MACROPRUDENTIALS: SEPARATE FROM MONETARY POLICY OR PART OF IT?

A Master's Thesis

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To My Family

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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ABSTRACT

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The structure of central bank in bank supervision is an important issue on which there is not much focus whereas the independence of central banks for the implementation of monetary policy is well investigated. Recently, especially after the financial crisis, there is an increasing attention from policy makers and academicians about financial regulation and monetary policy responsibility issue. Since the crisis turned to have severe macroeconomic consequences, the financial supervision issue is taken into consideration to revise. In this paper, first I briefly explain the policy objectives of both macro- and microprudential regulations. Then, I use a dynamic stochastic general equilibrium model which include separated and integrated responsibilities of financial stability and monetary policy. As macroprudential policy tool, time varying capital requirement ratio is used. Under a DSGE framework, it is hard to see the separation of regulators, however the analyses is done in terms of tools. The results imply that incorporating the central bank into financial stability considerations can help smooth business cycle fluctuations, and decreases the loss resulting from variances of main indicators.

Keywords: Macroprudential policy, monetary policy, DSGE model.

ÖZET

MAKROİHTİYATİ TEDBİRLER: PARA POLİTİKASI İLE VEYA AYRI?

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Yüksek Lisans, Ekonomi Bölümü

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Para politikasının uygulanması açısından merkez bankalarının bağımsızlığı üzerinde birçok araştırma yapılmış iken, diğer bir önemli konu olan merkez bankasının bankalar üzerindeki denetimsel yapısı üzerine çok fazla yoğunlaşılmamıştır. Son dönemlerde, özellikle küresel finansal krizi müteakip, politika belirleyiciler ve akademisyenler tarafından bu konuya artan bir ilgi mevcuttur. Krizin makroekonomik sonuçları ciddi olduğu için, makro-ihtiyati tedbirler yeniden gözden geçirilmek üzere dikkate alınmakta. Bu çalışmada ilk olarak mikro- ve makro-ihtiyati tedbirlerin amaçları kısaca açıklanacaktır. Sonrasında, ayrı ve birleşik fiyat istikrarı ve finansal istikrar sorumlulukları içeren dinamik stokastik genel denge modeli kullanılacaktır. Dinamik stokastik genel denge modeli çerçevesinde iki otoritenin ayrı veya birleşik olduğunu saptamak çok açık olmasa da politika araçları üzerinden analiz yapılmıştır. Sonuçlar göstermektedir ki merkez bankası konjonktür dalgalanmalarını sakinleştirmek ve temel göstergelerin varyanslarından hesaplanan refah kaybını azaltmak için finansal istikrarı dikkate almalıdır.

Anahtar Kelimeler: Makro-ihtiyati politika, para politikası, Dinamik stokastik genel denge modeli

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CHAPTER 1

INTRODUCTION

The structure of central bank in bank supervision is an important issue on which there is not much focus whereas the independence of central banks for the implementation of monetary policy is well investigated. Recently, especially after the financial crisis, there is an increasing attention from policy makers and academicians about financial regulation and monetary policy responsibility issue. There are many elements of this debate. First one is whether bank supervisory duties affect the performance of monetary policy of central bank or not. In other words, whether the combination of monetary policy responsibility and supervisory responsibilities leads to conflicts of interest or not. This leads to the main debate of bank supervision and monetary policy responsibilities' separation or integration issue. The financial crisis highlighted another issue related to supervision responsibilities due to financial instabilities and imbalances. Since the crisis turned to have severe macroeconomic consequences, the financial supervision issue is taken into consideration to revise.

The consensus on this issue is that macroprudential regulations should be strengthened instead of giving much attention to microprudential regulations due to the results faced with the financial crisis for the whole system. In this paper, first I will briefly explain the policy objectives of both macro- and

microprudential regulations. Then, I will use a dynamic stochastic general equilibrium model which include separated and integrated responsibilities of financial stability and monetary policy. Under different implementation of the two policies, there are experiments conducted. The results state that the welfare implications differs and minimizes when the two regulatory bodies exist and the central bank takes the financial stability into account.

The remainder of the paper is organized as follows. Section 2 provides a brief literature review including the policy objectives of macro- and microprudential regulations, and the motivation of my research. Section 3 provides a brief description of distinct models, and of the model of my study; then, identifies alternative tools and policy experiments, and states the results. Section 4 concludes.

CHAPTER 2

LITERATURE REVIEW AND MOTIVATION

2.1 Literature Review

Firstly, the separation of monetary policy responsibility and supervisory responsibility issue will be reviewed. In the literature, there are opponents and proponents of separation of monetary policy responsibilities and supervisory responsibilities. The argument consists that for either combination, the central bank's supervisory duties affect monetary policy and vice versa. Proponents argue that the combination leads to conflict of interest between the monetary authority seeking higher interest rates and the supervisory authority concerned with profitability of banking sector and the adverse effect of interest rate on the solvency. On the other hand, opponents argue that these two responsibilities of central bank are linked to the central bank's aim of systematic stability of financial system and to the protection of the payments system. The argument especially considers the central bank's lender-of-last-resort facilities, and for these facilities, there arises moral hazard issue.

To begin with the arguments for separation in the literature, Goodhart and Schoenmaker (1992) made a general point that states the cyclical behavior of macro (monetary) and micro (regulatory) policy tend to be in conflict.

The effects of regulation and supervision tend to be procyclical, whereas monetary policy is generally countercyclical. During the periods of economic slowdown, the financial conditions of banks usually deteriorate, but the supervisory requirements make banks to tighten credits during recessions. For that reason, the central bank is expected to be less strict in supervision to complement monetary policy. Because of the conflicts, the key point is the institutional setup. Some researchers argue that internalizing conflicts within a single agency may be an efficient solution. (Briault, 1999; Llewellyn, 1999) Heller (1991) and Goodhart and Schoenmaker (1992) compared the inflation who have central banks with and without supervisory responsibilities to see whether conflicting goals affect the central banks' supervisory responsibilities. Their findings state that the countries whose central banks without supervisory responsibilities achieved lower inflation rates on average.

On the other hand, for the opposition to the separation of responsibilities, Goodhart and Schoenmaker (1995) begin the separation issue by examining which regime is more efficient in decreasing banking failures, and at the same time, trying to avoid from systematic consequences. Particularly, they analyzed the methods for handling bank failures and the resources of funding under each regime is the same or not. Furthermore, they investigate whether bank rescues are financed on an implicit bank/commercial bank basis, or on an explicit deposit insurance/government basis. They conduct a cross-country survey of how some 104 major bank failures were handled. They claim that central banks are changing their behavior and retreat their primary role which is price stability due to two reasons: firstly, since banking system becomes less clearly defined, it is more difficult to persuade the members of the banking club to cooperate financial rescues; secondly, the central bank is able to organize cooperation on a self-regulatory basis. They argue that because of structural developments, supervisory function shifts to an independent body that is more directly under political control. They found that countries where

these two responsibilities are not separated, there are fewer bank failures on average.

Peek, Rosengren and Tootell (1999) examines whether supervisory responsibilities improve the efficiency of monetary policy implementation. They claim two reasons to expect supervisory information improve economic forecast accuracy and the efficiency of monetary policy. Firstly, problems in banking sector may be a signal of worsening macroeconomic conditions. Secondly, the information may help to notice changes in lending behavior of banks. Their study concerns whether internal forecasts of the Fed incorporate confidential bank supervisory information, whether this supervisory information affects monetary policy and, lastly, whether the Fed should involve in supervisory role directly through a model. They found that supervisory information affects monetary policy, as banking sector worsens, the probability of tightening monetary policy decreases. The evidence shows that the conduct of monetary policy requires full access to supervisory information. This interaction may become more important in developing countries because of the fact that their credit markets are usually bank-centered. They claim that due to the problems in banking sector, many countries are contemplating separation of supervision responsibilities from central bank.

Similarly, Iaoannidou (2005) examines whether monetary policy duties affect the central bank's supervision. If it is the case, how the channel of the effect is, and the analysis is conducted by using the segmented structure of the US bank regulatory and supervisory system. The study uses the Federal Insurance Corporation (FDIC) and the Office of Comptroller of the Currency (OCC), who have also supervisory responsibilities with the Fed, as control groups, and compare the supervisory behavior of the Fed with these two agencies. The paper's analysis is focused on a particular aspect of bank supervision which is the imposition of formal regulatory actions. According to the estimation results, the Fed's monetary policy duties alter its bank

supervisory responsibility. He mentions that causality is one way from monetary policy to supervision. By sensitivity analysis, this paper also examines whether any business cycle indicators affect bank supervision and the result states that indicators of business cycle matter for all the three agents. Moreover, by another robustness check, it is seen that the Fed's behavior cannot be attributed to monetary policy having a greater impact on the particular banks that it supervises.

Masciandro, Quintyn and Taylor (2008) analyze recent trends and determinants of financial supervisory governance. First, they compute the independence and accountability ratings of supervisions for 55 countries in which there are 27 countries that have integrated responsibilities, and 28 countries that have separated responsibilities. By using the degree of supervisory governance as dependent variable, they run three regressions, which take dependent variables as total governance, independence and accountability of supervision. In the regressions, they have an independent variable as central bank effect to control for the impact of the policymaker's decision to have the supervisor inside the central bank. For one regression equation, it tests for the impact of the central bank as supervisor. Another independent variable is integrated supervisor, which concerns the degree of integration of the supervisor-the choice between sector-specific supervisors on one extreme and fully unified supervisors. For another regression equation, it tests the impact of the degree of concentration of supervisory activities.

Their results state that the presence of supervisors in the central bank has a significant and negative impact on governance behaviors, but, more integrated supervisors outside the central bank increase the probability of higher governance ratings. Furthermore, the results for the overall ratings state that neither the role of the central bank as a supervisor nor the degree of unification outside the central bank seems to have an impact on the degree of independence; and, the presence of the central bank has a negative effect

on accountability of supervision, but, if the supervisors located outside the central bank are more unified, accountability of supervision increases.

A recent study is conducted by Eichengreen and Dincer (2011). It is stated that transfer of supervisory authority to a governmental agency separate from the central bank raised the issue of accountability and independence. On the other hand, during the crisis, the central bank's role is to provide emergent liquidity to the banking system, and as being a lender of last resort, the central bank must be involved in supervision of financial system. But, to fulfill the duty to provide emergent liquidity, the central bank should have up-to-date information. To analyze both sides and make a systematic analysis for cross section of countries, they pooled the data according to the structure of bank supervision and used 140 countries from 1998 to 2010. They find that supervisory responsibilities tend to be assigned to the central bank in low-income countries. They also showed that this choice of separation makes a difference in outcomes. For example, countries with independent supervisors have less nonperforming loans as a share of GDP even after controlling for inflation, per capita income and country/year fixed effects. Furthermore, they claim that supervision is often assigned to an independent agency where accountability of government is high.

In addition to separation of supervisory responsibility and monetary policy, the issue of how financial stabilization is conducted is also become important especially after the financial crisis. Regulatory framework was claimed as deficient because of its microprudential structure. The safeguards against financial instability should be strengthened, and the debate is about the channel of the defense. The recent consensus is a move from microprudentials to macroprudentials. According to Ben Bernanke (2008):

"Going forward, a critical question for regulators and supervisors is what their appropriate 'field of vision' should be. Under our current system of safety-and-soundness regulation, supervisors often focus on the financial conditions of individual institutions in isolation. An alternative approach, which

has been called system wide or macroprudential oversight, would broaden the mandate of regulators and supervisors to encompass consideration of potential systemic risks and weaknesses as well."

In the literature, it is claimed that by both supervisory agency and the central bank, important aspects of macroeconomy have been overlooked. The argument about financial system is that systemic risk has not been taken into account as it should be. The regulations conducted for financial stability was microprudentials in which the policy is limited to distress of individual institutions. The ultimate objective of microprudential regulation is consumer (investor/depositor) protection. The risk is taken as exogenous, and correlations and common exposures across institutions are considered to be irrelevant. As a result, the calibration of prudential controls is bottom-up. The idea is that while the banks financing themselves with government-insured deposits and deposit insurance has the effect of preventing runs (Diamond and Dybvig, 1983; Bryant, 1980), it creates an incentive for managers of banks to take excessive risks. The aim of capital regulation is to make banks internalize losses to protect the deposit insurance fund and to eliminate moral hazard. If the level of the probability of the deposit insurer bearing losses is low enough, the microprudential regulation is working. However, there is a critique that when a microprudentially-oriented regulator pushes a troubled bank to restore its capital ratio, the regulator does not care through which channel it is done, either raising new capital or by shrinking assets. If bank chooses to shrink its assets, and if the large fraction of the system is in trouble, similar attempts of many institutions can be damaging for the whole economy. (Borio, 2003)

Before the global financial crisis, systemic risk was insufficiently understood and its importance was underestimated. Its influence on the real economy was also ignored. That is why the emphasis is moving from macroprudential regulation to micro-prudential regulation which failed to ensure that financial institutions had sufficient capital and liquidity to cope with the financial and real sector shocks. The design of the macro-prudential policy is

under attention. The agreement is that the purpose should be to reduce the systemic risk, strengthening the financial system against shocks and to provide stable functioning. However, the questions and debate continues since there is not a consensus exists yet. Firstly, the point is to define the systemic risk. A proposed definition made by the IMF, FSB and BIS is as the following: a risk of disruption to financial services that is caused by an impairment of all parts of the financial system and has the potential to have serious negative consequences for the real economy. Macroprudential policy focuses on the financial market as system-wide. For that reason, it complements the focus of the microprudential policy that is the risk of individual institutions and takes economy as given. It has two main objectives: to strengthen the financial systems resilience to economic downturns, and to limit the build-up of financial risks to reduce the probability and the severity of a bust.

Central banks have the responsibility of financial stability, sometimes implicitly. Macroeconomic stability reduces the financial system vulnerability, and a strong financial system reinforces the monetary policy. In fact, they both need to take into account each others developments and objectives. The significance of each of them on the other depends on the financial conditions, macroeconomic environment and the share of bank-based intermediation. By the coordination of the two authorities, it is expected to gather more moderate cycles. Before the global crisis, the consensus is that the monetary policy should focus on inflation targeting. However, there is an increasing literature that searches the implementation of macroprudential policy while the central bank implements the price stability. The stabilization of the macroeconomic environment requires a successful monetary and macro-prudential policy that the two reinforce each other. The point is to clearly define and differentiate the two objectives not to have conflicts. To implement the two objectives, design of the instrument gains importance. The prudential standards such as high capital requirement and liquidity buffers should be adjusted dynami-

cally to correspond the changing financial environment. Adjustments should be done during boom time when the vulnerabilities are built, and in bust time, when risks of a destabilizing credit contraction are rising. The interaction between financial system and the macroeconomy remains incomplete in the literature. As a result, the exact definition of the systemic risk, the role of macroprudential policy effecting the behavior and interaction also remain imcomplete. Due to changes in banking activities and the structure of the financial system, the transmission mechanism seems to change over time.

In contrast to microprudential regulation, macroprudential regulation takes into account of the financial system as a whole. The proximate objective is to limit financial system wide risk, which is systemic risk, and it is considered as endogenous; for that reason, correlations and common exposures across institutions are important. The ultimate objective is to avoid output (GDP) costs. (Borio, 2003) The macroprudential regulation can be characterized as an effort to control the social costs associated with excessive balance sheet shrinkage in the part of multiple financial institutions hit with a common shock. By macroprudential regulation, the aim is to increase the degree of capitalization of financial intermediaries and reduce the pro-cyclicality of the financial system induced by risk-based capital rules. Since asset shrinkage has primary costs of credit-crunch and fire-sale effects, the macroprudential regulation should counterbalance the two incentives: first, instead of shrinking asset, choosing to recapitalize once a crisis is underway; and secondly, before a crisis occurs, operating with too-thin capital buffers. (Hanson, Kashyap, Stein, 2010)

While the macroprudential tools are discussed, there is a growing recent literature on the countercyclical behaviour of capital requirements which is one type of macroprudential tool. Christensen et al. (2011) analyze a study to conduct the merits of countercyclical bank balance sheet regulation for stabilization of financial an economic cycles, and examines its interaction

with monetary policy. They use bank-capital regulation as macroprudential regulation. They find that countercyclical bank leverage regulation can have desirable stabilization properties, especially when financial shocks are in an important source of fluctuations, but, the appropriate contribution of countercyclical capital requirements to stabilization after a technology shock depends on the size of the externality and on the conduct of monetary policy. Furthermore, they find that strong interactions between monetary policy and bank regulation policy may exist. They claim that the stabilization benefits of countercyclical capital requirements for a standard productivity shock depend on the policy response taken by the monetary authority.

Another study emphasizing the role of macroprudential regulation is of Aikman et al. (2010). They state that drawing on the evidence, some new policy may be needed which (unlike monetary policy) targets bank balance sheets directly but which (unlike microprudential policy) does so systematically. This is macroprudential policy. One important implication of this study is that coordination problem among individual institutions suggests systematic, across the system actions to smooth credit booms and busts. The tools to be used in smoothing can be procyclical capital, liquidity requirements, and remuneration packages.

Glocker and Towbin (2011) build a small open economy model with nominal rigidities, financial fractions and a banking sector that is subject to reserve requirements. They state that if the central bank's responsibility is only price stability and uses the interest rate as its main policy instrument, varying reserve requirements has little effect on economic stability in that case. They find that in an economy without financial frictions and where the central bank pursues a price stability mandate the gains are not as important, but in an economy where financial frictions are present, the central bank has a financial stability objective.

In my research I will consider basically integration and separation of fi-

nancial supervision and monetary policy responsibilities, in which financial regulation is conducted through the channels of macroprudential regulation. Recently, this issue is still debated. Ben Bernanke (2011) states that:

"In practice, the distinction between macroeconomic and financial stability objectives will always be blurred to some extent, given the powerful interactions between financial and economic conditions. For example, monetary policy actions that improve the economic outlook also tend to improve the conditions of financial firms; likewise, actions to support the normal functioning of financial institutions and markets can help achieve the central bank's monetary policy objectives by improving credit flows and enhancing monetary policy transmission. Still, the debate about whether it is possible to dedicate specific policy tools to the macroeconomic and financial stability objectives is a useful one that raises some important practical questions. A leading example is the question of whether monetary policy should 'lean against' movements in asset prices or credit aggregates in an effort to promote financial stability. In my view, the issue is not whether central bankers should ignore possible financial imbalances–they should not–but, rather, what 'the right tool for the job' is to respond to such imbalances.

The evolving consensus, which is by no means settled, is that monetary policy is too blunt a tool to be routinely used to address possible financial imbalances; instead, monetary policy should remain focused on macroeconomic objectives, while more- targeted microprudential and macroprudential tools should be used to address developing risks to financial stability, such as excessive credit growth.. The diverse tools of financial regulation and supervision, together with appropriate monitoring of the financial system, should be, I believe, the first line of defense against the threat of financial instability."

2.2 New arrangements in UK and USA

Recently, Europe, the US and the UK adopted new institutional arrangements in regard to macro-prudential policy.[1] In the US, the Financial Regulation Bill was approved and created a new Financial Stability Oversight Council (FSOC) which is independent from the Fed and headed by the Treasury Secretary (in July 2010). It is claimed to be the most extensive financial service regulation since the Great Depression. The Financial Regulation Bill creates the FSOC, and also, there are other regulations it establishes: a new system for the liquidation of certain financial companies; regulation of derivatives, credit rating agencies and securitization; corporate governance requirements. The FSOC has the duty of monitoring the systemic risks posed by large and complex financial firms, of monitoring international and domestic regulatory proposals, of making recommendation to regulators and the Fed on macro-prudential standards. Furthermore, to use in analysis, it request data from the Office of Financial Research (OFR). In the regulation process, qualified data flow to the policy makers is important and the OFR has the task of it, and provides support to the FSOC in that manner. Although the FSOC is independent from the Fed, the Fed is charged with establishing prudential standards autonomously or at the FSOCs recommendations. In the same period, in the UK, a new Financial Policy Committee within the Bank of England was created with a proposal to maintain financial stability. Since the UK noticed failure of the tripartite regulator system, with the new arrangement, the aim is to have a single authority that holds the responsibility of micro- and macro-prudential policy in its hands, and it is the central bank. The new Financial Stability Committee is created within the Bank of England and independent from the Monetary Policy Committee. However, it ensures that hereafter the monetary policy is aware of the macro-prudential policy. The coordination problem is solved due to the fact that the commit-

[1] Beau, Clerc, Mojon, 2011

tee chair is the Governor of the ECB. The importance of coordination plays a crucial role in the information flow process to consider the two objectives of monetary and macro-prudential policy. Furthermore, the database of the central bank to conduct the monetary policy provides a convenience to implement the macro-prudential policy. The main difference between the US and the UK is the lack of autonomous regulatory tools. In Europe, the European Systemic Risk Board (ESRB) was created by the European Commission independent from the European Central Bank. The FSOC has full authority to control macro-prudential tools, however the ESRB is not provided with full authority, it had the task to provide recommendations, after January 2011, it has the task of identifying and measuring the systemic risk. The Eurosystem and the ECB provides technical, analytical and administrative support to the ESRB. The governors of all EU central banks are present in the Board of the ESRB, and the president of the ECB is the chair of the ESRB, that shows the crucial role of the ECB in the new regulatory framework. It creates an ease of coordination and flow of information between authorities.

2.3 Motivation

The motivation of my research originates in the results of the financial crisis that Turkey experienced in 2001 and the global financial crisis of 2008-2009. After the crisis of 2001, Banking Regulation and Supervision Agency (BRSA) was founded. Proceeding the global crisis experienced at 2008-2009, many academicians and/or politicians claimed that since there is a banking regulatory system, and our financial system was strengthened, the global crisis did not affect our financial system, however, the real indicators of economy was affected. This claim is the starting point of my thesis. Recently, there is an increasing debate that BRSA has not been using its macroprudential tools, for that reason monetary policy is not as efficient as it is expected to be.

My contribution to the existing literature will be in the framework of the separation issue to see the discrepancies of the two different structures of regulatory bodies. With a dynamic stochastic general equilibrium model, in a simple setup of banking sector, my aim is to capture the interaction of macroprudential policy with monetary policy. In line with my motivation, the interest of my study is how the effect of a macroprudential regulation on the real indicators of the economy, especially output, in case of a real shock such as productivity shock, is. Moreover, my extension will be the comparison of the cases for different mix of the macroprudential tool and monetary policy tool, and the analysis of an integrated one policy maker.

CHAPTER 3

MODEL

3.1 Benchmark Models in the Literature

In this section, first, I will briefly introduce four distinct models, then introduce my study's model. First model will be of Angelini et al. (2010)., the second one is of Gerali et al. (2010) which is a benchmark model for Angelini et al.'s study, the third one is of Unsal (2011), and the fourth one is of Aydin and Volkan (2011). As a benchmark model to my paper, I will use Aydin and Volkan's model with some modifications that is appropriate for this research and for the aim of the research. The details of the changes will be given in the preceding part. For the other models, the reason why the part of the model is used, not used or modified will be explained. In fact, I will use the logic of all the models when constructing my model or modifying the benchmark model.

Firstly, the study of Angelini et al. (2010) is described as following.[1] They use a dynamic general equilibrium model of the euro area to answer three main questions: 1. Within a standard macroeconomic framework, how should macroprudential objectives be modelled? 2. How should macroprudential tools/rules be designed? 3. What would be the interaction between

[1]Since the model of Gerali et al.(2010) is a benchmark model for Angelini et al. (2010), the two will not be introduced separately

macroprudential policy and monetary policy? They build on a DSGE model developed by Gerali et al. (2010) that features a banking sector with capital to capture the basic elements of banks' balance sheets. In the model, the economy is populated by entrepreneurs, households and banks. Households consume, work and accumulate housing wealth. There exist two types of households that differ in degree of impatience (discount factor), this gives rise to borrowing and lending in equilibrium. Entrepreneurs produce consumption and investment goods using capital and labor supplied by households. There are two types of one-period financial instruments supplied by banks: saving assets and loans. Borrowers face a collateral constraint which is tied to the value of collateral holdings. Banks set interest rates on deposits and loans to maximize profits, and they face a quadratic cost of deviating from an optimal capital to assets ratio. Different from Gerali et al. (2010) model, they introduce heterogeneity in the creditworthiness of the various economic operators in a reduced form ad hoc way, and risk-sensitive capital requirements, use time varying capital requirements which is fixed at its steady state value in benchmark model. Furthermore, they introduce the objective (loss) functions of the two authorities while introducing the two macroprudential tools.

As macroprudential policy, they use two tools: the first one is countercyclical capital requirements, and the second one is loan-to-value ratio. The macroprudential regulator is interested in stabilizing the loans/GDP ratio and GDP around steady state. Their first exercise is that for given monetary policy, the macroprudential policymaker chooses the parameters of the capital requirement function to minimize the loss function of the macroprudential policymaker. They compare the values of the objective function under a technology shock and a credit crunch shock for both macroprudential policies separately. Instead of comparing the loss function, they check for volatilities of output and the ratio of loans to output, and state that an active management

of capital requirements is more effective than managing the loan-to-value ratio under both types of shocks. However, the loan-to-value policy is relatively more effective in the stabilization of the loans to output ratio, which leads to the conclusion that there is a trade off between stabilization of economic activity and financial stability. It is seen that the variance of inflation and policy rate increase regardless of which type of macroprudential tool is used. This suggests that there might be a conflict between monetary policy and macroprudential policy.

The second exercise is a game setup to see the interaction between monetary policy and macroprudential policy. Firstly, they assume that only one policy maker that have monetary policy and macroprudential policy responsibility, and have the objective of stabilizing the variances of inflation, output, the loans to output ratio, and of the changes in the instruments. In this case, the equilibrium is a cooperative one since there is one authority implementing the two policies. In the game setup, secondly, they assume that the monetary policymaker and the macroprudential policymaker interact a la Nash. Each authority minimizes its own loss function and takes the others policy as given. There are three equilibria found, cooperative and two Nash. There is no significant change in the volatilities of the key macroeconomic variables. However, the variability of the policy rate increases between 14 and 18 times depending on the type of Nash equilibrium, but the variability of the capital requirement can either increase or decrease relative to the cooperative equilibrium. This result suggests that there is a conflict between the two instruments.

To sum their conclusions: the results suggest that macroprudential policies have the power to stabilize the dynamics of the economy. When there is a technology shock, the best result is gathered by the link of capital requirements and output growth through macroprudential policy. In all cases that were analyzed, macroprudential policy attains a reduction in the variability

of output, loans to output ratio and the cost of inflation variability.

In the cooperative equilibrium, the macroprudential policy acts as countercyclical, and results in a modest effect. If they let two authorities to optimize their own objective function independently, two Nash equilibria arise. In the first one, the monetary policy authority is better than macroprudential authority and in the second one the opposite case holds. The Nash equilibria suggest that there is substantial coordination problems that bring suboptimal results.

This model is helpful to identify the functional form of macroprudential policy. However, in the benchmark model of Gerali et al.(2010) Bayesian estimation method is used, and since the agents of the model is detailed beyond the necessity, due to time constraint, I will use the functional form of macroprudential policies and the loss function of two authorities.

The study of Unsal (2011) analyzes the interplay between monetary policy and macroprudential regulations in an open economy DSGE model framework under nominal and real frictions. In this study, a two country sticky price DSGE model is developed with a full specification of trade and financial linkages between two countries. Three important modifications are made: macroprudential measures are introduced into the monetary policy, entrepreneurs are allowed to borrow from domestic and foreign resources, and capital inflows are modelled as a favorable change in the perception of lenders.

The representative household seeks to maximize expected life-time utility subject to the budget constraint. There are three types of firms in the model: production firms, importing firms and competitive firms. Production firms produce a differentiated final consumption good using capital and labor as inputs. Final goods' prices are sticky in terms of the local currency of the markets where they are sold. Importing firms have some market power and face adjustment costs in changing prices. The law of one price does not hold due to price stickiness. Competitive firms combine investment and rented

capital to produce unfinished capital goods that are sold to entrepreneurs. Entrepreneurs produce capital that is rented to production firms and finance investment in capital through internal funds and external borrowing.

There exists a continuum of perfectly competitive financial intermediaries that collect deposits from households and loan the money to entrepreneurs in every period, and receive capital inflows from the rest of the world in the form of foreign loans to domestic entrepreneurs. According to the zero profit condition, the lending rates are equal to the expected value of interest rate times external risk premium on foreign and domestic borrowing. For the introduction of macroprudential policy, the lending rates equation is used. It is claimed that for either type of macroprudential policy tool entails additional costs for financial intermediaries. When macroprudential policy is introduced to the model, the spread between lending rate and policy rate is affected by the risk premium and regulation premium which is defined as a function of the aggregate nominal credit growth.

In the study, the performance of policies are compared under financial and technology shock cases for the following scenarios: Taylor rule, Taylor rule with macroprudential policy, macroprudential policy without monetary policy, optimized Taylor rule with macroprudential policy and Taylor rule with capital controls.

The results of this study suggest that macroprudential policy on capital controls is less effective than broader tools to decrease the effect of the shocks. Also, macroprudential policy tools are not a substitute for a tighter monetary policy and cannot provide the stability of the economy. Furthermore, it is stated that the use of macroprudential policy is supported under large capital inflows which are resulted from a positive shock to investors' perception.

Another study is conducted by Aydin and Volkan (2011). They use small open economy DSGE model, and calibrate it for Korea for the period 2003-2007, with real and financial frictions. This model is based on Bernanke et

al. (1998). The frictions in the model are price stickiness, investment delays, and financial frictions. Financial frictions are captured by explicitly incorporating a housing sector and entrepreneurs, and modelled using financial accelerator framework to capture the amplifying effect of financial shocks on macroeconomy. The economy consists of consumers, homeowners, construction companies, entrepreneurs/wholesale producers, capital producers, retailers, banks as the financial sector, the government and the external sector. Consumers are infinitely-lived risk-averse agents. They work, consume, and save. They save in the form of bank deposits which pay a risk-free interest rate. Homeowners own the entire housing stock. The rental payment received from consumers is their main source of income. They finance their housing investment through a down payment and a one period mortgage loan extended by the bank. Construction companies repair old houses and build new housing stock. Entrepreneurs/wholesale producers manage the production of wholesale goods. Entrepreneurs demand labor simultaneously while their demand for capital is decided one period ahead. Capital producers use the existing capital to produce investment goods. Retailers are monopolistically competitive firms owned by consumers. Banks extend corporate and mortgage loans to the nonfinancial sector by relying on their net worth, consumer deposits, and borrowings from international financial markets. The external sector consists of the economy's trade and the rest of the world.

On the government side, government follow the fiscal rule for a balanced budget, and the monetary policy applies an inflation targeting framework. To compare the benchmark interest rule to alternative inflation targeting rule with financial stability (ITFS), they consider four alternative ITFS rules. First one incorporates nonfinancial sector risk premium into monetary rule. The second one incorporates financial sector risk premium into monetary policy rule. The third alternative rule, they use credit volume under two financial stability considerations: the central bank ensures financial stability

by (i) encouraging credit to nonfinancial private sector, (ii) by discouraging credit. As the fourth rule, they incorporate the volatility in the house prices to the benchmark inflation targeting rule. The simulations they conducted show that a central bank can conduct policy better by incorporating financial stability into its inflation targeting framework, especially if the distortions is form the supply side. This paper incorporates alternative financial stability rules into the inflation targeting framework. In my analysis, it will be guiding for the construction of monetary policy rule when monetary policy authority and financial stability authority is not separated. Since the model much more incorporated into housing sector and analyzes the supply side, I will not use this model as the benchmark model for my research, but update it according to my analysis.

The Benchmark Model

To understand the new strand of policy, the measures of systemic risk and financial instability, and also the policy tools should be defined accurately. From the literature review, it is obvious that the macroprudential policies are important as monetary policy tool contemporaneously. The current consensus highlights the following considerations: policies aim reducing the procyclicality of the financial system are in potential conflict with other policies which also aim smoothing business cycle fluctuations, the closer link between monetary policy and macroprudential regulation increases the transmission of monetary policy target; and, the stated proposals pursue the two objectives of macroprudential regulation without differentiating the two.

In my research my aim is to see the effects of separated or integrated supervision, and monetary policy responsibilities on the social welfare. Following the recent consensus, I assume financial regulation is macroprudential. Firstly, by using a dynamic stochastic general equilibrium model, I will address to the following questions: (i) how should the macroprudential

framework be modelled within a standard framework? (ii) How would be the interaction of monetary policy and macroprudential regulation? In other words, should these two responsibilities separated, in which they cooperate, or integrated for the welfare of the society?

My contribution will be to answer to the problem of coordination of two authorities, and to control and compare for different cases of two regulatory bodies for the macroprudential tool of time-varying capital requirements.

In my research, I will model macroprudential policy tool as Angelini et al. (2010) study and use their definition for the loss functions for each regulatory body. As a subcase (future work) for integrated two regulatory bodies, I will use the general formulation of loss function given as:

$$L = \alpha L^{cb} + (1 - \alpha) L^{mp}$$

in which α denotes the relative weight of the central bank, and $(1-\alpha)$ is of the macroprudential regulator. If is allowed to vary between zero and one, it gives the chance to see its impact on the total loss function. I will analyze for the separated cases in which there also exist a communicative behaviour between two policy makers. The overall loss function that will be used will help to see the overall loss to the society for given different levels of powers of policy makers, for different cases results from different tools implemented by macroprudential regulator.

The model is solved numerically using MATLAB, log linearization is made, the first order approximation and stochastic simulations is gathered using Dynare.

For future work, the model will be simulated for the data of Turkey. Since Turkey is a good example economy to check for the effectiveness of macroprudential policy tools since it has foreign borrowing, and capital flows, it is obvious that the macroprudential regulation is substantially important for the control of the systemic risk. I expect to see a difference in the welfare

loss when the two responsibilities are separated or integrated. The results will also depend on which macroprudential tool is used.

Curdia and Woodford (2009) states that in a simple new Keynesian model with-time varying credit due to financial frictions the optimal target criterion is the same as in the basic New Keynesian model, for that reason, the central bank loss function is defined accurately to capture the stabilization of inflation and output gap. Welfare loss for both policy authorities are defined as the sum of the variables' volatilities from their steady state values. In the standard loss function of the monetary policy authority, there is no mention of macroprudential tool. However, if we regard the two authorities are integrated, the loss function will change as including financial instability.

3.2 Model

3.2.1 Households

Households are infinitely-lived risk averse agents. They work, consume and save. They work for the wholesale goods producers for a wage income, and decide how much of the disposable income to consume and save. They consume tradable goods from domestic and foreign wholesale producers. They save in the form of bank deposits that pay a risk-free interest rate.

Households maximize the life-time utility function:

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \left[ln(C_t - hC_{t-1}) - \frac{1}{1+\chi} L_{c,t}^{1+\chi} \right] \right\} \tag{3.1}$$

with discount factor $0 < \beta < 1$, $\chi > 0$ inverse of the Frisch labor supply elasticity. At time t, consumers supply labor services $L_{c,t}$ at the real wage $W_{c,t}$, consume a composite consumption good C_t, pay lump-sum real taxes T_t to the government, and receive real dividends from banks $\Pi_{b,t}$, save D_{t+1} as real deposits in banks in return of risk-free interest rate. The budget

constraint of households is given by:

$$C_t + \frac{\theta_d}{2}\left(\bar{D} - D_{t+1}\right)^2 = W_{c,t}L_{c,t} - T_t + \Pi_{b,t} + R_{t-1}D_t - D_{t+1} \tag{3.2}$$

C_t is the composite of the tradable consumption goods, the CES index defines household preferences over domestic consumption, $C_{d,t}$, and foreign consumption $C_{f,t}$:

$$C_t = \left[(\gamma)^{\frac{1}{\rho}}(C_{d,t})^{\frac{\rho-1}{\rho}} + (1-\gamma)^{\frac{1}{\rho}}(C_{f,t})^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}} \tag{3.3}$$

where $0 < \rho < 1$ is the intertemporal elasticity of substitution between domestic and foreign final goods, γ is the share of domestic final good in composite consumption good. $C_{d,t}$ is a composite of differentiated products sold by domestically competitive retailers. The corresponding Consumer Price Index (CPI) equation is given by:

$$P_t = \left[(\gamma)(P_{d,t})^{1-\rho} + (1-\gamma)(P_{f,t})^{1-\rho}\right]^{\frac{1}{1-\rho}} \tag{3.4}$$

The demand for domestic relative to foreign final goods by consumers is given as:

$$\frac{C_{d,t}}{C_{f,t}} = \frac{\gamma}{1-\gamma}\left(\frac{P_{d,t}}{P_{f,t}}\right)^{-\rho} \tag{3.5}$$

The household's objective is to maximize their life-time utility subject to the budget constraint. Optimal consumption allocation, labor supply and consumption/saving decision is found as:

$$\lambda_t = (C_t - hC_{t-1})^{-1} - \beta h(C_{t+1} - hC_t)^{-1} \tag{3.6}$$

$$\lambda_t = \beta\lambda_{t+1}R_t(1 - \theta_d(D_{t+1} - \bar{D}))^{-1} \tag{3.7}$$

$$L_{c,t} = (\lambda_t W_{c,t})^{\frac{1}{\chi}} \tag{3.8}$$

where λ_t is the marginal utility of the consumption index.

3.2.2 Real Sector

Entrepreneurs and Wholesale Producers

Entrepreneurs are risk neutral agents who make the production in the economy. They manage wholesale goods production with a finite expected life horizon of $1/(1-\phi_e)$, ϕ_e is the probability that each entrepreneur will survive until next period. The entrepreneurs' population is stationary. To ensure that new entrepreneurs have some funds available when starting out, each entrepreneur is endowed with $L_{e,t}$ units of labor. The entrepreneur starts any period with capital K_t Using labor L_t, which is given as $L_t = L_{e,t}^{(\Omega)} L_{c,t}^{(1-\Omega)}$ and capital services $u_t K_t$, where u_t is the capital utilization rate entrepreneurs produce domestic wholesale output $Y_{w,t}$:

$$Y_{w,t} = \omega_t A_t (u_t K_t)^{\alpha} L_t^{1-\alpha} \tag{3.9}$$

The common productivity shock, A_t, follows an AR(1) process which is common to all entrepreneurs:

$$A_t = A_{t-1}^{\rho_a} exp(\epsilon_{a,t}) \tag{3.10}$$

The idiosyncratic shock, ω_t is assumed to be an i.i.d random variable with $E_t\{\omega_t\} = 1$, and it affects the effective quantity of capital in production of wholesale goods and the production of new goods. In other words, it may be considered as a measure of the quality of his overall capital investment. Let $P_{w,t}$ be the real price of wholesale output, $P_{I,t}$ the replacement price of capital, Q_t the real market price of capital. The entrepreneur's gross project output, $GPY_{w,t}$, is equal to the sum of output revenues, and the market value of the capital stock, net of the cost of repairing the depreciated capital, by definition.

$$GPY_{w,t} = P_{w,t} Y_t + (Q_t - P_{I,t}\delta_t)\omega_t K_t \tag{3.11}$$

The capital depreciation rate is increasing in u_t where utilization is endogenized following Greenwod, Hercowitz and Huffman. Depreciation is increasing in utilization rate and a convex function of it, and defined by[1]:

$$\delta_t = \delta + \frac{b}{1+\xi}(u_t)^{1+\xi} \tag{3.12}$$

where $\delta, b, \xi > 0$. Entrepreneurs' decision problem is to choose labor, capital and capital utilization rate conditional on A_t, ω_t and K_t maximizing the profit as:

$$\max_{u_t, L_t} \left[P_{w,t}Y_{w,t} + (Q_t - P_{I,t}\delta_t)\omega_t K_t - W_t L_t\right] \tag{3.13}$$

The optimal choice of labor, capital and capital utilization rate is:

$$(1-\alpha)(1-\Omega)\frac{Y_{w,t}}{L_{c,t}} = \frac{W_{c,t}}{P_{w,t}} \tag{3.14}$$

$$(1-\alpha)\Omega\frac{Y_{w,t}}{L_{e,t}} = \frac{W_{e,t}}{P_{w,t}} \tag{3.15}$$

$$\alpha\frac{Y_{w,t}}{u_t} = \omega_t \delta_t^{'} K_t \frac{P_{I,t}}{P_{w,t}} \tag{3.16}$$

$$\alpha\frac{Y_{w,t}}{K_{t+1}}P_{w,t} + (Q_{t+1} - P_{I,t+1}\delta_t)\omega_{t+1} = R_{b,t+1}Q_t \tag{3.17}$$

where the optimal capital utilization rate equation states that the marginal value of the output gain from a higher rate of utilization with its marginal cost is equal to a higher rate of capital depreciation. The last equation represents the demand for capital which depends on the marginal real external financing cost and marginal real cost. The marginal return to capital is next period's ex post gross output net of labor costs, normalized by the period t market value of capital. Thus, we can express the expected marginal return as:

$$E_t\left\{R_{b,t+1}\right\} = \frac{\alpha\frac{\bar{Y}_{w,t}}{K_{t+1}}P_{w,t+1} + (Q_{t+1} - P_{I,t+1}\delta_t)}{Q_t} \tag{3.18}$$

[1] as in Baxter and Farr (2005)

where $\bar{Y}_{w,t}$ is the average level of output per entrepreneur such that ($Y_{t+1} = \omega_{t+1}\bar{Y}_{w,t}$). The marginal cost to the entrepreneur depends on the financial conditions,i.e. the comparison of external and internal finance. As in Bernanke, Gertler, Gilchrist (1999)(called as BGG afterwards), assuming a costly state verification problem, the idiosyncratic shock which is private information for entrepreneur is observed by the lender, the banks, only if they pay an auditing cost. That is a fixed proportion μ_b of the entrepreneur's gross project output, thus the auditing cost for the lender will be:

$$M_t = \mu_b R_{b,t+1} Q_t K_{t+1} \tag{3.19}$$

The financial contract between the entrepreneur and the lender satisfies is signed to make: (i) the entrepreneur not to misrepresent earnings, (ii) minimize the expected auditing costs. Following BGG, if the entrepreneur does not default, the lender receives a fixed payment independent of ω_t; if the entrepreneur defaults, the lender gathers the whole earning of the entrepreneur. The external finance is more costly than internal finance since the lender charges a premium to cover the bankruptcy costs. The entrepreneur purchases capital to use in the subsequent period at the end of period t. This purchase is partly financed with the entrepreneur's real net worth, $N_{e,t+1}$, and by borrowing from banks, B_{t+1}:

$$Q_t K_{t+1} = N_{e,t+1} + B_{t+1} \tag{3.20}$$

The external finance premium varies with the entrepreneur's net worth, i.e. if the entrepreneur increases the share of capital, bankruptcy cost decreases and the external finance premium becomes smaller. The external finance premium is the additional return to the bank and is an increasing function of the entrepreneur's leverage ratio:

$$s_t(.) = s\left(\frac{B_{t+1}}{N_{e,t+1}}\right) \tag{3.21}$$
$$s'(.) > 0, s(0) = 0, s(\infty) = \infty$$

By definition, the entrepreneur's overall marginal cost of funds is the product of gross premium for external funds and the real gross opportunity cost of funds that would arise in the absence of capital market frictions. Thus, the following equation provides the basis for the financial accelerator mechanism:

$$E_t\{R_{b,t+1}\} = s_t(.)E_t\{R_{t+1}\} \tag{3.22}$$

If we define the explicit form of the external finance premium:

$$\Psi_{e,t} = \left[1 + \frac{B_{t+1}}{N_{e,t+1}}\right]^{\psi_e} \tag{3.23}$$

Then, eqn. (3.22) becomes:

$$E_t\{R_{b,t+1}\} = \Psi_{e,t}E_t\{R_{t+1}\} \tag{3.24}$$

At the margin, the real return of a unit of capital financed by debt would be equal to its real cost in capital market without frictions compounded by risk premium.

The relation that describes the evolution of the entrepreneurial net worth is another key component of the financial accelerator mechanism. V_t denotes the value of the entrepreneurial firm capital net of borrowing costs carried from the previous period, given as:

$$V_t = R_{b,t}Q_{t-1}K_t - s_{t-1}(.)R_{t-1}B_t \tag{3.25}$$

where $R_{b,t}$ is the real return on capital on capital $s_{t-1}(.)R_{t-1}$ is the cost

of borrowing. The net worth of entrepreneur is the sum of the value of entrepreneurial capital net of borrowing costs carried over from the previous period, and the managerial wage:

$$N_{e,t+1} = \phi_e V_t + W_{e,t} \tag{3.26}$$

or explicitly:

$$N_{e,t+1} = \phi_e \left[R_{b,t} Q_{t-1} K_t - \Psi_{e,t-1} R_{t-1} B_t \right] + W_{e,t} \tag{3.27}$$

From the net worth equation, it is seen that variations in asset price, i.e. Q_t is the main source of fluctuations in $R_{b,t}$, then we can conclude that asset price movements is crucial in the financial accelerator mechanism. Furthermore, unexpected deflation reduces the net worth.

The amount of consumption that is consumed by exiting entrepreneurs is the total amount of equity that is removed from the market, and given as:

$$C_{e,t} = (1 - \phi_e) V_t \tag{3.28}$$

Capital Producers

They engage in repair of the depreciated capital and construction of new capital competitively. Both of these activities take place after the production of the output at time t. Entrepreneurs require $\delta_t K_t$ units of the investment good to repair the depreciated capital. This is purchased at a cost of $P_{I,t} \delta K_t$ which are borne by entrepreneurs who own the capital stock. Investment good, that is used as input in repair and construction activities, is composed of the foreign and domestic final goods:

$$I_t = \left[(\gamma_i)^{\frac{1}{\rho_i}} (I_{d,t})^{\frac{\rho_i - 1}{\rho_i}} + (1 - \gamma_i)^{\frac{1}{\rho_i}} (I_{f,t})^{\frac{\rho_i - 1}{\rho_i}} \right]^{\frac{\rho_i}{\rho_i - 1}} \tag{3.29}$$

The corresponding investment price index will be:

$$P_{I,t} = \left[(\gamma_i)(P_{d,t})^{1-\rho_i} + (1-\gamma_i)(P_{f,t})^{1-\rho_i}\right]^{\frac{1}{1-\rho_i}} \tag{3.30}$$

The intra-temporal optimal consumption allocation gives:

$$\frac{I_{d,t}}{I_{f,t}} = \frac{\gamma_i}{1-\gamma_i}\left(\frac{P_{d,t}}{P_{f,t}}\right)^{-\rho_i} \tag{3.31}$$

The construction of the new capital is constant returns to scale with respect to I_t^n and K_t where I_t^n is the net investment given as:

$$I_t^n = I_t - \delta K_t \tag{3.32}$$

The economy wide new capital accumulation is:

$$K_{t+1} = K_t + \Phi\left(\frac{I_t^n}{K_t}\right)K_t \tag{3.33}$$

where Φ is a constant returns to scale technology consistent with the adjustment costs for net investment, it is increasing and concave. Furthermore, there is no substitution between repaired old capital and new capital.

Capital producers choose inputs I_t^n and K_t to maximize expected profits by the construction of new investment goods. They make their plans to produce new capital one period in advance, following BGG. The optimality conditions are:

$$E_{t-1}\left\{Q_t\Phi'\left(\frac{I_t}{K_t} - \delta_t\right) - P_{I,t}\right\} = 0 \tag{3.34}$$

$$E_{t-1}\left\{Q_t\left[\Phi\frac{I_t^n}{K_t} - \Phi'\left(\frac{I_t^n}{K_t}\right)\frac{I_t^n}{K_t}\right]\right\} = 0 \tag{3.35}$$

Equation (3.34) gives the standard "Q-investment" relation.

Retailers

Monopolistically competitive retailers are owned by the consumers. They buy wholesale goods in a competitive market, differentiate the product at a fixed cost κ, and sell those goods to consumers. The fixed cost is assumed to be proportional to the steady state value of wholesale output such that at the steady state, the retailers' profit is equal to zero. The final domestic good is a CES composite of individual retail goods differentiated by retailer z.

$$Y_{d,t} = \left[\int_0^1 (Y_{d,t}(z))^{\frac{v-1}{v}} dz\right]^{\frac{v}{v-1}} - \kappa \tag{3.36}$$

The price of the composite domestic final good is:

$$P_{d,t} = \left[\int_0^1 (P_{d,t}(z))^{1-v} dz\right]^{\frac{1}{1-v}} \tag{3.37}$$

The isoelastic demand for the differentiated final domestic good is:

$$Y_{d,t}(z) = \left(\frac{P_{d,t}(z)}{P_{d,t}}\right)^{-v} Y_{d,t} \tag{3.38}$$

The households, capital producers, the government and the rest of the world buy final goods from the retailers. The isoelastic demand is gathered as a result of cost minimization.

The retailers set the nominal prices in basis a la Calvo ($Calvo, 1983$). $(1-\theta)$ is the probability that the retailers reset their prices to the optimal independent of time elapsed since the last adjustment. If they do not change the prices, they keep it fixed at the previous period's price. For example, if $\theta = 0.75$ per quarter, on average, the prices are fixed for a year. Let $\bar{P}_{d,t}$ be the optimal price at time t. In the neighborhood of the steady state, the domestic price index evolves as:

$$P_{d,t} = (P_{d,t-1})^{\theta} (\bar{P}_{d,t-1})^{1-\theta} \tag{3.39}$$

The optimal price is:

$$\bar{P}_{d,t} = \mu \prod_{i=0}^{\infty} (P_{w,t+i})^{(1-\beta\theta)(\beta\theta)^i} \tag{3.40}$$

where $\mu = (1 - (1/v))$ is the retailer's gross mark-up over wholesale prices. The retailers reset the prices based on the expected future path of their marginal cost.

For domestically produced goods, the gross inflation rate is:

$$\frac{P_{d,t}}{P_{d,t-1}} = \left(\mu \frac{P_{w,t}}{P_{d,t}}\right)^{\lambda} E_t \left\{ \frac{P_{d,t+1}}{P_{d,t}} \right\}^{\beta} \tag{3.41}$$

where $\lambda = (1-\theta)(1-\beta\theta)/\theta$. This equation is the canonical form of the new optimization-based Phillips curve. [2]

Due to imperfect competition, the price of the foreign goods sold in domestic market has similar pattern. The gross inflation rate for foreign final goods:

$$\frac{P_{f,t}}{P_{f,t-1}} = \left(\mu_f \frac{S_t P^*_{f,t}}{P_{f,t}}\right)^{\lambda_f} E_t \left\{ \frac{P_{f,t+1}}{P_{f,t}} \right\}^{\beta} \tag{3.42}$$

where $\lambda_f = (1-\theta_f)(1-\beta\theta_f)/\theta_f$ The real exchange rate S_t is defined as:

$$S_t = \frac{P_{w,f,t}}{P^*_{f,t}} \tag{3.43}$$

The pricing process implies that temporary deviations form the law of one price due to the delay in the exchange rate pass-through mechanism is captured by the parameter θ_f. In the simulation of the model, $\theta = \theta_f$.

Since CPI inflation is a composite of domestic and foreign good price inflation, it is given by:

$$\frac{P_t}{P_{t-1}} = \left(\frac{P_{d,t}}{P_{d,t-1}}\right)^{\gamma} \left(\frac{P_{f,t}}{P_{f,t-1}}\right)^{1-\gamma} \tag{3.44}$$

[2] see Gali and Gertler, 1999

3.2.3 Financial Sector

The financial sector consists of banks which are risk-neutral, owned by the consumers. The banks' balance sheet consists of the loans to entrepreneurs as assets, and as liabilities, the deposits from the consumers:

$$B_{t+1} = N_{b,t+1} + D_{t+1} \tag{3.45}$$

where D_{t+1} denotes the deposits from the households, B_{t+1} is the loans to entrepreneurs ans $N_{b,t+1}$ is the net equity of the banking sector. The banks obey the balance sheet identity of the form $''loans = deposits + capital''$. Furthermore, I assume that banks have an optimal target for their capital-to-asset ratio, i.e. the inverse of the leverage, and deviation from this target value imposes a quadratic cost to banks. This optimal target value of the capital-to-asset ratio is determined by the macro-prudential regulator. The optimal leverage ratio helps to study the implications of the costs of regulatory capital requirements. In this setup, the bank capital is the key determinant to specify the credit supply. It generates the mechanism between the real and the financial sectors of the economy. For example, when the economy is in the bust period, banks profit and capital might be also hit depending on the nature of the shock. Due to weak financial position, banks may decrease lending which will lead to an increase in the capital-to-asset ratio that deepens the original contraction. It is obvious that real economy shrinkage followed by reduction in bank profits and capital, and credit restriction.

Following BGG, due to the lending contracts, banks assume that the borrowers pay their debt independent of the idiosyncratic shock, thus their expected return from each lending contract will be :

$$R_{b,t+1} B_{t+1} \tag{3.46}$$

Then, the expected profit of the banks is defined as:

$$E_t \{\Pi_{b,t}\} = E_t \{R_{b,t+1} B_{t+1} - R_t D_{t+1} - M_t + \Delta_t - KC_t\} \tag{3.47}$$

where M_t is the total debt monitoring costs defined previously, in other terms, it is the auditing cost assuming a costly state verification problem. Since the lending contracts are designed to minimize the monitoring costs, it is negligible; Δ_t is the deposit transaction receipts and KC_t is the quadratic costs that banks pay whenever the capital-to-asset ratio moves away from the target value of ϑ_t. The quadratic costs is defined as[3]:

$$KC_t = \frac{\kappa_b}{2} \left(\frac{N_{b,t}}{B_t} - \vartheta_t \right)^2 N_{b,t} \tag{3.48}$$

Banks decision problem consists of choosing loans and deposits to maximize expected profits. Accordingly, it is defined as:

$$\max_{B_t, D_t} E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \Lambda_{0,t} \Pi_{b,t} \right\} \tag{3.49}$$

where $\Lambda_{0,t} = \frac{\lambda_t}{\lambda_0}$, and since banks are owned by households, they value future profits by using the discount factor $\Lambda_{0,t}$. Using the balance sheet constraint for time t and $t+1$, the optimization problem of the banks reduces to:

$$\max_{B_t, D_t} R_{b,t} B_t - R_t D_t - \frac{\kappa_b}{2} \left(\frac{N_{b,t}}{B_t} - \vartheta_t \right)^2 N_{b,t} \tag{3.50}$$

The first order conditions are derived as:

$$R_{b,t} - \frac{\kappa_b}{2} \left\{ 2 \left(\frac{B_t - D_t}{B_t} - \vartheta_t \right) \left(\frac{D_t}{B_t^2} (B_t - D_t) \right) + \left(\frac{B_t - D_t}{B_t} - \vartheta_t \right)^2 \right\} = 0 \tag{3.51}$$

[3]Gerali, Neri, Sessa, Signoretti, 2010

$$-R_t-\frac{\kappa_b}{2}\left\{2\left(\frac{B_t-D_t}{B_t}-\vartheta_t\right)\left(\frac{-1}{B_t}\right)(B_t-D_t)+(-1)\left(\frac{B_t-D_t}{B_t}-\vartheta_t\right)^2\right\}=0 \tag{3.52}$$

where R_t is the monetary policy rate, ϑ_t is the optimal capital to assets ratio set by regulator. When the bank wants to extend its loans, thus increases its leverage and its profits. However, if leverage increases, the capital-to-asset ratio falls below ϑ_t and banks pay a cost that they transfer on the interest paid by borrowers. It is assumed that the banks have access to finance at policy rate R_t, for that reason, by arbitrage, the deposit rate is equal to policy rate. Using the last two equations (the FOCs of the banks), the condition that is the spread between the loan rate and deposit rate is delivered as:

$$R_{b,t}=R_t-\kappa_b\left(\frac{N_{b,t}}{B_t}-\vartheta_t\right)\left(\frac{N_{b,t}}{B_t}\right)^2 \tag{3.53}$$

where $(R_{b,t}-R_t)$ represents the marginal benefit from increasing lending, and the second term in the right hand side represents the marginal cost of deviating from ϑ_t. For that reason, banks need to choose the level of loans as to equalize the marginal benefit and cost of reducing the capital-to-asset ratio.

At the end of time t, the net equity in the banking sector is:

$$N_{b,t+1}=R_{b,t}B_t-R_{t-1}D_t-KC_t \tag{3.54}$$

3.2.4 Government

Fiscal Policy

Government has a balanced budget policy that the government expenditures are financed by lump-sum taxes:

$$G_t=T_t \tag{3.55}$$

Also, the government expenditures follows an AR(1) process as:

$$G_t = G_{t-1}^{\rho_g} exp^{\epsilon_{g,t}} \tag{3.56}$$
$$\epsilon_{g,t} \sim N(0, \sigma_g^2)$$

3.2.5 External Balances

The wholesale price of foreign goods and the retail price in the domestic market is differentiated considering the arbitrage in goods market. In the domestic market, imperfect competition and pricing to market exist. At the wholesale level, the law of one price holds. The rest of the world demands for the domestic goods, $C_{d,t}^*$:

$$C_{d,t}^* = \left[\left(\frac{P_{d,t}^*}{P_t^*} \right)^{-\epsilon} Y_t^* \right]^{\eta} (C_{d,t-1}^*)^{1-\eta} \tag{3.57}$$

where $0 \leq \eta \leq 1$, Y_t^* is real foreign output and taken as given. $C_{d,t-1}^*$ represents inertia in foreign demand for domestic outputs. P_t^*, $P_{d,t}^*$, Y_t^* represents the price level in foreign currency, price of domestic good in foreign currency, and the real output produced in the rest of the world, respectively. In steady state, trade is in balance and the term of trade is normalized to unity. The gross foreign real interest rate and the price of the foreign tradable good are taken as exogenous.

3.2.6 Monetary Policy

The central bank adopts the monetary policy that is modelled via a Taylor rule implementing an inflation-targeting framework as:

$$R_t = (R_{t-1})^{\rho_R} (\pi_t)^{\chi_\pi} \left(\frac{Y_t}{\bar{Y}} \right)^{\chi_y} exp(\epsilon_{m,t}) \tag{3.58}$$

where $\epsilon_{m,t} \sim N(0, \sigma_m^2)$ is a pure monetary shock. In the simulations of the model, this rule is called as the simple Taylor rule.

3.2.7 Resource Constraint

For the domestic good sector, the resource constraint is given as:

$$Y_{d,t} = C_{d,t} + C_{e,t} + C_t^* + I_t + G_t \tag{3.59}$$

3.3 Alternative Tools and Policy Experiments

This section discusses the alternative experiments of monetary policy and macroprudential policy to implement for different cases in which they mix, and we can see their welfare implications. For this purpose, the scenarios that are analysed and compared are introduced after the policy alternatives.

Alternative Monetary Policy Tools

Firstly, the central bank follows simple Taylor rule. In that case, the central bank has the following loss function[4]:

$$L^{cb} = \sigma_\pi^2 + k_y \sigma_y^2 \tag{3.60}$$

An alternative Taylor rule is that the central bank implements the following augmented Taylor rule where monetary policy contains credit/GDP ratio to minimize the loss function defined above:

$$R_t = (R_{t-1})^{\rho_R} (\pi_t)^{\chi_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\chi_y} \left(\frac{B_t}{Y_t}\right)^{\chi_b} exp(\epsilon_{m,t}) \tag{3.61}$$

[4]Please note that, in loss functions, σ^2 denotes the asymptotic (unconditional) variances from the steady state values

In that case, the central bank has the loss function as:

$$L^{cb} = \sigma_{\pi}^2 + k_y \sigma_y^2 + k_b \sigma_{b/y}^2 \tag{3.62}$$

Since, in this model, the credit is the borrowings of the entrepreneurs, B_t is taken as the credit in the augmented Taylor rule.

Macroprudential Authority

The macroprudential policy authority has its own objective and defined as[5]:

$$\vartheta_t = (1 - \rho_\vartheta)\bar{\vartheta} + (1 - \rho_\vartheta)\chi_\vartheta X_t + \rho_\vartheta \vartheta_{t-1} \tag{3.63}$$

where as macroprudential tool, capital-to-asset requirement ratio is used, $\bar{\vartheta}$ measures the steady state level of ϑ_t, X_t is a key macroeconomic variable such as output growth, loans growth, with the sensitivity parameter of χ_ϑ. The aim is to see that which one helps in improving the stabilization properties of the capital requirement rule. The loss function of the macroprudential authority is defined as:

$$L^{mp} = \sigma_{b/y}^2 + k_{y,mp} \sigma_y^2 \tag{3.64}$$

The total loss realized by the two authorities is calculated as:

$$L = L^{cb} + L^{mp} \tag{3.65}$$

Policy Experiments

Firstly, for the economy in which the macro-prudential regulator does not exist, the two alternative Taylor rules of the central bank is analysed. The aim of this experiment is to analyse the main indicators of the economy and the loss to the society that if the central bank is responsive to financial instability which is measured by the credit to output growth in the model.

Secondly, I contrast and compare the two economies where the macro-

[5]it is the log-linearized version

prudential authority exist and does not exist. For the one that the central bank is the only regulator, she implements the simple Taylor rule. When the two authorities exist, the macro-prudential authority has its own objective function as regulating the banks' capital-to-asset ratio. This experiment is beneficial to see if there is a need for macro-prudential regulation or not. In the case of two regulatory bodies, the loss functions are calculated separately for each, then summed.

For the third experiment, in one economy, only the central bank exists and implements the augmented Taylor rule; in the second one, both regulators exist, the central bank implements simple Taylor rule. This experiment would be helpful to see which one is better: one regulator considering financial stability without macro-prudential tool or two regulators that each considers different objectives of price stability and financial stability.

The fourth one is similar to the previous one, however, now the central bank implements the augmented Taylor rule when there are two regulatory bodies. This experiment would be helpful to see if there is a further cooperative action for the financial instability regulation, that the two regulatory bodies are integrated or coordinated.

For the fifth experiment the two cases are compared: two regulatory bodies exist, the central bank implements simple Taylor rule and separate macro-prudential authority exists; the other one is designed as two regulatory bodies exist, but the central bank implements the augmented Taylor rule. This experiment shows more explicitly that whether the two regulatory bodies should be separated or integrated. When the two regulatory bodies exist and considers the financial stability, observation of the two are separated or integrated is not straight forward, but as loss function, the loss function is the sum of the two authorities' loss function.

For the sixth experiment, Taylor rule without output gap is considered and analysed for different cases. Since the output volatility is also considered

as a financial instability indicator, this gives idea about the responsibility of the central bank in terms of financial stability. It is a compare and contrast analysis of Taylor rule for given macro-prudential regulation. In that scenario, there exist a sequencing in the decision making process of the two regulatory bodies. The reason can be supported as macroprudential decisions are taken with lower frequency. Furthermore, the symmetric analysis is conducted for macro-prudential policy. For given simple Taylor rule, macro-prudential policy tool is checked without output gap and loan to output growth. The justification of that scenario can be that since the macroprudential policy maker is less active, first monetary policy authority sets monetary policy rule and then macroprudential authority sets the macroprudential tool as taking the monetary policy given.

As another case, the parameters ρ_ϑ and χ_ϑ of macro-prudential tool is checked for different values for the sensitivity analysis.

Lastly, the monetary policy tool and macroprudential tool is changed as the two regulatory bodies are taking each other's tool into consideration. Then the tools is changed as[6]:

$$R_t = \rho_R(R_{t-1}) + \chi_\pi(\pi_t) + \chi_y\left(Y_t - \bar{Y}\right) + \chi_\vartheta \vartheta_t + \epsilon_{m,t} \tag{3.66}$$

$$\vartheta_t = (1-\rho_\vartheta)\bar{\vartheta} + (1-\rho_\vartheta)\chi_\vartheta X_t + \rho_\vartheta \vartheta_{t-1} + \chi_{\vartheta,r} R_t \tag{3.67}$$

I call this case as integrated two regulatory bodies, however, in this context of model, it is not obvious to see the two are separated or integrated since they both take each other's tool into consideration when they are also separate.

[6]in log-linearized terms

3.4 Results

Results of the Policy Experiments

Before proceeding into analysis through different experiments via different cases, it would be beneficial to recall the channels that monetary policy and macro-prudential policy affect the economy. Monetary policy affect, firstly, the cost of borrowing for entrepreneurs and, secondly, the return on households deposits. Through the first channel, it affects the investment decision of entrepreneurs; and through the second channel, it influences consumption and saving decision of households that do not borrow from banks and hold deposits, respectively. Macro-prudential policy affects the costs of banks capital position, and, for that reason, it affects the cost for entrepreneurs borrowing from banks. Macro-prudential policy has no direct influence on the deposit rate.

To see the effect of the macro-prudential policy implemented to the system, I will compare and contrast different cases: (1) simple Taylor rule versus augmented Taylor rule, (2) simple Taylor rule versus simple Taylor rule and independent time varying macro-prudential policy, (3) augmented Taylor rule versus simple Taylor rule and independent time varying macro-prudential policy, (4) augmented Taylor rule versus augmented Taylor rule and independent time varying macro-prudential policy, (5) simple Taylor rule and independent time varying macro-prudential policy versus augmented Taylor rule and independent time varying macro-prudential policy, (6) simple Taylor rule without considering output gap and independent time varying macro-prudential policy versus simple Taylor rule and independent time varying macro-prudential policy, (7) sensitivity analysis for the time varying macro-prudential tool by changing the variable parameters, (8) integrated two regulatory tools. Analysis is done through the loss calculated by unconditional variances and the impulse response function (IRF) graphs of key variables.

For the first experiment, there is only one regulator, the central bank,

implementing the Taylor rule. It compares the simple Taylor rule and the augmented Taylor rule. This experiment is conducted to see if there is a remarkable change when the central bank takes the credit growth into consideration or not. When a monetary shock hits to the economy, the effect on output dies faster under simple Taylor rule. It is the case for all other key variables such as investment, inflation, real interest rate. It also holds for the borrowings of entrepreneurs. However, when we compare the unconditional variances, the variance of output and inflation increases. It may be due to the fact that there is a conflict arises between the objectives of the central bank. The variance of the borrowings decreases since it takes the credit (borrowings of entrepreneurs in the model) into account. Under technology shock and a shock to the government expenditure, the results are the same, the effect of the shock on the variables dies faster in the simple Taylor rule, but the borrowings respond lasts more. Furthermore, the net worth (capital) of the banks, and the entrepreneurs, and the external finance premium respond more smoothly under technology shock. Moreover, for the Taylor rule specification, I checked that whether the Taylor rule should contain the lag of policy rate or not, the one that contains the lag of the policy rate gave smoother IRFs. For that reason, it is chosen in the analyses.

In the second experiment, there are two regulatory bodies in the economy, the central bank conducting simple Taylor rule and the macro-prudential policy maker issues time-varying capital requirement ratio. Surprisingly, there is no significant difference between the two, however, it does not mean there is no need for macro-prudential regulatory body. It may imply that independent two regulatory bodies do not provide any improvement in the welfare. For that reason, further analysis is needed.

In the third experiment, in one case, the augmented Taylor rule is implemented by one regulator considering both price stability and financial stability; for the other case in which two regulatory bodies exist, the simple

Taylor rule is implemented by the central bank and the time varying macro-prudential policy by the macro-prudential regulator. When we compare the two cases, output is more volatile and the effect of monetary shock on output dies more slowly in the case of one regulator. All other key variables respond to monetary shock in the same manner except the borrowings. In response to a monetary shock, borrowings respond more volatile in the case of two separate regulators, and turns to initial value more slowly. Under the technology shock and government expenditure shock, the results from the IRFs are the same except that the deposits are a bit more responsive, and although the credit responds more, it turns back to its initial value faster in the case of two regulatory bodies. This experiment gives idea about the fact that the two regulatory bodies should be separated and independent of each other if we consider the output gap as instability indicator. However, the borrowings is less volatile in the case of one regulator, but since the difference of responsiveness and the volatility do not differ significantly, from this experiment we can conclude that the two regulatory bodies should be separate.

As a fourth experiment, in one case, there exist one regulator implementing the augmented Taylor rule, and in the other case, there are two regulatory bodies implementing the augmented Taylor rule and a time-varying macro-prudential policy where dependence exist between the regulatory bodies since both of them takes credit into account. In that experiment, when the IRFs of the key variables are compared, there is not an explicit difference between the two cases; however, the difference arises in the variances. The variance of output, inflation and credit increase, and in percentage, the credit increases the most in the case that the two authorities exist and cares financial stability. This experiment may show that there might emerge coordination problems between the two regulatory bodies.

For the fifth experiment, under both cases, the two regulatory bodies exist. The only difference is in the structure of the Taylor rule, in one case, the

central bank implements simple Taylor rule and, in the other, the augmented Taylor rule. If a monetary shock hits the economy, except the credit, all key variables are more responsive and have higher volatilities, output responds to technology shock more cyclically, however, the credit seems to be more controllable. If we compute the loss to overall economy, we can see that although the variance of output, inflation and monetary policy rate increased, the decrease in the variance of the credit compensates, and the overall loss to the economy decreases significantly in the case that the central bank implements augmented Taylor rule. At this point, the important thing is the weights of variables in the loss function. This experiment gives idea about the independence of macro-prudential policy. Since the loss decreases when the central bank do not take the credit to output ratio into consideration, it may imply that the macro-prudential policy maker should be independent from the central bank; or the result might be implying the coordination problems between the two bodies, so a solution for coordination problem should be searched. Also, if the central bank implements the augmented Taylor rule, it is seen that the response and volatility of inflation increases which suggests that conflict of interests for the central bank arises.

For the sixth experiment, given macro-prudential policy, another version of Taylor rule is checked; it is simplified version of simple Taylor rule that does not considers output growth, which is also seen as financial stability indicator. Moreover, as a similar experiment, for given monetary policy different structures of macro-prudential policy is analysed, i.e. extracting the output growth and credit to output ratio, the rule is simulated. For the first subcase, given macro-prudential policy, if the output growth is extracted from monetary policy, by the analysis of IRFs, it is seen that under a monetary policy rate shock, the impulse of key variables such as output, investment, consumption increases whereas the IRFs of the two cases have similar patterns apart from the responsiveness. The capital and the inflation rate is less

volatile and respond to shock more smoothly. Less volatile inflation rate is an expected result since without output gap, the only objective of the central bank becomes the price stability. When there is technology shock, the similar results are gathered, but, monetary policy rate, real interest rate and inflation has smoother IRFs and the effect of the shocks die faster than the case where Taylor rule with output growth is implemented.

As the second subcase, for given monetary policy, the changes in the macro-prudential policy are analyzed. When the output growth and credit growth is removed from the macro-prudential policy rule, there is not a significant difference between the impulses, the only change is the impulse of macro-prudential tool as expected. The unconditional variances of key variables are almost the same as the case where both of them are included to the macro-prudential policy tool.

Another experiment is that the two regulatory tools are affecting each other. If we call it as integrated case, the IRFs claims that under monetary shock, the loans volatility increases, but under a technology shock, the respond of the monetary policy tool rate decreases and smoother inflation is gathered.

The last experiment is the sensitivity analysis of the macro-prudential tool. The analysis is done by changing the parameters of output growth, loan growth and the parameter that enters into the cost of banks (κ_b). When the parameter of output growth (χ_ϑ) is increased so much, the volatility of output decreases parallel to the increase in the sensitivity parameter as expected. However, the volatility of the macro-prudential tool increases in the same manner. The change in the lag of the macro-prudential tool (ρ_{mp}) creates a change in the variance of macro-prudential tool, if it decreases, the variance of it increases. However, there is no considerable change in the unconditional variances and the impulses of the key variables.

Under sensitivity analysis, the change of the κ_b creates more significant

changes than any other parameter change. Since it is the parameter of the channel that macro-prudential policy tool affects directly the economy. When the value of the kappa increases, the loss of the economy increases and almost all the key variables are more impulsive including output; however, if the value of the kappa decreases the loss to the society decreases.

With different experiments, in total, mainly the following cases is checked: (i) simple Taylor rule, (ii) augmented Taylor rule, (iii) simple Taylor rule and time-varying macroprudential tool, (iv) augmented Taylor rule and time-varying macroprudential tool, (v) integrated tools. To sum up, with the help of different experiment analyses and the IRFs, it is seen that in the content of a DSGE model that I used, the separation and integration of the two authorities is cannot be explicitly identified since the legal basis of such an arrangement cannot be made in such a DSGE setup for my model. However, we can make some comments related to the two tools of financial stability and price stability. In case of no separate macroprudential tool, the central bank should implement augmented Taylor rule, meaning she should take the financial stability responsibility into consideration. When the two tools are used, it is seen that, the central bank should implement the augmented Taylor rule and there should be a separate macroprudential regulation tool.

Mainly, if we make the concluding analyses through loss function calculations, different values of the parameters of output growth and loan to output ratio (k_y, $k_{y,mp}$) are checked. The aim is to minimize the sum of losses since I assume that the financial stability and price stability has same weights for the total loss. The minimum loss is gathered when there is one regulator, the central bank, implementing augmented Taylor rule. The results are the same when the weight of the output growth is increased in the loss function of central bank for given parameters of the loss function of the macroprudential authority. Also, for given parameters of the central bank loss function, if we change the weight of output growth in the loss function of the macropruden-

tial authority, the result remains the same. The second best is the one that there exist two regulatory authorities and the central bank implements augmented Taylor rule. Furthermore, it is seen that for higher weight of output growth in central bank loss function, the difference between one regulator implementing Taylor rule and two regulators implementing separate tools decreases, and the two become closer. Moreover, the integrated tools case is a second best only if the central bank has output in its loss function but the macroprudential regulator has only loan to output growth.

For further analysis of future work, when the two authorities considers financial stability, the following loss function should be simulated:

$$L = \alpha L^{cb} + (1 - \alpha) L^{mp} \tag{3.68}$$

where α can affect the overall welfare and gives an intuition about the relative importance of price stability with respect to financial stability.

CHAPTER 4

CONCLUSION

There is an increasing debate about the structure of financial stability and price stability responsibilities. This paper examines the role of the central bank implementing different Taylor rules and the role of a macroprudential authority implementing the time-varying capital requirement. Different scenarios for different policy rules and mix of two regulatory bodies are compared and contrasted.

The analyses of different cases is done through the impulse response functions of main indicators and the loss function of the two authorities. There are three types of shocks in the model: monetary shock, technology shock and government expenditure shock. I made the comparison for all type of shocks. However, my main interest is the real shocks to see the mechanism that by a real shock, the macroprudential tool is affected, then in turn, it affects the balance sheet of the banks, but, my aim is to see an effect on the real indicators of the macroeconomy to capture the channel between financial sector and real sector. The results was as I expected. In the case of a positive technology shock, an upturn of the economy, the banks increase loans to entrepreneurs, and the bank capital also increases more than loans which is the result that we want since the macroprudential tool aims capitalization of banks in an upturn of the economy. Furthermore, the return to initial values

are faster in the case of a macroprudential tool.

When I compare one regulator implementing simple Taylor rule and two regulators implementing separate tools, there is not an explicit difference monitored with the help of impulse response functions. It might be the result of the sensitivity parameter that the macroprudential tool affects the economy. However, with further analysis, according to the impulse response function graphs, it is obvious that the best results are gathered when the central bank takes the loan to output growth into consideration, in other terms it implies that the central bank should take the financial stability into consideration.

When we compare the cases that one regulator implementing augmented Taylor rule and two regulatory bodies, the results states that one regulator case has more stable outcomes for the main indicators of the economy. The result implies conflict of interest arises in the case of two stability tools. However, there is not an explicit difference when I compare the loss functions.

The price stability and financial stability may seem running a horse race among each other, however, the two reinforces each other for the stability of the economy as a whole. The results implies the requirement of financial stability considerations. In case of a separate time-varying macroprudential tool, the central bank also takes financial stability into consideration.

Further and future work involves changing the weight of each regulatory body in the total loss function. Moreover, after extending the model that fits more to the real economy, the model will be calibrated for Turkey. Another future work involves the empirical study to see whether the macroprudential policy creates such an effect emphasized in theory as in the literature.

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APPENDICES

4.1 Appendix A-Table of Parameters

Table 4.1: Parameters

Symbol	Value	Description
β	0.99	discount factor of consumers
h	0.5	habit persistence parameter
ρ	1.1	consumption intra-temporal elasticity of substitution
χ	0.5	inverse of the Frisch labor supply elasticity
γ	0.5	share of domestic goods in composite consumption good
ϕ_e	0.9728	entrepreneur's average survival rate
Ω	0.01	share of entrepreneurial labor
α	0.5	share of capital in production function
ρ_a	0.9	AR(1) coefficient for technology process
δ	0.0125	parameter in the functional form of the capital depreciation rate
$\delta(u)$	0.025	steady state depreciation rate of capital
b	0.025	parameter in the functional form of the capital depreciation rate
ξ	1	elasticity of marginal depreciation with respect to utilization rate
u	1.0	steady-state capital utilization rate
μ	1.2	steady-state mark-up
η	0.25	$(1-\eta)$ is weight of inertia in export demand
ϵ	1	elasticity of export demand
γ_i	0.5	share of domestic goods in investment
ρ_i	0.25	intra-temporal elasticity of substitution of investment
θ	0.75	probability of fixing prices in domestic final goods market
θ_f	0.75	probability of fixing prices in foreign final goods market
ρ_g	0.95	AR(1) coefficient for government expenditure process
ρ_R	0.77	interest rate smoothing factor
χ_π	2	Taylor rule coefficient on inflation
χ_y	0.75	Taylor rule coefficient on output
χ_b	0.75	Taylor rule coefficient on credit to output ratio
ρ_ϑ	0.9990	macroprudential tool smoothing factor
$\chi_{\vartheta,y}$	1.9779	sensitivity parameter of output growth in macroprudential tool
$\chi_{\vartheta,b}$	2.05	sensitivity parameter of credit growth in macroprudential tool

4.2 Appendix B-Table of Unconditional Variances

Unconditional variances for output, inflation and loan growth under different policy experiments[7]

Table 4.2: Unconditional variances

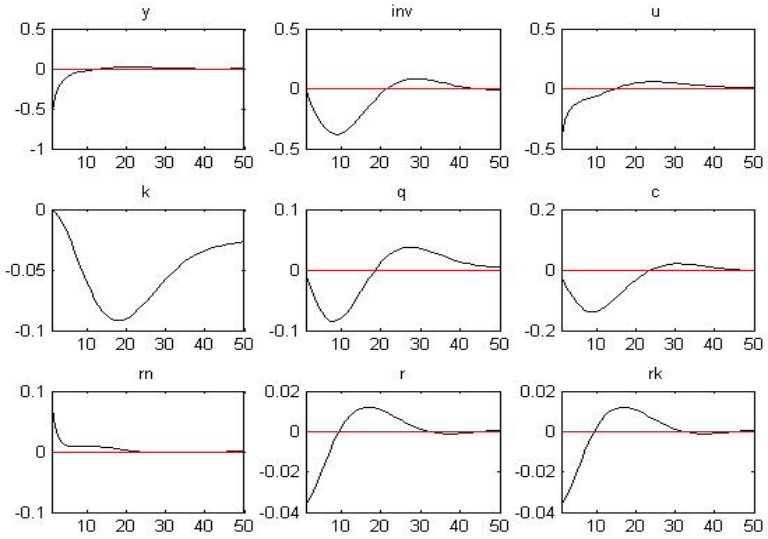
Symbol	Value	Description			
	sTR	aTR	sTRmp	aTRmp	integrated
$outputgrowth$	0.343297	0.40657	0.346894	0.416674	0.470406
$inflation$	0.081311	0.120195	0.081608	0.12219	0.122964
$loangrowth$	0.825237	0.274008	0.853658	0.288594	0.691621

[7]sTR represents simple Taylor rule, aTR represents augmented Taylor rule, sTRmp represents simple Taylor rule and macroprudential tool, aTRmp represents augmented Taylor rule and macroprudential tool

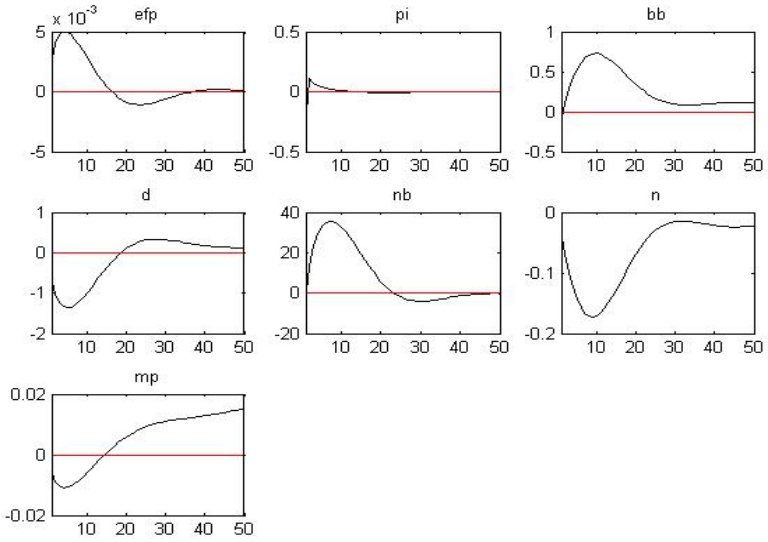
4.3 Appendix C-Impulse Response Function Graphs

Two regulators: the central bank implementing the simple Taylor rule, and separate time-varying macroprudential tool

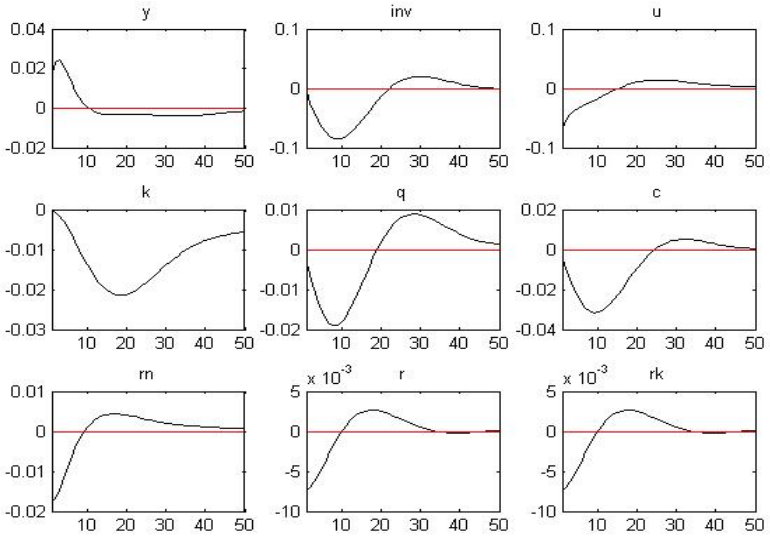
Orthagonolized monetary shock



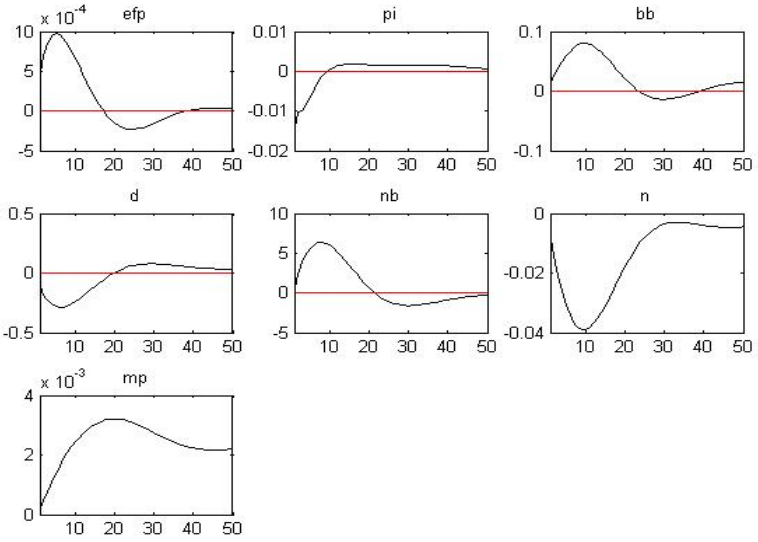
Orthagonolized monetary shock



Orthagonolized technology shock

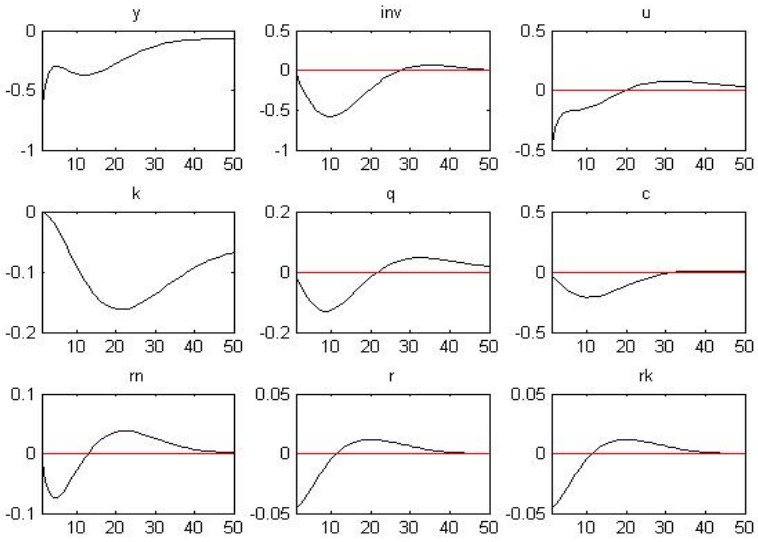


Orthagonolized technology shock

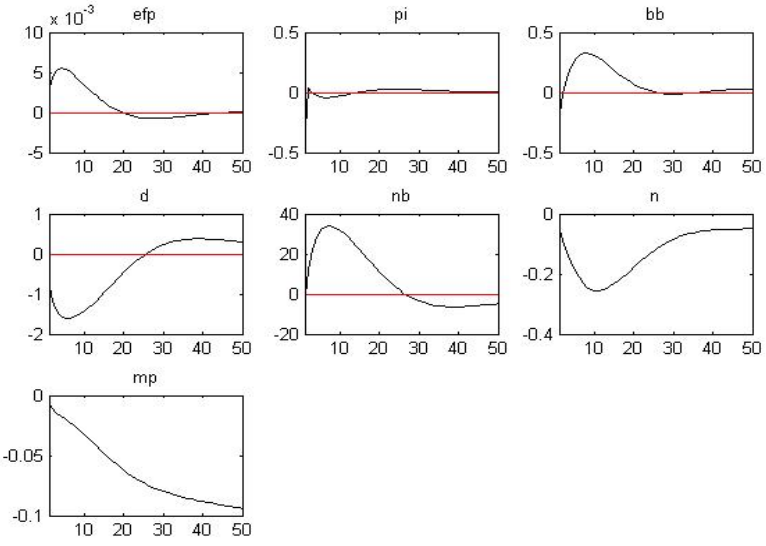


Two regulators: the central bank implementing the augmented Taylor rule and separate time-varying macroprudential tool

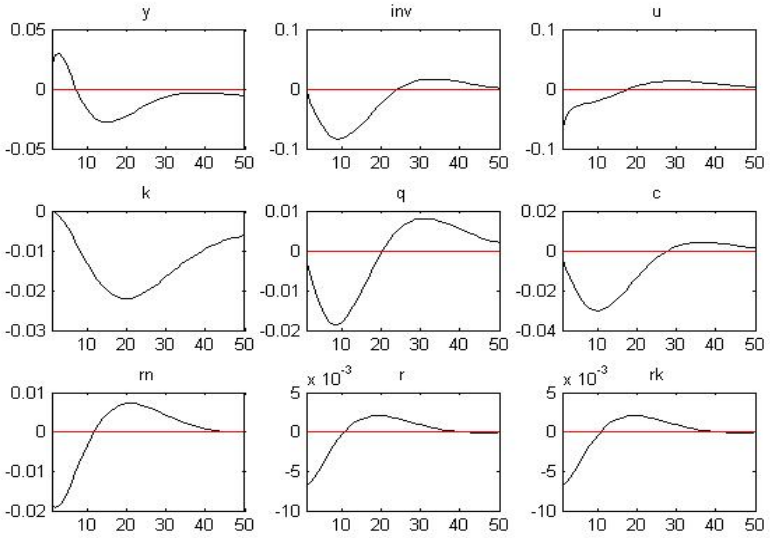
Orthagonolized monetary shock



Orthagonolized monetary shock



Orthagonolized technology shock



Orthagonolized technology shock