t-1}^F + X_t - rer_t M_t + s.def_{t-1} \quad (SS.28)$$

Here, foreign firms act as a monopolistic competitive agent as well by setting a mark up over the marginal cost. This foreign price is also exposed to shock  $z_t^{\eta^W}$  where

$$\pi_t^W = E_t(\beta^W \pi_{t+1}^W - \pi_t^W) + 1/\gamma_p^W y_t^W - z_t^{\eta^W} \quad (SS.29)$$

and the world interest rate is similar with domestic interest rate setting which follows an auto-regressive mode for inflation deviation from the pre-determine targets and output gap, such as

$$i_t^W = \tau^W i_{t-1} + (1 - \tau^W) \left[ \tilde{r} + \pi_t^{TW} + \frac{\tau_\pi^W (\pi_t^W + \pi_{t-1}^W + \pi_{t-2}^W + \pi_{t-3}^W - 4\pi^W)}{4} + \frac{\tau_y^W (y_t^W + y_{t-1}^W + y_{t-2}^W + y_{t-3}^W - 4y^W)}{4} \right] + z_t^{MW} \quad (SS.30)$$

**Market Clearing** This section clears the model interlinkage, both domestic and the rest of the world

$$Y_t^d = C_t^d + J_t^d + J_t^{construct} + X_t \quad (SS.31)$$

$$Y_t^W = C_t^{W,d} + M_t \quad (SS.32)$$

**Non-Fundamental Shocks(Bubble Process)** One important rule of solving DSGE model is to have at least as many shocks as there are observed variables in the model. Some shocks are considered as fundamental shock that come from structural equations. Alternatively, shocks from arbitrage equation are considered as non-fundamental shocks or as bubbles. In modeling bubble process, we follow Bernanke approach, (*quote bernanke*) where there is a fundamental value  $q$  that represent an asset, that is equal to the current return  $\text{div}_t$  with an additional expected value for the next period, discounted with expected return  $r$

$$q = \frac{(\text{div}_t + E_t(q_{t+1}))}{(1 + r_t)} \quad (SS.33)$$

Furthermore, aside from this fundamental value  $\text{div}_t$ , there is a non fundamental shock  $x_t$  that follows a bubble process

$$x_{t+1} = \begin{cases} \left(\frac{a}{prob}\right) x_t(1 + r_t) + e_t & prob \\ 0 & (1 - prob) \end{cases}$$

with  $a < \frac{1}{(1+r)}$  and the expected value of  $x_t$  is  $E_t(x_{t+1}) = \frac{ax}{(1+r)}$ . Next, we define the market price  $s_t$  for another asset such where

$$s_t = q_t + x_t \quad (SS.34)$$

That asset price also follow a "bubble" process such as

$$((1 + r_t)(1 - (1 - a))\frac{s_t}{x_t})s_t = \text{div}_t + E_t(s_{t+1}) \quad (SS.35)$$

that equation implies that when non-fundamental process such as bubble happen, the expected return of an asset in the next period will deviate from the fundamental return  $r$  either by a positive or negative premium. Therefore, the asset price will follow the equation of risk premium such as

$$riskp_t = -(1 - a)\frac{x_t}{s_t} \quad (SS.36)$$

where the bubble factor  $x$  increase before the bubble process burst and disappear afterward. This deviation from fundamental value concept also applies in price variable for firm capital ownership, residential housing, land ownership and exchange rate.

### 3.4 Model Solution and Estimation

Again, we apply Bayesian methods to estimate some parameters of the model, using Indonesian quarterly data from 2000Q1 to 2012Q4 as the observed variables.

Similar to the previous chapter, we set the prior parameters value following their theoretical bounds as well as relevant previous studies. Connecting the observed variables with model variables, we apply measurements equations and set the prior distribution. The solution of the model is expressed in a state-space form and the likelihood function is computed using a Kalman Filter recursion.

Then, the prior distribution is combined over the model's parameters with the likelihood function, applying the Metropolis-Hastings algorithm to obtain the posterior distribution.

### 3.5 Impulse Response Function

Before the interpretation of the IRF, herewith the summary of the shocks in the model. First shock is the massive capital inflows to the emerging market due to increased savings in the Rest of the World  $Z_{c_w}$  or flight to quantity in favor of higher yield in emerging market assets  $Z_{b_f}$ , Technology or productivity shocks, expansionary monetary policy post global economic crisis  $Z_m$ , asset price bubble in the stock market  $Z_v$  and housing market  $Z_h$ , following the inflows. Next shock is the excessive leverage in the mortgage market  $Z_x$ , followed by systemic shock from defaulting mortgage loans default. We also compare the effectiveness of macro prudential regulation on asset side against one in liabilities side where both policies are set endogenously. Asset sides is represented with LTV regulation while liabilities sides is represented by tax on non-core liabilities.

First IRF (annex 1) is a productivity shock that have permanent impact to the economy and its spillover impact to other economic sector resulted in increases in all domestic demand components thus rise in GDP. However, this shock did not capture the domestic economy boom post capital inflows, particularly explaining changes in the composition of domestic demand. Increasing consumption combined with low coefficient of import substitute also resulted in the fall in the trade balance.

Relax monetary policy implies more accommodative policy. To keep a stable

the interest rate differential after the global economic crisis, emerging market central bank has to reduce interest rate can account for some stylized features of the boom. The reduction of interest rates favors investment growth over consumption growth, it worsen the trade balance and leads to a real depreciation of the US dollar. This makes it a relevant shock especially for the period 2002-2005.

A change in the loan to value ratio for debtors, either increase or decrease, will also affect consumption and residential investment in the same direction, particularly Ricardian households. However, corporate investment has the opposite sign because of interest rate effects. A loosening of credit constraints can therefore only be a partial explanation of the boom since it suggests too much of a co-movement between residential investment and private consumption and it wrongly predicts a decline of corporate investment. This co-movement also resulted to big discrepancy between the drop of housing investment but stable private consumption. For the same reason, there is a puzzle where credit crunch for subprime borrowers (as a result from reduction of the loan to value ratio) cannot explain the strong discrepancy between the fall of residential investment and the relative stability of private consumption.

Defaulting mortgage loans result in persistent financial losses in the corporate sector and are borne as income losses by saver household as the bank owners. Especially the expectation of protracted losses and long lasting recapitalization efforts of shareholders increases the required rate of return on assets, thus increasing yield. With this increasing required yield on investment, financial losses originating in the mortgage market adversely affects corporate investment with more expensive financing cost. This persistent negative investment response leads to long lasting level shift of GDP, which seems to be a stylized

fact of many financial crises. By reducing the debt burden on credit constrained households it also stabilizes private consumption, but for the same reason it does not generate the strong decline in residential investment

A Global saving glut leads to an increasing domestic bank lending as well as real appreciation of the Rupiah and a fall of interest rates. It increases all domestic demand components at similar magnitudes and causes a deterioration of the trade balance. However, since most lending goes to ricardian households, higher indebtedness of this type of households leads to a relatively rapid turnaround of demand and the exchange rate. This feature could therefore partly explain the depreciation following the appreciation until an exercise of tax on non-core liabilities

A falling risk premium for the Indonesian assets attract capital flows to search for higher yield ('flight to quantity') It also lowers real interest rates in the Indonesia and leads to an increase in both corporate and residential investment, followed by a more modest increase in private consumption. Like in the previous case, this shock lowers interest rates in Indonesia and reduces demand for Indonesian exports, in this case via an appreciation of the rupiah. Both shocks taken together match qualitatively a large number of stylized facts.

### **3.6 Impact of Policy Choices on Social Welfare**

To find an optimal choice of policies, instead of using a structural loss function, we use the graphical comparison between Ricardian and Non-Ricardian household consumption or simply rich and poor households' consumption, which is empirically considered as one of the most important measure of social welfare.

We only pick mortgage default as the domestic shock and the global banking glut as the external shock.

From the simulation (Annex 2), it is clear that the macro prudential policy such as LTV is considered as the efficient tool for domestic shocks such as increasing mortgage default, however, for cross-border shocks, such as global banking glut, capital flow management is considered as the more effective way to avoid massive amplification of financial cycle, which create more systemic risk and widened the income inequality

Empirically financialization does not have any implication on increasing social welfare since typically the Ricardian type of households who have access to bank and capital market. Increasing non-core liabilities to emerging economies (post Lehman) has increased bank source of funding. Households with access to bank enjoyed the benefit from increasing bank risk-taking behavior that overlooked the prospective mortgage market instead of household's loan payback ability. Historically emerging economy housing prices were rising faster than the CPI index and after the bank-led inflows, the rate was doubled even created a loophole that one household could own more than one mortgage up to nine mortgages contract. Following this phenomenon, several emerging economy exercised lending restriction policy for domestic households such as lowering LTV ratio. However as simulated in the IRF part that excessive funding at bank balance sheet created opportunity to fund unregulated sector such corporate investment. Since saver household is the owner of corporations, increasing profits for this type of Ricardian household will also widen the income inequality. Furthermore, from the increasing mortgage default simulation, decreasing wealth effect in Ricardian households will also have a trickle down impact to

non-Ricardian households through consumption channel. Therefore, from the perspective of policy maker, managing the source of funding on banks using tax on non-core liabilities is considered the optimal alternative for emerging economy.

### **3.7 Conclusion**

The correct policy response to asset price booms such as housing price is an art more than a science. From the set of policy available, macro prudential policy is more effective since it is more precisely targeted at specific risks such as excessive leverage. Specifically, more heterogeneous approach can be applied to macro prudential policy by accommodating the specific circumstances in different locations at different times. For example, different policy magnitude for different region or treatment on resident and non-resident, in the end, will strengthen the resilience of the banking system as a whole. These measures can be particularly helpful in countries with fixed or managed exchange rate regimes or common market like European Union, or Asean Economic Community where the impact of systemic risk is greater. However, some conditions make these macro prudential measures less effective. First is the regulatory arbitrage behavior from financial intermediary, known as the pecuniary externalities from incomplete market. It implies that the more targeted the macro prudential policy, the more room for financial intermediaries to do arbitrage. One solution is the more general rule such as capital requirement such as Basel that covers all types of lending. For example, Basel III revision is to enhance the risk sensitivity of capital requirements and increase the quality and quantity of bank capital holding. However, it leads to second problem with the Basel

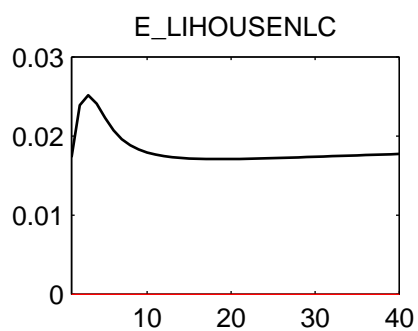
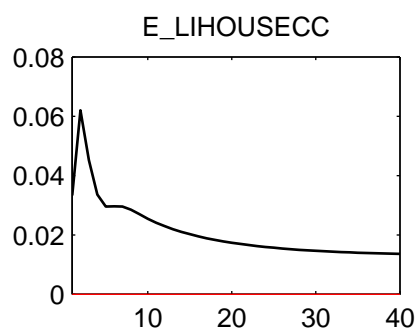
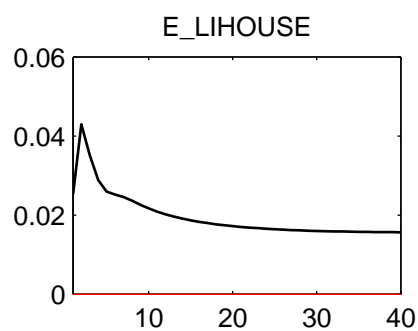
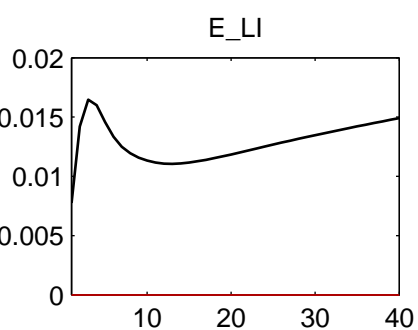
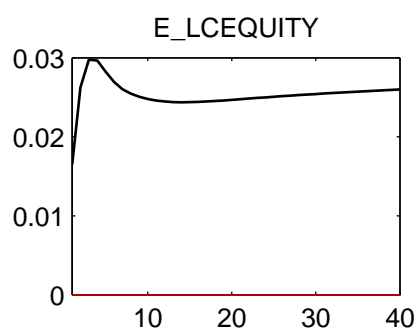
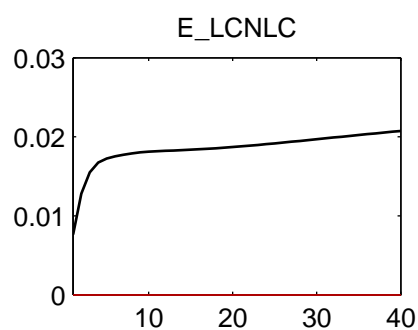
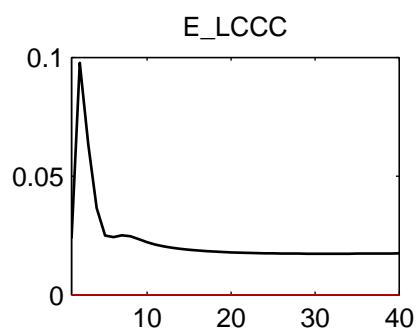
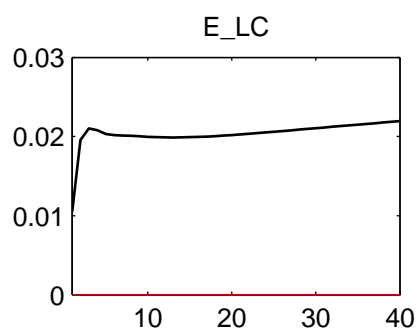
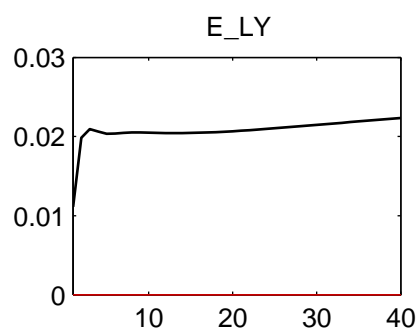
risk weight system where this regulatory measure of bank portfolio risk really catches the true portfolio risk. Any discrepancies will induced bank to invest in risky assets, which maximize return, while reducing capital requirement (Val-lascas and Hagendoff, 2013). Therefore, the use of liabilities instrument such as tax on non-core liabilities will directly hit the source of the problem with less opportunity for the receiver of that capital flows to do arbitrage decision in the asset side. Finally, this tax on non core liabilities can also help to effectively mitigate massive amplification of financial cycle that widened income equality between households.

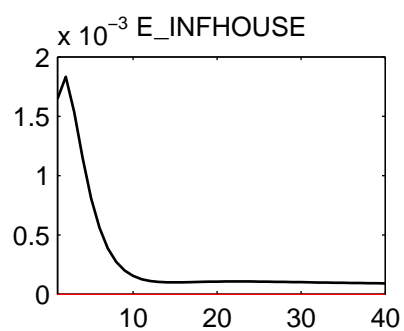
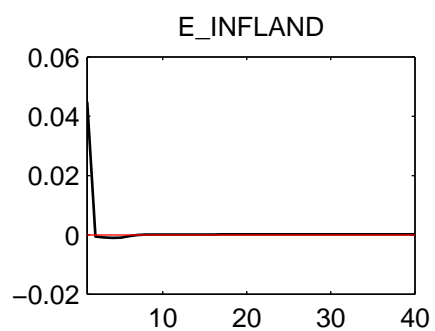
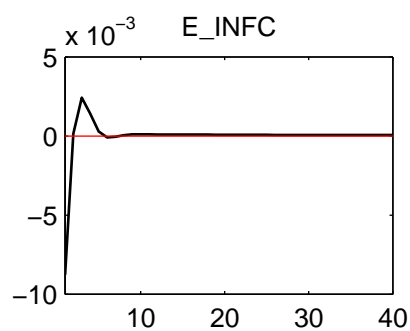
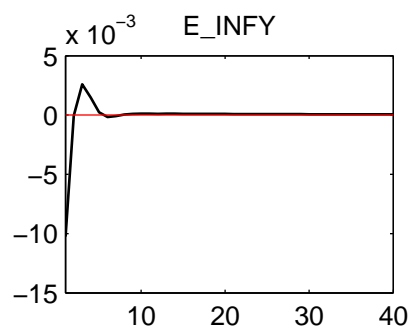
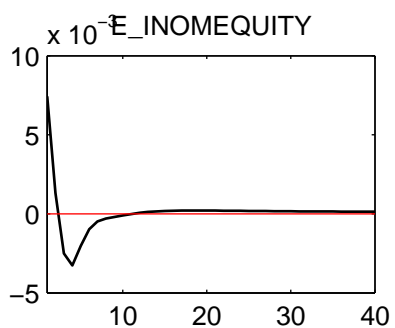
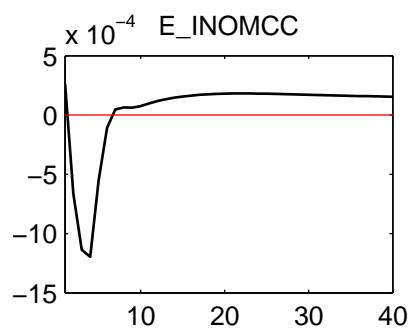
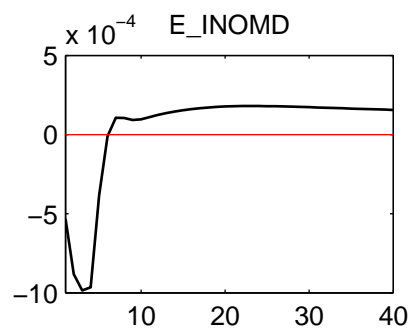
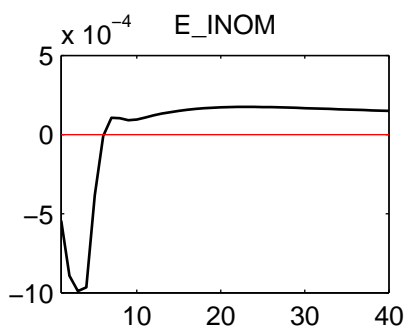
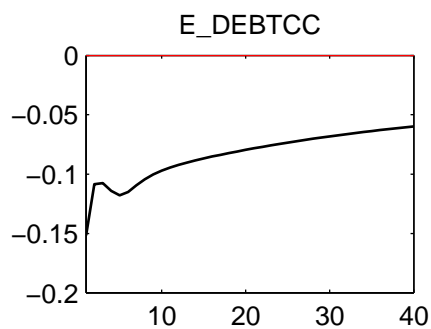
The next research agenda is to calculate what is the optimal tax on non core liabilities. This optimal tax should have characteristics that fit a particular country and become a well-structured device that plays its role as a state-contingent automatic stabilizer. From the political economic perspective, this tax rule is also an effective pre-commitment device, helping the policy maker to withstand the political pressures and the temptation to discount the capital control policy because of structural domestic saving-investment gap issues. In the end, all of the policy instruments in these essays are cyclical instruments but the best protection against global challenges comes from structural strengths Accomodative policies may be useful as short-term medicine but only structural policies can restore economies in the long term.

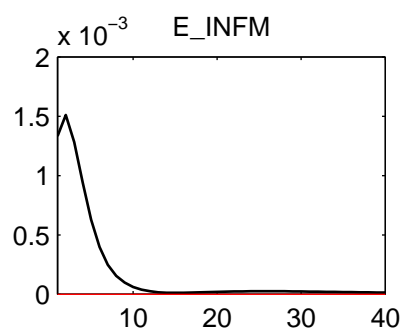
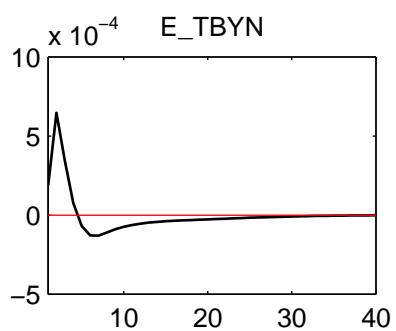
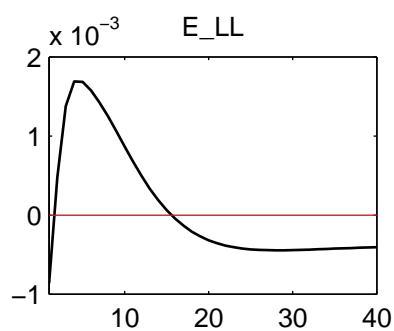
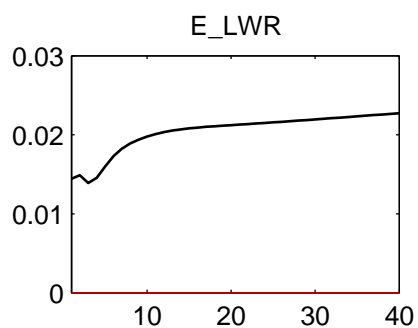
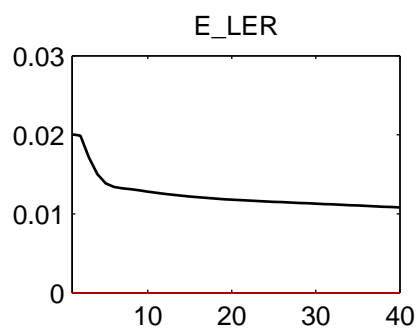
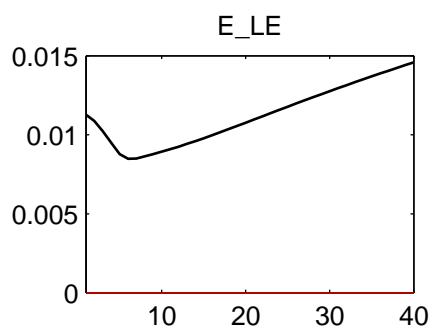
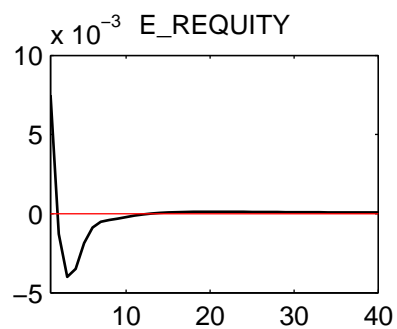
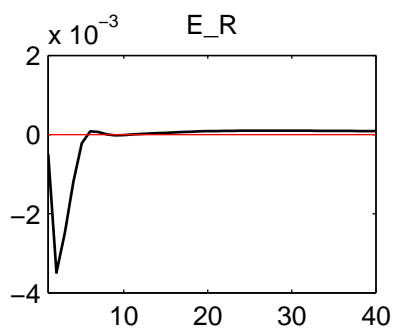
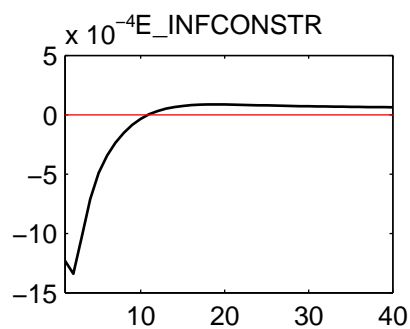
### Appendix 3.1 Impulse Response

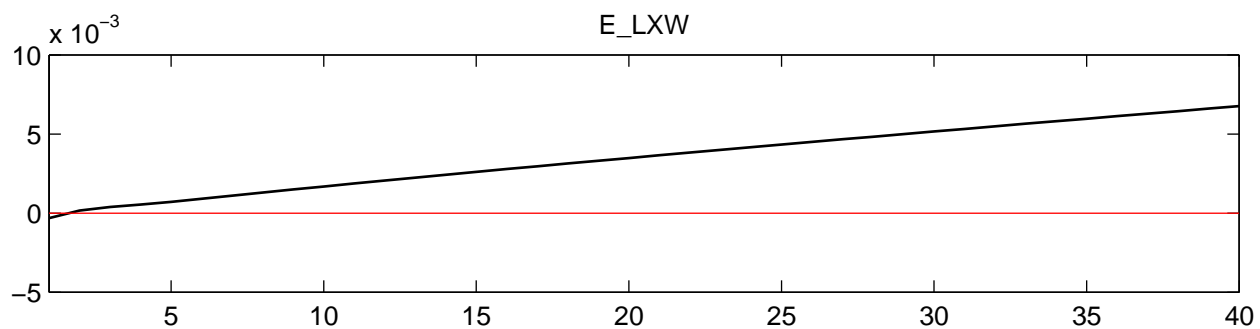
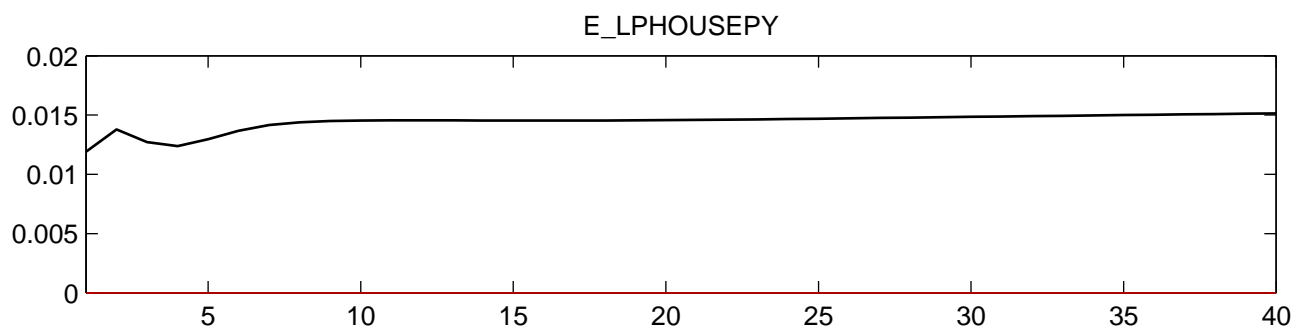
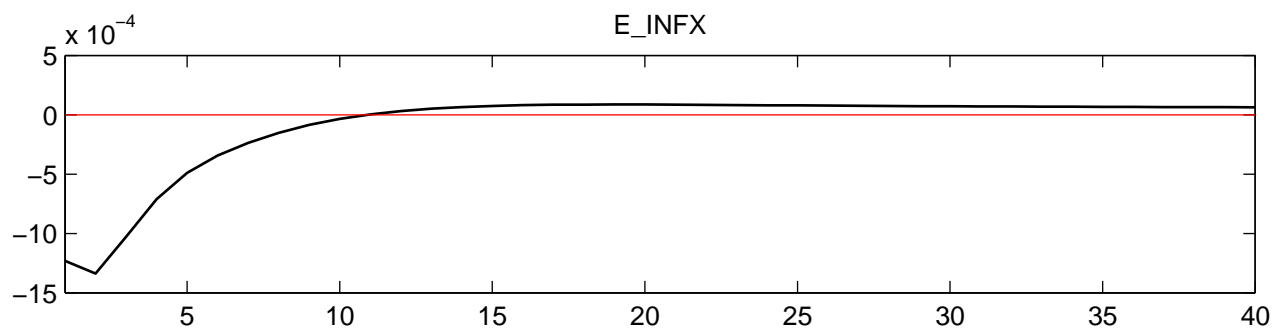
LY: log of GDP;  
LC: log of consumption;  
LCCC: log of consumption (Non Ricardian);  
LCNLC: log of consumption (borrower);  
LCEQUITY: log of consumption (saver);  
LI: log of corporate investment;  
LIHOUSE: log of residential investment;  
LIHOUSECC: log of residential investment (borrowers);  
LIHOUSENLC: log of residential investment (savers);  
DEBTCC: Stock of mortgage loans;  
R: real interest rate;  
REQUITY: required return on equity  
LER: log of real exchange rate;  
LWR: log of real wage rate;  
LL: log of hours worked;  
TBYN: trade balance to GDP ratio;  
LPHOUSEPY: log of house prices to price of final output;  
GXW: Growth rate of RoW;  
REQUITY: required return on equity

# Labor productivity Shock

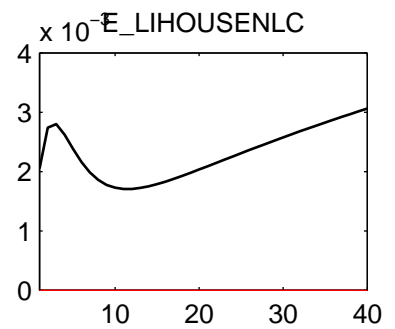
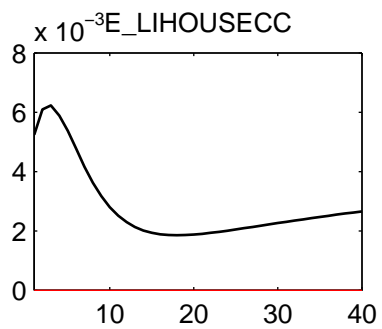
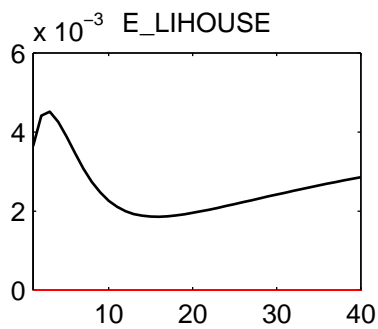
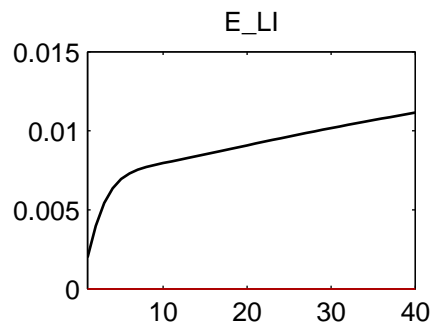
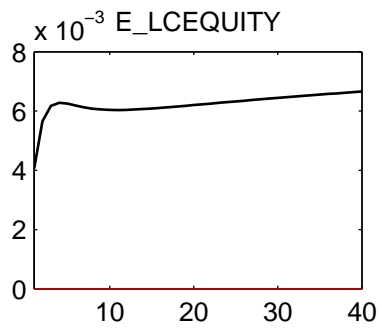
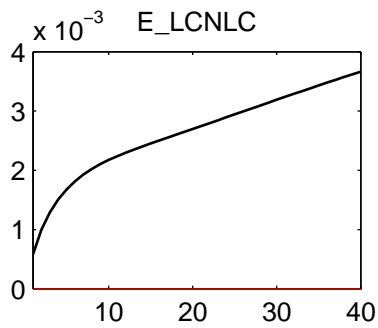
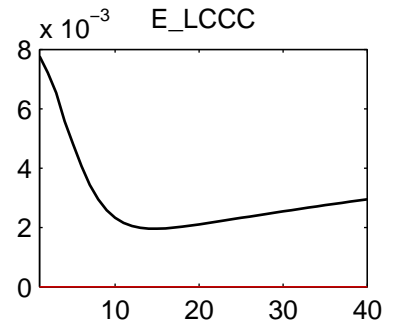
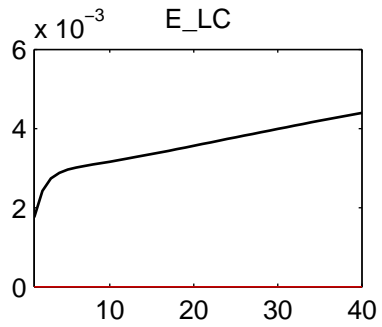
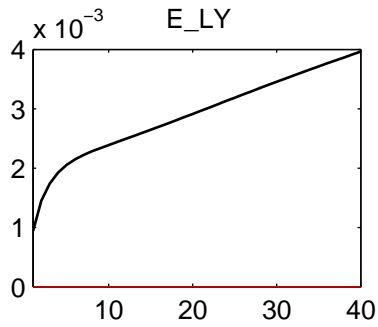


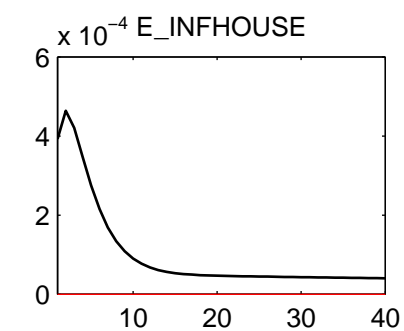
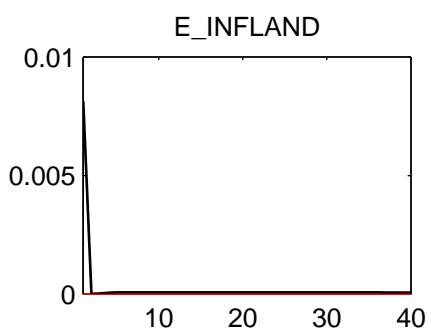
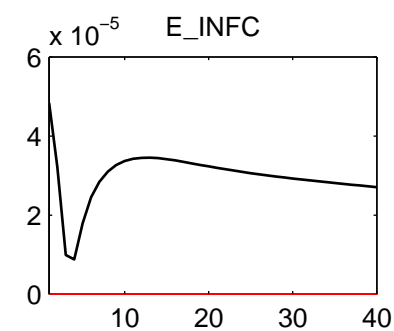
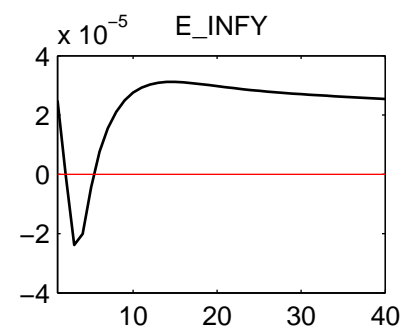
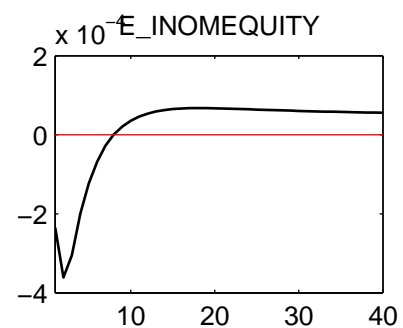
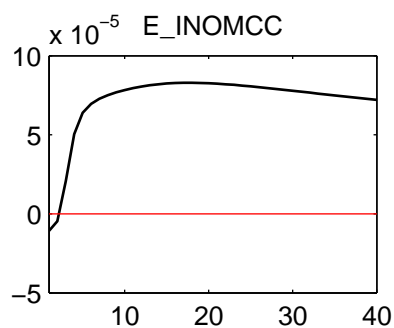
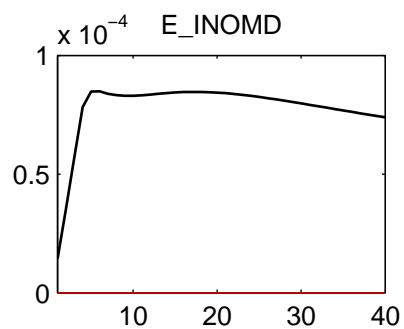
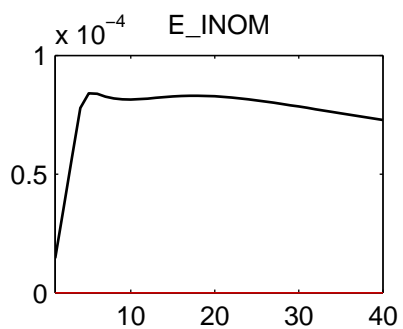
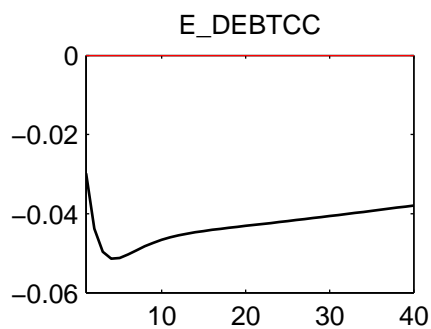


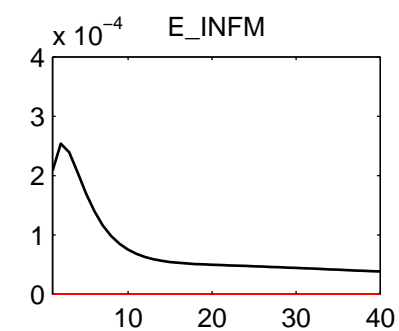
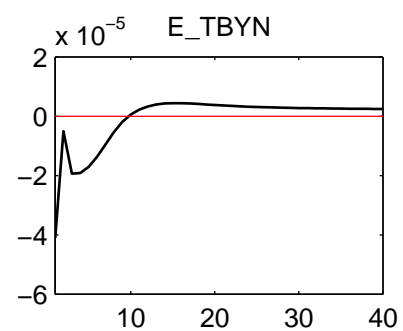
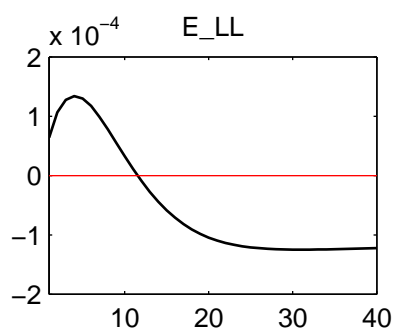
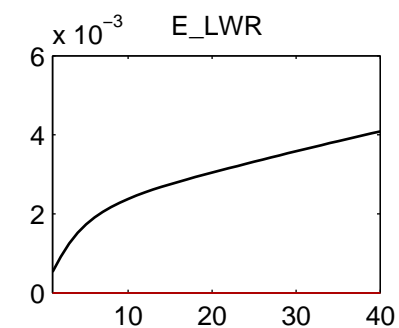
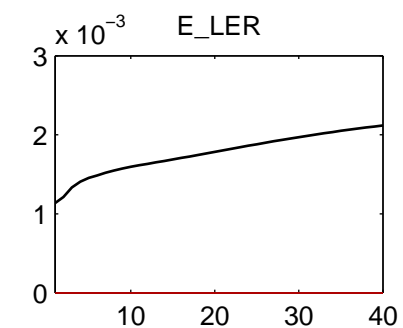
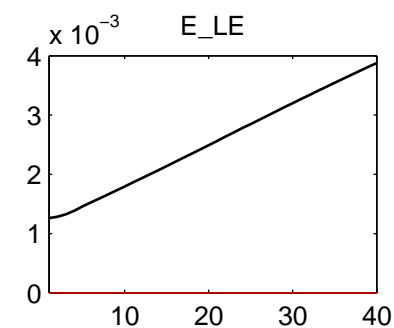
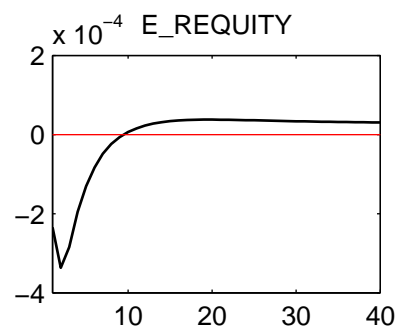
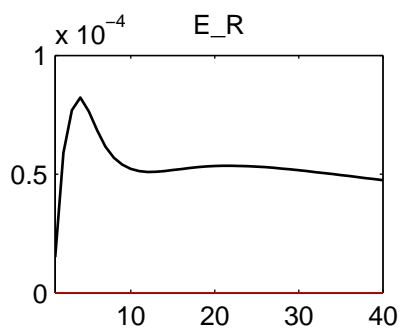
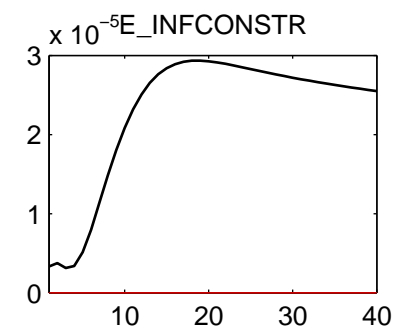


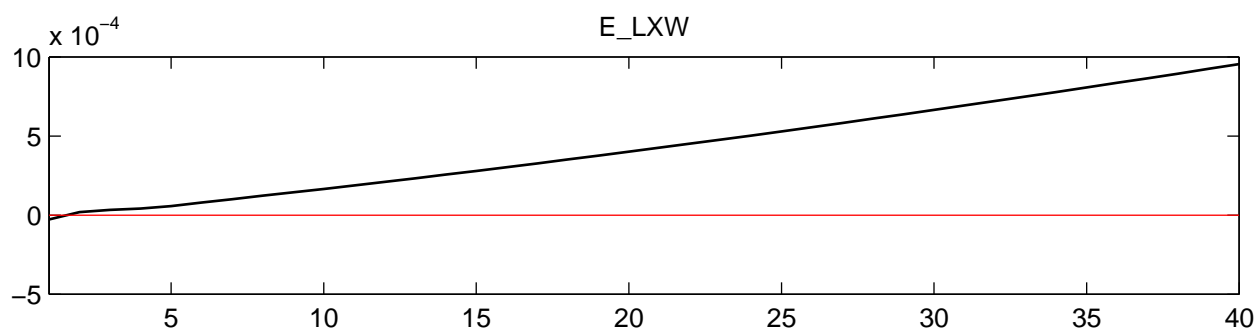
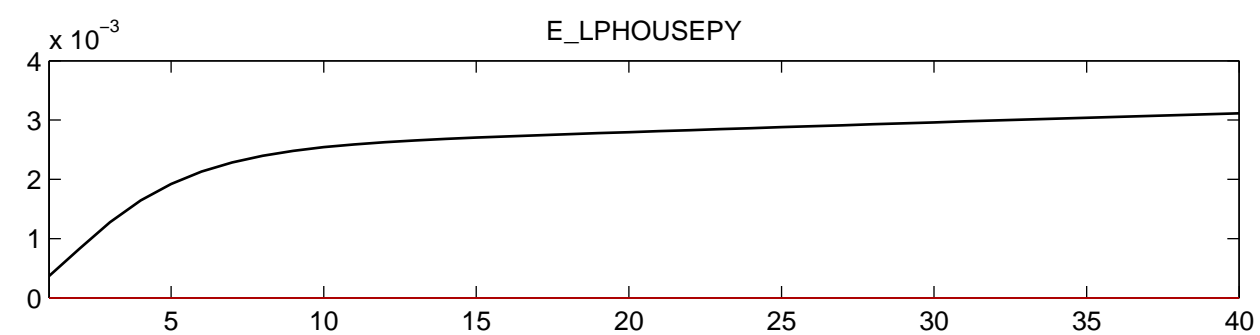
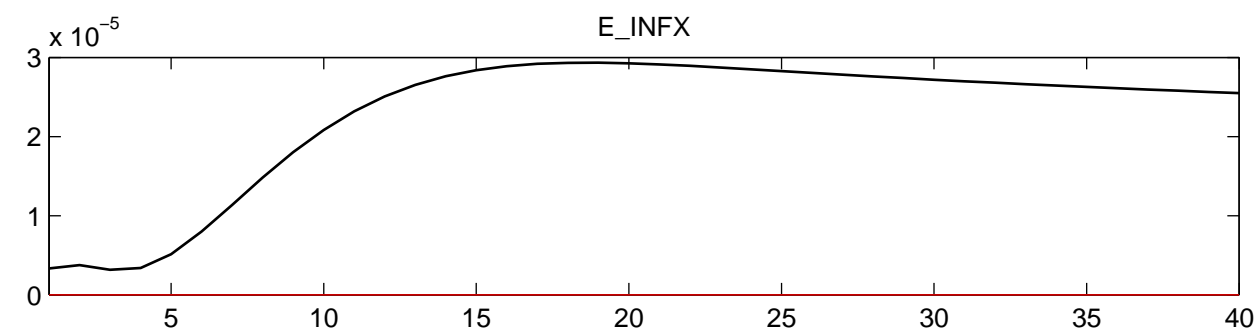


## Capital Productivity Shock

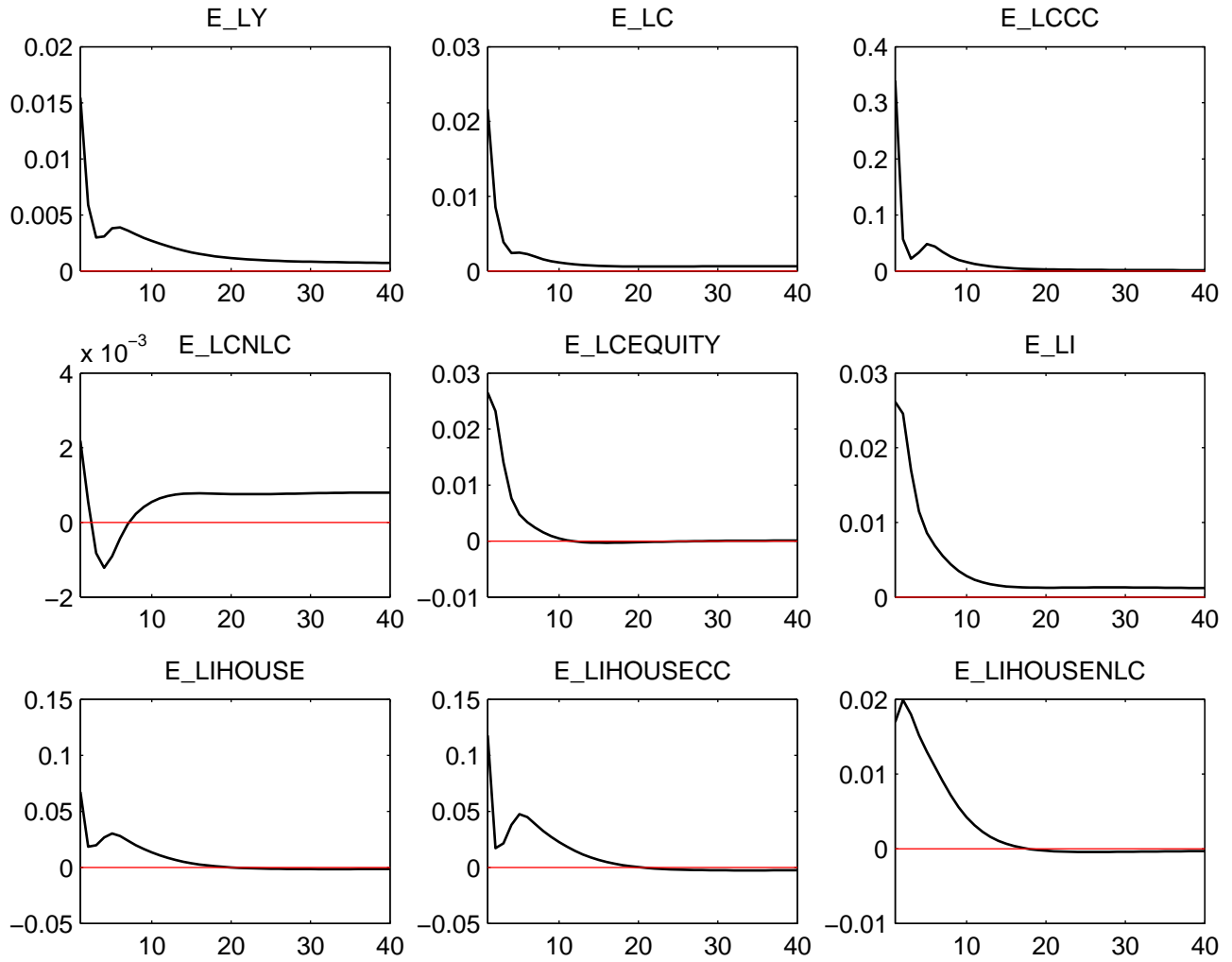


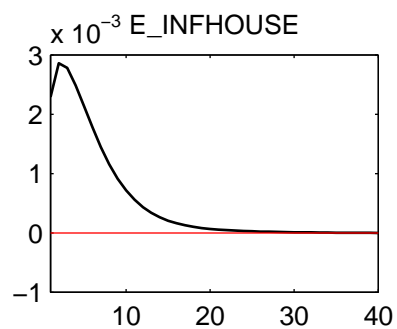
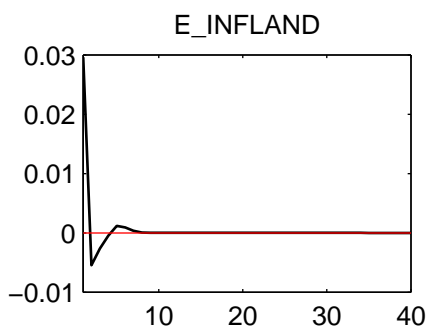
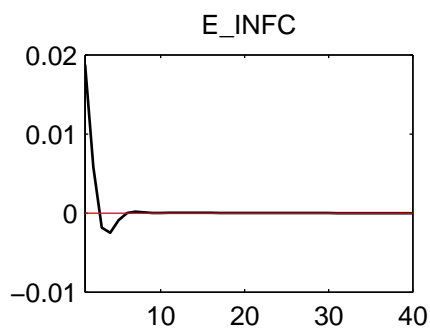
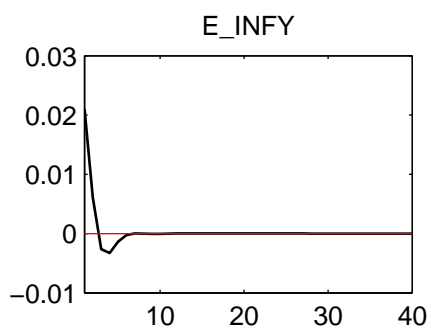
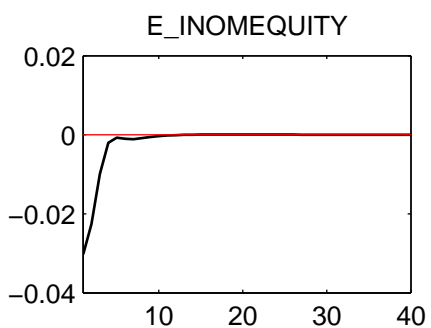
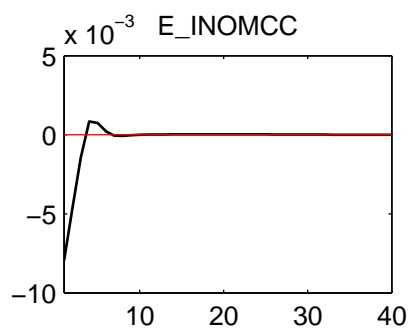
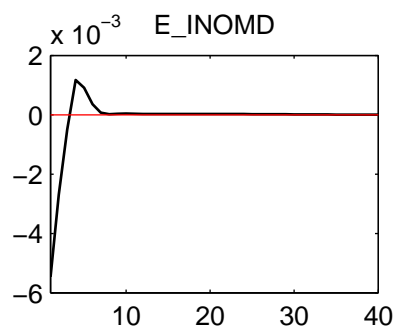
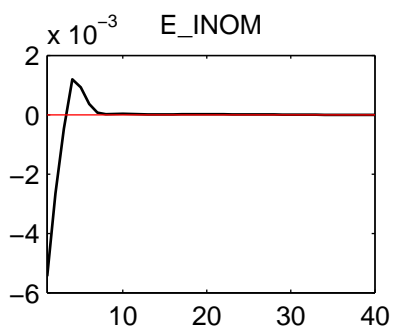
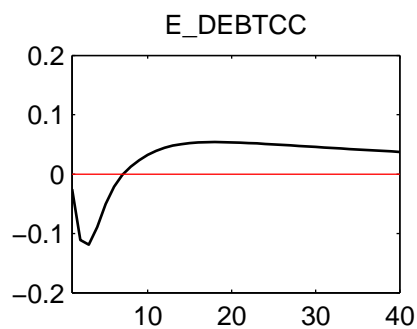


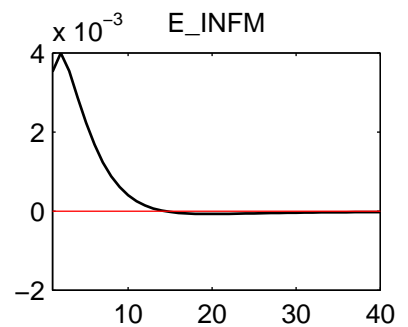
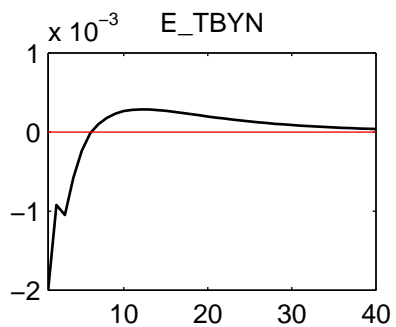
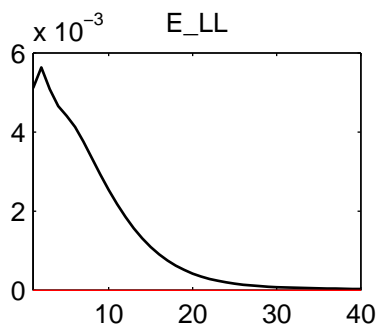
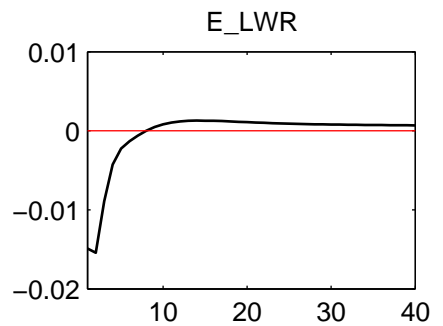
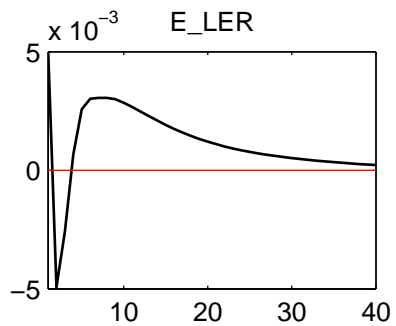
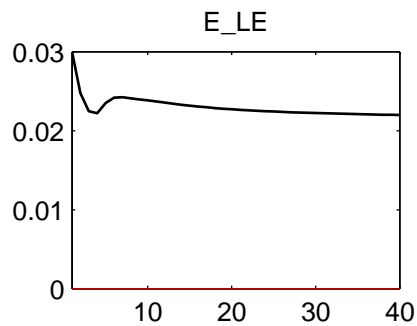
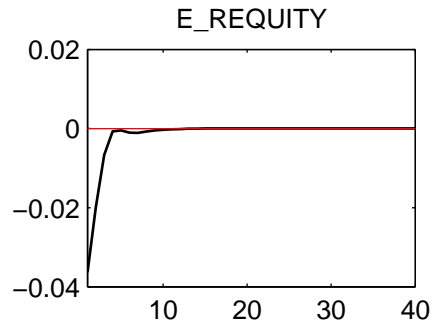
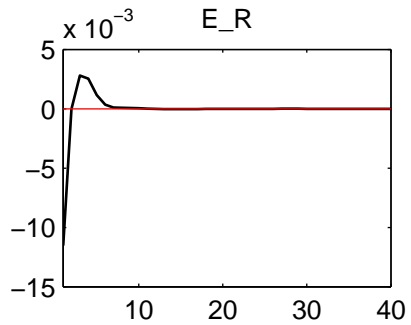
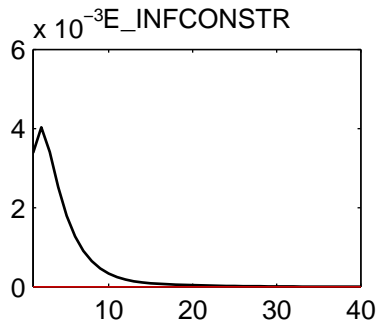


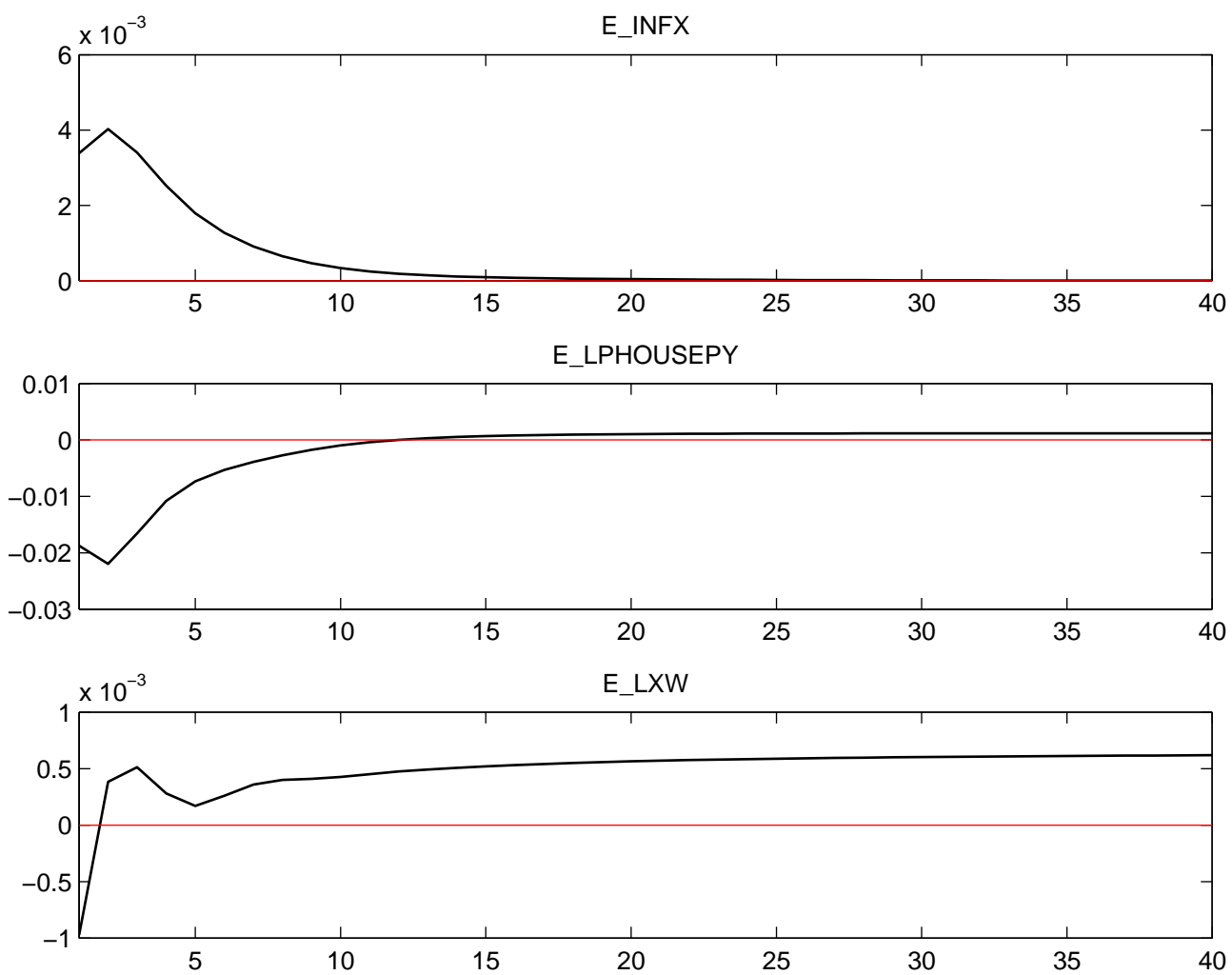


# Monetary Policy Shock

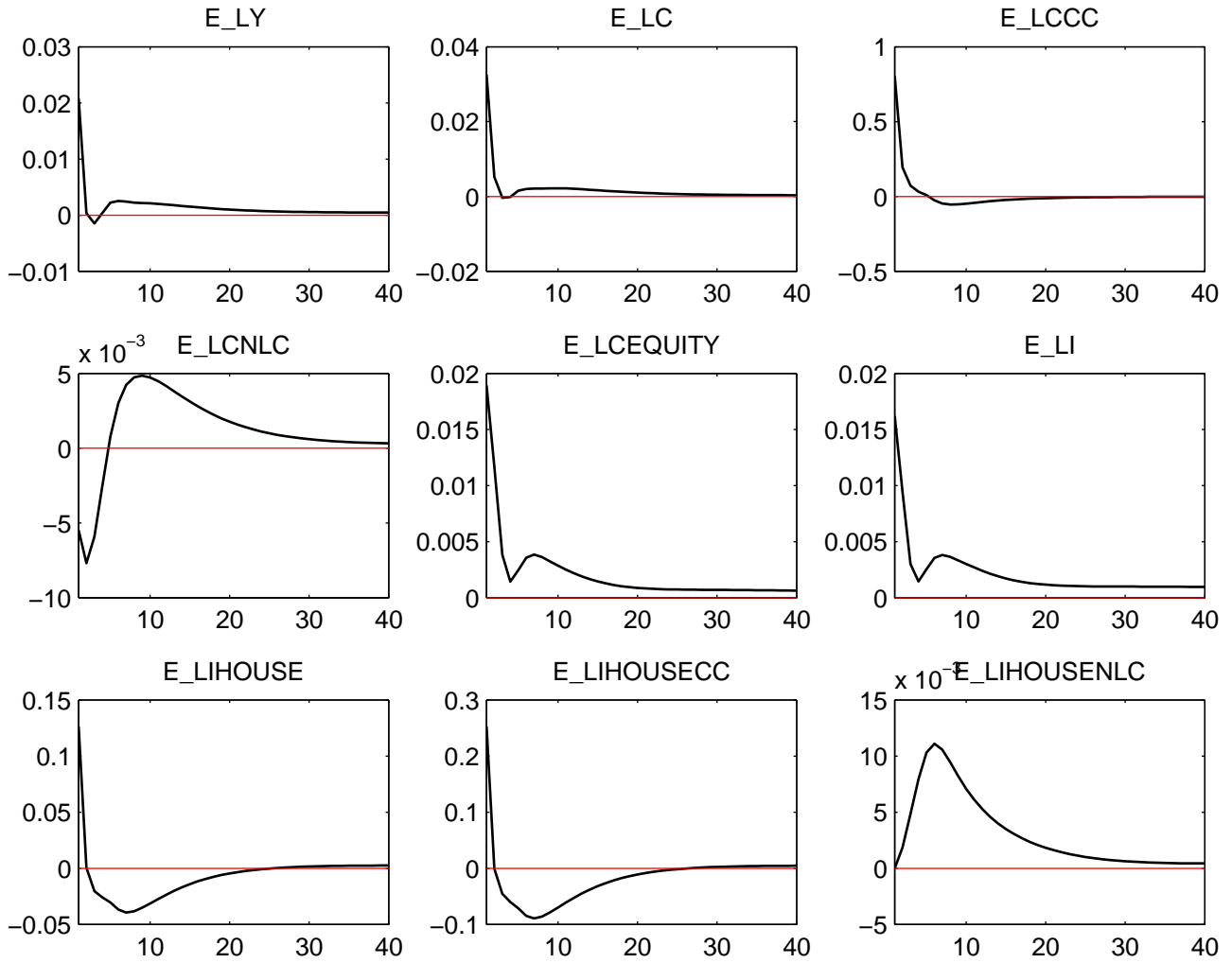


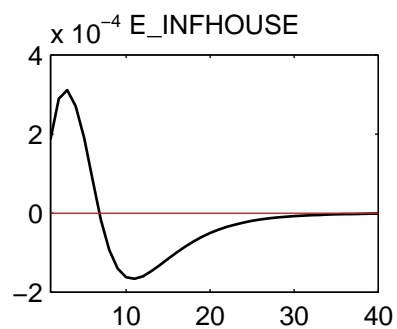
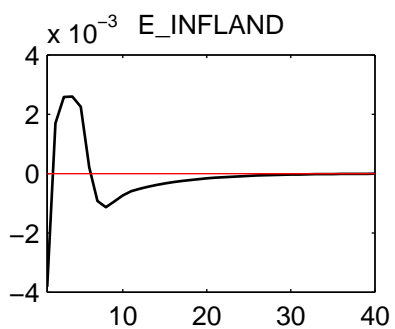
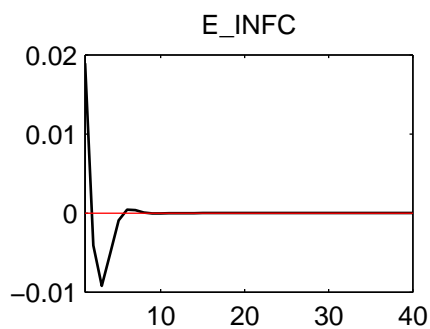
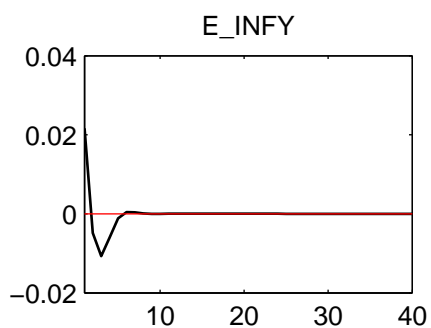
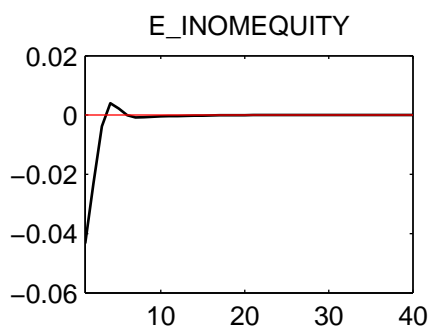
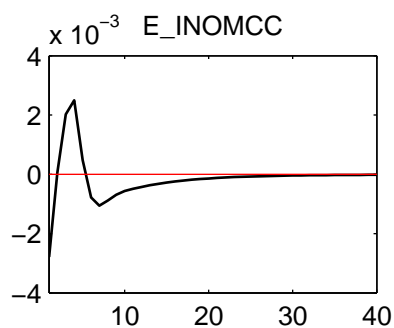
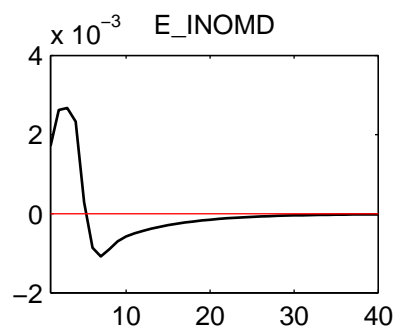
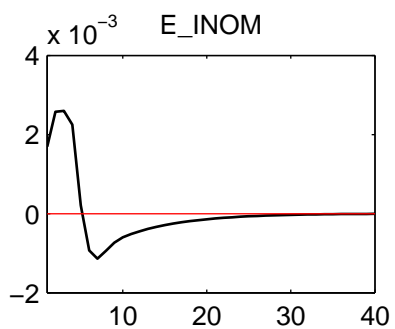
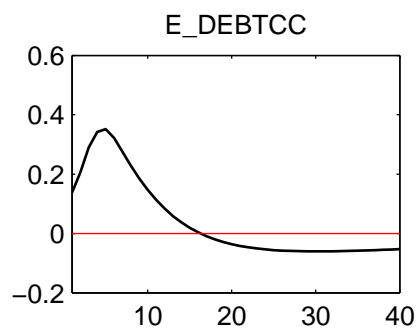


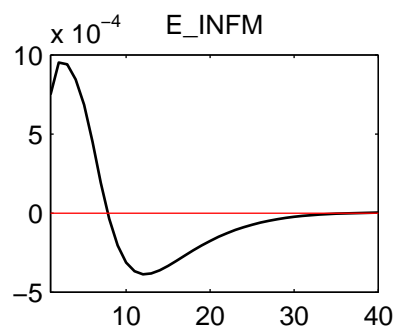
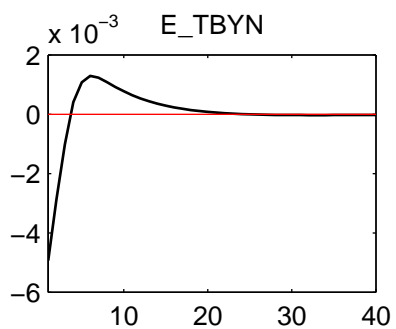
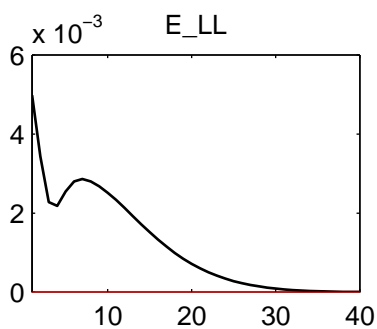
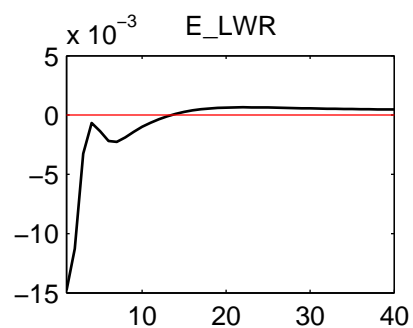
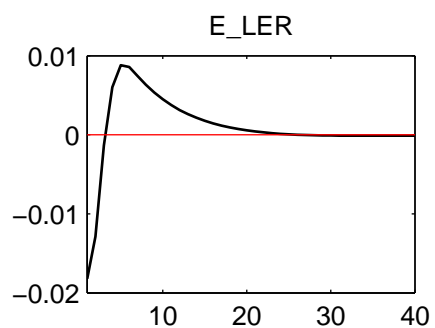
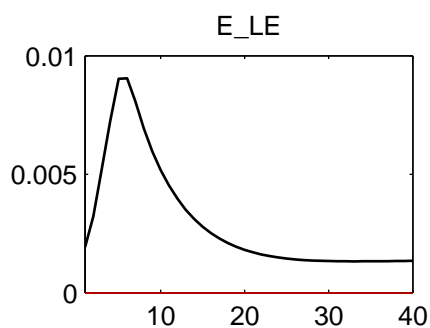
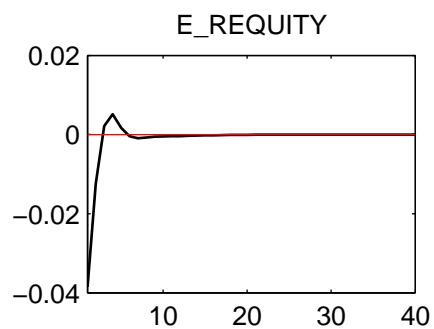
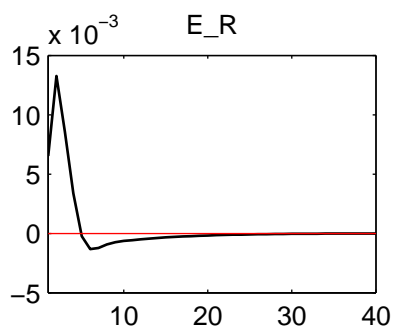
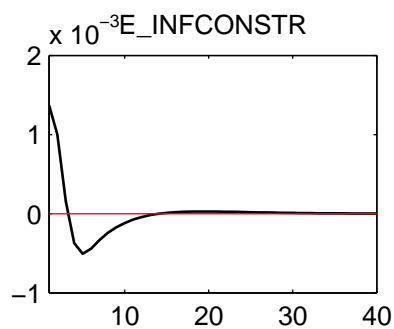


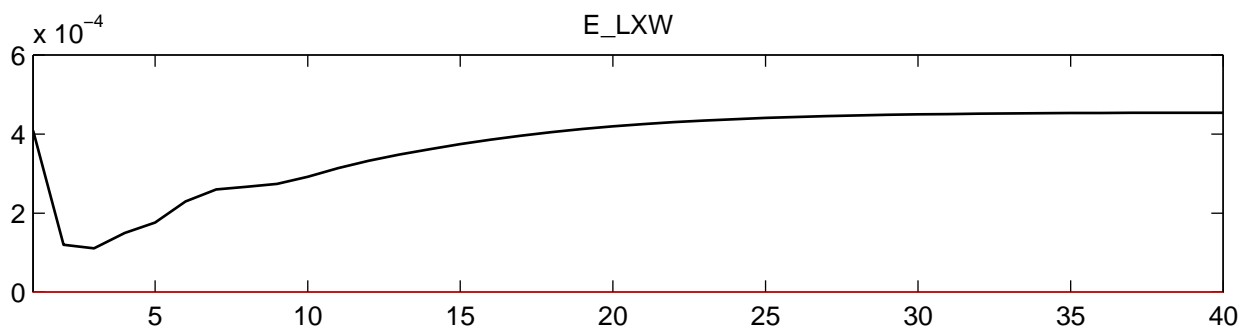
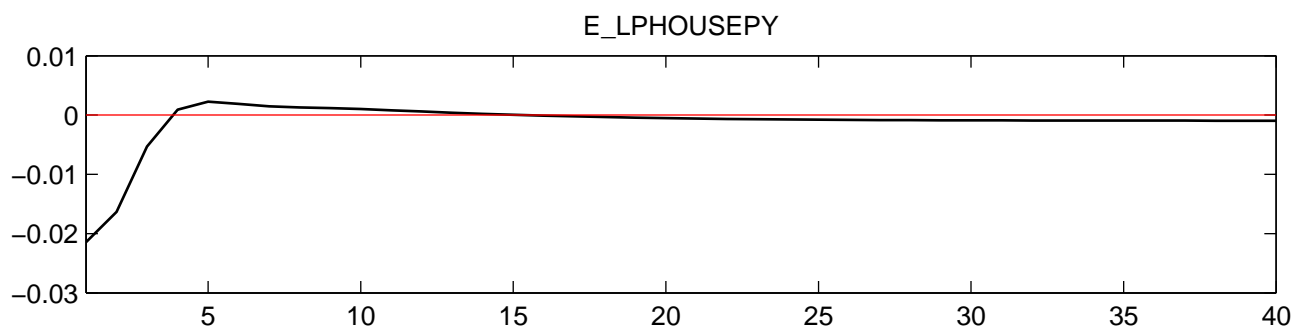
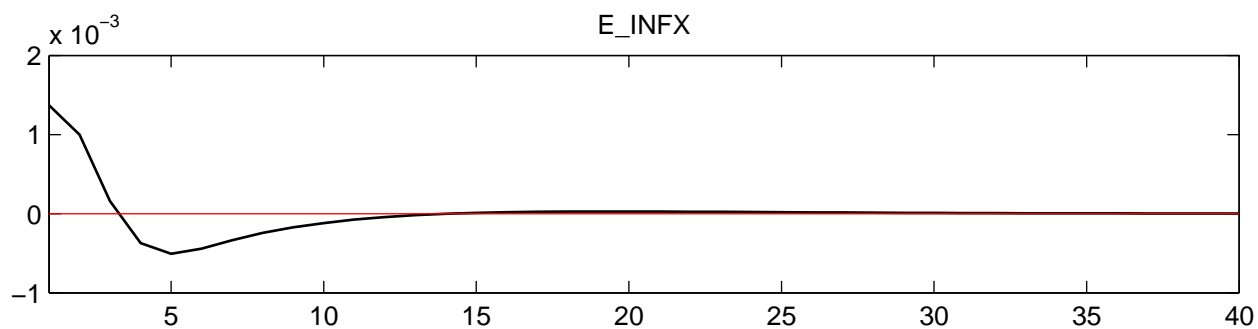


# Lower LTV

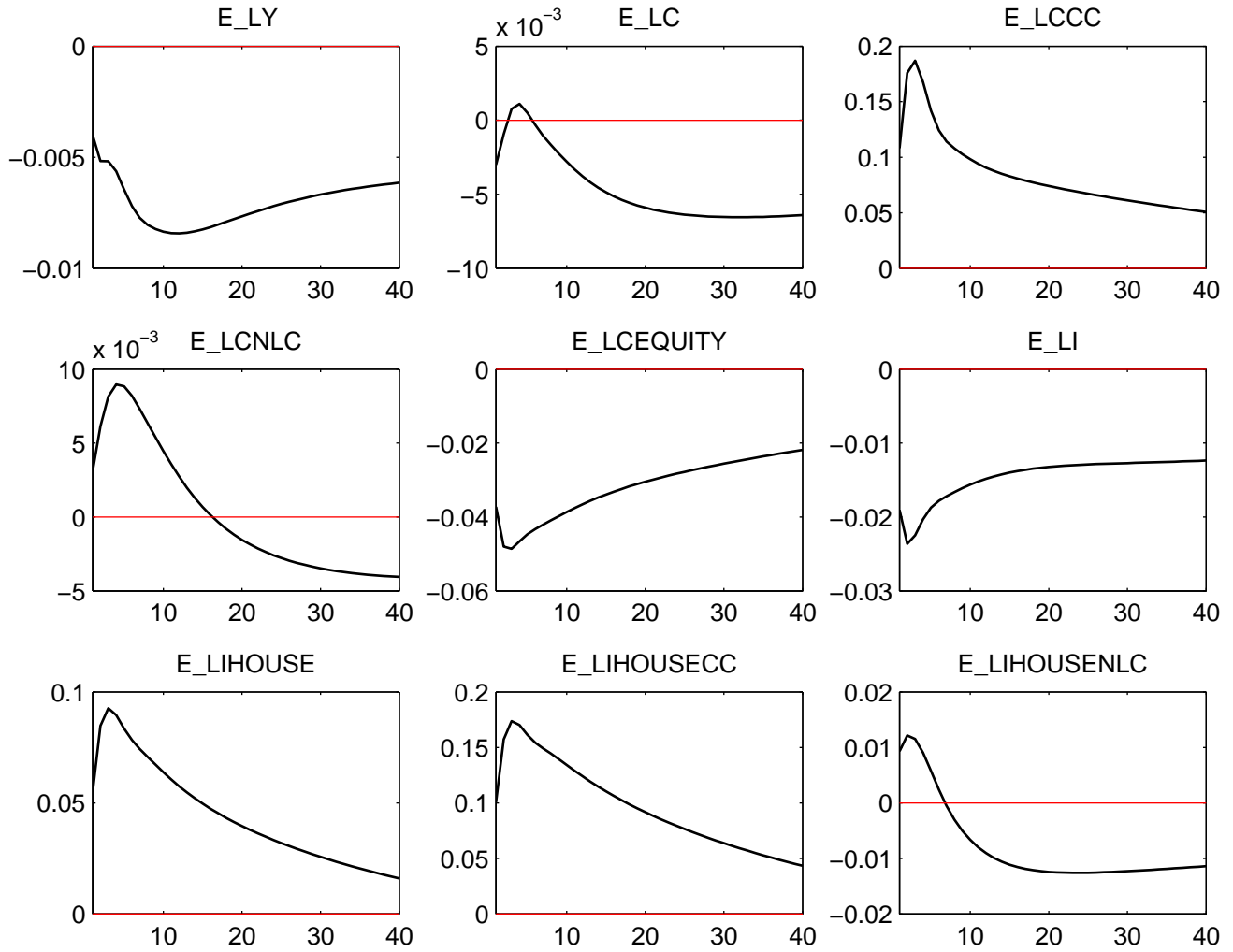


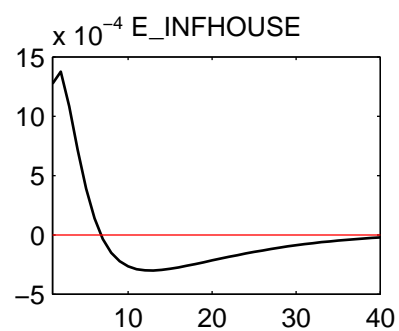
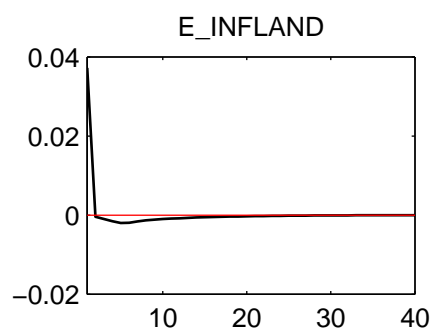
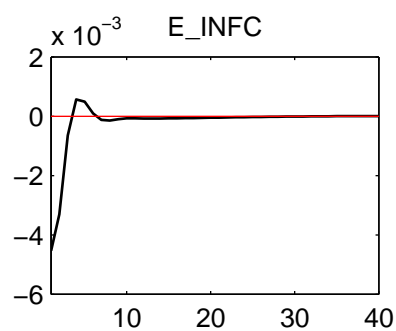
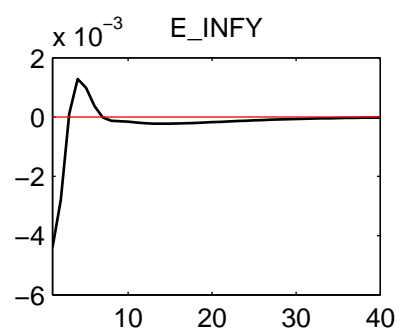
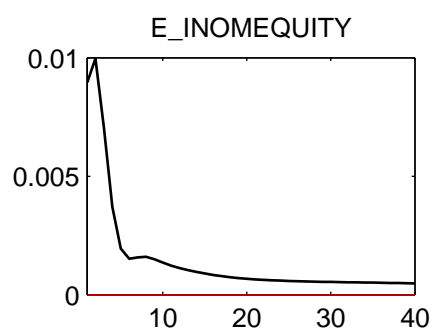
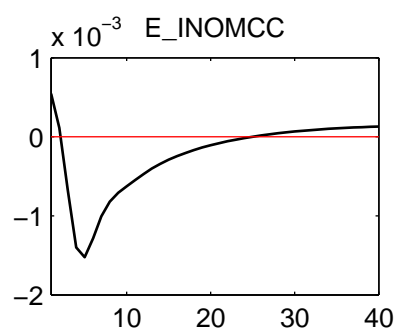
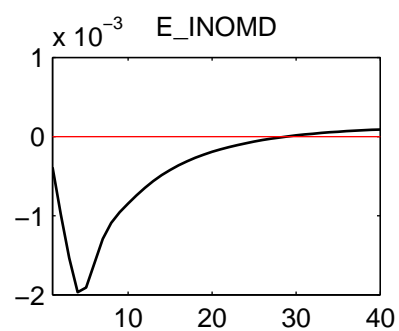
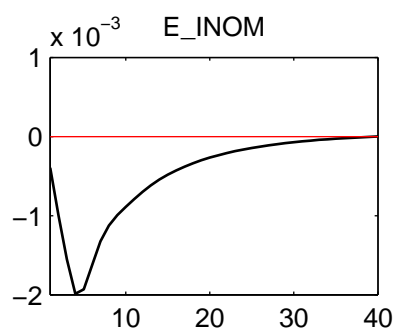
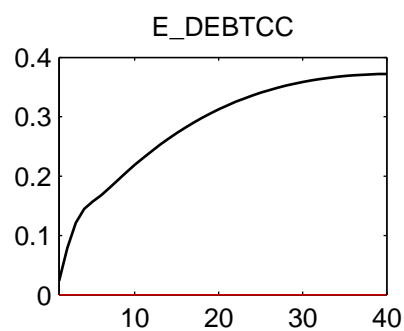


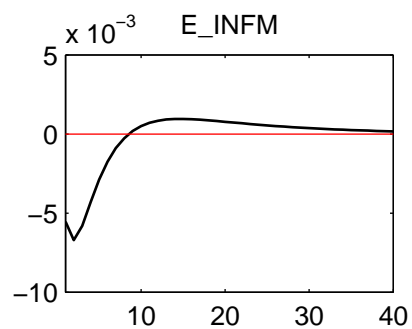
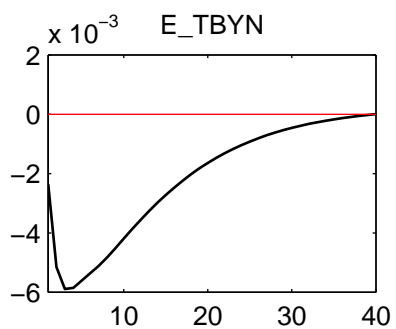
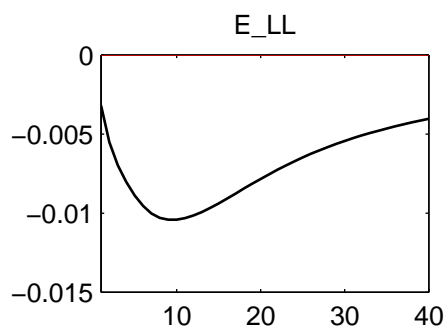
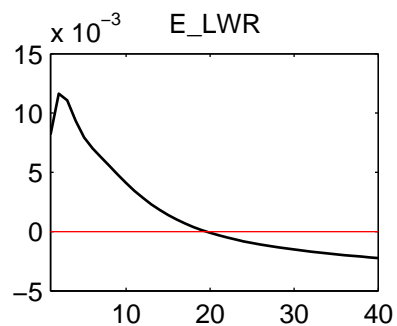
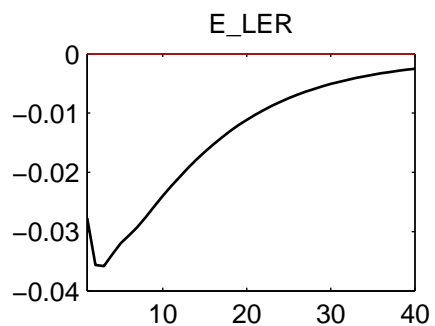
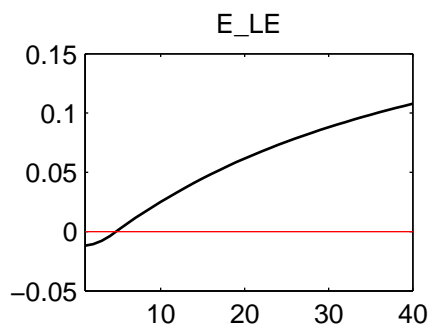
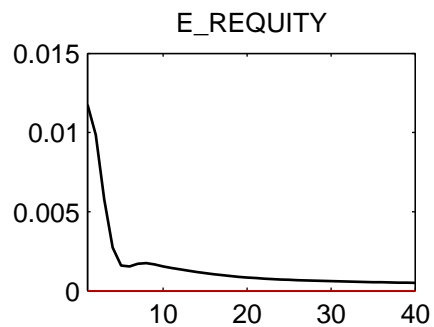
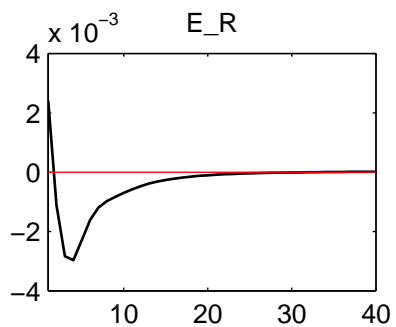
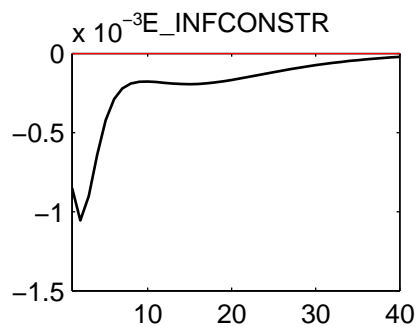


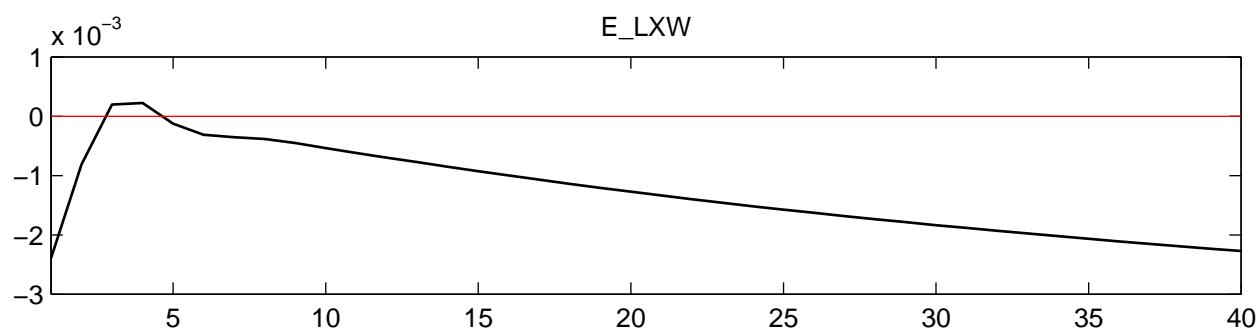
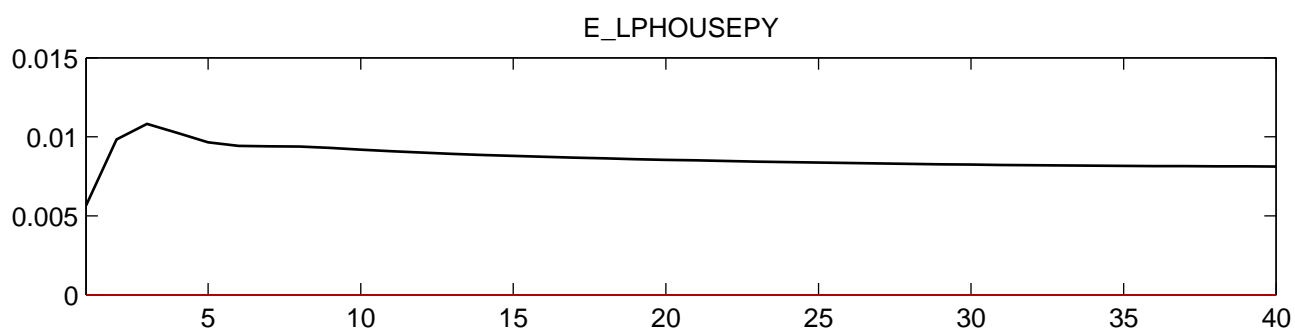
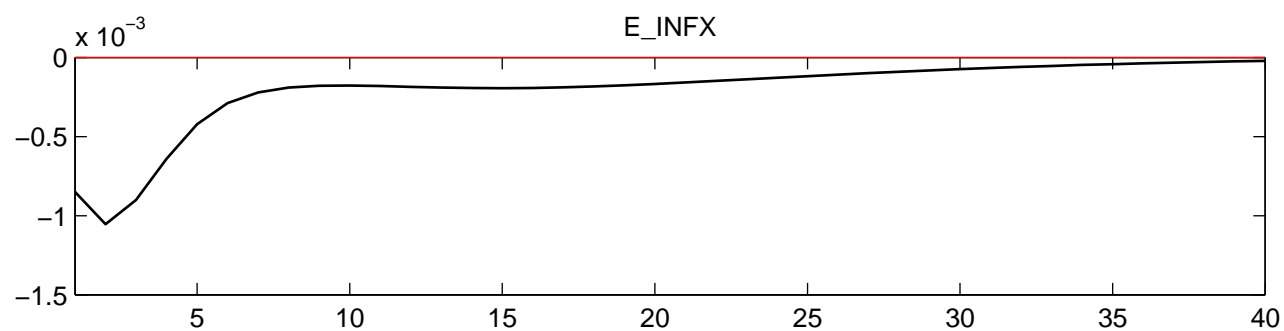


# Mortgage Default Shock

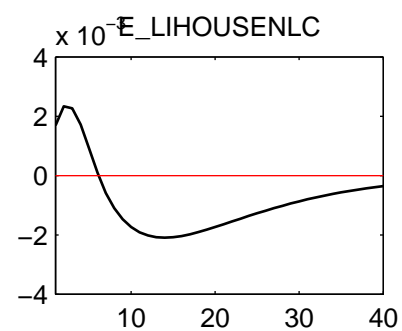
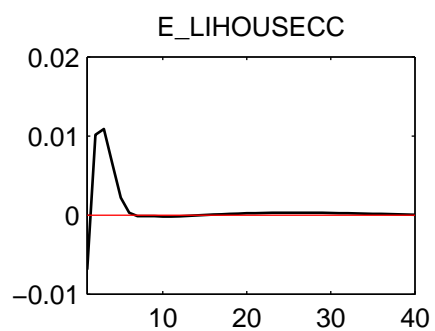
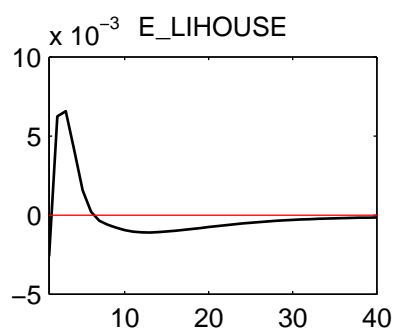
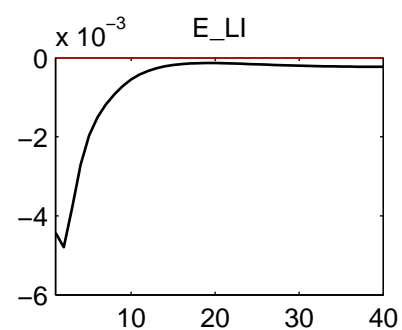
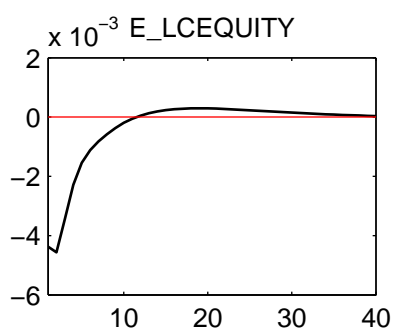
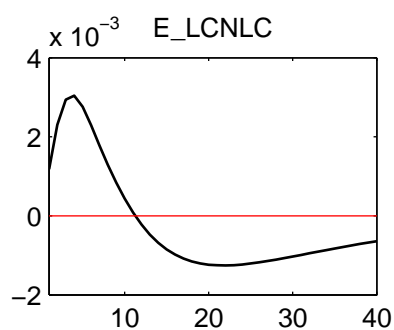
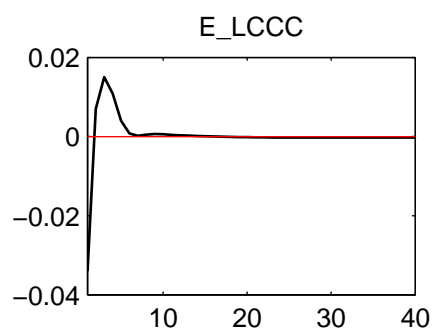
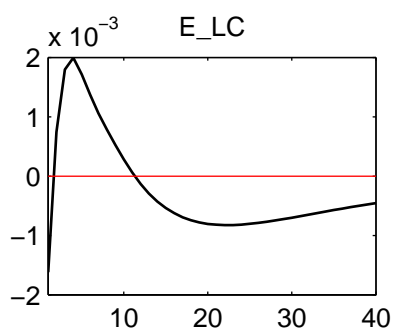
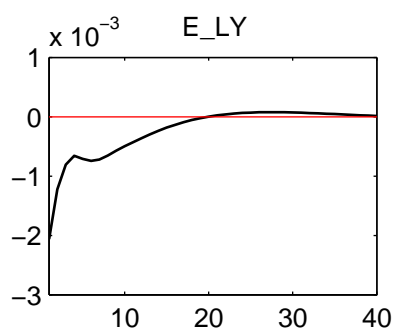


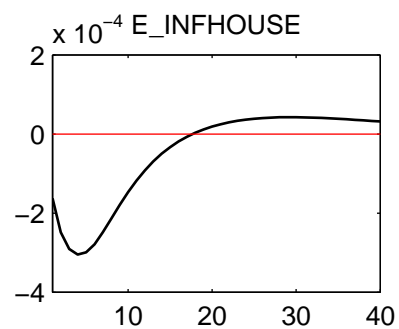
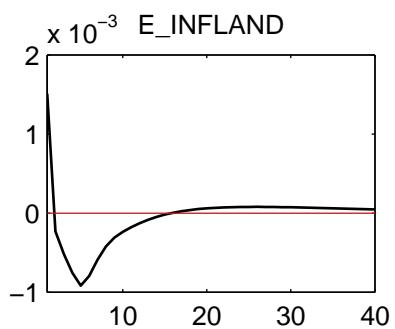
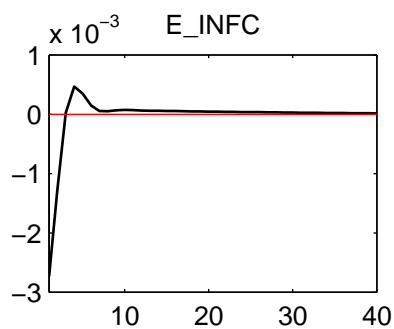
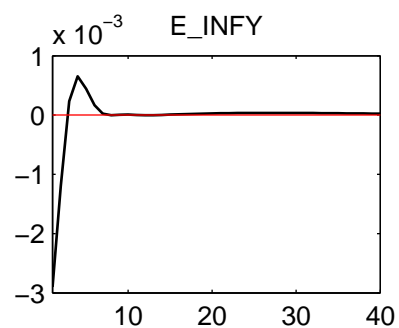
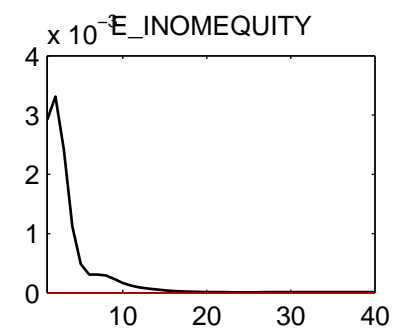
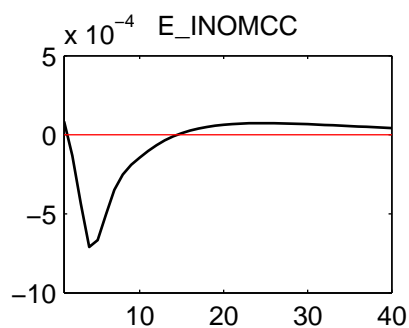
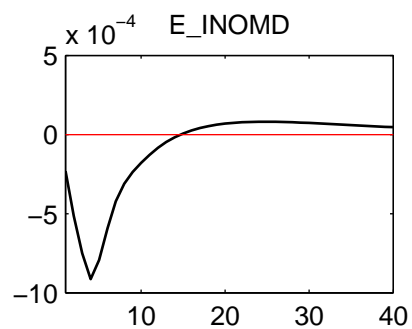
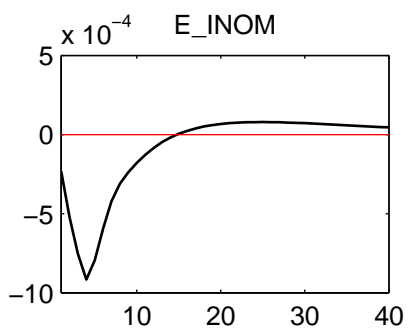
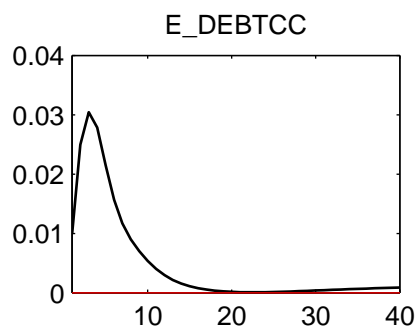


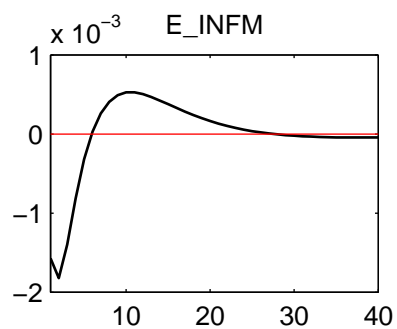
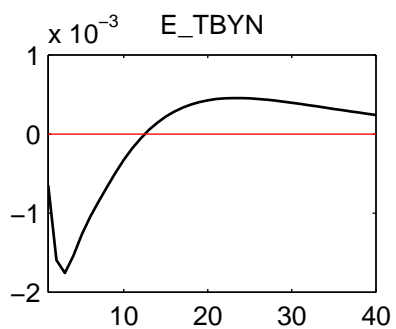
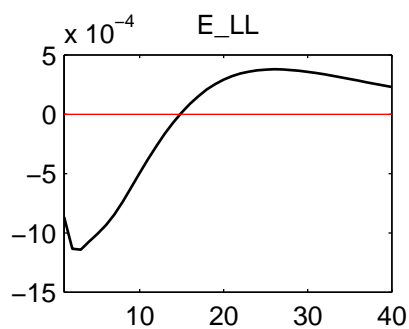
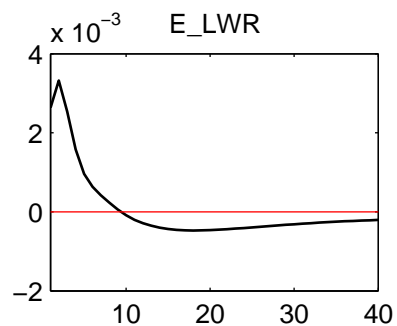
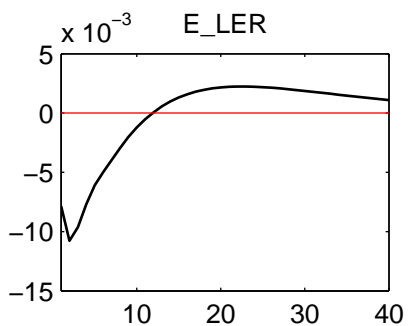
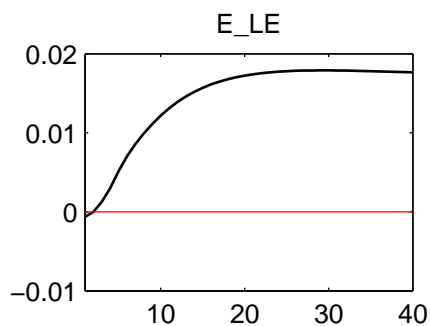
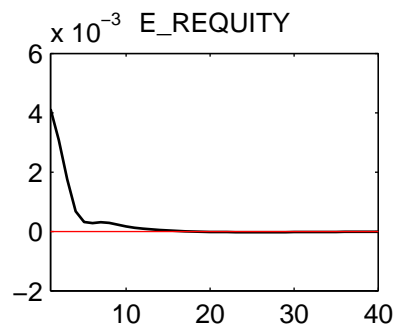
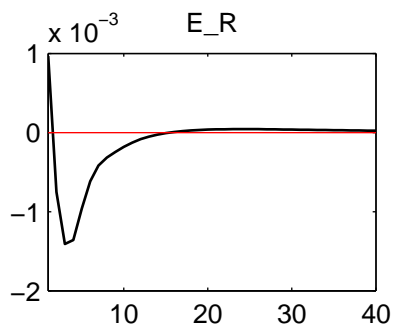
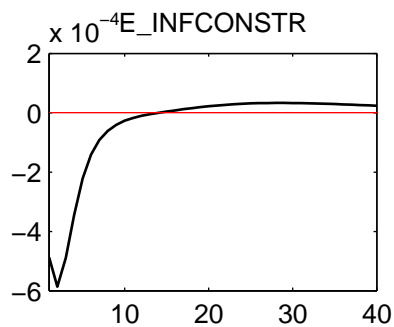


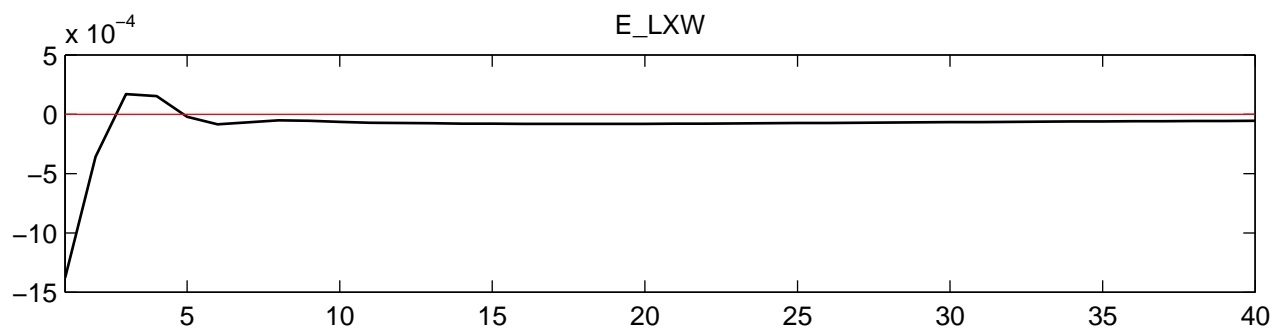
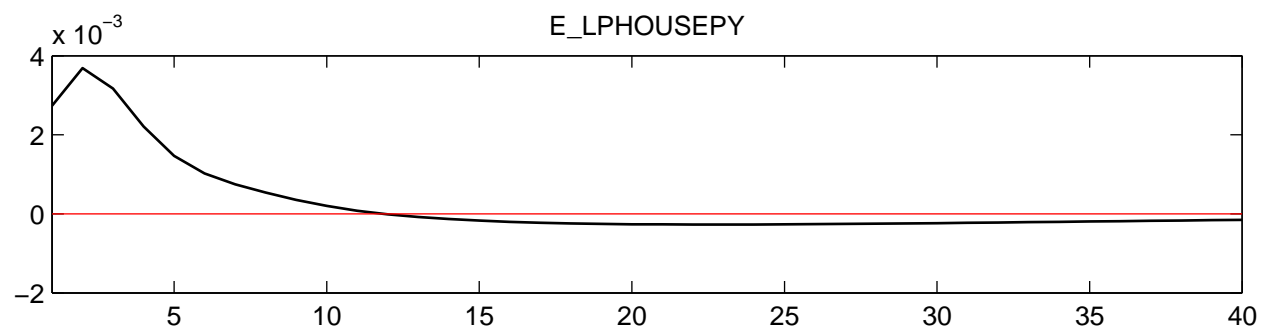
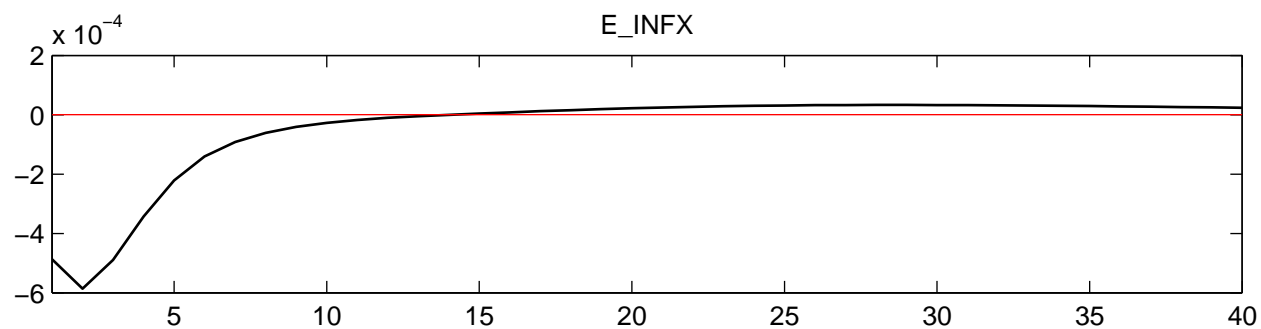


## Global Banking Glut

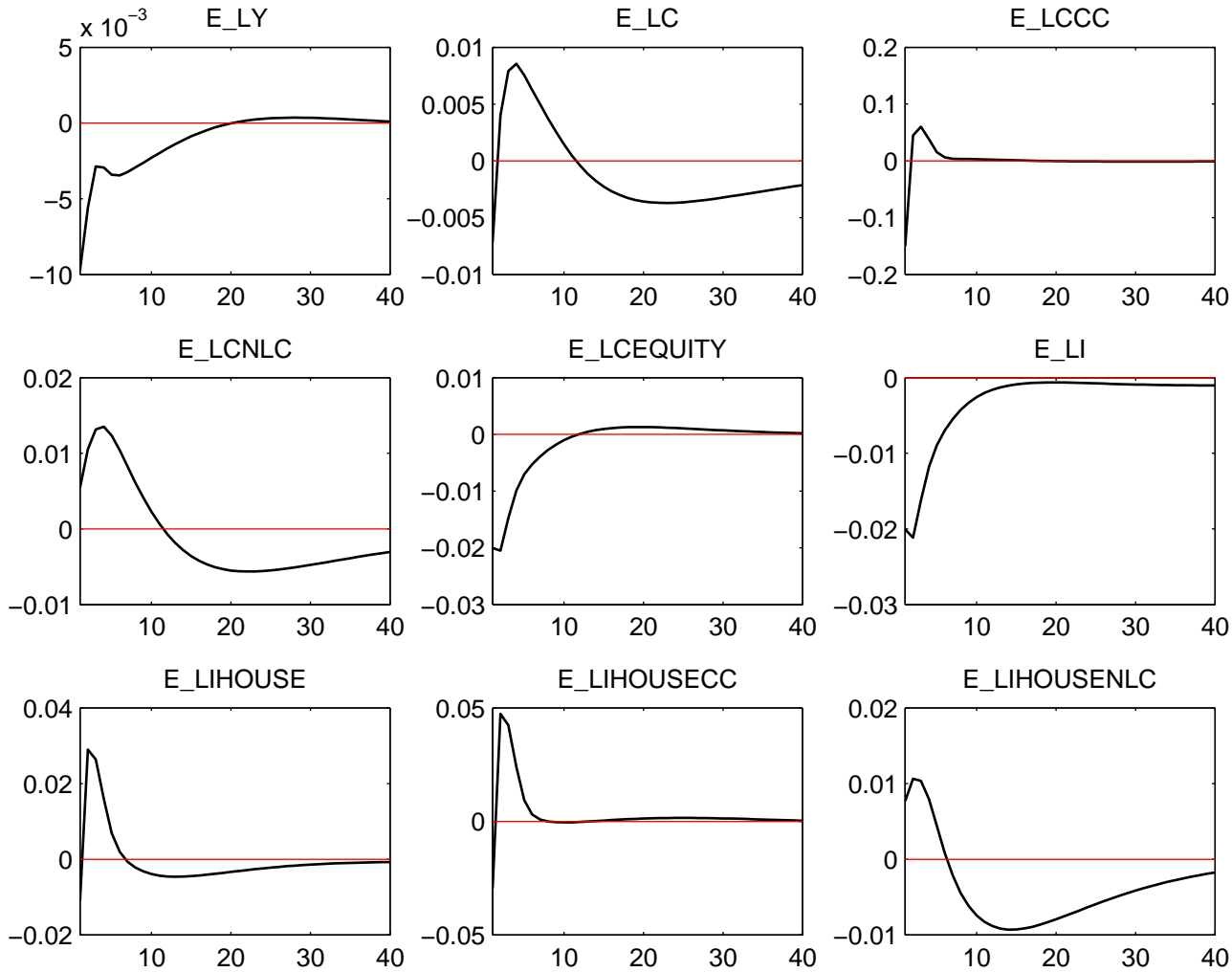


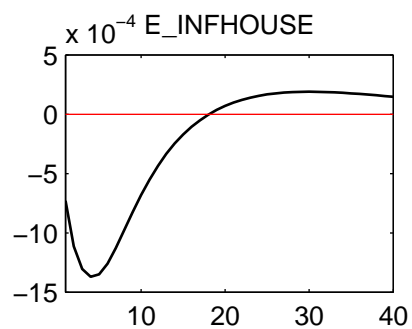
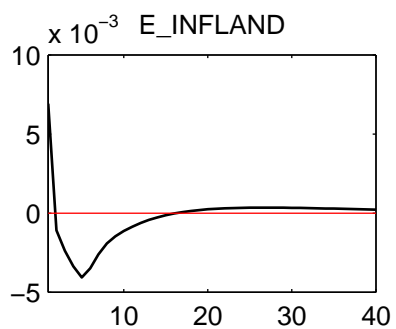
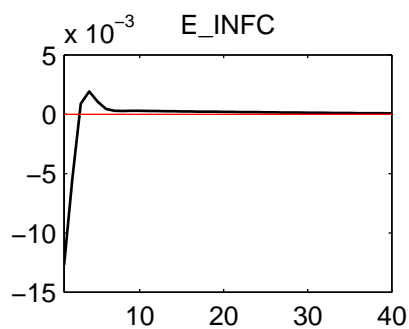
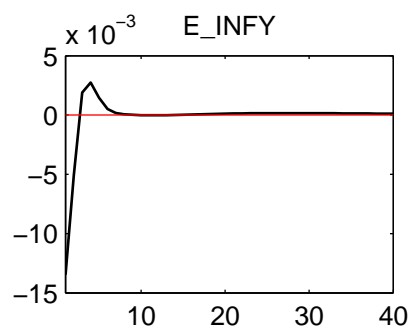
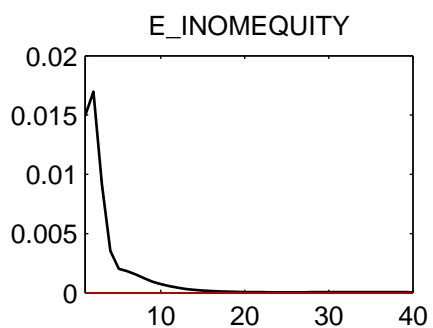
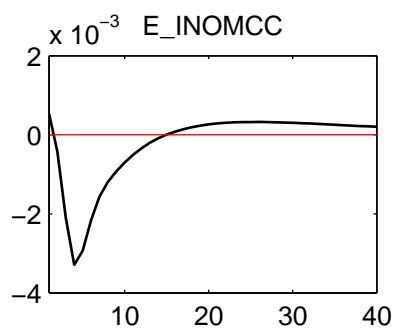
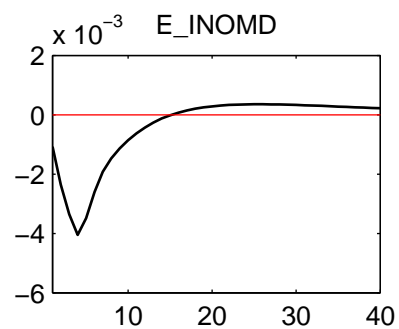
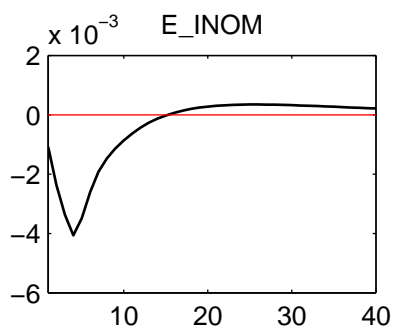
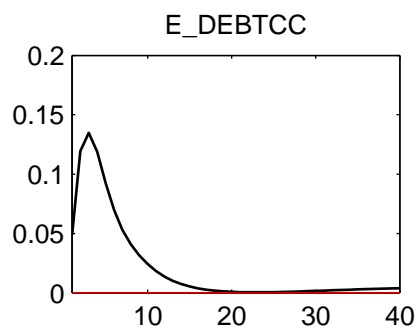


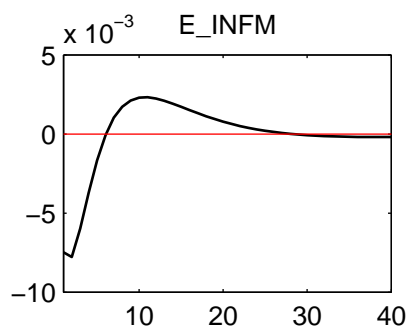
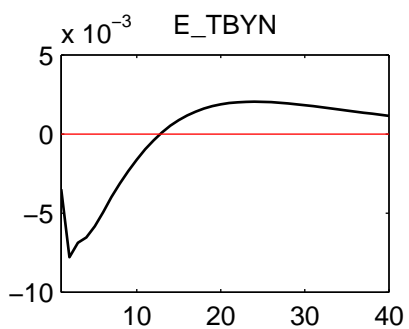
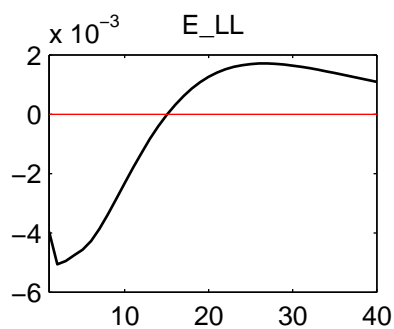
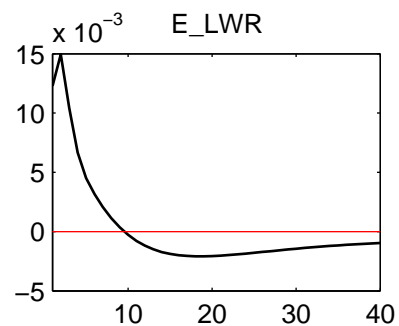
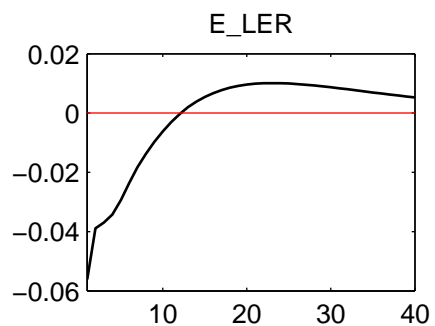
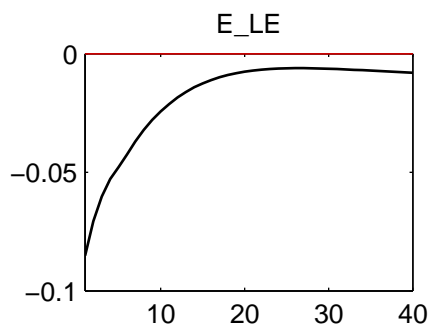
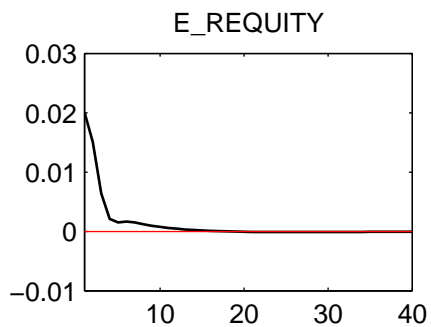
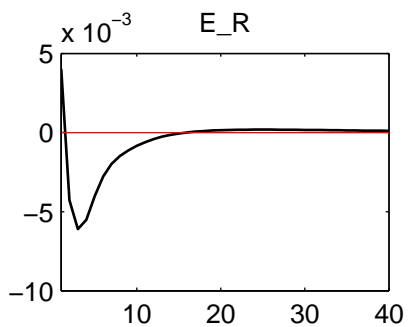
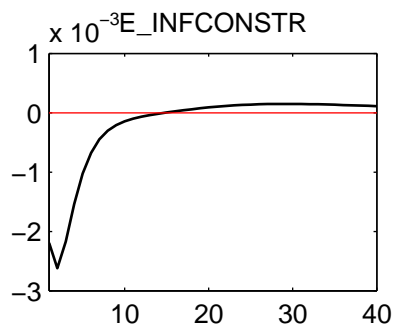


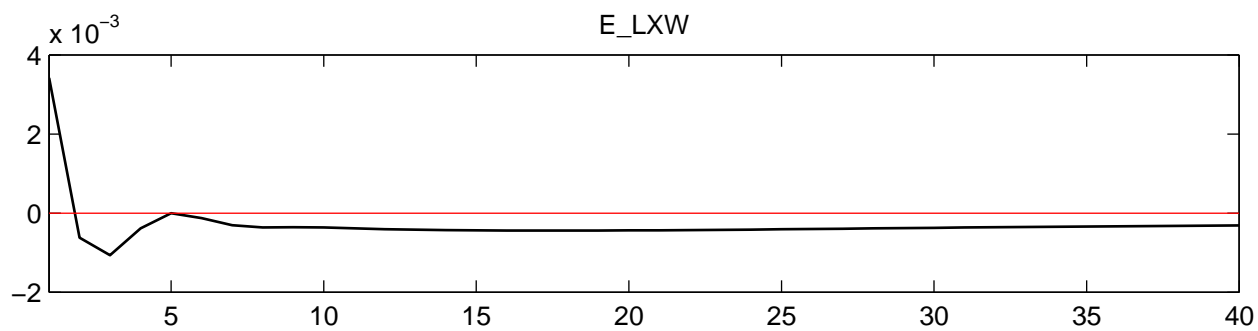
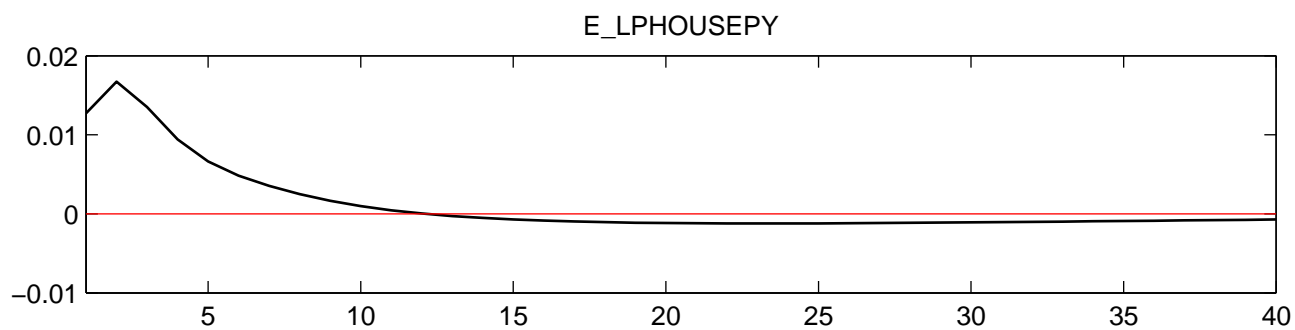
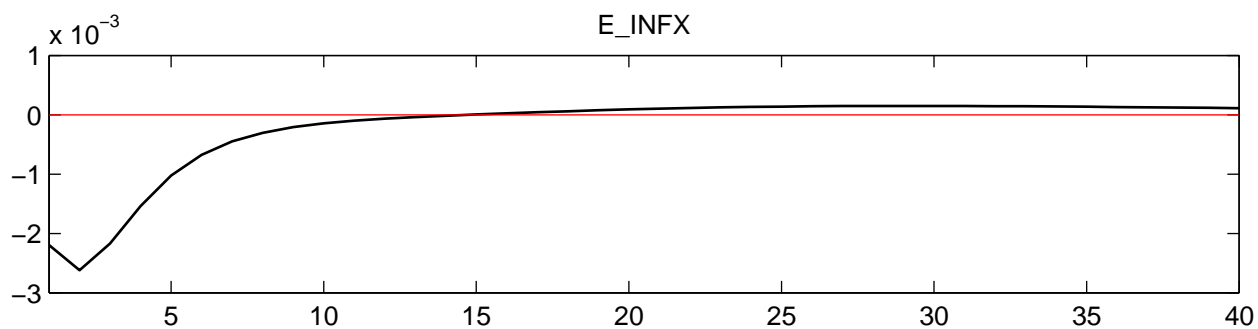


Flight to Quantity  
Searching for higher yield



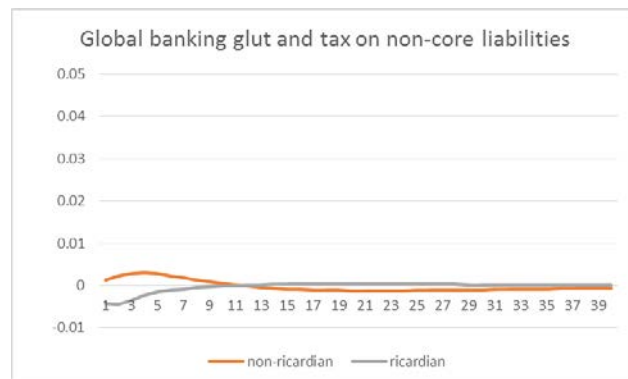
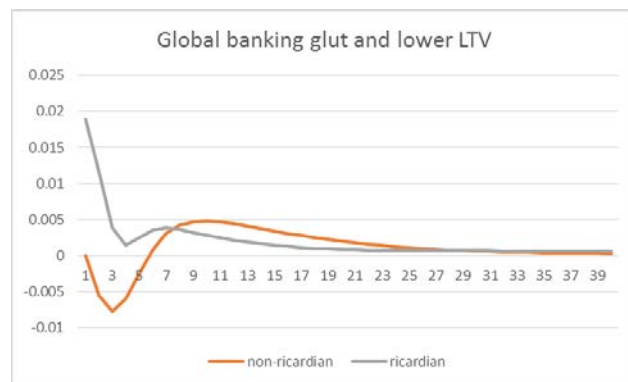
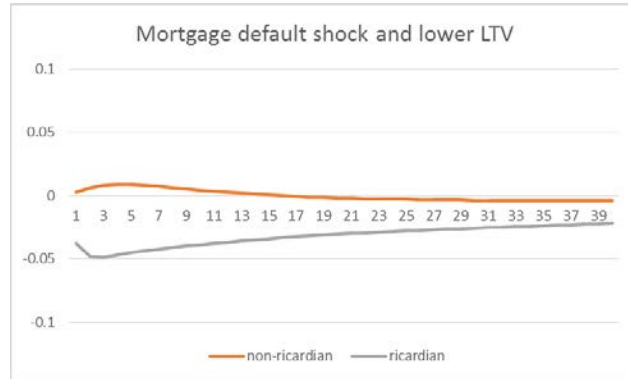






Annex 2

Impact of Policy Choice to Welfare : Households  
consumption





## REFERENCES

- “A Pigovian Approach to Liquidity Regulation - Enroci Perotti and Javier Suarez - November 2011 - International Journal of Central Banking.” International Journal of Central Banking (IJC.B)..
- Allen, Franklin. Cross-Border Banking in Europe: Implications for Financial Stability and Macroeconomic Policies. CEPR, 2011..
- Angelini, P. et al. “BASEL III: Long-Term Impact on Economic Performance and Fluctuations.” Available at SSRN 1785522 Journal Article (2011):
- Angeloni, Ignazio, and Ester Faia. A tale of two policies: Prudential regulation and monetary policy with fragile banks Journal Article (2009):
- Asiedu, Elizabeth, and Donald Lien. “Capital Controls and Foreign Direct Investment.” World Development 32.3 (2004): 479–490.
- Azis, Iwan J. et al. The Threat of Financial Contagion to Emerging Asia’s Local Bond Markets: Spillovers from Global Crises. Asian Development Bank, 2013.
- Benigno, Pierpaolo, and Michael Woodford. “Optimal Monetary and Fiscal Policy: A Linear-Quadratic Approach.” NBER Macroeconomics Annual 2003, Volume 18. The MIT Press, 2004. 271–364.
- Bernanke, B. S., M. Gertler, and S. Gilchrist. “The Financial Accelerator in a Quantitative Business Cycle Framework.” Handbook of macroeconomics 1. Journal Article (1999): 1341–1393.
- Bernanke, Ben, and Mark Gertler. Monetary Policy and Asset Price Volatility. National bureau of economic research, 2000.
- Bianchi, Javier. “Overborrowing and Systemic Externalities in the Business Cycle.” American Economic Review 101.7 (2011): 3400–3426
- Borio, C., and I. Shim. “What Can (macro-) Prudential Policy Do to Support Monetary Policy?” Journal Article (2007)
- Borio, Claudio E. V. Implementing a Macroprudential Framework: Blending Boldness and Realism. Rochester, NY: Social Science Research Network.

Brunnermeier, Markus et al. "Banks and Cross-Border Capital Flows: Policy Challenges and Regulatory Responses." Brookings Committee on International Economic Policy and Reform (2012):

Buckle, Bob, and Aaron Drew. "Testing Stabilisation Policy Limits in a Small Open Economy: Editor's Summary of a Macroeconomic Policy Forum." Reserve Bank of New Zealand Bulletin 69 (2006):

Chirinko, Robert S., and Huntley Schaller. "Business Fixed Investment and 'Bubbles': The Japanese Case." American Economic Review (2001): 663–680

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans. "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy." Journal of Political Economy 113.1 (2005): 1–45.

Clark, Alastair, and Group of Thirty. Macprudential Policy: Addressing the Things We Don't Know. Washington, DC: Group of Thirty, 2011. Print. Occasional Paper / Group of Thirty no. 83.

Coenen, Günter, and Roland Straub. "Does Government Spending Crowd in Private Consumption? Theory and Empirical Evidence for the Euro Area\*." International Finance 8.3 (2005): 435–470.

Committee on International Economic Policy and Reform (Washington, DC)., and Barry J. Eichengreen. Rethinking Central Banking. Brookings Institution, 2011.

De Paoli, Bianca, and Anna Lipińska. Capital Controls: A Normative Analysis. Federal Reserve Bank of New York, 2013.

DeJong, David N., Beth F. Ingram, and Charles H. Whiteman. "A Bayesian Approach to Dynamic Macroeconomics." Journal of Econometrics 98.2 (2000): 203–223

Tarasev et al, "Evaluating the Potential Impact of Deleveraging by Euro Area Banks on Emerging Market Economies." N. p., 12 Dec. 2011.

Forbes, Kristin et al. Bubble Thy Neighbor: Portfolio Effects and Externalities from Capital Controls. National Bureau of Economic Research, 2012.

Fujiwara, Ippei, and Yuki Teranishi. "Financial Stability in Open Economy." Nov. 2013.

Galati, G., and R. Moessner. "Macroprudential Policy—a Literature Review." Journal of Economic Surveys Journal Article (2012)

Galí, Jordi, and Mark Gertler. Macroeconomic Modeling for Monetary Policy Evaluation. National Bureau of Economic Research, 2007.

Gali, Jordi, J. David López-Salido, and Javier Vallés. “Understanding the Effects of Government Spending on Consumption.” *Journal of the European Economic Association* 5.1 (2007): 227–270.

Gali, Jordi, and Tommaso Monacelli. “Monetary Policy and Exchange Rate Volatility in a Small Open Economy.” *The Review of Economic Studies* 72.3 (2005)

Galí, Jordi, and Tommaso Monacelli. *Optimal Monetary and Fiscal Policy in a Currency Union*. Department of Economics and Business, Universitat Pompeu Fabra, 2005.

Hahm, Joon-Ho, and National Bureau of Economic Research. *Macroprudential Policies in Open Emerging Economies*. Cambridge, Mass: National Bureau of Economic Research, 2012.

Hammond, Gill, SM Ravi Kanbur, and Eswar Prasad. *Monetary Policy Frameworks for Emerging Markets*. Edward Elgar Publishing, 2009.

Heid, Frank et al. *German Bank Lending during Emerging Market Crises: A Bank Level Analysis*. Discussion Paper, Series 2: Banking and Financial Supervision, 2004.

Horvath, Michal. “The Effects of Government Spending Shocks on Consumption under Optimal Stabilization.” *European Economic Review* 53.7 (2009): 815–829.

IN’T VELD, Jan et al. “The Recent Boom Bust Cycle.” (2010)

International Monetary Fund. *Macroprudential Indicators of Financial System Soundness*. Washington, DC: International Monetary Fund, 2000. Print. Occasional Paper no. 192.

Jeanne, Olivier, and Anton Korinek. *Managing Credit Booms and Busts: A Pigouvian Taxation Approach*. National Bureau of Economic Research, 2010.

Jeanne, Olivier, and National Bureau of Economic Research. *Macroprudential Regulation Versus Mopping Up After the Crash*. Cambridge, Mass: National Bureau of Economic Research, 2013.

Kannan, P., P. Rabanal, and A. Scott. *Monetary and Macroprudential Policy Rules in a Model with House Price Booms*. International Monetary Fund, Research Department, 2009.

Kiyotaki, Nobuhiro, and John Moore. “Credit Cycles.” *Journal of Political Economy* 105.2 (1997): 211–48.

Kollmann, Robert. “Global Banks, Financial Shocks and International Business Cycles: Evidence from an Estimated Model.” (2012)

Korinek, Anton. *Regulating Capital Flows to Emerging Markets: An Externality View*. Rochester, NY: Social Science Research Network, 2010.

---. “The New Economics of Prudential Capital Controls: A Research Agenda.” *IMF Economic Review* 59.3 (2011): 523–561.

Leeper, Eric M., and Tack Yun. Monetary-Fiscal Policy Interactions and the Price Level: Background and Beyond. National Bureau of Economic Research, Inc, 2005

Leith, C., and S. Wren-Lewis. Interactions between Monetary Policy and Fiscal Rules. Exeter University, Department of Economics, 1999.

Leith, Campbell, and Simon Wren-Lewis. Taylor Rules in the Open Economy. Exeter University, Department of Economics, 2002.

McGuire, Patrick, and Nikola Tarashev. “Bank Health and Lending to Emerging Markets.” BIS Quarterly Review 12 (2008): 67–80.

Medina, Juan Pablo, Anella Munro, and Claudio Soto. What Drives the Current Account in Commodity Exporting Countries? The Cases of Chile and New Zealand. Rochester, NY: Social Science Research Network.

Moore, John, and Nobuhiro Kiyotaki. “Credit Cycles.” Journal of Political Economy 105.2 (1997)

Muscattelli, V. Anton, and Patrizio Tirelli. “Analyzing the Interaction of Monetary and Fiscal Policy: Does Fiscal Policy Play a Valuable Role in Stabilisation?” CESifo Economic Studies 51.4 (2005): 549–585. Print.

Prasad, Eswar S. Role Reversal in Global Finance. National Bureau of Economic Research, 2011.

Quint, D., and P. Rabanal. “Monetary and Macprudential Policy in an Estimated DSGE Model of the Euro Area.” International Monetary Fund mimeo

Rudebusch, Glenn, and Lars EO Svensson. “Policy Rules for Inflation Targeting.” Monetary Policy Rules. University of Chicago Press, 1999. 203–262.

Schmitt-Grohé, Stephanie, and Martín Uribe. “Optimal Fiscal and Monetary Policy under Sticky Prices.” Journal of Economic Theory 114.2 (2004): 198–230

Shin, H. S. “Macprudential Policies beyond Basel III.” Policy Memo, November Journal Article (2010)

Shin, Hyun Song. “Global Banking Glut and Loan Risk Premium.” IMF Economic Review 60.2 (2012): 155–192.

Shin, Hyun Song, and Kwanho Shin. Procyclicality and Monetary Aggregates. National Bureau of Economic Research, 2011.

Shiratsuka, Shigenori, and Nihon Ginkō. A Macprudential Perspective in Central Banking. Tokyo, Japan: Institute for Monetary and Economic Studies, Bank of Japan, 2011. Print. IMES Discussion Paper Series discussion paper no. 2011-E-3.

Smets, Frank, and Raf Wouters. "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area." *Journal of the European economic association* 1.5 (2003)

Suh, Hyunook. *Macroprudential Policy: Its Effects and Relationship to Monetary Policy*. Federal Reserve Bank of Philadelphia, 2012.

---. *Evaluating Macroprudential Policy with Financial Friction DSGE Model* Journal Article (2011):

Torre, De la, Augusto, and Alain Ize. *Regulatory Reform: Integrating Paradigms*. Rochester, NY: Social Science Research Network, 2009.

Utari, GA Diah, and Trinil Arimurti. "A MACRO-PRUDENTIAL ASSESSMENT FOR INDONESIA." *Bank Indonesia Working Paper* 2012.

Vallascas, F., and J. Hagendorff. "The Risk Sensitivity of Capital Requirements: Evidence from an International Sample of Large Banks." *Review of Finance* 17.6 (2013)

Van Rijckeghem, Caroline, and Beatrice Weder. *Financial Contagion: Spillovers through Banking Centers*. CFS Working paper, 1999.

Woodford, Michael. "Optimal Interest-Rate Smoothing." *The Review of Economic Studies* 70.4 (2003): 861–886.

World Bank. "The Changing Role of International Banking in Development Finance." *Global Development Finance* (2008):

"World Bank 2008. *The Changing Role of International Banking in Development*." n. pag. Print.

Zhang, Longmei. *Bank Capital Regulation, the Lending Channel and Business Cycles*. Discussion Paper Series 1: Economic Studies, 2009.