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OPTIMAL MONETARY POLICY FOR ENSURING FINANCIAL STABILITY

A MASTER'S THESIS

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ABBREVIATIONS

BCT **:** Banque Centrale Turque

BIS **:** Bank for International Settlements

BRSA **:** Banking Regulation and Supervision Agency

CBT **:** Central Bank of Turkish Republic

DSGE **:** Dynamic Stochastic General Equilibrium

ECB **:** European Central Bank

FX **:** Foreign Exchange

GDP **:** Gross Domestic Product

ISE **:** Istanbul Stock Exchange

MPC **:** Monetary Policy Committee

NK **:** New Keynesian

RBC **:** Real Business Cycle

ROM **:** Reserve Option Mechanism

TCMB **:** Türkiye Cumhuriyeti Merkez Bankası

TurkStat **:** Turkish Statistical Institute

LIST OF SYMBOLS

x_t	: The output gap
Φ	: The intertemporal elasticity of substitution
i_t	: Nominal interest rate
$E_t \pi_{t+1}$	: Expected inflation level
$E_t x_{t+1}$	: Expected output gap
g_t	: Expected changes in government purchases relative to expected changes in potential output.
ΔQ_t	: Change in the exchange rate
L_t	: Financial stability gap
π_t	: Inflation level
γ_t	: Cost push shock
k_t	: Credit gap
L_{t+1}	: Expected financial stability
υ_t	: Financial shock
τ	: Weight of credit channel
ξ	: Weight of exchange rate channel
$\bar{r}$	: World real interest rate
r	: Turkish real interest rate
$E\Delta Q_{t+1}$	: Expected change in exchange rate
s^j	: The subjective discount factor
α_1	: The weight CBT attaches to the output
α_2	: The weight CBT attaches to the financial stability
L_t^*	: Optimal financial stability gap
π_t^*	: Optimal inflation level
x_t^*	: Optimal output gap

i_t^* : Optimal interest rate

θ : The coefficient of financial stability variable in IS equation

β : The coefficient of expected inflation in Philips equation

λ : The coefficient of output gap in Philips equation

ρ_g : The persistency of public spending shock

ρ_γ : The persistency of cost push shock

ρ_v : The persistency of financial shock

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RÈSUMÈ

En 2008, l'économie globale a connu la plus profonde crise depuis la Grande Dépression de 1929. Pour réduire les effets destructeurs et faciliter la sortie, presque toutes les banques centrales ont pris des précautions de manière coordonnée. Ces précautions ont été prises surtout par les banques centrales des pays développés en fournissant des niveaux extraordinaires de liquidité aux marchés. Par exemple, du point de vue de plusieurs observateurs, les actions politiques extraordinaires de la Réserve Fédérale ont réduit la profondeur et la durée de la récession pendant la crise récente (Rudebusch, 2009). Afin de lutter contre la panique et le bouleversement dans les marchés financiers, la Fed a fourni un énorme montant de liquidité. Au début de 2008, le bilan de la Fed a été $926 milliards; son bilan avait atteint $2,9 trillions. Pour atténuer les dépenses et le chômage, elle a réduit le taux d'intérêt des fonds fédéraux – son instrument habituel de la politique – presque aux limites de zéro. Afin de fournir des mesures de relance monétaire supplémentaires, la Fed s'est tournée vers un outil de politique non conventionnel – des achats de titres à long terme qui ont conduit à une énorme expansion de son bilan. Cependant, toute sorte d'outils de politique monétaire a été utilisée pendant la période de crise, sans aucune hésitation des risques possibles sur les bilans des banques. Cette période a aussi conduit à un déficit budgétaire gouvernemental plus élevé à cause de vastes programmes de soutien financier. Pourtant, l'exécution des politiques monétaires exceptionnellement accommodantes et des politiques fiscales expansionnistes pour une période prolongée peut entraîner de nouvelles distorsions économiques potentielles, comme le risque d'inflation, qui pourraient devenir très couteuses à contrôler à l'avenir.

Pour cette raison, sous la lumière des crises, « les stratégies de sortie » devient une des questions les plus chaudes des politiques monétaires. Les discussions sur les macro-mesures prudentielles et sur les opérations de normalisation des politiques monétaires ont commencé dans ce cadre. Pour réduire les effets destructeurs et

faciliter la sortie, presque toutes les banques centrales ont pris des précautions de manière coordonnée. Ces précautions ont été prises surtout par les banques centrales des pays développés. C'est pourquoi les banques centrales ont introduit « des mesures de politique monétaire non-conventionnelles » pour la gestion de la crise économique et financière qui s'est matérialisée à la suite de l'éclatement de la bulle du crédit globale. Le reflet de ceci est l'idée que toutes les banques centrales doivent attacher plus d'importance à la stabilité financière et cette idée a progressivement devenu un sujet de discussion dans les plateformes internationales comme G-20.

L'approche de la politique monétaire non-conventionnelle a émergé après la vue changeante de la banque centrale dans la période post-crise. Cette approche provient de l'idée qu'en se concentrant sur la stabilité des prix, les banques centrales ne doivent pas négliger les risques s'accumulant dans le système financier et les bulles dans les prix des actifs. En plus, les études favorables à l'exécution des macro-politiques prudentielles par des objectifs de la prévention de la crise ont commencé à occuper l'agenda de la littérature économique récente de plus en plus sur le plan académique (Bianchi and Mendoza 2011, Jeanne and Korinek 2010). Dans ce cadre, le besoin d'une politique monétaire adaptée au contexte de crise a changé l'approche à la fois des politiques économiques et de la banque centrale. Le résultat final des crises globales et des politiques exécutées par les économies avancées ainsi que les déséquilibres globales actuelles a entraîné des dynamiques particulières dans l'économie globale. Les inquiétudes financières soulevées surtout après les crises globales montrent que les mécanismes conventionnels de transmission monétaire des économies avancées ne sont pas suffisants pour repérer les déséquilibres des marchés financiers. Les effets négatifs de la crise financière ont augmenté l'urgence d'adapter la politique monétaire classique, ils ont donné lieu aux quêtes alternatives et ils ont motivé à questionner les rôles des banques centrales sur le sujet de la stabilité financière. Il est devenu évident que toute autorité de politique monétaire visant à la fois la stabilité de prix et la stabilité financière a besoin d'outils de politique monétaire supplémentaires ainsi que le taux d'intérêt politique à cause du compromis entre le prix et la stabilité financière. La BCRT (la Banque Centrale de la République Turque) qui vise la stabilité de prix et la stabilité financière, a ajusté son cadre de politique monétaire. Afin d'atteindre à la fois la stabilité de prix et la stabilité financière, la BCRT a diversifié ses outils de politique comme le corridor du taux

d'intérêt entre les emprunts et les prêts à un jour, les politiques de liquidité et les réserves obligatoires ainsi que les taux directeurs à court terme.

L'usage de l'inflation redessinée visant le cadre de la politique monétaire pour prévenir les crises financières et pour assurer la stabilité financière avec l'aide de macro-mesures prudentielles a acquis une position dominante dans la littérature économique récente (Bailliu et. al. 2012, Woodford 2011, Ünsal 2011). Cependant, la définition de la stabilité financière est un concept controversé en ce qui concerne la façon dont elle peut être mesurée ou avec quels indicateurs elle peut être représentée. Dans la littérature, le cadre théorique qui intègre la stabilité financière identifie essentiellement trois sources de stabilité financière : Premièrement, les problèmes financiers peuvent provenir du secteur bancaire (le ratio de levier financier, les flux de crédit globales, etc. voir par exemple Gertler and Karadi, 2011; Bailliu et al., 2012). Un autre courant des travaux sur la stabilité financière (voir par exemple Baudocco, Bulir and Cihak, 2011) assume que les problèmes financiers proviennent du secteur non-bancaire (la solvabilité des ménages, l'utilité marginale des revenus, etc.). Un troisième type de travaux définissent la stabilité financière provenant à la fois du secteur bancaire et du secteur non-bancaire (voir par exemple Woodford, 2011; Aydın et al. 2011). De l'autre côté, du point de vue de Schinasi (2004), il n'y a pas une seule variable qui peut être le signal exact sur la performance du système financier. Il définit la stabilité comme un indicateur du système financier pour faciliter l'allocation des ressources, évaluer, fixer le prix, allouer, gérer les risques financiers et pour maintenir sa capacité à effectuer les fonctions-clé.

La stabilité financière est traditionnellement considérée comme l'objective de la macro politique prudentielle quand la stabilité de prix est vue comme l'objective de la politique monétaire. Par conséquent, après la crise financière globale, le défi clé pour les banques centrales est d'atteindre en simultanéité la stabilité de prix et la stabilité financière (Granville and Mallick, 2009). Pour modéliser la politique monétaire ajustée de la BCRT après la crise financière globale, nous suivons une approche qui suggère la combinaison de l'exécution de la politique monétaire avec celle des macro-outils prudentiels.

Afin de clarifier la position de notre modèle dans la littérature, nous analysons plusieurs contributions récentes sur la politique monétaire optimale sous la stabilité financière des économies fermées ou ouvertes dans le cadre de différentes définitions

de la stabilité financière que nous avons déjà mentionnées au-dessus. Suite à la littérature précédente, un modèle simple peut nous aider à clarifier la manière selon laquelle un régime visant l'inflation peut être modifié pour intégrer les inquiétudes pour les effets des décisions de la politique monétaire sur la stabilité financière. Comme Curdia and Woodford (2010), Del Negro et al. (2010) ou Gertler and Karadi (2011), l'intermédiation financière est traitée comme purement exogène dans le document présent.

Le modèle a le but de capter la conception récente de la politique monétaire qui a une portée plus vaste parce qu'il considère une stratégie visant l'inflation qui englobe la stabilité financière. Cette nouvelle conception de la politique monétaire est une sorte de l'exécution de la politique mixte désignée par la Banque Centrale de la République Turque (BCRT). Afin de construire notre cadre, nous utilisons un micro-fondé modèle stochastique dynamique d'équilibre général basé sur la nouvelle école keynesienne intégrant la monnaie et les rigidités des prix nominaux temporaires qui ont été développées par Clarida et all. (1999). Notre modèle enrichit le modèle de référence en deux manières ; Premièrement, nous relâchons l'hypothèse de l'économie fermée et nous adaptons un ordre d'économie ouverte afin d'analyser le cas de la petite économie ouverte et pour mieux comprendre le cas de la BCRT. Deuxièmement, nous modifions le modèle en ajoutant une équation supplémentaire de stabilité financière qui englobe l'instabilité financière future attendue et les changements attendus dans le taux de change réel pendant la période prochaine en fonction de l'hypothèse de la petite économie ouverte. Ces prolongements permettent d'observer séparément les effets des canaux de crédit et des taux d'intérêt de la BCRT et permettent aussi d'analyser les effets des expectations dans le procès de l'exécution de la politique monétaire. En plus, ce modèle peut être résolu analytiquement.

Nous utilisons ce cadre pour évaluer l'effet des inquiétudes pour la stabilité financière de la BCRT sur les outils de la politique monétaire optimale ainsi que sur les indicateurs économiques principaux comme l'écart de production et l'inflation. Pour ce but, nous comparons les niveaux optimaux des variables pertinentes sous deux cas différents : quand la BCRT vise seulement la stabilité de prix et quand la BCRT vise à la fois la stabilité de prix et la stabilité financière. Les résultats analytiques montrent que le taux d'intérêt optimal réagit moins aux changements de

l'inflation tandis qu'il réagit plus aux changements de l'inflation attendue quand la BCRT se soucie de la stabilité financière. La réaction accrue des taux d'intérêt optimaux contre l'inflation attendue est aussi soutenue par Özatalay (2011). Cela prouve que notre modèle est capable de capturer l'importance accrue des expectations sous les inquiétudes pour la stabilité financière.

Notre cadre montre aussi que la réaction du taux d'intérêt optimal contre les changements dans les chocs financiers dépend de la persistance du choc quand la BCRT se soucie aussi de la stabilité financière. L'effet ambigu des chocs financiers sur les taux d'intérêt nominaux à cause de la persistance de la magnitude des chocs est différent des résultats d'Özatay (2011). Il est également utile de mesurer les effets sur le bien-être dans le cadre de la politique monétaire changeante de la BCRT. Etant donné que le modèle permet les résultats analytiques, c'est possible de donner une évaluation exacte de la fonction de perte sous les deux cas qui sont analysés. Cependant, à cause de la complexité des expressions analytiques pour la solution de plusieurs variables, une telle estimation ne semble pas pratique. En vérité, sous l'inquiétude pour la stabilité financière, l'écart de production élevé et l'inflation exercent un effet négatif sur le bien-être tandis que l'inquiétude pour la stabilité financière diminue l'instabilité financière et crée un effet positif sur le bien-être. A propos du bien-être, que l'effet positif de l'écart de la stabilité financière moins élevé domine l'effet négatif de l'écart de production élevé et l'inflation dépend des paramètres du modèle.

En plus, le niveau optimal de l'écart de la stabilité financière est moins élevé parce que la BCRT vise à la fois la stabilité de prix et la stabilité financière et c'est un résultat fortement attendu. En conséquence de notre hypothèse de petite économie ouverte, l'inflation optimale ne dépend pas seulement des chocs sur les coûts. Elle dépend aussi des taux d'intérêt mondial et d'autres chocs possibles de la stabilité financière quand la BCRT se soucie de la stabilité financière. Ces résultats sont différents des résultats d'Özatay (2011). Le cadre de l'économie fermée d'Özatay ne peut pas capter l'effet des perturbations provenant du reste du monde. Avec l'aide de ce cadre, nous pouvons analyser les effets des écarts du taux de change, qui résultent des changements du taux d'intérêt mondial, sur les réactions du taux d'intérêt optimal.

Il y a plusieurs manières d'améliorer la capacité explicative du modèle présent. Premièrement, le modèle ne peut pas capter l'usage de l'incertitude par la BCRT pour induire le système bancaire à être plus prudent. Par exemple, la BCRT ne révèle pas d'informations sur la durée de la gestion de la liquidité restrictive afin de décourager les banques d'augmenter le volume du crédit. Cependant, dans notre modèle, il n'y a aucune hypothèse d'incertitude qui pourrait affecter la formation des anticipations du secteur privé par la voie de la création de l'incertitude politique par la BCRT. Les travaux dans lesquels l'incertitude est introduite (Rotemberg ve Woodford, 1997) et autres travaux dans lesquels l'hypothèse de l'information asymétrique est incluse (Paciello ve Wiederholt, 2010) sont présents dans la littérature.

Deuxièmement, le secteur financier est considéré comme exogène dans le modèle présent. Ça pourrait être intéressant de donner une modélisation explicative du secteur financier en définissant ce secteur intrinsèque ou endogène. De la même manière, les modèles, qui prennent en compte les asymétries du taux de change et celles de l'échéance, pourraient posséder une capacité explicative plus élevée des politiques de la stabilité financière.

Troisièmement, étant donné que nous étudions le cas Turque, notre modèle considère une petite économie ouverte. Cependant, afin d'étudier le problème dans une étendue plus vaste, on pourrait élargir l'hypothèse et former une économie directement ouverte en utilisant un cadre à deux pays. Par cette manière, les interactions monétaires entre la Réserve Fédérale (FED) et la Banque Centrale Européenne (BCE) pourraient être analysées. En plus, ça pourrait être possible de comparer les effets des taux de change fixe et flexible comme dans les travaux d'Ünsal (2011) parce que la BCE fonctionne dans une union monétaire.

Puisque nous essayons de parvenir aux résultats analytiques, nous avons construit des normalisations qui pourraient être irréalistes parmi les paramètres du modèle. Même si ces hypothèses n'altèrent pas l'aspect de la relation entre les variables, elles peuvent exposer leurs effets plus ou moins forts que les effets actuels. Toutefois, ce n'est qu'une altération quantitative.

Finalement, ce modèle rend possible d'observer le changement des variables économiques entre le cas où la BCRT vise seulement la stabilité de prix et l'autre cas

où elle vise à la fois la stabilité de prix et la stabilité financière. Grâce à ce modèle, on peut aussi qualifier les bénéfices obtenus de la politique monétaire optimale sous la stabilité financière et la stabilité de prix. Etant donné que la BCRT a désigné et a exécuté un nouveau cadre de politique monétaire depuis presque trois années, ça peut être utile de posséder une approche économétrique avec un recueil des données suffisantes pour faire une évaluation efficace à l'avenir.

ABSTRACT

In 2008, the global economy experienced the deepest crisis since the Great Depression in 1929. In order to reduce the destructive effects and facilitate the exit, almost all central banks took precautions in a coordinated way. These precautions were mainly taken by the central banks of developed countries by providing extraordinary levels of liquidity to the markets. For example, to many observers, the Federal Reserve's extraordinary policy actions during the recent crisis curtailed the depth and duration of the recession (Rudebusch, 2009). To combat panic and dislocation in financial markets, the Fed provided an enormous amount of liquidity. In the beginning of 2008, the Fed's balance sheet was $926 billion; its balance sheet had reached $2.9 trillion. To mitigate declines in expenditures and employment, it reduced the federal funds interest rate—its usual policy instrument—essentially to its lower bound of zero. To provide additional monetary stimulus, the Fed turned to an unconventional policy tool—purchases of longer-term securities which led to an enormous expansion of its balance sheet. At that time, without any hesitation of possible risks on balance sheets of the banks, all kind of monetary policy tools were used accurately in the crisis period. This period also led to a higher government budget deficit because of the extensive financial support programs. However, the implementation of unusually loose monetary policies and expansionary fiscal policies for an extended period may cause new potential economic distortions such as the risk of inflation, which might be very costly to control in the future. Therefore, in the light of the crises, "exit strategies" becomes one of the most discussed issues in monetary policies in which macro prudential measures are taken during the global crisis and normalization operations of monetary policies. In order to reduce the destructive effects and facilitate the exit, almost all central banks took precautions in a coordinated way. These precautions were mainly taken by the central banks of developed countries. Therefore central banks have introduced "unconventional monetary policy measures" to deal with the economic and financial crisis that materialized in the aftermath of the bursting of the global credit bubble. As a

reflection of this, the idea that the central banks should attach more weight to financial stability has gradually been discussed across international platforms like G-20. Unconventional monetary policy approach has emerged after the changing view of the central banking in the post-crisis period. This approach stems from the idea that while focusing on price stability, central banks should not overlook the risks accumulating in the financial system and the bubbles in asset prices. Moreover, on the academic side, studies advocating the implementation of macro prudential policies for crisis prevention purposes have increasingly occupied the agenda in the recent economic literature (Bianchi and Mendoza 2011, Jeanne and Korinek 2010). The search of new adjusted monetary framework for central banks is needed for both changing the approach of economic policy framework and central banking. The ultimate result of the global crises and implemented policies by advanced economies as well as prevailing global imbalances led to unusual dynamics in the global economy. Financial concerns mainly raised after the global crises shows that the conventional monetary transmission mechanisms across advanced economies is not enough to repair the financial market imbalances. The adverse effect of the financial crisis increased the urgency to adjust the monetary policy approach and search for alternative approaches and raised important questions about the role of central banks in financial stability. Any monetary authority targeting both price and financial stability needs additional policy tools besides the policy rate because of the tradeoff between price and financial stability. In order to achieve both price and financial stability, CBT (Central Bank of Turkish Republic) has adjusted its monetary policy framework. In order to achieve both price and financial stability, CBT diversified its policy tools such as the interest rate corridor between overnight borrowing and lending rates, liquidity policies and required reserves in addition to short-term policy rates.

The use of redesigned inflation targeting framework of monetary policy in order to prevent financial crises and ensure financial stability with the help of the macro prudential measures gains dominance in recent economic literature (Bailliu et. al. 2012, Woodford 2011, Ünsal 2011). However, the definition of financial stability is a controversial concept regarding how it can be measured or with which indicators it can be represented. In the literature, the theoretical framework that incorporates financial stability identifies mainly three sources of financial instability: First, financial problems may arise from the banking sector (leverage ratio, overall credit

flows etc., see for example Gertler and Karadi, 2011; Bailliu et al., 2012). Another stream of related works (see for example Baudocco, Bulir and Cihak, 2011) with financial stability assumes that financial problems arise from the non bank sector (household solvency, marginal utility of income etc.). A third type of works defines financial stability as stemming from both banking and non bank sector (see for example Woodford, 2011; Aydın et al. 2011). On the other hand, according to Schinasi (2004), there is no single variable that can be an exact signal on the performance of the financial system. It defines financial stability as an indicator of the financial system to facilitate efficient allocation of resources, to assess, price, allocate, manage the financial risks and to maintain its ability to perform key functions.

The financial stability is traditionally considered as the objective of macro prudential policy while price stability is viewed as the objective of monetary policy. Thus, a key challenge for central banks is to simultaneously achieve price and financial stability (Granville and Mallick, 2009) after the global financial crisis. In order to model the adjusted monetary policy of CBT after the global financial crisis, we follow an approach which suggests that monetary policy implementation can be combined with macro prudential tools.

In order to clarify the position of our model in the literature, we analyze a number of recent contributions on optimal monetary policy under financial stability in closed or open economies according to the above mentioned differentiated financial stability definitions. Following the previous literature, a simple model may be helpful in clarifying the way in which an inflation targeting regime could be modified in order to incorporate concerns for the effects of monetary policy decisions on financial stability. Following Curdia and Woodford (2010), Del Negro et al. (2010), or Gertler and Karadi (2011), financial intermediation is treated as purely exogenous in the present paper.

The model aims to capture the recent design of monetary policy which has a broader scope since it considers an inflation targeting strategy that encompasses financial stability. This new design of monetary policy is a sort of mixed policy implementation designed by Central Bank of CBT. In order to construct our framework, we use a micro-founded dynamic general stochastic equilibrium model

based on the New Keynesian literature incorporating money and temporary nominal price rigidities which was developed by Clarida et all. (1999). Our model extends the benchmark model in two ways; First, we relax the closed economy assumption and adopt an open economy set up in order to analyze the case of small open economy. Second, we modify the financial stability equation by adding the expected future financial instability and the next period expected change in the real exchange rate depending on small open economy assumption. These extensions make possible to separate the credit and exchange rate channels and incorporate the role of expectations. Moreover, the model can be solved analytical.

We use this framework, to assess the effect of financial stability concerns of CBT on the optimal monetary policy tool as well as on main economic indicators such as the output gap and inflation. For this purpose, we compare the optimal levels of the relevant variables under two different cases: when CBT is targeting only price stability and when CBT is targeting both price and financial stability. The analytical results show that the optimal interest rate reacts less to the changes in inflation but more to the changes in expected inflation when CBT cares for financial stability. The increased reaction of optimal interest rates to expected inflation is also supported by Özatay (2011). This proves that our model is capable of capturing the increased importance of expectations under financial stability concerns.

Our framework also shows that optimal interest rate reaction to the changes in financial shocks depends on the persistency of shock when financial stability also matters for CBT. The ambiguous effect of financial shocks on nominal interest rates due to the persistency of the magnitude of the shock differs from the results of Özatay (2011). It is also useful to measure the welfare effects of the adjusted framework. Since the model allows for analytical results, it is possible to give an exact evaluation of the loss function under the two cases that are analyzed. However, due to the complexity of the analytical expressions for the solution of several variables, such a computation does not seem practical. Intuitively, higher output gap and inflation under financial stability concerns exert a negative effect on welfare while the lower financial stability gap under financial stability concerns implies a positive effect. Whether the positive effect of lower financial stability gap dominates the negative effect of higher output gap and inflation depends on the parameters of the model.

Furthermore, optimal level of financial stability gap is lower since CBT is targeting both price and financial stability which is highly an expected outcome. As a result of our small open economy assumption, the optimal inflation depends only on cost push shocks under price stability alone whereas it is also a function of the world interest rates and financial stability shocks when CBT is concerned with financial stability. These findings differ from those of Özatay (2011). The closed economy framework of the latter cannot capture the effect of perturbations stemming from the rest of the world. With the help of this framework, we can analyze the effects of exchange rate deviations resulting from the world interest changes on optimal interest rate reactions.

There are several ways in order to improve upon the explanatory capacity of the present model. First, the model cannot capture the use of uncertainty by the CBT to induce the banking system to be more cautious. Indeed, CBT does not reveal information on the duration of the restrictive liquidity management in order to discourage banks from increasing credit volume. However, in our model there is no uncertainty that could affect the formation of expectations by the private sector. The addition of this type of behavior in the model requires introducing model uncertainty as in Rotemberg and Woodford (1997) or introducing asymmetric information as in Paciello and Wiederholt (2010).

Second, the financial sector is considered as exogenous in the present model. It would be interesting to give an explicit modeling of the financial sector. As such it would be possible to see the effect of maturity and exchange rate mismatches on the financial stability.

Third, since we consider the Turkish case, our model considers a small open economy. However, in order to consider the problem in a wider scope, one can assume a two-country framework and evaluate the monetary interactions between FED and ECB. In this context, it would also be interesting to compare the case of fixed and flexible exchange rates as in Ünsal (2011) since ECB operates in a currency union.

Since we try to allege analytical results, we make unrealistic normalizations for the values of several parameters in the model. However, we believe that this does not alter the results qualitatively but only quantitatively. Finally, one might quantify the

benefits gained from optimal monetary policy under both financial and price stability. Since the CBT designed and implemented a new adjusted monetary policy framework for almost three years, it can be useful to have an econometric approach with collecting the enough data in order to have an efficient evaluation in the future.

ÖZET

Küresel ekonomi, 1929 yılında yaşanan Büyük Buhrandan sonraki en büyük ekonomik krizini 2008 yılında tecrübe etmiştir. Küresel krizin ortaya çıkardığı yıkıcı etkileri ortadan kaldırmak ve krizden hızlı bir şekilde çıkmak için neredeyse tüm merkez bankaları koordineli bir şekilde birtakım düzenleyici önlemler almaya başlamıştır. Bu önlemler gelişmiş ekonomiler tarafında çoğunlukla piyasalara yüklü miktarlarda likidite sağlamak şeklinde olmuştur. Örneğin, birçok araştırmaya göre, Amerika Merkez Bankası'nın krizden çıkmak için yürüttüğü geleneksel olmayan para politikaları krizin süresini arttırmış ve olumsuz etkilerini derinleştirmiştir (Rudebusch, 2009). Kriz sonrası ortaya çıkan panik ortamını yumuşatmak için Amerika Merkez Bankası çok yüksek miktarlarda likiditeyi piyasaya sürmüştür. 2008 yılı başında 929 milyar $ olan Amerika Merkez Bankası bilançosu uygulanan politikalar sonrasında 2.9 trilyon $'a ulaşmıştır. Aynı zamanda toplam harcamalardaki azalışı engellemek ve işsizlikteki artışı azaltmak amacıyla federal fonların faiz oranları (olağan politika aracı) neredeyse sıfır seviyelerine indirilmiştir. İlave parasal bir saik yaratmak amacıyla geleneksel olmayan para politikası araçlarına yönelinmiş ve ciddi miktarlarda uzun dönemli hisse senedi ve tahvil alımları ile Amerika Merkez Bankası bilançosunda çok büyük genişlemelere yol açılmıştır. Aynı zamanda bankaların bilançolarında olabilecek olası riskler göz ardı edilerek her türlü para politikası aracı devreye sokulmuştur. Bu dönemde bankalara ve piyasalara sağlanan yüksek miktarlı finansal destekler dolayısıyla hükümet açıkları yüksek rakamlara ulaşmıştır. Olağanüstü genişletici para politikası ve gevşek maliye politikası uygulamalarının yüksek enflasyon oranı, işsizlik vb. gibi birtakım ekonomik bozulmalara yol açması beklenmekteydi.

Bu sebeple, krizlerin ışığında, para politikasında "çıkış stratejileri" olarak literatürde yer alan tartışmalar popüler olmaya başlamıştır. Bu çerçevede, çıkış politikaları kapsamında makro sakıngan önlemlerin alınması ve para politikası sürecinin normalleştirilmesi tartışmaları başlamıştır. Krizin yıkıcı etkilerini azaltmak

ve krizden çıkışı sağlamak için başta gelişmiş ülkelerin merkez bankaları olmak üzere birçok merkez bankası önlem paketleri tartışmaya başlamıştır. Bu çerçevede, küresel ekonomik kriz sonrası, merkez bankaları geleneksel olmayan politika önlemleri almaya başlamışlardır. Bunun bir yansıması olarak merkez bankaları G-20 gibi uluslararası platformlarda da tartışılmakta olan finansal istikrar sağlama hedefine de önem verilmesi gerektiği fikrine varmışlardır. Geleneksel olmayan para politikası yaklaşımı, kriz sonrası dönemde klasik merkez bankacılığı bakış açısında da değişikliğe yol açmıştır.

Geleneksel olmayan para politikası yaklaşımı, merkez bankalarının fiyat istikrarı hedefine odaklanırken finansal sistemde ortaya çıkan risklerin gözden kaçırılmaması ve varlık fiyatlarındaki şişmelerin de dikkate alınması fikrinden ortaya çıkmaktadır. Yakın dönem iktisadi literatürde, krizleri önlemek için makro sakıngan politika uygulamaları oldukça savunucu bulmaktadır (Bianchi ve Mendoza 2011, Jeanne ve Korinek 2010). Bu çerçevede, kriz ortamına göre uyarlanmış para politikası ihtiyacı iktisat politikaları ve merkez bankacılığı yaklaşımını değiştirmiştir. Küresel krizlerin nihai sonucu ve gelişmiş ekonomiler tarafından uygulanan politikalar küresel ekonomide olağandışı dinamiklere yol açmıştır. Küresel kriz sonrası ortaya çıkan finansal endişeler, gelişmiş ekonomiler tarafından uygulanmakta olan geleneksel para politikası yaklaşımının finansal dengesizlikleri telafi etmede yeterli olmadığını göstermiştir. Finansal krizin negatif etkileri klasik para politikası çerçevesinde değişime gidilmesi gerekliliğini ortaya çıkarmış, alternatif arayışlara yol açmış ve merkez bankalarının finansal istikrar konusundaki rollerinin sorgulanmasına neden olmuştur. Hem fiyat istikrarı hem de finansal istikrar hedefi olan para politikası otoritelerinin politika faiz oranı dışında ilave para politikası araçlarına ihtiyaç duyabileceği de kaçınılmaz bir gerçek olmuştur. Hem fiyat istikrarı hem de finansal istikrarı sağlamak hedefinde olan Türkiye Cumhuriyeti Merkez Bankası da (TCMB) para politikası çerçevesinde değişime gitmiştir. TCMB, hem fiyat istikrarı hem de finansal istikrarı sağlamak için politika araçlarında çeşitliliğe gitmiş ve kısa vadeli politika faiz oranına ilave olarak aktif faiz koridoru kullanımı, duruma göre değişen likidite politikaları ve aktif zorunlu rezerv oranı kullanımını da politika araçları havuzuna eklemiştir.

Finansal krizleri önlemek ve finansal istikrarı sağlamak için makro sakıngan önlemlerin yanı sıra finansal istikrarı da göz önünde bulundurma amacıyla enflasyon

hedeflemesine dayalı para politikası çerçevelerinin yeniden tasarlanması yakın iktisadi literatürde oldukça önem kazanmıştır (Bailliu ve diğerleri 2012, Woodford 2011, Ünsal 2011). Söz konusu finansal istikrar kavramı literatürde oldukça tartışmalıdır. Çünkü finansal istikrarın veya istikrarsızlığın tek bir gösterge ile ölçülmesi mümkün olmadığı gibi ölçüm yöntemleri hususunda da fikir birliğine varılamamıştır. Literatürde yer alan teorik modellerde kullanılan finansal istikrar tanımlarından yola çıkarak finansal istikrarsızlık kaynaklarını üç grupta incelemek mümkün olmaktadır. Birinci grup, finansal problemlerin bankacılık sektöründen (kaldıraç oranı, toplam kredi hacmi vb.) kaynaklanabileceğini incelemiştir (Gertler ve Karadi 2011, Bailliu ve diğerleri 2012). İkinci grupta finansal problemlerin banka dışı sektörlerden (hanehalkı ödeme gücü, tüketici gelirinin marjinal faydası) kaynaklanabileceğini incelenmiştir (Baudocco, Bulir ve Cihak, 2011). Üçüncü grup çalışmalarda finansal istikrarsızlığın hem bankacılık hem de banka dışı sektörlerden kaynaklanabileceği şekilde tanımlama yapmıştır (Woodford 2011, Aydın ve diğerleri 2011). Diğer bir yandan, finansal sistemin performansını tek ve net bir değişken ile ölçmenin mümkün olmadığı da tartışılmaktadır (Schinasi, 2004). Schinasi, finansal istikrarı, finansal sistemde kaynakların etkin dağılımının sağlanması ve finansal risklerin yönetilmesi, dağıtılması, fiyatlandırılması vb. görevlerin yerine getirilmesi ve finansal sistemin temel fonksiyonlarını yerine getirebiliyor olması şeklinde tanımlamaktadır.

Küresel finans krizi sonrasında, finansal istikrar geleneksel yaklaşımda makro sakıngan politika amacı olarak görülmekte iken fiyat istikrarı para politikası amacı olarak karşımız çıkmaktadır (Granville and Mallick, 2009). Bu çalışmada, küresel finans krizi sonrasında TCMB'nin değişen para politikası çerçevesini modellemek için makro sakıngan politikaları da içerisinde bulunduran para politikası yaklaşımlarını temel alacağız.

Modelimizin literatürdeki yerini doğru belirlemek için, yukarıda yapmış olduğumuz finansal istikrar tanımları çerçevesinde finansal istikrar hedefini de içeren optimal para politikası literatüründe yapılmış birçok çalışmayı analiz etmiş bulunmaktayız. Yaptığımız literatür taraması sonrasında finansal istikrar hedefini de içerisinde barındıran enflasyon hedeflemesi rejimine dayalı teorik bir model referans olara alınmıştır. Bu çerçevede, bu çalışmada literatürdeki birtakım çalışmalar takip

edilerek finansal sektör tamamen dışsal kabul edilmiştir (Curdia ve Woodford 2010, Del Negro ve diğerleri 2010, Gertler ve Karadi, 2011).

Bu çalışmada, TCMB'nin finansal istikrar hedefini de içine alan enflasyon hedeflemesi rejimi ile yeniden tasarlanmış para politikası çerçevesi modellenmeye çalışılmıştır. Bu yeni tasarım TCMB'nin uygulamaya çalıştığı bir politika karmasıdır. Model çerçevemizi oluşturmak üzere, Clarida ve diğerleri (1999) tarafından geliştirilen Yeni Keynesyen yaklaşımı temel alan fiyat ve ücret katılıklarını içeren mikro temelli bir genel dinamik stokastik denge modeli kullanılmıştır. Çalışmamız, referans modeli (Clarida ve diğerleri, 1999) iki açıdan geliştirmiştir. Birincisi, modelimiz referans modelin kapalı ekonomi varsayımını küçük açık ekonomi haline getirmiştir ki böylece TCMB durum örneğini daha iyi bir şekilde ele alabilelim. İkinci olarak modelE ek bir finansal istikrar denklemi eklenmiş ve bu denklemde geleceğe yönelik finansal istikrar beklentileri ve reel döviz kurunda gelecek dönemde beklenen değişim de küçük açık ekonomi varsayımına uygun bir şekilde kapsanmıştır. Bu genişlemeler, TCMB'nin kredi ve döviz kuru kanallarının etkilerinin ayrı ayrı gözlemlenebilmesini sağlamış ve para politikası uygulanması sürecinde beklentilerin etkisini de analiz edebilmemizi sağlamıştır. Ayrıca kurulan teorik model analitik olarak çözülebilmiştir.

Bu çerçevenin kullanılmasında temel amaç, finansal istikrar kaygılarının optimal para politikası ve araçları üzerindeki etkilerini gözlemleyebilmek ve nihayet çıktı açığı ve enflasyon gibi temel ekonomik göstergeler üzerindeki etkilerini incelemektir. Bu amaçla, TCMB'nin sadece fiyat istikrarı hedefi olduğu durum ile hem fiyat hem de finansal istikrar hedefi olduğu durumlarda optimal ekonomik değişkenlerin seviyelerini kıyaslayabilmemizi sağlamaktadır. Analitik sonuçlar TCMB'nin finansal istikrar hedefi de olduğu durumda optimal faiz oranının enflasyona daha az tepki vereceğini ama beklenen enflasyona daha çok tepki vereceği sonucunu ortaya çıkarmaktadır. Optimal faiz oranının beklenen enflasyona artan tepkisi Özaty (2011) çalışmasında da ortaya konmaktadır. Burada çıkan sonuçlar modele entegre edilen beklentiler kanalının aslında finansal istikrar hedefi altında ne kadar önemli olduğunu ortaya koymaktadır.

Bu çalışmada oluşturduğumuz çerçeve optimal faiz oranının finansal şoklara olan tepkisinin de şokun sürekliliğine bağlı olduğunu ortaya koymaktadır. Finansal

şokların optimal faiz oranı üzerindeki belirsiz etkisi sonucu Özatay (2011) sonuçlarından farklı çıkmaktadır. Yine, TCMB'nin değişen para politikası çerçevesinde refah etkilerini analiz etmek oldukça yararlı olacaktır. Modelimiz analitik çözümü mümkün kıldığı için sadece fiyat istikrar hedefi ve hem fiyat hem finansal istikrar hedefi altındaki iki durum için bir kayıp fonksiyonu hesaplaması mümkün olmaktadır. Ancak denklemlerdeki değişken sayısının çok olması işlemi biraz zorlaştırmakta ve böyle bir hesapla yapabilmek çok patrik olmamaktadır. Aslında finansal istikrar kaygısı altında yüksek çıktı açığı ve enflasyon refah üzerinde negatif bir etkiye neden olurken diğer bir taraftan finansal istikrar kaygısı finansal istikrarsızlığı azaltacak ve refah üzerinde olumlu bir etki yaratacaktır. Refah üzerinde oluşan biri pozitif diğeri negatif olan iki ters etki sonrasında nihai etkinin ne olacağı modeldeki parametrelerin değerlerine bağlı olarak değişecektir.

Bunun yanında bir diğer bulgu TCMB'nin hem fiyat hem finansal istikrar hedefi varken finansal istikrar açığının daha düşük olacağıdır ki bu da oldukça beklenen bir sonuç olacaktır. Küçük açık ekonomi varsayımımıza bağlı olarak çıkan bir diğer sonuç ise optimal enflasyon seviyesinin yalnızca maliyet çekişli şoklara bağlı olmadığı bunun yanı sıra dünya faiz oranlarına ve finansal istikrara gelebilecek diğer şoklara da bağlı olduğu sonucuna ulaşılmıştır. Sonuçlar küçük açık ekonomi varsayımı dolayısıyla Özatay'dan (2011) farklı çıkmaktadır. Referans modelimizde (Clarida ve diğerleri, 1999) olduğu gibi kapalı ekonomi varsayımı dış dünya etkilerini göz ardı etmektedir. Bu çalışmadaki çerçeve yardımıyla, dünya faiz oranındaki değişikliklerden kaynaklanan döviz kuru dalgalanmalarının optimal faiz oranı üzerindeki etkileri analiz edilebilmektedir.

Çalışmamızdaki modelin açıklayıcı gücünü arttırmak için birçok yol var. Birincisi, model TCMB tarafından belirsizlik yaratmak yoluyla uygulanabilecek politikaların etkilerini kapsayamamaktadır. Örneğin, TCMB likidite daraltma veya arttırma yoluyla kredi hacmini etkilemeye çalışırken bankacılık sistemine açık bilgi vermemektedir. Modelimizde belirsizlik varsayımı olmadığı için TCMB'nin politika belirsizliği yartamak yoluyla özel sektör beklentilerini etkileme ihtimali ortadan kalkmaktadır. Belirsizlik ortamının modele entegre edildiği çalışmalar (Rotemberg ve Woodford, 1997) ve asimetrik bilgi varsayımı içeren modeller de (Paciello ve Wiederholt, 2010) literatürde mevcuttur.

İkincisi, bu çalışmada daha öncede söylediğimiz gibi finansal sektör dışsal olarak ele alınmıştır. Finansal sektörün içsel veya endojen bir şekilde tanımlandığı modellerin açıklama gücü bu çalışmaya çok daha yüksek olabilecektir. Yine aynı şekilde döviz kuru ve vade uyumsuzluklarını da göz önünde bulunduran modellerin de finansal istikrar tanımı çerçevesinde politikaları açıklama gücü daha yüksek olabilecektir.

Üçüncü olarak, modelimizi Türkiye örneğine uyarlamak için küçük açık ekonomi varsayımı yapmıştık. Ancak bu varsayım genişletilerek doğrudan açık ekonomi durumuna getirilerek iki ülkeli çerçeve kullanılabilir ve Amerika Merkez Bankası ve Avrupa Merkez Banksı arasındaki parasal etkileşimler de analiz edilebilirdi. Dahası, bu çerçevede Ünsal'ın (2011) yaptığı gibi sabit döviz kuru ve esnek döviz kuru etkileri de analiz edilebilirdi.

Bu modelde, analitik sonuçlara ulaşabilmek için parametrelerde gerçekçi olmayabilecek normalizasyonlar yapılmıştır. Bu varsayımlar değişkenler arasındaki ilişkinin yönünü değiştirmese de etkilerini olduğundan daha fazla veya daha eksik göstermiş olabilir. Son olarak, bu modelde TCMB'nin yalnızca fiyat istikrarı hedefi olduğu durum ile hem fiyat hem de finansal istikrar hedefi olduğu durumlar arasında ekonomik değişkenlerin değişimini görmek mümkün olabilmiştir. Yine, TCMB'nin gitmiş olduğu para politikası çerçeve değişikliği ülkemizde yaklaşık üç yıldır uygulanmaktadır. Yeterli veriye ulaşıldığı takdirde geleceğe yönelik daha sağlıklı analizler yapabilmek için ekonometrik bir yaklaşım benimsenmesinin oldukça faydalı olabileceğine inanılmaktadır.

CHAPTER 1. INTRODUCTION

Major central banks have introduced "unconventional monetary policy measures" to deal with the economic and financial crisis that materialized in the aftermath of the bursting of the global credit bubble. As a reflection of this lesson, the idea that the central banks should attach more weight to financial stability has gradually been discussed across international platforms like G-20. Unconventional monetary policy approach has emerged after the changing view of the central banking in the post-crisis period. This approach stems from the idea that while focusing on price stability, central banks should not overlook the risks accumulating in the financial system and the bubbles in asset prices. Moreover, on the academic side, studies advocating the implementation of macro prudential policies for crisis prevention purposes have increasingly occupied the agenda in the recent economic literature (Bianchi and Mendoza 2011, Jeanne and Korinek 2010). The search of new adjusted monetary framework for central banks is needed for both changing the approach of economic policy framework and central banking. The ultimate result of the global crises and implemented policies by advanced economies as well as prevailing global imbalances led to unusual dynamics in the global economy. Financial concerns mainly raised after the global crises shows that the conventional monetary transmission mechanisms across advanced economies is not enough to repair the financial market imbalances. The adverse effect of the financial crisis increased the urgency to adjust the monetary policy approach and search for alternative approaches and raised important questions about the role of central banks in financial stability. Any monetary authority targeting both price and financial stability needs additional policy tools besides the policy rate because of the tradeoff between price and financial stability. In order to achieve both price and financial stability, CBT (Central Bank of Turkish Republic) has adjusted its monetary policy framework. In order to achieve both price and financial stability, CBT diversified its policy tools such as the interest rate corridor between overnight borrowing and

lending rates, liquidity policies and required reserves in addition to short-term policy rates.

The use of redesigned inflation targeting framework of monetary policy in order to prevent financial crises and ensure financial stability with the help of the macro prudential measures gains dominance in recent economic literature (Bailliu et al. 2012, Woodford 2011, Ünsal 2011). However, the definition of financial stability is a controversial concept regarding how it can be measured or with which indicators it can be represented. In the literature, the theoretical framework that incorporates financial stability identifies mainly three sources of financial instability: First, financial problems may arise from the banking sector (leverage ratio, overall credit flows etc., see for example Gertler and Karadi, 2011; Bailliu et al., 2012). Another stream of related works (see for example Baudocco, Bulir and Cihak, 2011) with financial stability assumes that financial problems arise from the non bank sector (household solvency, marginal utility of income etc.). A third type of works defines financial stability as stemming from both banking and non bank sector (see for example Woodford, 2011; Aydın et al. 2011). On the other hand, according to Schinasi (2004), there is no single variable that can be an exact signal on the performance of the financial system. It defines financial stability as an indicator of the financial system to facilitate efficient allocation of resources, to assess, price, allocate, manage the financial risks and to maintain its ability to perform key functions.

The financial stability is traditionally considered as the objective of macro prudential policy while price stability is viewed as the objective of monetary policy. Thus, a key challenge for central banks is to simultaneously achieve price and financial stability (Granville and Mallick, 2009) after the global financial crisis. In order to model the adjusted monetary policy of CBT after the global financial crisis, we follow an approach which suggests that monetary policy implementation can be combined with macro prudential tools.

In order to clarify the position of our model in the literature, we analyze a number of recent contributions on optimal monetary policy under financial stability in closed or open economies according to the above mentioned differentiated financial stability definitions. Following the previous literature, a simple model may be helpful in clarifying the way in which an inflation targeting regime could be

modified in order to incorporate concerns for the effects of monetary policy decisions on financial stability. Following Curdia and Woodford (2010), Del Negro et al. (2010), or Gertler and Karadi (2011), financial intermediation is treated as purely exogenous in the present paper.

The model aims to capture the recent design of monetary policy which has a broader scope since it considers an inflation targeting strategy that encompasses financial stability. This new design of monetary policy is a sort of mixed policy implementation designed by Central Bank of CBT. In order to construct our framework, we use a micro-founded dynamic general stochastic equilibrium model based on the New Keynesian literature incorporating money and temporary nominal price rigidities which was developed by Clarida et all. (1999). Our model extends the benchmark model in two ways; First, we relax the closed economy assumption and adopt an open economy set up in order to analyze the case of small open economy. Second, we modify the financial stability equation by adding the expected future financial instability and the next period expected change in the real exchange rate depending on small open economy assumption. These extensions make possible to separate the credit and exchange rate channels and incorporate the role of expectations. Moreover, the model can be solved analytical.

The rest of the master's of art dissertation is organized as follows: Chapter 2 analyzes the general framework of conventional monetary policy implemented by CBT in Turkey between 2002 and late 2010's. Chapter 3 describes the application of the adjusted monetary policy framework by CBT after financial stability matters. Chapter 4, first reviews the related literature and reveals the position of our model with respect to the related work and then proposes a model suitable for explaining the behavior of a CBT that seeks to achieve price and financial stability at the same time. Finally, Chapter 5 concludes.

CHAPTER 2. GENERAL FRAMEWORK OF MONETARY POLICY: THE CASE OF TURKEY

This chapter discusses the general framework of monetary policy implemented from 2002 to until late 2010 and the effects of global crises on CBT's monetary policy as well as the motivation for an adjustment on the framework of the monetary policy.

2.1 CBT's monetary policy under price stability until late 2010

It is important to fully apprehend the strategy to be implemented in the upcoming period in order to evaluate the monetary policy decisions of CBT in relation to the developments in the last years. Therefore, it is useful to provide a general evaluation of the inflation targeting regime before discussing the general framework of the monetary and exchange rate policy until 2010, which has been implemented since 2001. The Central Bank implemented an implicit inflation targeting regime under which short-term interest rates were used as the main policy tool between 2002 and 2005. CBT's transition period to full-fledged inflation targeting focused mainly on three issues. First, with the help of the internal projects concentrated on the new inflation dynamics and monetary transmission mechanism, technical infrastructure was improved. Second, communication skills were enhanced over time by publishing more explicit statements regarding CBT's view on the inflation outlook. Third, with the announcement of fixed dates for the monetary policy committee meetings, the decision making process shifted to a more predictable and systematic set up in 2005. Finally in 2006, the transition to an explicit inflation-targeting regime was announced. The general framework of the traditional inflation targeting regime is mainly the central bank's target of keeping inflation in line with the target by using the short term interest rates. In order to fight inflation, the output gap, which is the deviation of aggregate demand from the potential level of output, and other variables affecting the medium term inflation outlook are taken into consideration. Monetary authority reacts to variables such as

credit growth, asset prices and exchange rates solely based on their indirect impact on future inflation level. However, when the adoption of the explicit inflation-targeting regime was realized, the global economic outlook was undergoing a rapid change. Turkish economy faced a series of shocks at that time. Unfortunately, when we look at the pattern of the inflation in Turkey illustrated by Figure 2.1, it is apparent that there is an increase in the inflation level between 2006 and 2008. This increase mostly results from the developments independent of monetary policy implementations. Changes in the global economic outlook have prolonged impacts on Turkey's inflation path which results in an overshooting of the target during this period.

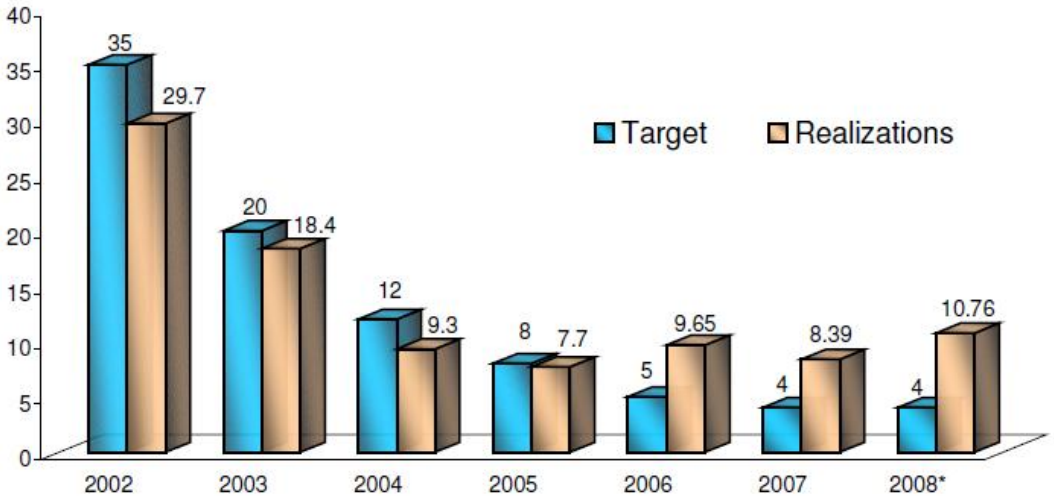


Figure 2.1: Evolution of Inflation in Turkey, 2002-2008
Source: TURKSTAT and CBT

The first serious shock to the inflation targeting regime occurred when international capital conditions changed to the disadvantage of developing countries and capital outflow was experienced in many countries including Turkey from May 2006 and onwards. Moreover, the capital conditions worsened for developing countries and capital outflow was experienced in Turkey from May 2006. In this period, there are several reasons for inflation to exceed the target level such as the depreciation of the national currency around 30 percent and the lack of confidence created by financial turbulence and sharp increases in food prices due to drought in the world. The Central Bank tightened monetary policy significantly and took a series of additional policy measures such as postponing purchases of foreign exchange monitoring national currency and foreign exchange liquidity in order to avoid any permanent effect on pricing behaviors. With the help of these measures,

inflation and inflation expectations were brought under control to a great extent. In the period covering 2007 and onwards, the main factors preventing the disinflation process were sharp increases in oil and other commodity prices in the international markets. In 2007 and onwards, rapidly increasing food and energy prices in the international markets caused inflation to display an upward trend on a global scale. As we can see from Figure 2.2, inflation rates exceeded inflation targets by a significant margin in all developing countries (except Brazil) that implemented inflation-targeting regimes. This result confirms the fact that the relatively high inflation figures of 2007 and 2008 in Turkey stems mainly from the global factors.

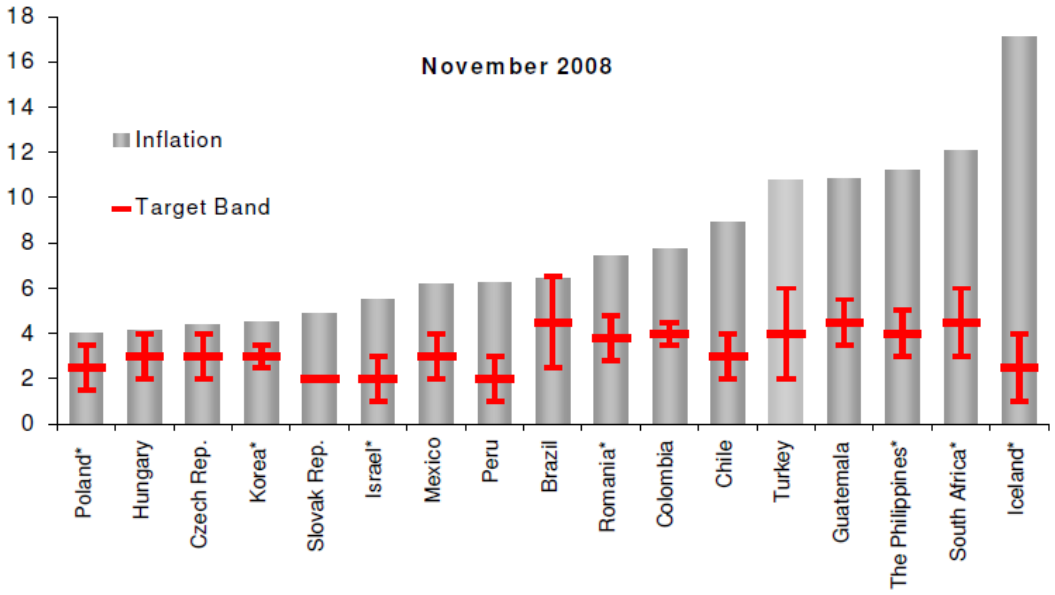


Figure 2.2: Inflation targets and realization in developing countries as of October, 2008
Source: Central Banks, TURKSTAT and CBT

In order to decrease inflation level which remained at higher levels from the target, Central Bank decided to pursue an efficient communication strategy. In this framework, since 2007, when supply shocks became more apparent, the Central Bank emphasized the importance of core inflation indicators excluding energy and food prices. Under the communication framework, if the rise in energy and food prices is temporary, and inflation will return to its downward trend, the main aim of CBT was to direct the focus of economic agents to the medium-term in order to avoid undesired fluctuations in economic activity. In the first part, this approach was successful in containing inflation expectations. However, the fact that shocks were more persistent than expected, caused an increase in food and energy prices which

led to an increase in core inflation indicators. In early 2008, when perturbations in the housing market then in financial markets started in summer 2007 combined with domestic political uncertainties, significant depreciation was observed in national currency. This result makes considerably difficult to push inflation expectations down to levels consistent with the previously set inflation target of 4 percent. Furthermore, overshooting of inflation target for two consecutive years have undermined the role of inflation targets as an anchor for inflation expectations in 2008. Since the overshooting led to an increase in the cost of inflation, Central Bank proposed setting new targets for the medium term in order to control inflation expectations and to re-establish the reputation of the implemented regime. Following this proposal, the inflation targets for 2009, 2010 and 2011 were revised as 7.5, 6.5, and 5.5 percent, respectively. Hence, the inflation targets were used as a reference by economic agents to form their expectations. With the help of these targets, CBT aims to contain inflation expectations and reduce the cost of the fight against inflation. During the period of target revision, a slight deterioration was observed in the medium-term inflation expectations but with diminishing political uncertainties and monetary tightening, inflation expectations have been controlled. In the last quarter of 2008, the uncertainties in the global financial markets had negative effects on the global liquidity flow and created an extraordinary demand especially for US dollar liquidity. This led to significant depreciation of the national currency as in other developing countries. Despite these developments in the exchange rate, slowdown in total demand and the decline in commodity and food prices affected inflation outlook positively which lets CBT to act freely for monetary policy. On the other hand, several measures were taken to support the liquidity of the financial system and to ensure the efficient functioning of the credit markets by CBT. Since, the Central Bank can directly control national currency liquidity; it can support smooth functioning of financial and credit markets by providing the required liquidity. As for foreign exchange liquidity developments however, external conditions are more influential. For example, in a period when uncertainties surrounding the global economy are at high levels, the Central Bank adopted the strategy to use foreign exchange reserves to support the foreign exchange liquidity of the Turkish banking system. Within this framework, the Central Bank continued its activities as a financial intermediary in the foreign exchange deposit market; lending rates of this market were reduced and maturities were extended. Besides, during periods of ailing

price movements, foreign exchange liquidity was injected via foreign exchange selling auctions. Moreover, at that time, it was announced if deemed necessary, additional measures might be taken by CBT to ensure that the financial markets function efficiently. All these measures have helped contain the effects of the global financial turmoil on the domestic economy. The Central Bank continued to take the necessary measures, provided that they do not conflict with the price stability objective. In the last quarter of 2008, global financial conditions have been tighter than required from the monetary policy perspective, due to mainly the aggravation of the global financial crisis. Turkey has also been undergoing a similar process. In this context, the Central Bank recently made a measured cut in short-term interest rates, in order to offset the extra tightening in monetary conditions. In order to be able to comprehend the monetary policy decisions of the Central Bank, the nature of the shocks to the economy are tried to be analyzed properly at the outset. For instance, while an unexpected and strong monetary tightening was implemented in the face of capital outflows in May and June 2006, an expansionary monetary policy was adopted following capital outflows in the last quarter of 2008 due to the global financial crises (Figure 2.3).

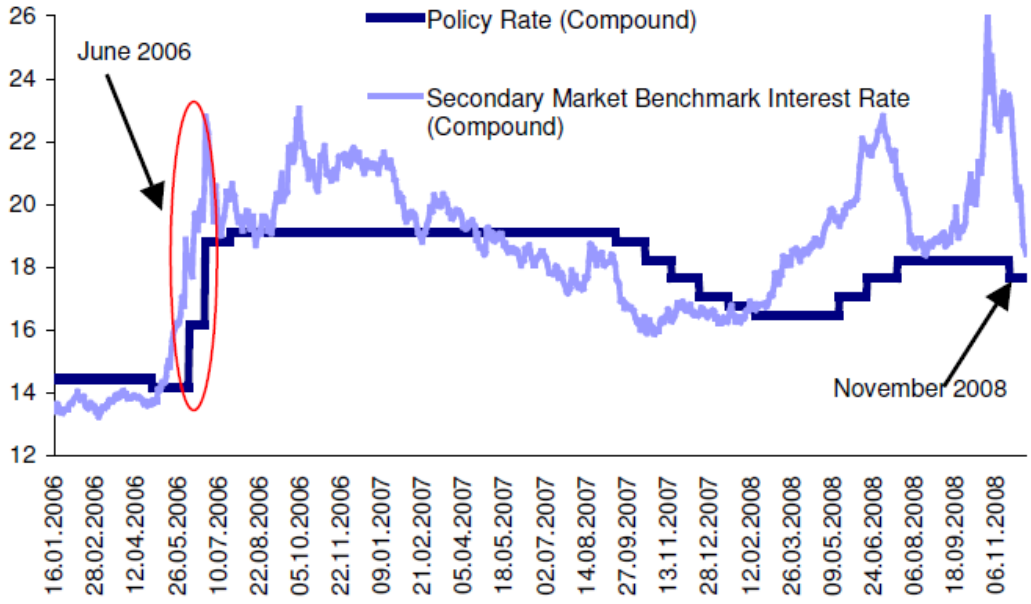


Figure 2.3: Policy rates and market interest rates in the 2006-2008 period.

Source: CBT and ISE

For example, if we look at the responses of CBT in 2006 and 2008 respectively. Regarding the Figure 2.3, domestic and external demand were strong

and the exchange rate movements triggered by capital outflows had the potential to rapidly damage disinflation and inflation expectations in 2006 that is why CBT increased policy rates gradually . However, it is observed that the downward pressure of the global recession and of the weak domestic demand on the inflation has come to exist in 2008 which leads a decrease in policy rates. Therefore, it is seen that the inflation-targeting regime has provided a significant amount of flexibility to take the necessary measures in the face of high-level shocks.

2.2 Central banking policy in light of the crises

In 2008, the global economy experienced the deepest crisis since the Great Depression in 1929. In order to reduce the destructive effects and facilitate the exit, almost all central banks took precautions in a coordinated way. These precautions were mainly taken by the central banks of developed countries by providing extraordinary levels of liquidity to the markets. For example, to many observers, the Federal Reserve's extraordinary policy actions during the recent crisis curtailed the depth and duration of the recession (Rudebusch, 2009). To combat panic and dislocation in financial markets, the Fed provided an enormous amount of liquidity. In the beginning of 2008, the Fed's balance sheet was $926 billion; its balance sheet had reached $2.9 trillion. To mitigate declines in expenditures and employment, it reduced the federal funds interest rate—its usual policy instrument—essentially to its lower bound of zero. To provide additional monetary stimulus, the Fed turned to an unconventional policy tool—purchases of longer-term securities which led to an enormous expansion of its balance sheet. At that time, without any hesitation of possible risks on balance sheets of the banks, all kind of monetary policy tools were used accurately in the crisis period. This period also led to a higher government budget deficit because of the extensive financial support programs. However, the implementation of unusually loose monetary policies and expansionary fiscal policies for an extended period may cause new potential economic distortions such as the risk of inflation, which might be very costly to control in the future. Therefore, in the light of the crises, "exit strategies" becomes one of the most discussed issues in monetary policies in which macro prudential measures are taken during the global crisis and normalization operations of monetary policies. In order to implement an effective policy, general public has also been informed about exit strategies due to the importance of institutional transparency and predictability by the Central Bank.

During the crisis period, many central banks have worked on exit strategies about how to strengthen the economy again and they have been preparing the financial markets for the normalization process. Of course, each central bank will form its own exit strategy according to structural conditions in terms of their main economic indicators.

For the Turkey case, CBT has prepared its framework depending on above mentioned flexible and effective inflation targeting regime with the well regulated and crisis experienced banking system. Turkey has some advantages in terms of having strong and well regulated banking system, flexible and effective liquidity management framework and experience gained from several crises which makes possible to do small adjustments on the general framework of CBT's monetary policy. The structure of the Central Bank's balance sheet was not damaged during the crisis period as it happened in other countries. Thus, the Central Bank's exit strategy from the crisis period will be simpler and easier than that of other central banks. The Central Bank implemented an effective communication policy with the public about the existing liquidity management strategy, transmission mechanisms and the liquidity facilities to be in use starting from the deepening of the crisis, October 2008.

2.3 Motivation for the adjusted monetary policy

Unconventional monetary policy approach has emerged after the changing view of the central banking in the post-crisis period. This approach stems from the idea that while focusing on price stability, central banks should not overlook the risks accumulating in the financial system and the bubbles in asset prices. Major central banks have introduced "unconventional monetary policy measures" to deal with the economic and financial crisis that materialized in the aftermath of the bursting of the global credit bubble. As a reflection of this lesson, the idea that the central banks should attach more weight to financial stability has gradually been discussed across international platforms like G-20. Moreover, on the academic side, studies advocating the implementation of macro prudential policies for crisis prevention purposes have increasingly occupied the agenda in the recent economic literature (Bianchi and Mendoza 2011, Jeanne and Korinek 2010). The search of new adjusted monetary framework for central banks is needed for both changing the approach of economic policy framework and central banking. The ultimate result of the global

crises and implemented policies by advanced economies as well as prevailing global imbalances led to unusual dynamics in the global economy. As we mentioned above, the adverse effect of implemented policies on balance sheets of the public and banking system, particularly in advanced economies, continue to damage the improvement. Financial concerns mainly raised after the global crises shows that the conventional monetary transmission mechanisms across advanced economies is not enough to repair the financial market imbalances. The adverse effect of the financial crisis increased the urgency to adjust the monetary policy approach and search for alternative approaches. Thus, the adjustment necessity encouraged central banks to diversify their monetary policy tools.

Above mentioned loosening of monetary policy and expansionary policy packages led to quantitative easing in advanced economies and the increased fragilities in the global financial system caused substantial volatility in capital flows in recent years. Figure 2.4 depicts the standard deviation of VIX index which is the mostly cited global risk appetite indicators. While, the level of this index represents some measure of risk, its volatility stems mostly from uncertainty. As clearly seen in Figure 2.4, uncertainty seems to have reached to unprecedented levels following the global crisis. As a consequence, capital flows towards emerging economies have been highly volatile which can be seen in Figure 2.5. These changes constitute a major challenge for macroeconomic and financial stability in emerging economies which need sizeable external financing facilities. This nature requires more flexible and diverse policies to provide effective and punctual responses to external shocks.

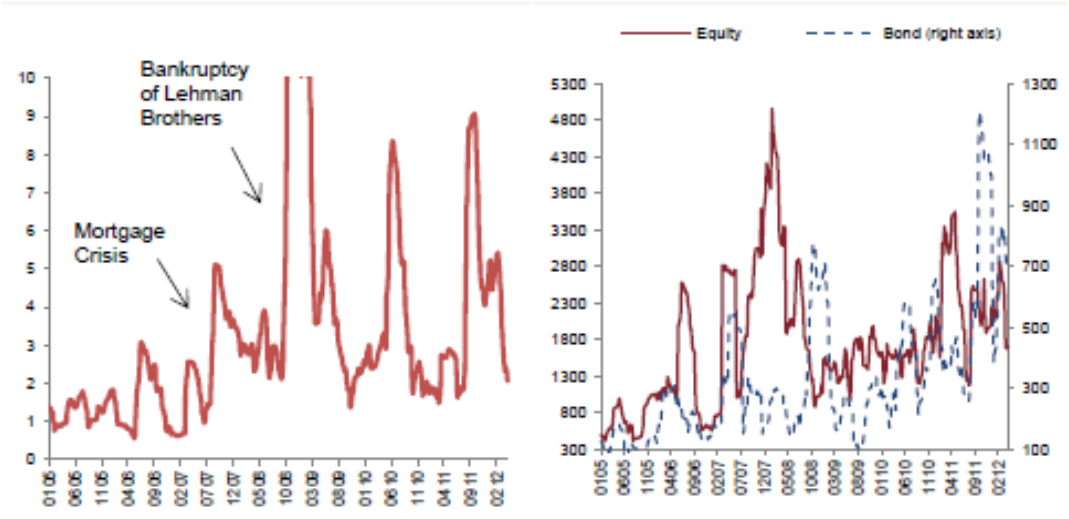


Figure 2.4: Standart deviation of the daily VIX (3-month)
Source: Bloomberg, CBT, EPFR

Figure 2.5: Volatility in portfolio flows to emerging countries
Source: Bloomberg, CBT, EPFR

As an example, a discussion of the capital flows effect on macroeconomic balances held by CBT is useful to review post-crisis dynamics of the Turkish economy, by the late 2010. As we mentioned above, after the contraction in 2009, Turkish economy experienced a rapid recovery on the back of strong fundamentals and solid domestic demand. At that time, capital inflows have increased with the help of the low policy interest rates and quantitative easing monetary policies by advanced economies led to a domestic credit growth which caused an excessive appreciation in the Turkish lira. Higher credit growth, strong domestic demand and appreciated national currency caused an increase in imports. Moreover, due to the global financial crisis and decreased external demand, foreign trade and current account balance experienced a notable deterioration (see Figures 2.6 and 2.7) which increased the vulnerability of the economy against sudden reversals in the global risk appetite. Thus, the excessively volatile nature of global risk appetite in the post-global crisis world together with increasingly short-term nature of current account finance raised further concerns about financial stability. The current account deficit has been financed almost completely through short-term capital and portfolio investments which increase the vulnerability of the economy in the last quarter of 2010 (see Figure 2.7).

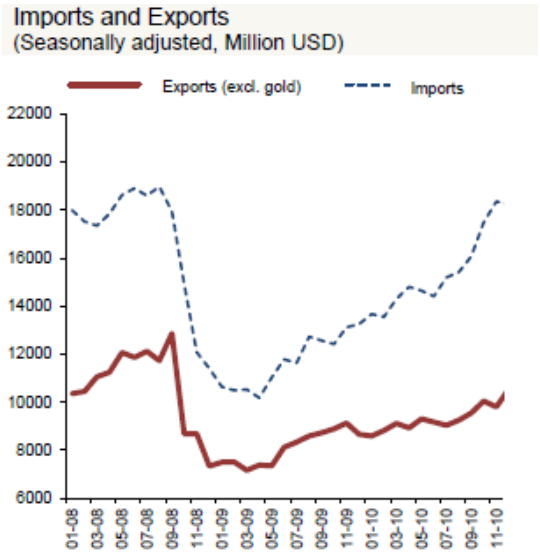


Figure 2.6: Imports and Export (million USD)
Source: TurkStat

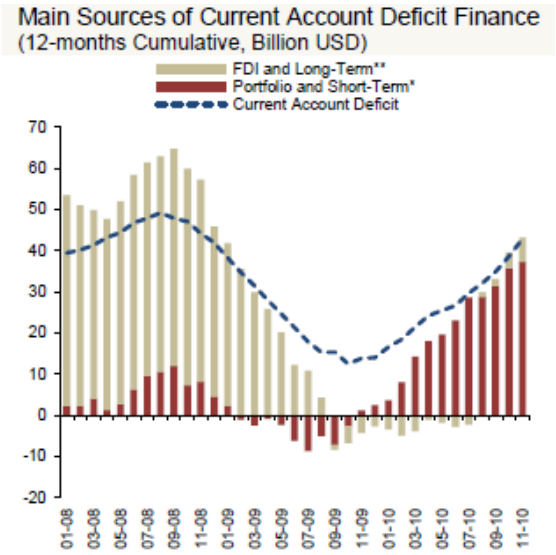


Figure 2.7: Main sources of current account deficit finance
Source: TurkStat

In Turkey, it is always necessary but not the sufficient condition to achieve balanced composition of foreign financing in order to have macroeconomic stability and sustainable growth. As illustrated in Figure 2.8, all of the troughs in economic activity combined with a sudden stop in capital flows occurred in 1994, 2001 and 2008 crises. In order to mitigate the vulnerability of the economy, a more flexible approach of monetary policy is required. All of these conditions being given, the CBT designed and implemented a new monetary policy framework starting from late 2010. In this respect, the general framework of inflation targeting was adjusted and besides the target of price stability, financial stability target was adopted as a supplement. Additional policy tools were introduced to the monetary policy framework in order to achieve multiple targets. The main target of the new policy design is to strengthen the resilience of the economy against both internal and external fragilities that are driven by credit expansion and capital flows. The current account balance and the course of capital flows in Turkey are the most important indicators for financial stability and macro financial risks. For example, higher risk appetite in times of strong global growth accelerates capital inflows; leads to rapid credit growth, increases maturity and exchange rate mismatches on balance sheets, leading to accumulation of risks by distorting the resource allocation.

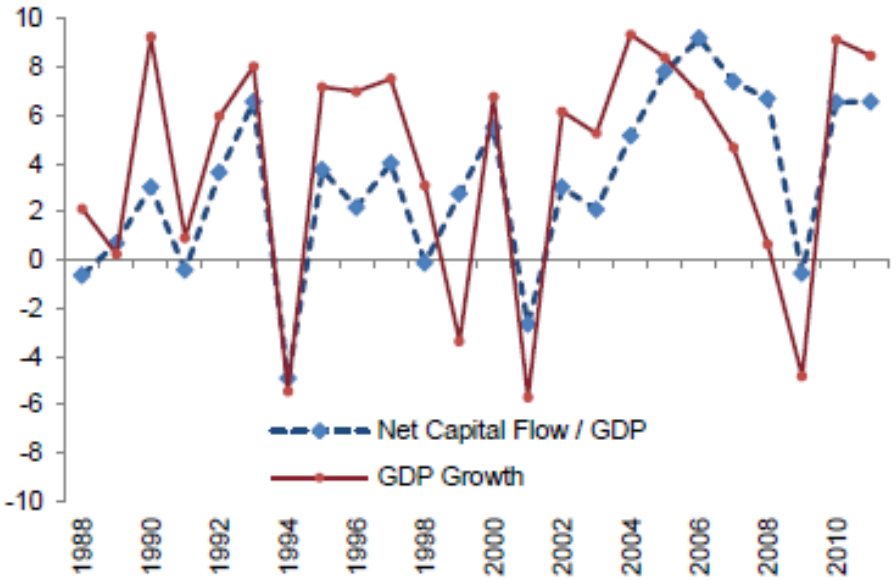


Figure 2.8: GDP growth and capital flows

Source: TurkStat, CBT

In the meanwhile, the current capital inflows led to an appreciation of the local currency and rapid credit expansion. The deterioration in current account and the volatility in external financial flows can have an adverse effect and increase the risk of a “sudden stop”, which can be defined as a type of systemic risk. Therefore, current account balance and capital flows are at the center of the new policy design besides the traditional variables like credit growth. Regarding the policies implemented since late 2010, they were concentrated mainly on decreasing the adverse effects of capital flow volatility, aiming at soft landing and improving the external financing structure. This new policy framework will be discussed in detail in the next chapter.

CHAPTER 3. ADJUSTED MONETARY POLICY FRAMEWORK AFTER FINANCIAL STABILITY CONCERNS

In this part, we will discuss, in depth, the new monetary policy framework that started since late 2010 and the additional monetary policy tools as well as the transmission mechanism from the policy tools toward the final targets of price and financial stability.

3.1 New instruments of monetary policy

As we discussed in chapter 2, in the traditional inflation targeting framework, central banks mainly aim at keeping inflation in line with the target by using the short term interest rate in order to stabilize inflation. For this aim, the output gap and other variables which are affecting future inflation are taken into consideration. CBT reacts to variables such as credit growth and asset prices only indirectly through their impact on future inflation.

However, a monetary authority with an explicit financial stability concern can directly respond to such variables. Any monetary authority targeting both price and financial stability needs additional policy tools besides the policy rate because of the tradeoff between price and financial stability. In order to achieve both price and financial stability, CBT diversified its policy tools such as the interest rate corridor between overnight borrowing and lending rates, liquidity policies and required reserves in addition to short-term policy rates. The adjusted monetary transmission mechanism can be summarized as in Figure 3.1. The main policy instruments are the interest rate corridor, one-week repo rate and liquidity management tools and reserve options mechanism. Reserve option mechanism (ROM) is basically a mechanism that allows banks to keep a certain ratio of their Turkish lira (TL) reserve requirements in the form of foreign exchange (FX) and/or gold. The credit and exchange rate channels bridge the gap between the policy tools and final objectives.

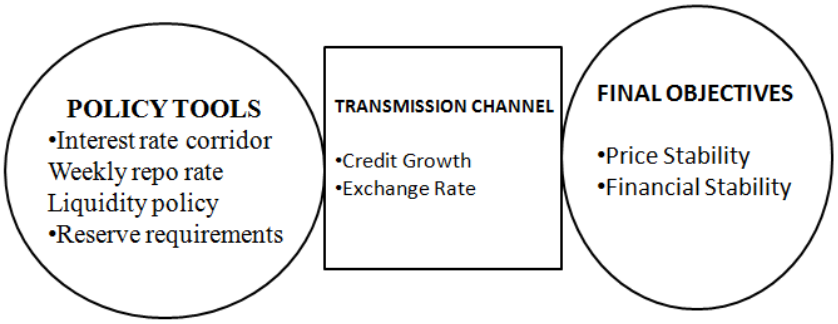


Figure 3.1: CBT policy tools and objectives
Source: CBT

When the new policy tools were first introduced into the transmission mechanism, the role of interest rate corridor and required reserves were largely uncertain at the beginning of the new policy. Thus, in order to introduce these tools, CBT made additional efforts in terms of communication policy. To enhance the communication about the transmission mechanism, the CBT defined two intermediate variables such as credit growth and exchange rates. Since these variables are directly observable and the relevant data are available at any time, economic agents can easily follow and analyze them. Moreover, the linkage between the intermediate variables and the final objectives are straightforward in the sense that they can be easily connected to each other. This adjusted approach provides a more reliable and effective communication regarding the monetary policy implementation.

In the traditional monetary policy implementation, in which price stability is the only objective and the short term policy rate is the single instrument, the central bank does not need to have a separate impact on credit and exchange rate channels. The only important matter is the net impact of these channels on only inflation. However, this case turns out to be different in the adjusted monetary policy framework. For example, consider a case of traditional inflation targeting regime where inflation overshoots the target due to an increase in domestic demand. The only thing needs to be done by CBT is to raise the policy rate to bring inflation back to the target path. Higher interest rate will slow down the credit volume and it will usually lead to an appreciation in domestic currency through higher capital inflow. These two separate effects of decreasing credit volume and appreciation in domestic currency work in the same way which will lead to a fall in inflation together. Therefore, raising policy rates during times of overheating would be sufficient to

achieve the monetary policy goal under a conventional inflation targeting regime since the monetary authority is only interested in putting inflation back to the target path. On the other hand, if the central bank cares also for the financial stability, increasing the policy rate may not be desirable as it would lead to exchange rate appreciation which may conflict with the financial stability objective. Therefore, monetary authorities' explicit objective of financial stability requires the use of credit and exchange rate channels separately. As a result of this requirement, monetary authority may need to resort to other instruments besides the short-term policy rate in order to affect both credit and exchange rate channels in the desired direction. That is why the CBT enriched the set of policy instruments during the adoption of the new policy framework.

3.2 Transmission mechanism

In order to comprehend the transmission mechanism, we will first analyze the first part of the Figure 3.1 which is the relationship between the policy tools and transmission mechanism. Then, we will discuss the second part of the same figure indicating the relationship between credits and exchange rates with the final objectives of price and financial stability.

3.2.1 The transmission mechanism from policy tools to credit and exchange rates

Among monetary instruments used by CBT, liquidity management and interest rate corridor are the key ones in order to comprehend the new policy framework. In this part, we will discuss the operational framework and analyze the relationship of these instruments with exchange rate and credit channels.

3.2.1.1 Operational framework: Liquidity management and the interest rate corridor

The CBT has various instruments to affect the amount of liquidity and interest rates in the interbank money market. CBT can provide short term funds (daily, weekly, or monthly) to banks that are short of liquidity and borrow from those that have excess liquidity. The main instrument the CBT uses to manage the liquidity of the system and to change the stance of monetary policy is the one-week repo

auctions. The area that lies between the rates at which the CBT can borrow and lend overnight on the money market is called the "interest rate corridor" (see Figure 3.2).

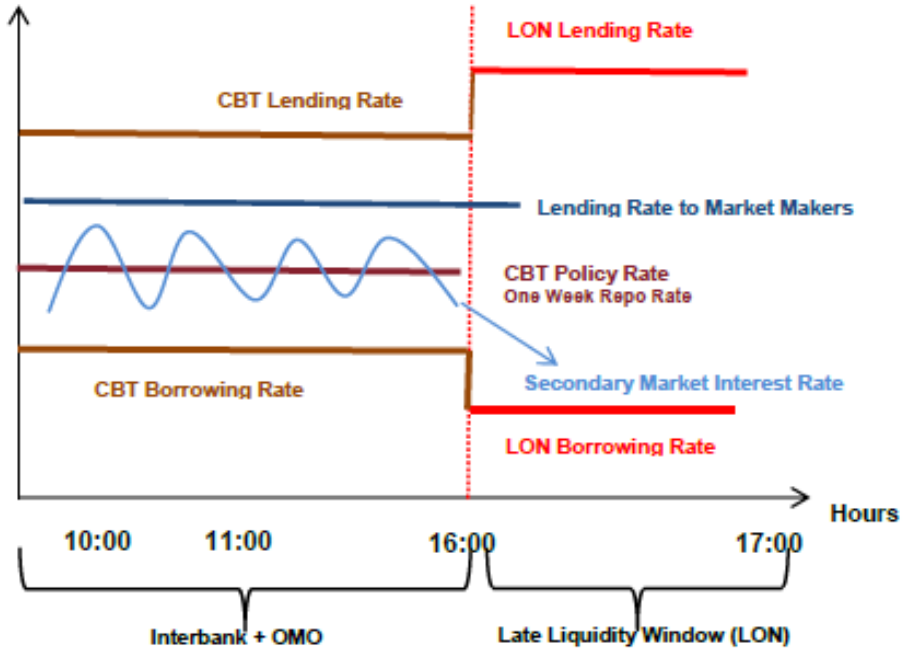


Figure 3.2: Operational framework of CBT's monetary policy
Source: CBT

In the traditional inflation targeting framework, repo rate determined on weekly quantity auctions and the interest rate corridor are revised by the Monetary Policy Committee (MPC) on a monthly frequency which means that short-term interest rates stay unchanged until the next meeting. When the interest rates are announced, short term money market rates fluctuate around the policy rate by only a small margin indicating the CBT's implicit commitment to keep the money market rates nearly constant until the next MPC meeting. Since, the interest rate for the main funding operation is predetermined, average funding rate of the CBT stays approximately stable during the whole month.

On the other hand, under the adjusted monetary policy framework, there is no short-term commitment for the level of market rates or average cost of funding by the CBT. The most crucial feature of the interest rate corridor is that the market interest rates can be changed on a daily basis by adjusting the quantity of funds provided through one-week repo auctions. In this framework, the overnight interest rate can be targeted anywhere inside the corridor, which determines the upper and lower bounds. In this structure, the width of the interest rate corridor determines the

interval of overnight interest rates that can be set by the CBT. This framework allows the volatility of the short term interest rates to be used as an additional policy instrument. Under a conventional inflation targeting framework, the average cost of short term funds provided to banks by the central bank is almost equal to the policy rate, which is very close to the interbank money market rate by definition. However, as described above, the new corridor system allows the short term money market rates to persistently deviate from the average funding cost of the CBT (see Figure 3.3). This differential, coupled with the active liquidity policy and interest rate corridor, allows the CBT to affect the credit and exchange rate channels in separate ways (see the discussion below).

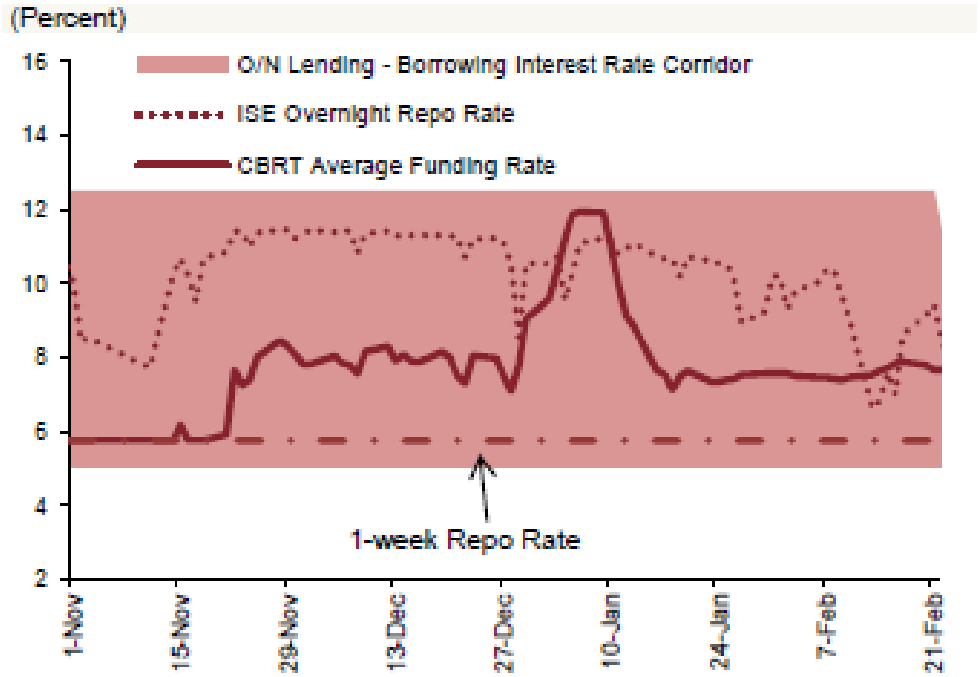


Figure 3.3: Interest rates and repo rates of CBT
Source: CBT, ISE

To summarize, it can be said that in this new setup, the interest rate corridor has an important role in the implementation of monetary policy. This new instrument allows the CBT to "fine tune" the monetary stance on daily and weekly frequencies, gives a quick response to rapid changes in risk appetite and provides flexibility against uncertainties in the global economy.

3.2.1.2 The interaction of interest rate corridor and liquidity policy with the credit channel

In the monetary transmission channel of the traditional inflation targeting framework, current and expected levels of short-term interest rate plot the yield curve and determine the nature of monetary policy which in turn affects banks' lending rates and lending condition. In the adjusted framework, the transmission mechanism works in a similar way in the sense that the average cost of short term funds provided by the CBT is used as a control variable for uncertainties in the global economy. However, unlike the previous framework, the short end of the yield curve is now affected via a combination of liquidity policies rather than just the single policy interest rate. With the help of this framework, the CBT can now frequently control the marginal cost of credit for banks that have a liquidity shortfall with the use of the corridor and liquidity facilities. The most important contribution of this framework is that CBT can change the uncertainty by using the funding rate as a policy tool. For instance, when there is an undesired acceleration (slow down) in credit growth, CBT can increase (decrease) the uncertainty regarding the amount and cost of funding provided to banks and lead to a tightening (loosening) in credit supply. Moreover, implementing high frequency monetary tightening through active use of a wide interest rate corridor can have a crucial effect on the credit supply. In this case, banks usually take the upper limit of the interest rate corridor as a basis when they are pricing the interest rate risk. As a consequence, the mechanism enables the loan rate and loan-deposit spread to be closely related to the upper bound of the interest rate corridor. Thus, in a market which the CBT is a net creditor, it can have a significant effect on credit rates and credit growth. As we can see in Figure 3.4, loan rates exhibited a significant increase after October 2011, when the CBT decided monetary tightening by raising the average funding rate through interest rate corridor (additional tightening) and leaving at the same time the extent and duration of this tightening uncertain (widening the corridor).

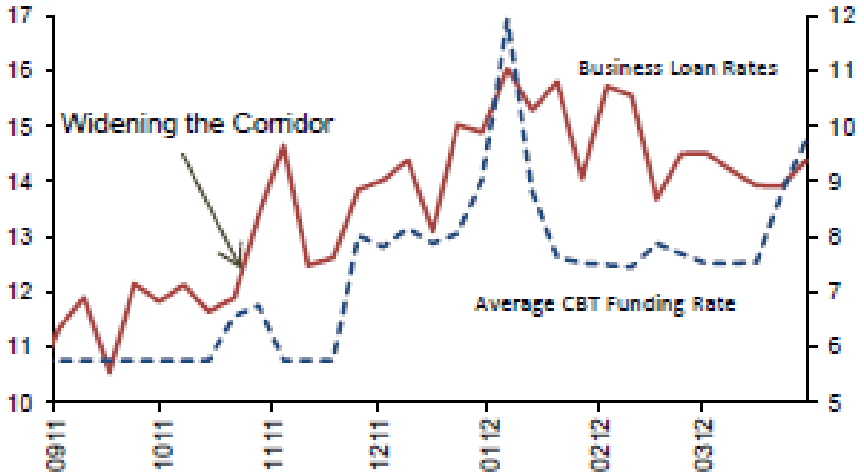


Figure 3.4: TL business loan rate and the average funding rate
Source: CBT

3.2.1.3 The interaction of interest corridor and liquidity policy with the exchange rate channel

Exchange rate channel works mainly according to the uncovered interest rate parity condition. In this framework, an unexpected rise in domestic short-term rates appreciates the domestic currency. With the presence of the interest rate corridor and liquidity facilities, CBT can adjust overnight interest rates on a daily basis in order to smooth out the volatility in short term capital flows and exchange rate. For example, in periods of high global risk aversion, Turkey is likely to experience capital outflows. In such a case, the CBT can prevent an excessive depreciation of the Turkish lira by supplying less liquidity than demanded by the market and let the short-terms rates rise in order to encourage the capital inflow. This policy also works by inducing banks to sell foreign exchange in order to meet the excess demand for foreign exchange which would also mitigate the depreciation pressure on the domestic currency. As we can see from Figure 3.5, following the periods of significant hikes in short term market rates, the Turkish lira exhibits a relative appreciation.

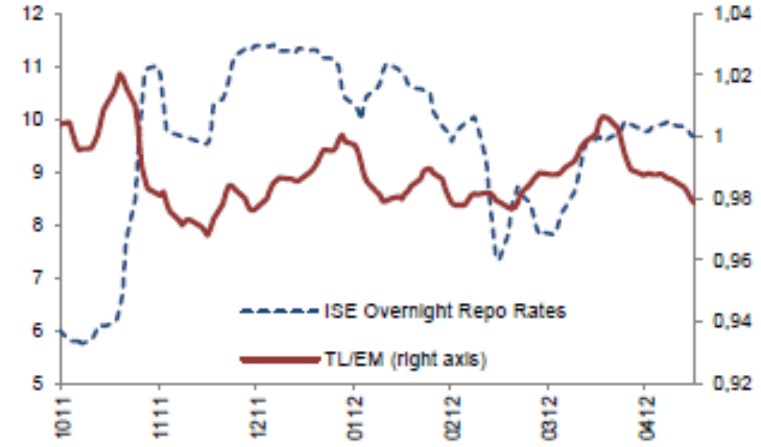


Figure 3.5: ISE overnight repo rates and relative exchange rates
Source: ISE, CBT

CBT can stabilize the exchange rate volatility by changing the width of the corridor. For instance, it is possible to raise the upper bound of the corridor in periods of weak risk appetite in order to limit the amount of capital outflows for a given level of domestic interest rate and country risk premium. On the other hand, by widening the interest rate corridor downwards in periods of strong capital flows, interest rate volatility can be considerably increased. In other words, the system can be adjusted to smooth the flow of capital in both directions of capital flows. In fact, following the widening of the interest rate corridor downwards at the end of 2010, short term interest rate volatility displayed a rise, which contributed to a decline of capital flows. On the other hand, when the corridor was widened upwards in October 2010, exchange rate volatility has displayed a notable decline as can be seen from Figure 3.6.

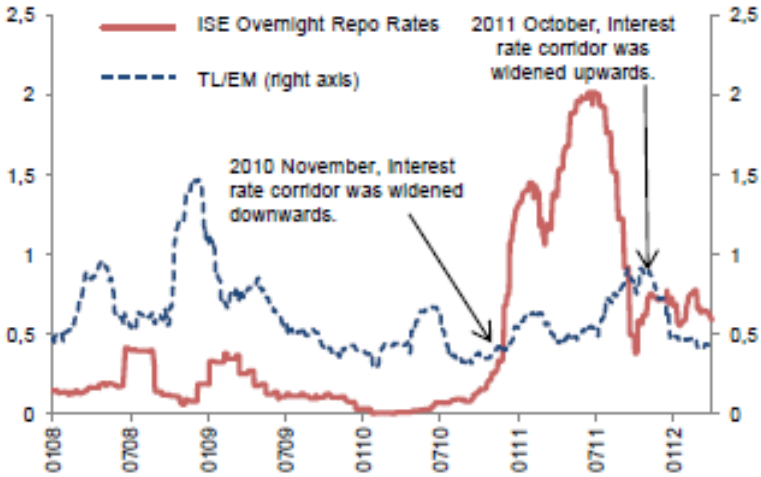


Figure 3.6: ISE overnight repo rates and volatility in TL
Source: ISE, CBT

3.2.1.4 The interaction of required reserve policy with credit and exchange rate channels

In the monetary policy framework, required reserves are mainly used for liquidity management and also for affecting credit supply. When there is an increase in capital inflows, it will eventually increase the credit supply conditions, decrease interest rates and lead to rapid credit growth. The most crucial role of higher required reserve ratio is its ability to limit the acceleration in credit supply by decreasing the macro financial risks. Changes in required reserve ratios directly affect the funding costs of banks by two channels: (i) direct cost channel, (ii) liquidity channel. Banks have a tendency to reflect the changes in required reserves into interest rates on credits and/or deposits (Alper and Tiryaki 2011). However, in an environment of low deposit rates, the additional cost introduced through changes in reserve requirement ratios remains limited. For example, the CBT stopped the remuneration of required reserve ratios as of September 2010 and pulled the weighted averages of required reserve ratios to 13.3 percent until April 2011, which led to a direct cost effect of around 100 basis points (Başçı and Kara 2011). Even if this cost is fully reflected on lending rates by the banks, the effect on credit demand would not be significant, as the sensitivity of credits to interest rates is relatively limited in Turkey (Alper and Tiryaki, 2011). Thus, the effect of required reserve ratios on credits through cost channel would be rather limited. The impact of required reserves on credits is mainly through the liquidity channel, which functions interactively with the interest rate corridor and the liquidity management policies.

Under a conventional inflation targeting regime with short maturity of deposits, the liquidity withdrawn from the market through the increase in required reserve can be easily substituted by the CBT funding, and therefore liquidity channel is expected to be inefficient. Since, under the adjusted monetary policy framework of CBT, the corridor system and the active liquidity management strategy increases the volatility in short term rates by limiting the substitutability of the deposits with the central bank funding. Therefore, in times of additional tightening implemented by the CBT, banks (in the liquidity needs) should act more cautiously against credit expansion. Hence, the effect of required reserves on credit supply would be strengthened through the interest rate corridor. As an additional tool, the CBT allows the banks to keep a certain ratio of Turkish lira required reserves in foreign exchange or gold.

This flexible adjustment which is called the reserve option mechanism (ROM) has the potential to smooth out the effects of fluctuations in capital flows on the exchange rate and financial markets. For instance, when there is a rise in foreign exchange liquidity and a fall in foreign interest rates in times of accelerated capital inflows, banks will keep a larger part of their required reserves in foreign exchange. This can alleviate the appreciation pressure on the exchange rate and can support financial stability by reducing the excess lending in foreign exchange. In that sense, ROM mechanism acts as an automatic stabilizer for the foreign exchange and also reduces the sensitivity of the credits to capital flows.

3.2.2 The transmission mechanism from credit, exchange rates to final objectives

After the explanation of interaction of policy instrument with credit and exchange rate channels, in order to complete the transmission mechanism depicted in Figure 3.1, we will now discuss the second part of the interaction between these two intermediate variables (credit and exchange rate channel) and the final objectives (price stability and financial stability).

3.2.2.1 Effect of credit and exchange rate channels on price stability

The CBT's main interest is ensuring the medium term inflation outlook in line with the inflation target by using two channels: demand and cost channels. Credit plays an important role for the demand channel, while the exchange rate is the main determinant of the cost channel. Credit channel directly affects the aggregate economic activity and the output gap. As we can see from Figure 3.7, there is an upward trend of average credit/GDP ratio in almost all type of country groups besides Turkey since 2010. According to the CBT, this ratio of credit to national income reached 55 percent by the end of 2012 in Turkey which indicates the credit channel has a prominent role in financing consumption and investment. The credit channel is expected to have a greater impact on aggregate demand as financial deepening increases. Therefore, the credit channel is the main transmission mechanism to affect the output gap and medium term inflation dynamics.

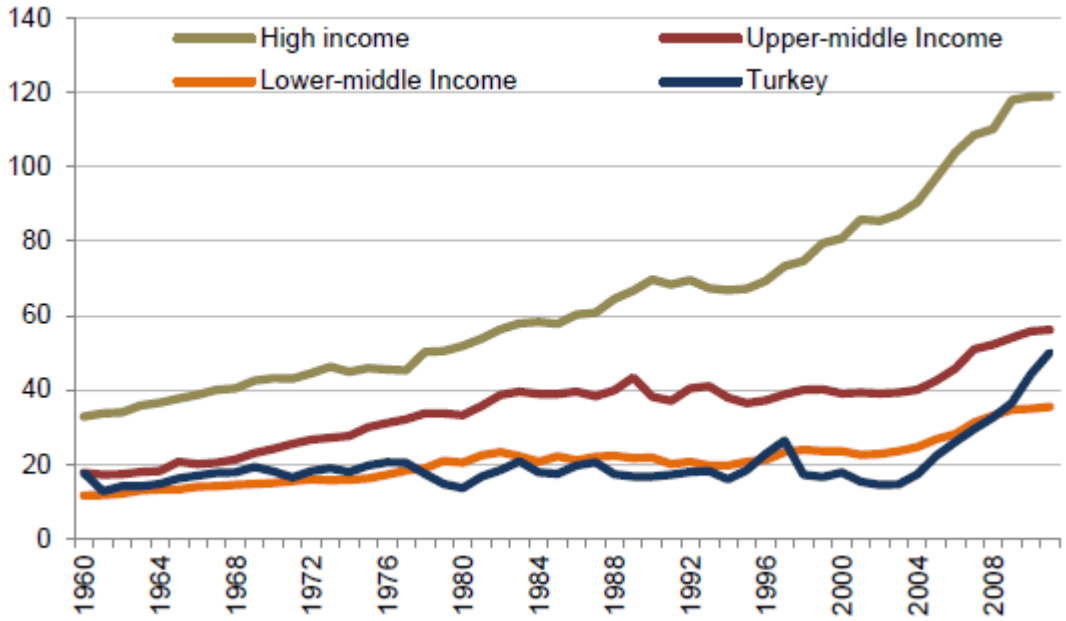


Figure 3.7: Average credit/GDP Ratio by income* groups (percent), *Countries are grouped according to World Bank's most recent income group classification.(July 2012)
Source: World Bank

The exchange rate is the key variable for the cost channel. Since imported intermediate inputs are intensely used in the production sector in Turkey, exchange rate pass-through is typically the main channel for the short term inflation outlook. According to the recent forecasts conducted by CBT, a 10 percent permanent depreciation of the Turkish lira against the Euro-USD basket increases the overall price index by around 1.5 percent over one year's time. A sizable fraction of the pass-through effect is materialized within six months (Kara and Öğünç, 2012). In sum, credit and exchange rates are important determinants of inflation dynamics basically through demand and cost channels.

3.2.2.2 Interaction of credit and exchange rate channels with macro financial risks

Financial stability is a much more complex concept than price stability. As we mentioned in the first section of the present work, main factors affecting the financial stability are rapid credit growth, external imbalances, and misalignment of the exchange rate in the case of Turkey. These symptoms of financial stability are increasingly emphasized in the academic literature in recent years with the primary leading indicators of rapid credit growth and excessive appreciation of the local currency (Tornell and Westermann 2005, Mendoza and Terrones 2008, Mendoza

2009, Jordà et. al. 2011, Reinhart 2012, Gourinchas and Obstfeld 2012, Schularick and Taylor 2012).

In fact, credit and exchange rates directly interact with the current account balance and macro financial risks. For example, acceleration in credit growth increases the expenditures on goods with high import component like durable consumption goods and investments. Moreover, as rapid credit growth can reduce saving rates in the short-term, it directly increases the current account deficit from saving and investment perspectives. As we can see from Figure 3.8, the current account balance exhibits a strong relationship with the credit use in the Turkish case.

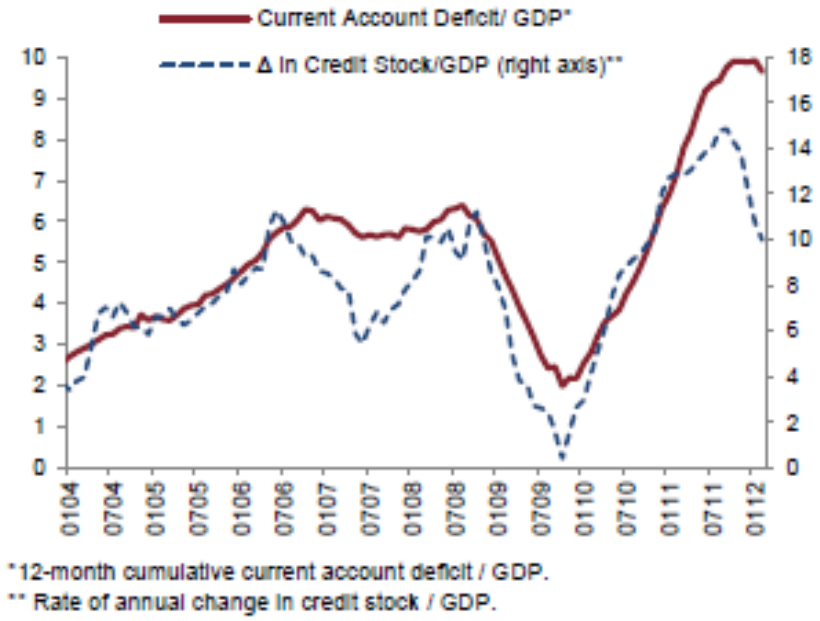


Figure 3.8: Credit use and current account deficit
Source: BRSA, CBT

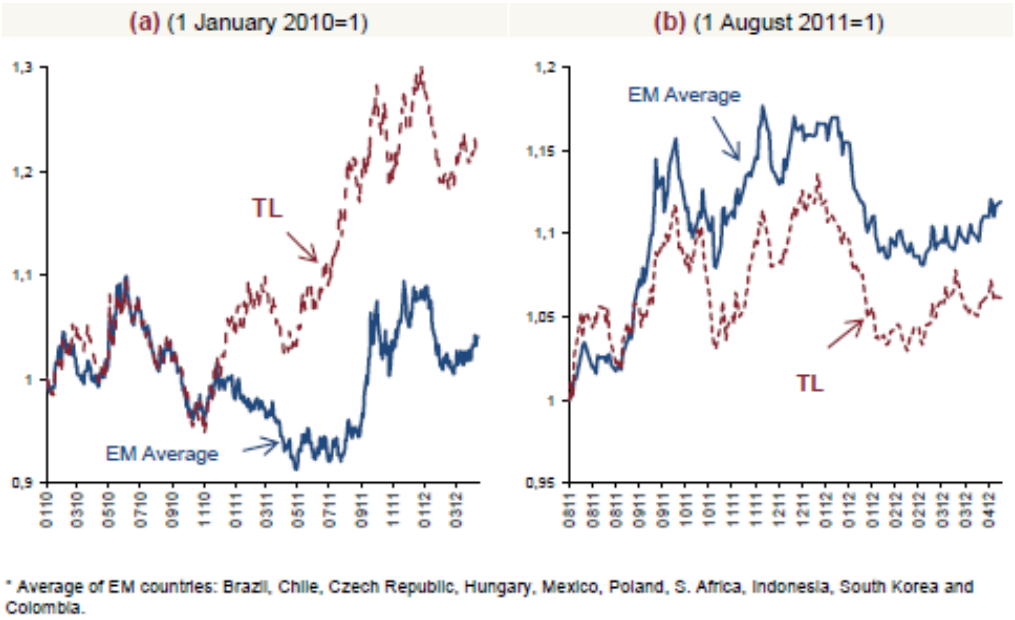
On the other hand, excessive appreciation in the exchange rate accelerates the demand for imported goods. As a result, both credit expansion and over appreciation of the local currency deteriorate the current account balance and may increase the fragility of the economy against abrupt changes in capital movements. Under such circumstances, a monetary authority that attaches some direct weight to financial stability prefers a slower growth in credits and a less appreciated local currency (as the CBT did since the end of 2010) as long as this preference does not conflict with the objective of price stability.

3.3 Implementation of the new adjusted monetary policy

In this section, we summarize the monetary policy strategy that has been implemented by the CBT since the last quarter of 2010 and assess the effectiveness of these policies in attaining final objectives.

3.3.1 The Effect of implemented policies on credit and exchange rate

Since the main focus of CBT is price stability and financial stability, we should evaluate the policy implementations in terms of the effects on these final objectives. However, before evaluation, it is also important to assess the impact of the policies on credit and exchange rates, since these intermediate variables have been playing a crucial role in the transmission and communication of the recent policy mix. The capacity of the monetary policy instruments to affect credit and exchange rates in the desirable way is directly related to credibility of the policies. One of the main goals of the policies implemented since late 2010 was to limit the divergence between domestic and external demand. In order to do this, CBT aimed to have the exchange rates that are in line with economic fundamentals while slowing credit growth to more reasonable levels. As we can see from Figure 3.9, until November 2010 the value of the Turkish lira and the currencies of peer emerging markets moved together. After the implementation of adjusted monetary policy framework, the national currency considerably diverged from emerging market economies. Until August 2011, a period which was marked by the intensification of the Euro area debt crisis, relative depreciation of the Turkish lira reached around 20 percent (Figure 3.9.a). After August, the deterioration in the global risk appetite led to a sharp depreciation in emerging market currencies against the USD but the Turkish lira faced a more limited depreciation (Figure 3.9.b). This observation suggests that policies implemented by the CBT have been useful in strengthening the economy against a shock in domestic financial markets during the Euro area debt crisis. The fact that Turkish lira has already experienced a “correction” before the intensification of the Euro area sovereign debt problems, has limited the risk of a sudden stop in capital flows.



* Average of EM countries: Brazil, Chile, Czech Republic, Hungary, Mexico, Poland, S. Africa, Indonesia, South Korea and Colombia.

Figure 3.9: TL and other EM currencies against USD*
Source: Bloomberg, CBT

Under the new policy framework, exchange rate volatility has been low compared to other emerging economies. In fact, although the Turkish lira depreciated significantly in 2011, its volatility has remained relatively stable (Figure 3.10). More importantly, in the period which was marked by higher sovereign debt problems in the Euro area (from August 2011 to the end), the rise in the volatility of the Turkish lira was significantly lower among peer currencies.

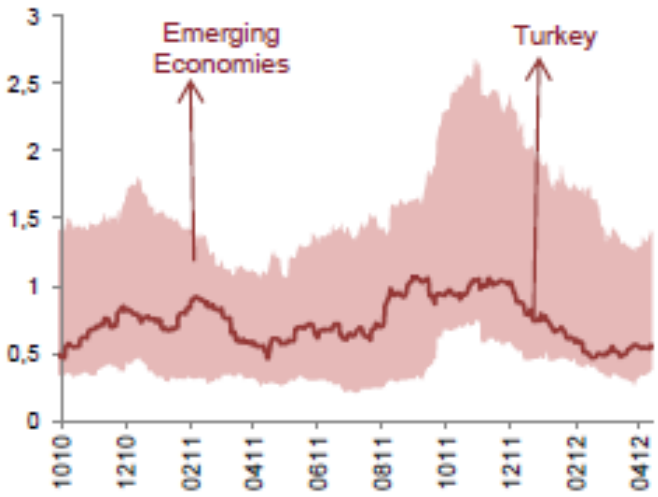


Figure 3.10: Relative volatility of TL
Source: Bloomberg, CBT

Following the adoption of the new policy framework, credit growth has also moved towards the desired direction. Figure 3.11 shows the monthly path of credit

growth. It suggests that credit volumes experienced gradual slowdown following the CBT's policy response since the end of 2010. The slowdown in credit growth has become more pronounced with the measures taken by the Banking Regulation and Supervising Agency as of mid 2010. Credit growth lost further momentum after October 2011 following the upward widening of the interest rate corridor and tightening in liquidity conditions. Thus, credit growth has moved to more reasonable levels in the context of financial stability

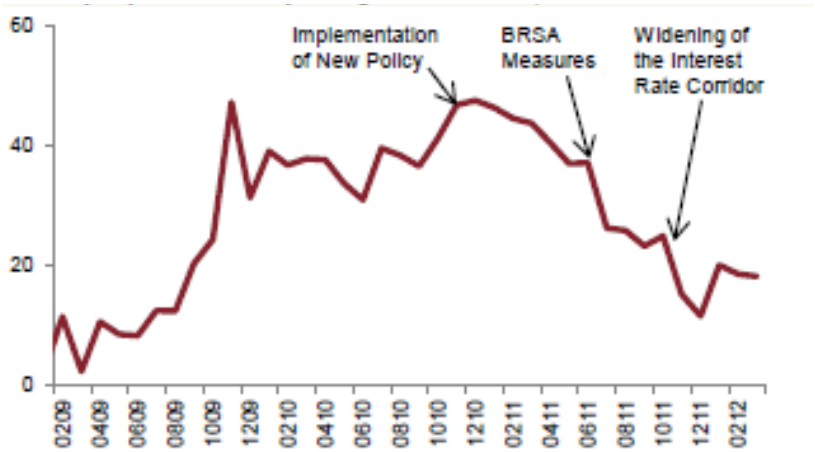


Figure 3.11: Growth trend in consumer credits
Source: CBT.

3.3.2 The Effect of implemented policies on final objectives

The effectiveness of recent policies should be evaluated with respect to achieving final objectives rather than the impact on intermediate variables. Thus, in the next section, the outcomes of the new policy mix are assessed in terms of attaining the final objectives.

3.3.2.1. Financial stability: Rebalancing and soft landing

To motivate the new policy framework, the CBT underlined the importance of rebalancing and soft landing. "Rebalancing" means to change the composition of the growth towards net exports whereas "soft landing" refers to limit the cyclical component of the current account deficit. Figure 3.12 indicates that the current account deficit has started to decline beginning form the mid 2011. Moreover, there is a notable improvement in the quality of the current account financing as can be seen by Figure 3.13. By the end of 2010, almost all the financing was through short term capital inflows and portfolio movements. After the adoption of the new policy

mix, the ratio of foreign direct investments and long term borrowing has increased. These developments suggest that the policies implemented by the CBT were quite effective in terms of financial stability.

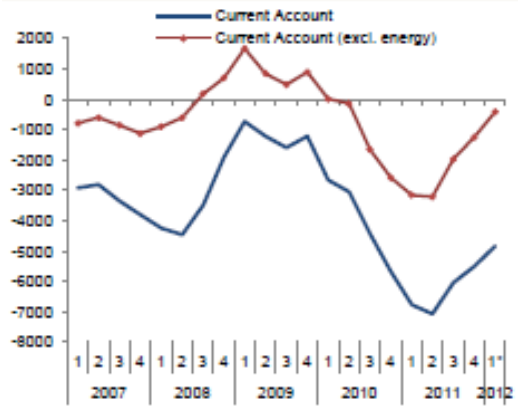


Figure 3.12: Current Account Balance (Million USD)
Source: TurkStat, CBT

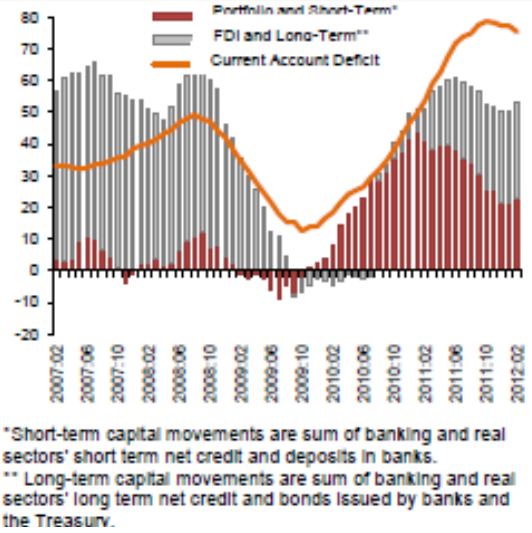


Figure 3.13: GDP nad final domestic demand
Source: TurkStat, CBT

Figure 3.14 illustrates the evolution of exports and imports after the adoption of the new policy mix. In order to analyze the rebalancing target, imports have fallen in real terms while exports have maintained their upward trend. As a consequence, there has been a notable increase in the contribution of net exports to growth. The shift in the composition of growth can be also observed in Figure 3.15 through the developments in domestic final demand and the GDP. Final domestic demand (consumption and investment) has followed a flat course since the first quarter of 2011, while GDP continued to grow. In other words, contrary to the previous periods, the improvement in the current account deficit did not occur with the contraction of GDP. This observation also confirms that the policies implemented were quite successful in rebalancing the economy and reducing the risk of a sudden stop.

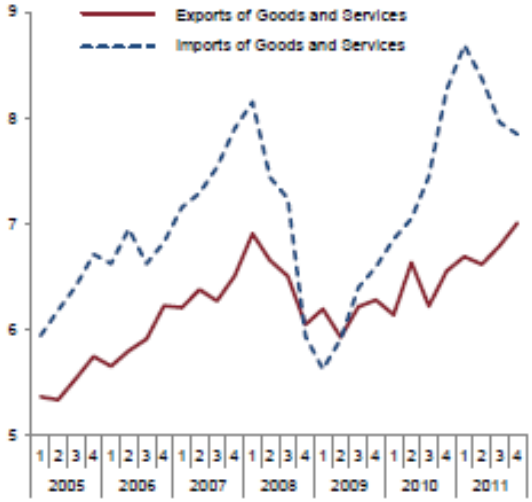


Figure 3.14: Real exports and imports (1998 prices, Billion TL)
Source: TurkStat, CBT

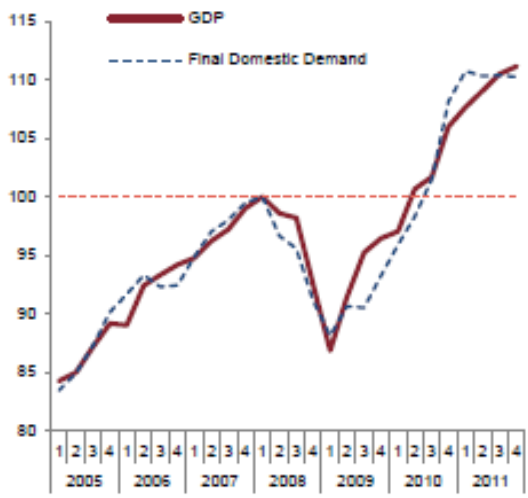


Figure 3.15: GDP and final domestic demand (1998)
Source: TurkStat, CBT

3.3.2.2 Price Stability

After the adjusted monetary policy framework, inflation jumped to 10.5 percent at the end of 2011, leading to a significant overshooting of the official target of 5.5 percent due to the many adverse factors during the last quarter of 2011. At first glance, high levels of inflation in 2011 may imply that the policy mix has worsened price stability in exchange of financial stability. However, two important factors should be taken into consideration when interpreting the inflation dynamics: Firstly, a rough accounting shows that almost half of the inflation in 2011 can be explained by increases in prices of imports, administered products and unprocessed food (see table 3.1) because of the global crises. Inflation decreased to 6.2 percent in 2012. However, the value of inflation in 2012 overshoots the official target of 5 percent, it has a downward path as it is expected.

Table 3.1: Decomposition of 2011 inflation

2011 Inflation	10.5
Contribution of Import Price Pass-Through	2
Contribution of Unprocessed Food Prices	2
Contribution of Tax Increases in Tobacco Prices	1.1

Source: CBT

Secondly, Figure 3.16 shows the inflation realizations and medium term (two years ahead) expectations. Inflation expectations have recently followed a fairly

stable course. The behavior of inflation expectations exhibit a notable change compared to the past episodes of 2006 and 2008 when medium term expectations had deteriorated considerably. However, following the rise in 2008 inflation expectations remained quite stable after the adjusted policy framework.

Figure 3.16: Inflation and medium term expectations
Source: TurkStat, CBT

All in all, medium term inflation expectations seem to be anchored despite the upsurge in inflation in 2011. This observation indicates that the CBT did not hamper price stability objective while dealing with financial stability.

3.4 Concluding remarks

CBT is mainly inspired from two factors while designing the new approach: (i) the changing attitude of central banking at a global scale, (ii) the extraordinary global conditions and higher volatility of capital flows. Since the policy framework is relatively new, implications can be discussed only by descriptive approach for the moment. It is substantial to emphasize that new policy mix implemented by the CBT has been successful in achieving soft landing and rebalancing of the economy without contradicting the price stability objective. According to CBT, for the first time in the recent history of the Turkish economy, current account deficit started shrinking without undergoing a crisis. All these adjustments done by CBT deserves a close attention as an example of how the existing inflation targeting frameworks can be modified to take into consideration both price and financial stability.

CHAPTER 4. OPTIMAL MONETARY POLICY WITH CONCERNS ON FINANCIAL STABILITY

This chapter first discusses both empirical and theoretical articles under the literature of optimal monetary policy and financial stability. Then, we propose a model of optimal monetary policy with financial concerns for the case of Turkey. We will introduce our setup and discuss the impact of financial stability concerns on optimal monetary policy.

4.1 An Overview of the Literature

According to mainstream economics, the main long run role of monetary policy is to determine the level of inflation since it does not affect output in the long run. However, in the short run, policy influences the variability of both output and inflation around their average levels. A good monetary policy is one that produces low average inflation and also keeps output and inflation as stable as possible. Whether these goals are best achieved under discretion or commitment has been a controversial subject among economists.

4.1.1 From discretionary monetary policy to rules and commitment

Under a discretionary regime, monetary authority makes no commitment about future money supply and prices. Monetary authority can print money and create more inflation than people expect. The benefits from this surprise inflation may include expansions of economic activity through lower real wages as well as reductions in the real value of government's liabilities. However, because people anticipate the policy maker's incentives, these types of surprises and their resulting benefits can not arise systematically in equilibrium. People adjust their inflationary expectations in order to eliminate a consistent pattern of surprises. In this case, the potential for creating inflation shocks, ex post, means that, in equilibrium, the average rates of inflation and monetary growth as well as the corresponding costs of inflation will be higher than otherwise without achieving a better employment performance (Barro

and Gordon, 1983). If there is an enforced commitment on monetary behaviour defined as monetary or price rules, the potential for ex post surprises are reduced. Therefore, the equilibrium rates of inflation and monetary growth can be lowered by shifts from monetary authorities that allow discretion to ones that enforce rules. In this framework, expectations gain importance in the sense that credibility of future policy intentions become a critical issue as emphasized by Prescott and Kydland (1977) who considers the rules as a form of commitment. A commitment amounts to a binding contract which specifies in advance the actions that someone will take. In contrast, under discretion, a person promises only to take those future actions that are best for his further objectives later on. Thus, discretion is the special case of a rule or contract in which none of today's provisions restrict a person's future actions. This concept boils down to comparing monetary policy under discretion against commitment. The key distinction between discretion and rules is whether current commitments constrain the future course of policy in any credible way. Under discretion, a perceptive private sector forms its expectations taking into account how the monetary authority adjusts policy, given that the central bank is free to reoptimize every period. In contrast, under a rule, it is simply the binding commitment that makes the policy viable in equilibrium.

The equilibrium under discretion involves high inflation in contrast to the equilibrium under rules, but no tendency toward surprisingly high inflation. Hence, the economy suffers the costs from high inflation, but secures none of the benefits from inflation surprises. Clearly, the policymaker can improve on this outcome by committing himself ex ante to low inflation. If this commitment is credible – that is if it is adequately enforced - then people also anticipate low inflation. Therefore, the equilibrium would exhibit low and stable inflation, with the same average amount of inflation as before. The issue raised here is more generally called as the time inconsistency of optimal policy. (for example, the government may announce that it will not tax capital in order to encourage accumulation; but once the capital is in place, the government may be tempted to renege on its premise because the taxation of existing capital is non-distortionary.) For this issue, the solution is to take away the monetary authority's discretionary power by binding it to a fixed policy rule which yields support for "constant-growth-rate-rule", although applied to prices rather than to the quantity of money per se (Barro, 1986).

4.1.2 From rules to optimal monetary policy

In order to accomplish the goals of monetary policy which are defined as low average inflation along with stable output and inflation levels, many economists argue that they are best achieved if money authorities follow a simple policy rule. In the 1960s and 1970s, there was a strong interest in a rule prescribing a fixed growth rate for money supply. Interest in money growth rules has waned because of apparent instability in money demand (Ball, 1999). Historically, many countries have based policy on exchange rate targets, but few economists currently advocate this approach for major developed countries. This leads to a search for new policy rules among both academic economists and central bankers.

This interest in the study of monetary rules has increased over the past decade, for reasons having to do with progress in central banking as well as in macroeconomic theory. On the one hand, many central banks have adopted inflation targeting approach while some others advocate for a policy that has not yet been tried such as targets for the growth of nominal GDP (see, Mc Callum 1994, Hall and Mankiw 1994). The inflation targeting banks have increasingly come to organize their deliberations around an attempt to conform to specific targets or objectives, sometimes explicit quantitative targets as in the case of Central Bank of New Zealand and Canada in the early 1990s and seven other countries followed (Kahn and Parrish, 1998). This widespread approval of inflation targeting approach is adopted by a number of industrialized countries in order to add transperancy, discipline and coherence to the monetary policy (see, for example Bernanke and Mishkin, 1997). Furthermore, another group advocates a "Taylor rule" in which interest rates are adjusted in responses to movements in output and inflation. No central bank has explicitly adopted a Taylor rule, but the behaviour of interest rates in the United States and several other countries closely mimic their behaviour under such a rule (Taylor 1993). Taylor suggested that monetary policy could be explained by a rule that links central banks' policy rate to deviations of inflation and output from their target and potential levels respectively. In broad literature survey, such basic rules explain at most two thirds of the empirical variance of interest rate changes (Svensson, 2003). The unexplained part includes discretionary policy making but it can also be seen as a measure of our ignorance about the actual rules used by policy makers. As for the Euro zone, the European Central Bank decided to adopt an

explicit inflation targeting regime, a narrow formulation of the target would appropriately serve the medium run objective of price stability stipulated by the Maastricht Treaty and subsequently reinforced by the Governing Council of the ECB.

This rebirth of interest on monetary policy rules has been influenced from two main factors. First, after the dominance of nonmonetary factors in the business cycle, a stream of empirical works has shown that monetary policy influences the short term course of the real economy. Most of these studies have focused on the effects of monetary shocks on real activity. Bernanke, Gertler and Watson (1997) present evidence suggesting that monetary policy rule may have an important effect on real activity. Second, there has been a substantial improvement in the underlying theoretical frameworks used for policy analysis. The main logic of the transition process from monetary policy rules to optimal monetary policy is that optimal monetary policy maximizes the welfare of a representative agent, given frictions in the economic environment. Although, monetary policy rules stipulate how much the central bank should change the nominal interest rate in response to changes in inflation, output or other economic conditions, they have no concern of optimizing the behavior of each agent in the economy. The need for the optimal policy emerges after the existence of the theoretical basis. The literature has incorporated the techniques of dynamic general equilibrium theory pioneered first in real business cycle analysis (RBC) then in New Keynesian (NK) analysis. One key element of the RBC theory is the intertemporal optimization approach to consumption and labor supply. Another one is the similar intertemporal analysis of investment and labor demand arising from the profit maximization decisions of the firms. In Prescott (1986) and Plosser (1989), the basic RBC model seems to be capable of generating business cycles. In the RBC model, productivity shocks have two sets of effects on output. First one is the mechanical increase or decrease through Solow decomposition. Second, productivity shocks also exert effects on macroeconomic activity because they affect marginal productivity. These marginal influences interact with the households' preferences to govern the dynamic response of the economy. Early in the RBC, a monetary sector is added to explore the types of business cycle correlations between money supply and output that could emerge if productivity shocks are the main driving factors (King and Plosser, 1994). At a later stage of research, the effects of inflation tax are explored (Cooley and Hansen, 1991). From

this research and other works, a number of conclusions have emerged that are broadly shared by macroeconomists. Firstly, according to the RBC research, endogenous variations in money supply arising from the actions of private banks and monetary authority at least partly explain the business cycle correlation of money and output. Secondly, although they can explain the correlation of money and output, they do less well at explaining cyclical variation in real and nominal interest rates suggesting that there is more to the cycle than real productivity shocks that cause variation in money (Sims, 1992). Finally, the predicted consequences of cyclical variations in expected inflation are quantitatively small within flexible-price models, if money demand is introduced through "cash in advance" assumption or with an explicit transactions technology. That is, for business cycle purposes, an RBC model with an explicit monetary mechanism works a lot like an RBC model with a money demand function just tacked on after a real general equilibrium analysis. The NK approach to macroeconomics evolved in response to the monetary controversy and to fundamental questions raised by Lucas critique[1] and in order to provide an alternative to the flexible-price and perfect-competition framework of RBC analysis. In the first generation of New Keynesian models, Gordon (1982) and Taylor (1980) modernized the specification of the wage-price block to incorporate monetarist and rational expectations insights. In the second generation New Keynesian models, New Keynesian economists shifted the location of nominal stickiness from wages to prices. In this new work, price setting firms were explicitly modeled as monopolistic competitors. The imperfect competition framework was used to explain the real output effect of money. As a third stage of research, models of price dynamics on fixed real costs of changing nominal costs were developed in the early 1970's. In these models, firms choose the timing and magnitude of their price adjustments in response to the state of economy, including the average rate of inflation and the stage of business cycle. This state dependent approach to pricing is attractive from a microeconomic perspective because individual firms are observed to discretely adjust their prices at infrequent intervals of apparently stochastic length and firms are more likely to adjust price when there are sustained inflation and large shocks to their markets. The features of the NK approach to monetary policy analysis adopt many of the tools originally associated with RBC theory which includes the use of dynamic

[1] The Lucas critique (Lucas, 1976), argues that it is naive to try to predict the effects of a change in economic policy entirely on the basis of relationships observed in historical data, especially highly aggregated historical data.

stochastic general equilibrium (DSGE) models based on optimizing behavior by households and firms with rational expectations, market clearing, etc. It differs from RBC models by introducing monopolistic competition. In NK models, nominal rigidities are a key element of the model and a main source of monetary policy non-neutrality. They are generally introduced in the form of constraints on the frequency with which firms and/or workers can adjust their nominal prices and wages, respectively. An implication of such constraints is that price and wage-setting decisions become forward-looking, since agents recognize that the prices/wages they set will remain effective beyond the current period and emphasis is on the endogenous component of monetary policy (i.e. monetary policy rules) and the consequences of alternative specifications of that component, rather than on the effects of exogenous changes in a monetary policy instrument. The development of a new generation of quantitative macroeconomic models that can be estimated using macroeconomic time series and have optimizing agents that allow an explicit evaluation of outcomes in terms of individual welfare, has allowed modern macroeconomic analysis to have a role on the evaluation of stabilization policies, in the context of models with sufficient claim to quantitative realism to be of interest to policymaking institutions. This extension of the analysis of optimal monetary policy rules brings the theoretical literature into closer contact with the practical concern of modern central bankers.

The optimal monetary policy implications can be divided into two branches. First branch is the conventional monetary policy which has been used until late 2007 and early 2008. The conventional monetary policy incorporates the idea that monetary policy mainly acts by setting a target for the overnight interest rate in the interbank money market and adjusting the supply of central bank money to that target through open market operations. In normal times, the central bank is neither involved in direct lending to the private sector or the government, nor in outright purchases of government bonds, corporate debt or other types of debt instrument. By steering the level of the key interest rates, the central bank effectively manages the liquidity conditions in money markets and pursues its primary objective of maintaining price stability over the medium term. This has proved to be a reliable way of providing sufficient monetary stimulus to the economy during downturns and of limiting inflationary pressures during upturns as well as of ensuring the sound functioning of money markets. The second branch is the unconventional monetary

policy which has emerged after the global financial crisis in US which occurred in the late 2007. Since then, conventional monetary policy turned out to be insufficient to achieve the Central Bank's objective. Unconventional monetary policy measures briefly include a broad range of measures aiming at easing financial conditions and achieving also financial stability along with the price stability. The remainder of this section will be dedicated to the discussions of the conventional and unconventional monetary policy frameworks respectively as well as their implications.

4.1.2.1 Conventional Optimal Monetary Policy

For achieving optimal monetary policy, we have to consider the desirability of the observed tendency of central banks to adjust interest rates in response to changes in economic conditions. A common view is that central banks are too slow to respond to new information that indicates the inappropriateness of current policy. Goodhart (1998) argues that, even though the interest rate is easy to forecast, observed delays in central bank decisions which are predicted weeks or months earlier by the private sector can be interpreted as a proof for the slow adaptation of the central bank. In addition to this view, it is also said that central banks seek to smooth interest rates in order to minimize the volatility of interest rates. There are several reasons why central banks should not prefer policies that require an excessively variable short term interest rate. First one is the zero nominal interest rate floor (results from the availability of cash as a riskless, perfectly liquid zero-return asset) which means that rates cannot be pushed below zero. This means that a policy consistent with a low average rate of inflation and nominal interest rates, can not involve interest rate reductions in response to deflationary shocks that are ever too large (Summers et. al., 1991; Rotemberg and Woodford, 1997). Second one is the fact that high nominal interest rates always imply distortions, as resources are wasted on unnecessary efforts to economize on cash balances. Thus, it is also desirable on this ground for monetary policy not to raise nominal interest rates too much in response to inflationary shocks (Friedman, 1969). These arguments lead to a new question in the literature which is called as "interest rate smoothing" behaviour of the Central Bank. That is, policy interest rate is a weighted average of some desired value that depends on the state of the economy and the lagged interest rate where the relative weights depend on the smoothing parameter. Whether the past interest rates should be of significance in determining the optimal current level of interest rate

perspectives has been argued for a while (for example Mankiw, 1987). In conclusion, according to Woodford, this argument stems from a misunderstanding of the kind of optimal control problem that a central bank faces. In particular, central banks fail to take proper account of forward looking character of private sector behaviour. Another important complication is that private sector behaviour or all other players' behaviour depends on the expected course of monetary policy, as well as the current monetary policy. Thus, credibility of monetary policy becomes relevant as a considerable contemporary literature has emphasized[2]. From this perspective, Kydland and Prescott (1977) emphasized that credibility of future policy intentions becomes a critical issue. For example, a central bank who can credibly signal its intent to inflation rates in the future may be able to reduce current inflation level with less cost in terms of output reduction than otherwise be required[3]. From the standpoint of policy design, credibility – enhancing commitment may not always be necessary for example in Kydland and Presscot (1977). Central Bank's loss increases with a deviation from the inflation and output targets. Therefore, the rule is already credible; there is no need for a credibility enhancing constraint (commitment). In contrast, whenever the CB has the opportunity to deviate from the rule, a commitment will be necessary to enhance credibility. Several papers analyze the necessity of commitment policy. This question boils down to comparing optimal monetary policy under discretion versus rules. A central bank operating under discretion chooses the current interest rate by re-optimizing every period whereas a central bank operating under a rule chooses a plan for the path of the interest rates that it is planning to stick forever. Since the pioneering work of Kydland and Presscot (1977), Barro and Gordon (1983) and Rogoff (1985), voluminous literature has developed on the issue of credibility of monetary policy[4]. This literature is divided into two strands. The first emphasizes the problem of persistent inflationary bias under discretion[5]. The ultimate source of this inflationary bias is a central bank that desires to push output above its natural level. Traditional theories suggest that inflationary bias will exist when monetary and fiscal policy is discretionary rather than rule based. Others have suggested that the inflationary bias exists even when

[2] For a survey of credibility literature, see Persson and Tabellini (1997).
[3] The issue of credibility is not tied to central bank objectives over output. In the Classic Barro/Gordon (1963), the central banks's desire to push output over potential output gives rise to the credibility problem.
[4] For surveys of the literature, see Fisher (1995), Mc Callum (1997) and Persson and Tabellini (1997)
[5] In addition to inflation bias, there may be also other costs of discretion. Discretion may lead to excessive variation in inflation and to little variation in output. (See, Svennson 1997c)

policy makers do not seek to push employment beyond its natural rate, and when their policies are based on rules. The second is the fact that disinflating an economy may be more painful than necessary, if monetary policy is perceived as not devoted to fighting inflation. Here the source of the problem is simply that the wage and price setting today may depend upon beliefs about where prices are headed in the future and in turn depends on the course of monetary policy. Although, they both suggest that a central bank can establish credibility one way or another and may be able to reduce inflation at lower cost, the sources of the above mentioned problems differ in each case.

A number of practical differences in interpreting the central bank behavior lead to various modeling techniques. For example, when the slow adjustment of the price level is due to imperfect information by decision makers in firms, the optimal monetary policy may depend on how much attention the firms devote to aggregate conditions (Paciello and Wiederholt, 2010). Furthermore, in some cases, even if central bank has access to data in real time, some key variables such as the natural level of output are not directly observable and are likely to be measured with great error (see Estrella and Mishkin, 1998 and Orphanides 1997). Moreover, information about the impact of current monetary policy on inflation is only available with a long lag which makes monitoring policy performance impossible (Svensson, 1997). Model uncertainty is another problematic issue on the implementation of optimal monetary policy which requires a change in the modeling technique and it is generally defined as a situation in which the monetary authority is not sure of the adjusted policy impact on the economy. An interesting illustration of this point is Rotemberg and Woodford (1997) who estimate an optimal interest rate policy. The historical interest rate displays much less volatility than the optimal interest rate. This finding is common in the sense that it generates high interest rate volatility under an optimal rule. Another aspect of policy that has received considerable attention involves the process of disinflation opportunism (Orphanides and Wilcox, 1996). In a traditional optimal policy model, if inflation is above the target, it is always optimal to tighten monetary policy to gradually bring inflation back to the optimum. However, Blinder (1997) suggests that if inflation is above but near the optimum, policy should not contract demand. It should rather take an opportunistic approach which boils down to waiting until achieving the inflation target could be done at the least cost in terms of incremental output reduction. Whereas, Blinder's original

concept is vague in details, Orphanides and Wilcox (1996) show that it is possible to rationalize something like opportunistic policy by making a small adjustment of the policy objective function. This is true in particular, when policy makers care quite a lot about small departures of output from target, at least relative to small departures of inflation or vice versa.

Another important aspect to take into account when analyzing optimal monetary policy is the openness of the economy. Specifically, the main question is whether rules designed to fit specific closed countries may be successfully adopted by open, interdependent, trade-oriented countries or does openness imply any policy trade-offs that have specific international dimensions[6].

In order to make an introduction to the literature, we analyze a number of recent contributions with which the model presented in this dissertation shares some common characteristics on optimal monetary policy in closed or open economies. It is useful to start with the presentation of a benchmark model of optimal inflation and output determination under alternative monetary policies, where monetary policy is specified in terms of a feedback rule for a short term nominal interest rate instrument. We will take Clarida et al. (1999) as a benchmark model to compare with the other similar recent analyses of optimal monetary policy rules in closed economy, including Moore (1972), Woodford (2001) Clarida et. al. (2002) and Gali (2008). As explained in Clarida et. al. (1999), the baseline framework is a dynamic general equilibrium model with money and temporary price rigidities. Within the model, monetary policy affects the real economy in the short run as in the traditional Keynesian IS/LM model. The novel feature of the model is that the aggregate behavioral equations are derived explicitly from optimizing households and firms. According to the reference model, current economic behaviour depends on expectations of the future course of monetary policy as well as on current policy. The key aggregate relationships of the baseline model are given as below,

(i) $$x_t = -\varphi[i_t - E_t\pi_{t+1}] + E_t x_{t+1} + g_t$$

(ii) $$\pi_t = \lambda x_t + \beta E_t \pi_{t+1} + u_t$$

[6]See Corsetti and Pesenti, 2004, Ball 1999, Benigno and Benigno 2003, Carlstrom and Fuerst 1999, Clarida, Gali and Gertler 2001, Devereux and Engel 2003, Gali and Monacelli 2002, Ghironi and Rebucci 2002, Laxton and Pesenti 2003, McCallum and Nelson 1999, Obstfeld and Rogoff 2000, 2002, Parrado and Velasco 2002, Sutherland 2001, Svensson 2000 and Walsh, 1999 for further examples.

In our benchmark model, the natural level of output is defined as the level of output that would arise if wages and prices were perfectly flexible. The gap between actual and natural level of output is an important variable which is represented by x_t. This equation represents an "IS" curve that relates the output gap (x_t) inversely to the real interest rate ($i_t - E_t\pi_{t+1}$) and positively to the expected future output gap, where E is the expectations operator. The disturbance g_t is a function of expected changes in government purchases relative to expected changes in potential output. It is possible to interpret g_t as a demand shock that shifts the IS curve. This IS curve differs from the traditional IS curve mainly because current output depends on expected future output. Specifically, higher expected future output raises current output. Since, individuals prefer to smooth consumption, expectations of higher consumption next period induce them to consume more today, which raises current demand. The negative effect of the real rate on current output reflects intertemporal substitution of consumption. In this framework, φ corresponds to intertemporal elasticity of consumption substitution.

Equation (ii), the Philips curve, is derived from staggered nominal price setting in the spirit of Fischer (1977) and Taylor (1980). A key difference is that individual price setting decision of firms, which provides the basis for equation (ii), is derived from an explicit optimization problem. The starting point is an environment with monopolistically competitive firms: When it has the opportunity, each firm chooses its nominal price to maximize profits subject to constraints on the frequency of future price adjustments. This problem is simplified by Calvo's formulation (1983) which captures the spirit of staggered setting, but facilitates the aggregation by making the timing of a firm's price adjustment independent of its history. Equation (ii) is obtained by taking a log-linear approximation around the steady state after aggregating the firms' individual pricing decisions. Since the equation relates the inflation rate to the output gap (x_t) and expected inflation ($E_t\pi_{t+1}$), it is a traditional expectations-augmented Philips curve (Blanchard, 1997). A key difference from the standart Philips curve is the expected future inflation which enters the equation additively. Furthermore, the model allows for the cost push shock (u_t) to enable the model to generate variation in inflation that arises independently of movements in excess demand.

Nominal interest rate is taken as the monetary policy instrument as opposed to a money supply aggregate. With the nominal interest rate as the instrument, it is not necessary to specify money market equilibrium (i.e., an LM curve). In contrast to the traditional mechanism, beliefs about how the central bank will set the interest rate in the future also matter, since both households and firms are forward looking. The policy objective of the Central Bank translates the behavior of the target variables into a welfare measure to guide the policy choice. The objective function of this model takes the following form:

(iii) $\text{Min}\ \frac{1}{2}\ E_t\ \sum_{i=0}^{\infty}\beta^i[\alpha x_{t+i}^2 + \pi_{t+i}^2]$

In equation (iii), the parameter α is the relative weight on output deviations. Since x_t is the output gap, the model implicitly take zero as the target inflation. There have been some recent attempts to derive the welfare criterion from the individual utility function of the representative household instead of simply postulating the loss function. There are different types of loss functions depending on the critical assumptions of the related models. For example, in some cases there may be a concern of monetary authority to minimize the output gap from a constant target value other than zero as can be modeled using equation (iv) below:

(iv) $\text{Min}\ \frac{1}{2}\ E_t\ \sum_{i=0}^{\infty}\beta^i[\ \alpha(x_{t+i} - x^*)^2 + \pi_{t+i}^2\ ]$

Another limitation of this approach is that the models do not seem to capture what many would argue as major costs of inflation on lifetime financial planning, taking a hypothetical household behaviour. For these deficiencies, various kinds of objective policy loss functions are suitable to analyze various monetary policy issues such as discretionary policy vs. rules, credibility and the gains from commitment, inflationary bias problem etc. For this, it is sufficient to adopt the loss functions to the problem that needs to be analyzed. For example, when there is a possibility that the target for output gap is higher than zero, the loss function takes the form below;

(v) $\text{Min}\ \ \frac{1}{2}\ E_t\ \sum_{i=0}^{\infty}\beta^i[\alpha(x_{t+i} - k)^2 + \pi_{t+i}^2]$

Another form of the loss function can imply an opportunistic policy as mentioned earlier. If policy makers care quite a lot about small departures of output

from target, at least relative to small departures of inflation, the loss function takes the form below:

(vi) $$\text{Min } \frac{1}{2} E_t \sum_{i=0}^{\infty} \beta^i [\alpha |x_{t+i} - k| + \pi_{t+i}^2]$$

When there is zero bound on nominal interest rates, the loss function can be adjusted by taking the below form:

(vii) $$E_t \sum_{i=0}^{\infty} \beta^i \left[\lambda_y (x_t - x_t^n - x^*)^2 + \lambda_i (i_t - i^*) + \pi_t^2\right]$$

In this case, incomplete inflation stabilization will be preferable to complete stabilization at higher rate. For each loss function, optimal values will differ.

Moore (1972) explores which monetary policy instrument should be preferred for monetary policy with stabilization purposes. For this, the author compares the income variance when money supply is the policy instrument to that when the interest rate is the central bank's instrument. The setup involves a dynamic LM curve composed of a money demand equation and a money market identity. The equations for investment, consumption and income identity form the IS curve. Since the model seeks the policy instrument that minimizes the variance of income rather than an optimal monetary rule, the setup does not include a loss function. Moore (1972) finds that the choice of monetary policy instrument (money supply or the interest rate) depends generally on the structure of the system, the relative magnitude and covariance's of disturbances in different sectors, the relative costs of stochastic movements in the money stock and interest rates. When the money stock is the control variable, successful stabilization policy requires countercyclical fluctuations of the money stock. When the level of interest rates is the control instrument, successful stabilization policy requires procyclical movements in the level of interest rates. Moore (1972) assumes backward looking framework in order to have a tractable model with the help of values of lagged and behavioral parameters which seem plausible in the light of limited knowledge of the structure of the economic system. The framework proposed in this dissertation and presented in the next section, differs from above mentioned model in that we assume a forward looking evolution of both IS equation and Philips curve. We intend to capture the fact that

households and firms take into account the future expected changes when they are shaping their current behaviour.

Woodford (2001) investigates the qualitative features of the Taylor rule and attempts to find a desirable policy that is likely to be robust to a variety of model specifications. The setup proposed by Woodford (2001) consists of two main equations. First one is an intertemporal IS equation almost the same as our reference model (see equation iii) in main logic. But it differs in terms of the definition of output. In this model, IS equation is given as below;

(viii) $$y_t = E_t y_{t+1} - \varphi[i_t - E_t \pi_{t+1}] + + g_t$$

In this IS equation, y_t denotes actual output (relative to trend) and not the output gap (the difference between actual and potential output level) as in our benchmark model. The second equation in Woodford's model is again the expectations-augmented AS equation as in our benchmark model given by equation (ii). But it differs again from our benchmark model in the sense that there is no cost push shock as in the equation (ii). In this model, AS equation is given as below:

(ix) $$\pi_t = \kappa(y_t - y_t^n) + \beta E_t \pi_{t+1}$$

Here, $(y_t - y_t^n)$ is the output gap given as in our benchmark model. y_t^n is defined as an exogenous disturbance (fluctuation in the natural rate of output). Woodford (1999) argues that both inflation and output-gap stabilization are sensible goals of monetary policy, as long as the "output gap" is correctly understood. Instead of postulating the loss function, Woodford (2001) derives a welfare based loss function by taking second order Taylor series approximation to the representative household's utility function which yields an expression similar to equation (iv). This loss function implies that the central bank minimizes the deviation of output gap from a constant factor indicated by $x^* > 0$. There are many types of the loss function in this model such as equation (iii), (iv) and (xii) mentioned above. According to Woodford, the optimal responses to shocks in the more complicated cases can be diversified[7]. Under at least simple conditions, a feedback rule that establishes a time variant relation between output gap and inflation and the level of nominal interest rates can bring an optimal pattern of responses to real disturbances but in reality, the

[7] For further examples, see Woodford (1999b) and Giannoni (2000)

rule suffers from several defects. The measure of the output gap suggested in Taylor's rule's empirical fit may be quite different from theoretically correct measure, as the efficient level of output should be affected by a wide variety of real disturbances. The rule assumes a constant intercept but a desirable rule is likely to have an intercept that can be adjusted in response to a variety of real disturbances.

Clarida et al. (2002) extends their closed economy model to the case of a small open economy. Although openness complicates the problem of monetary management to the extent that central bank must take into account the impact of the exchange rate on real activity and inflation, they find that open economy is isomorphic to the problem of the closed economy that we discussed earlier. The main consideration of the open economy case is the dependence of inflationary pressures on the degree of openness due to the pass through of the exchange rate which is defined as a percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries. Inevitably, the change in the import prices affects the retail, consumer prices and eventually inflation. Thus, openness gives rise to an important distinction between domestic inflation and consumer price index. This small open economy model with money and imperfect competition along with nominal price rigidities has a setup that is similar to those in Svensson (2000) and Monacelli (1999). However, Clarida et al. (1999) incorporates nominal price rigidities in the form of staggered price setting and allows for a friction in the labor market in order to introduce a short run tradeoff between inflation and output.

Other models with an open economy set up, relax the small open economy assumption and adopt rather a two-country framework with explicit interactions between monetary authorities in each country. These models generally analyze the welfare gains from international monetary cooperation[8]. Benigno and Benigno (2004) study the conditions under which price stability is the optimal policy in a two-country open-economy model with imperfect competition and price stickiness. The authors compare the allocation under cooperation to that under Nash (non-cooperative) strategy. The result suggests a role for international policy coordination under the key assumption of unitary intratemporal elasticity of substitution between

[8] See Hamada (1976), Qudiz and Sachs (1984) and Rogoff 1985 for early contributions. For recent efforts, see Corsetti and Pesenti (2001a,b), Obstfeld and Rogoff (1995,1996 and 2000); Clarida et. al (2002) and Benigno and Benigno (2004).

home and foreign goods. Since the degrees of monopolistic distortions are not equalized across countries, the intertemporal elasticity of substitution needs to be unitary or needs to be equal.

Corsetti and Pesenti (2005) provides a baseline general equilibirum model of optimal monetary policy among interdependent economies with monopolistic firms and nominal rigidities. It differs from Benigno and Benigno (2004)'s work by arguing that an inward-looking policy of price stabilization is not optimal when firms' markups are subject to exchange rate fluctuations. Pappa (2004) studies the sources of conflict between the monetary policy objectives of two large economies and the extent to which different types of international policy arrangements may overcome non-cooperative decisions. It uses a theoretical framework of a two-country model with monopolistic competition and price stickiness which is similar to that of Corsetti and Pesenti (2005), Obstfeld and Rogoff (2002) and Benigno and Benigno (2004) in terms of the basic assumptions. Contrary to these authors, the general specification adopted enables to characterize the conditions for international policy coordination and quantify the costs of the suboptimal monetary arrangements for different values of key variables such as openness, labor supply elasticity and substitutability between home and foreign goods. It concludes that monetary union may be suboptimal because of sluggish relative prices and non-cooperative equilibrium may be suboptimal because of terms of trade.

4.1.2.2 Unconventional Monetary Policy

As one can realize, until now, we only mentioned price stability because the modern literature on monetary policy generally emphasizes the central bank's role in fostering price stability[9]. Historically, however, a dominant concern for central bankers has been not just price stability, but also financial stability. The recent financial crisis has raised important questions about the role of central banks in financial stability. Several central bank reports of financial stability are aiming to highlight the issues that arise within the wide variety of institutional settings, historical contexts and political environments in which they operate. Rising interest in achieving financial stability leads discussion in the framework of why central bank has a prominent role in financial stability (BIS, 2012). According to these reports, it

[9] See, for example, Goodfriend (2007) for a recent articulation of this view.

is apparent to say that almost all central banks in the world are making reforms to governance arrangements for financial stability policy.

Goodhart (1998) argues that the original motivation for creating central banks in many countries was to temper the financial crises associated with unregulated "free banking" regimes. According to Stein (2012), the role for financial stability policy arises because the private choices of unregulated banks with respect to money creation are not in general socially optimal which has a negative effect on welfare. Unregulated banks may engage in excessive money creation, and may leave the financial system overly vulnerable to costly crises. There are several ways for a regulator to address this externality: one of them is the use of monetary policy tools. The severity of the financial crises and the economic contraction that has followed has raised fundamental questions about the role of financial system. A growing consensus is emerging that one necessary dimension of the reform agenda is to modify regulatory frameworks in order to place stronger emphasis on mitigating instability in the financial system as a whole[10]. The global financial crisis leads concerns in reassessment of financial regularity systems worldwide and called for central banks to consider more explicitly and systematically financial stability while determining optimal monetary policy rule.

In this framework, it is argued that macroeconomic outcomes are largely independent of the performance of the financial system according to the monetarist view of Friedman and Schwartz (1963), but also in the recently dominant Neo-Keynesian synthesis (Goodfriend and King 1997, Gali 2008, Mankiw and Romer, 1991). On the other hand, there are advocators such as Bernanke (1983) and Gertler (1988) arguing to some extent that financial factors can have a strong, distinct, and sometimes even dominant impact on the economy. Regarding this perspective, there is no widely accepted framework for defining the concept of financial stability. There are widespread indicators of financial stability depending on the perspective of which is analyzed. In the growing literature of financial stability, the definition is based on the channels through which it works.

[10] See Bank of England (2009), FSA (2009a), Shirakawa (2009), Blanchard et al (2010), Goodhart (2010), Group of Thirty (2010), Borio (2011), Clark and Large (2011), Dombret (2011), Eichengreen et al. (2011), FSB/IMF/BIS (2011), Hanson et al. (2011), IMF (2011a) and Tucker (2011), Galati and Moessner (2011) review the academic contribution to the literature.

According to the report published by Bank of International Settlements (BIS 2011), the channels affecting financial stability are classified mainly into three channels:

- Balance sheet tools: Maximum leverage ratio, countercyclical capital and liquidity buffers and time varying provisioning practices and distribution practices.
- Terms and conditions of transactions: The ability to restrict the quantity of the capital requirements on lending to value or lending to income.
- Market structure: The targeted disclosure requirements to reduce uncertainty about specific exposures or interconnections amplifying cyclical or structural risks.

On the other hand, according to Schinasi (2004), there is no single variable that can be an exact signal on the performance of the financial system. It defines financial stability as an indicator of the financial system to facilitate efficient allocation of resources, to assess, price, allocate and manage the financial risks and to maintain its ability to perform key functions.

The theoretical framework that incorporates financial stability identifies mainly three sources of financial instability: First, financial problems may arise from the banking sector (leverage ratio, overall credit flows etc.). For example, Obstfeld et al. (2008) consider reserve accumulation of the banking sector as a key tool for managing domestic financial instability as well as exchange rates in a world of increasing financial globalization. Another stream of related works with financial stability assumes that financial problems arise from non bank sector (household solvency, marginal utility of income etc.). Goodhart and Tsomocos (2007) suggest that the probability of default of each agent such as choosing a strategy, depending his/her risk aversion and the state of the world which is the key concept in any analysis of financial fragility. A third stream of related works with financial stability argues that the structure of the banking system plays a role on financial fragility. Barth, Caprio et. al. (1999) find that a higher degree of government ownership of banks tend to be associated with higher fragility of financial systems whereas Goodhart (2007) interprets this result as perhaps indicating that the presence of any non-profit maximizing banking entities may make financial systems more fragile.

The works cited above concentrate on identifying the relationship between financial stability and other economic indicators but they do not address the question of optimal monetary policy.

Whether the objective of financial stability should be incorporated into the analysis of optimal monetary policy is a controversial subject. In this regard, the literature is divided into two strands about the relationship between monetary policy and financial stability. First idea is that the target of financial stability should not be addressed through tighter monetary policy, but rather by more targeted macro prudential measures. Moreover, there are advocators suggesting that central banks implementing inflation targeting regimes failed due to the formation of a serious asset price bubble mainly in real estate market which lead to detoriation in the quality of credit (Leijonhufvud, 2008) and also increase in the likelihood of the financial crises are pure results of inflation targeting (Giavazzi and Giovanni, 2010). In brief, this approach stays against using monetary policy to address directly financial stability concerns. Within this approach in hand, it has been argued that central banks should consider potential tradeoffs between the objectives of price and financial stability when it comes to the monetary policy (Wadhwani, 2008). Increasing concerns about trade off lead discussions in the sense that success of price stability may have been associated with an increased risk of financial instability. However, it is observed that financial imbalances may also appear in an environment of stable prices and low rates of inflation. Furthermore, it has been argued that stable and low inflation rates could foster asset price bubbles. Therefore, we can say that price stability is of course a necessary but insufficient condition for achieving financial stability.

The second strand which advocates for the use of redesigned inflation targeting framework of monetary policy in order to prevent financial crises and ensure financial stability with the help of the macro prudential measures gains dominance in the recent economic literature (Bailliu et all., 2012, Woodford 2011, Ünsal 2011). The financial stability is traditionally considered as the objective of macro prudential policy while price stability is viewed as the objective of monetary policy[11]. Thus, a

[11] As Galati and Moessner (2011) state, the literature on monetary policy has seen a broad convergence of views on the policy objective but the literature on macro prudential policy is still far from such a consensus on its objectives. Macro prudential policy is seen as aiming at financial stability, but there is no common shared definition of financial stability.

key challenge for central banks is to simultaneously achieve price and financial stability (Granville and Mallick, 2009). This requires two separate tools: the policy interest rate (which is being used for price stability) and macro prudential tools[12] (which is planned to use for financial stability). This argument suggests that policy interest rate is an inadequate instrument to be useful to address financial stability concerns, which often includes systemic risks. Regarding the Tinbergen principle[13], above mentioned two instruments are necessarily complements in a deterministic environment and it is relevant to combine monetary policy which will respond to financial stability with macro prudential policy (Svensson, 2010). But in reality, however, central banks operate in a stochastic world and aim to minimize deviations from their targets, rather than aiming at those targets. Each instrument can be manipulated independently and may affect both targets in the same direction. In this case, the two instruments may become substitutes. Second approach favors more proactive monetary policy and hence implies a monetary policy more directly responsive to a financial stability objective. This argument suggests that no evidence exists for monetary policy's being cause of systematic risks leading to boom-bust cycles in credits and asset prices. In this regard, monetary policy – combined with macro prudential tools – could help mitigate procyclicality and address the time dimension of systemic risk, through its effect on the economy as a whole. According to this approach, the less aggressive macro prudential tools are, greater the potential role of monetary policy for maintaining financial stability. Moreover, too much reliance on macro prudential policy limits bank credit availability or leads to higher borrowing costs which may foster financial disintermediation.

In order to model the adjusted monetary policy of CBT after global financial crises, we follow the second approach which suggests that monetary policy implementation can be combined with macro prudential tools. In order to clarify the position of the model presented in the next section within this second approach, we analyze a number of recent contributions on optimal monetary policy under financial stability in closed or open economies. These recent contributions can be divided into three groups based on their definition of financial stability. The first group models optimal monetary policy under financial stability assuming that financial instability

[12] Macro prudential measures are defined as regulatory policies that aim to reduce systemic risks and establish a durable financial system against domestic and external shocks. (BIS, 2010).
[13] Tinbergen emphasized that achieving the desired values of a certain number of targets requires the policy maker to control an equal number of instruments.

stems mainly from the non-bank sector. The second group assumes that financial instability arises from both non-bank and banking sector in order to analyze the optimal monetary policy. The last group considers the optimal monetary policy under financial stability by assuming that financial instability stems from mainly the banking sector. We will start the discussion with the first group.

In this part, we consider the representative papers which are trying to model optimal monetary policy taking into consideration financial instability indicators mainly stemming from the non bank sector. This group considers the non bank sector as the main source of financial instability. As an example for the first group, Baudocco, Bulir and Cihak (2011) examine the central bank response to financial stability as a source of deviations from the traditional Taylor rule. In order to analyze how changes in financial sector soundness affect monetary policy, they make two modifications to the standard monetary dynamic stochastic general equilibrium (DSGE) model which are respectively the incorporation of a financial sector in which financial instability is measured by a probability of default in the non bank sector and the incorporation of forward looking elements into the Taylor rule[14]. The model's crucial assumption is mainly; (i) financial intermediaries supply external financing to some firms and (ii) firms that are sensitive to the supply of loans and interest rates are linked with the rest of the firms in the economy through a productivity nexus. Under the augmented policy rule, the central bank monitors the financial system, responding the deterioration in the financial system health with monetary loosening. The economy contains five types of agent: households, goods-producing firms that are monopolistic, innovative firms that are perfect competitors, financial intermediaries which are freely competitive and a central bank. The structure of the firms differs from our work since some of them do not need external financing. The control instrument of this model is the nominal interest rates defined by traditional Taylor rule mentioned above. According to the model, since central banks can achieve better predictions of financial stability due to their up-to-date prudential information on banks, it can rely on the "traditional" Taylor rule. However, when it detects a sizeable threat to the financial stability (in the context of the model, an adverse shock to the survival of borrowing firms), central bank will use its private information about the probability of default. When the economy hits with a shock to probability of default, the policy response function departs from

[14] See Berger, Kissmer and Wagner 2007 or Berg, Karam and Laxton 2006 for further examples.

traditional Taylor rule. The most interesting findings of the study is that if the adverse shock to the probability of default becomes public knowledge, the tradeoff between short term output and inflation volatility and the speed of return to trend would disappear under the assumption of central bank has privileged information on financial stability. Since the private sector would already incorporate the relevant information on financial instability (probability of default), there is no incentive for the central bank to deviate from the "traditional Taylor rule". The model differs from our model in the sense that financial stability stems from non-bank sector and it determines a threshold value of probability of default used as an indicator of financial stability.

The second group considers financial instability as stemming from both banking and non-bank sectors. Woodford (2011) modifies the inflation targeting regime incorporating concerns for the effects of monetary policy decisions on financial stability. According to Woodford, in order to address the concerns raised above, it is essential that the crises that disrupt financial intermediation not be treated as purely exogenous as it is in analyses such as those of Curdia and Woodford (2010), Del Negro et al. (2010), or Gertler and Karadi (2011). The latter treats only the question of how central bank policy can mitigate the effects of a crisis. Therefore, the model postulates a reduced-form in which endogenous state variables affect the probability of a crisis, and consider how allowance for such a relationship would change the standard theory of optimal monetary stabilization policy. The model is developed assuming credit frictions following Curdia and Woodford (2010) in order to modify the relation that would exist between aggregate real expenditure and the path of interest rates. In this model, households are heterogeneous in the sense that some are credit constrained while others are not. It differs from our work regarding the heterogeneous structure of the households. This assumption implies that marginal utilities of different households will differ from each other. This assumption represents a measure of the gap that exists at any time given between the marginal utilities of two types of households. So, this variable is mainly measuring the distortion of the allocation of expenditure due to the credit frictions. A larger value of the gap means that the marginal utility of borrowers exceed that of savers which means that the spending of the borrowers is inefficiently low and hence it is a useful measure of credit frictions. Because of this modification, the intertemporal IS curve and New Keynesian Philips curve now incorporate the effect of credit frictions. In

order to connect the model into the financial sector another new element of endogenous financial distortion measure is added to the model. With this addition, new equation of leverage (the rate of lending) is defined as a positive linear function of lagged value of itself and output gap. Therefore, the goal of the policy is to minimize a loss function which has an additional goal of reducing the incidence of financial crises. The findings of the Woodford (2011) is similar to ours in suggesting that central bank should be willing to trade off a greater degree of price and output gap stability for the sake of greater stabilization of the marginal crisis risk. In contrast to our setup, Woodford (2011) does not consider the financial sector as purely exogenous. Consequently, financial instability is represented by both financial distortions and the gap of the marginal utilities of income for two types of households. We follow Woodford (2011) by assuming a dynamic structure of financial stability equation and by incorporating an exogenous shock to the financial stability.

As an another example of the second group, Aydın et al. (2011) investigates the limits of a conventional inflation targeting regime in the presence of financial instability by suggesting alternative inflation targeting rules that incorporate financial stability indicators in Korean economy for the period of 2003 to 2007. Their model is a small open economy DSGE model, where the central bank adopts a conventional inflation targeting regime. The agents in the model can be grouped under five categories; consumers, nonfinancial sector, financial sector, government and the external sector. Although, the small open economy assumption is common in our model and in the setup proposed by Aydın et. al. (2011), in contrast to our framework, the authors incorporate a financial accelerator framework. They consider four systematically important financial stability indicators: i) nonfinancial sector's borrowing spread, (ii) bank's foreign exchange leverage, (iii) credit volume and asset prices instead of using only credit volume and (iv) real exchange rate fluctuations that have direct implications on private sector balance sheets. This paper proposes alternative inflation targeting rules for a central bank that incorporates financial stability indicators. Their simulations show that a central bank can do much better by incorporating financial stability to its inflation targeting framework, in particular if the distortions come from the supply side. For other distortions affecting demand side of the economy, an inflation targeting rule with or without financial stability is comparable. The paper proposes a wide range of policy prescriptions since they

analyze various financial stability indicators. However, in contrast to our model, their set up does not yield analytical results.

In the third group, we consider the representative papers which are trying to model optimal monetary policy taking into consideration financial instability indicators mainly stemming from the banking sector. According to Gertler and Karadi (2011), a deterioration of intermediary capital will disrupt lending and borrowing in a way that raises credit costs. To capture unconventional monetary policy in this environment, their core framework is the monetary DSGE model with nominal rigidities developed by Christiano et. al. (2005), Smets and Wouters (2007). In the model, there are five agents; households, financial intermediaries, non-financial good producers, capital producers and monopolistically competitive retailers. The main difference of their work is that they are trying to solve for the central bank credit intervention in crisis scenario. They do so under different assumptions about the efficiency costs of central bank intermediation. Then, they compute the welfare gains from optimal credit market intervention. Their quantitative monetary DSGE model with financial intermediaries that face endogenously determined balance sheet constraint is used to evaluate the effects of expanding central bank credit intermediation to combat a simulated financial crisis. Central Bank is less efficient than private intermediaries at making loans but it has the advantage of being able to elastically obtain funds by issuing riskless government debt. This is the main intuition of the paper in terms of the effects of financial crises on balance sheet constraints of private intermediaries. Gertler and Karadi (2011) inspired our work in the sense that they are using mainly the overall credit flows as a measure of financial instability.

As a second example of the third group, Bailliu et al. (2012) examines the interaction between monetary policy and macro prudential policy and whether policy makers should respond to financial imbalances or not. Use of macro prudential tool is triggered by signs of emerging financial imbalances and is assumed to have a direct influence on the funding cost of firms (via the external finance premium). The authors modify a standard sticky price DSGE model that includes financial market imperfections and a financial shock. In this model, financial imperfections stem from financial and credit conditions to the real economy. There are three types of agents; households, entrepreneurs and retailers. The authors consider the potential gains

under four different monetary policy and macro prudential regimes. The baseline model is a standard Taylor rule with interest rate smoothing, second policy regime is an augmented Taylor rule in which the baseline policy is augmented to allow the changes in nominal credit, third regime combines macro prudential rule with standard Taylor rule and the fourth regime combines macro prudential instrument with the augmented Taylor rule. They calibrate their model by using the data from Canadian economy over the period from 1997Q1 to 2009Q3 which features both financial frictions and shocks in order to compare the welfare under four circumstances. Instead of using a loss function, model defines a welfare function aiming to maximize the path of consumption. In this work, financial stability is measured by credit growth from its steady state. Their result is similar to ours in that their findings suggest that regimes where policy makers respond to financial imbalances using the policy rate and/or macro prudential tools yield a higher welfare (lower loss) with respect to the standard Taylor rule. The framework presented in the next section follows Baillu et. al.(2012) for the definition of financial stability and for incorporating financial imbalances in the augmented Taylor rule.

In another example of the third group, Ünsal (2011) analyzes the interplay between monetary policy and macro prudential policies with nominal and real frictions in a two-country DSGE model. The economy has three types of firms; production firms, importing firms and competitive firms where the other agents are households and financial intermediaries. It differs from our work since the model features the financial accelerator mechanism developed by Bernanke et al. (1999) in which they argue that financial accelerator results from changes in credit market conditions which affect the intrinsic costs of borrowing and lending associated with asymmetric information. In their framework, macro prudential measures are modeled as an increase in financial intermediaries' lending costs, which are then passed onto borrowers in the form of higher interest rates then finally negatively effecting the nominal credit growth. This model differs from the works in the third group in the sense that it features an analysis of how exchange rate regimes matter for the optimal stabilization role of macro prudential measures because the optimal reaction of macroprudential instrument to nominal credit growth is higher under a fixed exchange rate regime. According to their findings, exchange rate regime matters for the desirability of using macro prudential policies as a separate policy tool. Following Ünsal (2011), we incorporate the exchange rate channel into

our analysis but we abstract from the comparison of different exchange rate regimes and limit our attention to the case of flexible exchange rates.

As a fourth example of the third group, Özatay (2011) extends the setup proposed by Clarida et al. (our benchmark model) by adding an equation that captures the financial stability through the financial leverage of the banking sector. This paper is similar to ours in terms of the intuition and the method. However, we extend this framework in two ways. First, we relax the closed economy assumption and adopt an open economy set up in order to analyze the case of small open economy. Second, we modify the financial stability equation by adding the expected future financial instability and the next period expected change in the real exchange rate conformably to the small open economy assumption.

The extension of the closed economy to the case of small open economy allows us to consider the role of flexible exchange rate regime as a transmission channel of the monetary policy and define the role for macro prudential regulations through this transmission channel from the monetary policy perspective. Since, the exchange rate channel is one of the important monetary transmission channels on the price and financial stability for the Turkey case as we mentioned in the third chapter, it is necessary to take into consideration the real exchange rate which can only be possible in the open economy framework.

Second modification in the financial stability equation consists of two new variables. First variable is the forward looking financial stability indicator which implies that this equation has a dynamic structure. With the help of this extension, we can consider the effect of expectations channel on the price and financial stability targets. Second variable is the real exchange rate deviation from the target level. The addition of this variable is crucial in terms of our assumptions regarding the small open economy case and analyzing the effect exchange rate channel on the price and financial stability target.

The remainder of this chapter is organized as follows: Section 2 presents our open economy model for the behaviour of CBT, computes the equilibrium while section 3 derives the optimal monetary policy under financial stability. Section 4 compares the results to the optimal monetary policy without financial stability where the monetary authority is only concerned with price stability.

4.2 A model of optimal monetary policy with financial stability

A simple model may be helpful in clarifying the way in which an inflation targeting regime could be modified in order to incorporate concerns for the effects of monetary policy decisions on financial stability as we mentioned in the previous survey. Following Curdia and Woodford (2010), Del Negro et al.(2010), or Gertler and Karadi (2011), financial intermediation is treated as purely exogenous in the present paper. The above mentioned papers analyze only the question of how central bank policy reduces the effects of crises when there is a change in the factors affecting the financial instability.

In order to address the question of optimal monetary policy with financial stability, we use a micro-founded dynamic general stochastic equilibrium model based on the New Keynesian literature incorporating money and temporary nominal price rigidities which was developed by Clarida et al. (1999) – our benchmark model which is mentioned above in detail. The present work extends their framework in two ways as we discussed above: the addition of financial stability equation and extension to an open economy setup in order to analyze the case of a small open economy. The model aims to capture the recent design of monetary policy which has a broader scope since it considers an inflation targeting strategy that encompasses financial stability. Following the idea which is suggesting that monetary policy implementation can be combined with macro prudential tools, this new design of monetary policy is a sort of mixed policy implementation designed by Central Bank of Turkish Republic (CBT). Within the model, monetary policy affects the real economy in the short run. Moreover, Aggregate behaviour equations are derived explicitly from household and firm optimization (See Appendix Section A and B for a formal presentation of the microeconomic foundations of the model).

4.2.1 Setup

The model is composed of an IS equation which defines the goods market, the forward looking new Keynesian Philips equation and a forward looking financial stability equation. The CBT is assumed to minimize a quadratic loss function which depends on output gap, inflation as well as financial stability gap.

4.2.1.1 IS Equation

The IS equation is given as follows (see Appendix section D for derivation of the IS curve):

$$x_t = \frac{x_t - x_t^*}{x_t^*} = -\phi\,(i_t - E_t\,\pi_{t+1}) + E_t\,x_{t+1} + g_t + \Delta Q_t + \theta L_t \qquad \phi > 1,\ \theta > 0 \quad (1)$$

In equation (1), x_t defines the output gap, Q_t denotes the exchange rate while L_t is a measure of financial stability and g_t is a public spending shock. Inflation is denoted by π_t and i_t stands for the nominal interest rate. Equation (1) represents the micro based "**IS equation**" and differs from the traditional IS curve by its dynamic dimension. Indeed, the micro based IS equation is forward looking. It translates the idea that current output depends on expected future output as well as the interest rate reflecting the consumption smoothing behaviour of households. As implied by the Euler equation[15], higher expected future output raises current output. Expectation of higher output in the future induces households to advance their consumption in time. Specifically, the possibility of higher future income leads households to increase current consumption which raises current output. The negative effect of the real interest rate on current output reflects the intertemporal consumption substitution. The intertemporal elasticity of substitution is given by Φ .

This IS equation differs from that in Clarida et al. (1999) with its two variables. Firstly, it incorporates the ex post change in the real exchange rate. The exchange rate is defined as the home currency price of one unit of foreign currency. Starting from an initial steady state characterized by a zero output gap, any variation in the exchange rate modifies the current account and thereby causes a deviation of the output from its long run equilibrium level x_t^*. As a second difference, the present setup extends the IS curve by incorporating a measure of financial stability represented as L_t. As we discussed before, Özatay (2011) also relates the financial stability indicator positively to the output gap. The coefficient of the financial stability variable θ is assumed to be positive, implying that when the financial stability measure deviates with respect to the desired level, the output gap will deviate in the same direction. The idea behind is that the credit level is an important

[15] Using the market clearing condition, we can rewrite the log linearized consumption Euler equation at as:
$x_t = -\varphi(i_t - E_t\pi_{t+1}) + E_t x_{t+1} + g_t$. See appendix D.

determinant of financial stability. Therefore, it is possible to say that the present model is close to the third group discussed above, which suggests that financial stability mainly stems from banking sector and that mostly used indicators are overall credit flows (Gertler and Karadi, 2011). In order to rationalize this indicator, higher credit level implies higher investment and thereby higher output along with higher financial stability gap.

The disturbance g_t is a function of expected changes in government purchases relative to expected changes in potential output. g_t is an AR(1) disturbance term given as below where $\widehat{g_t}$ is an iid. random variable:

$$g_t = \rho_g g_{t-1} + \widehat{g_t} \qquad 0 < \rho_g < 1 \qquad (2)$$

4.2.1.2 Philips Equation

The new Keynesian Philips equation given below relates the inflation gap with the output gap as well as the expected inflation (See Appendix Section C for the derivation of the Philips Equation). Therefore, equation (3) is a traditional expectations augmented Philips curve. The key difference with the standard Philips curve is that the expected future inflation $E\pi_{t+1}$ is included in the Philips curve. x_t captures the evolution of marginal costs resulting from excess demand for inputs associated with an increase in output. As we discussed before, the "cost push" disturbance γ_t captures any other variable that is likely to affect expected marginal costs in our present work differing from the Philips curve equation used in Woodford (2001). The cost push disturbance is assumed to follow an AR(1) process and features a similar process to public spending shock.

In equation 3, we implicitly assume that the desired level of inflation is zero.

$$\pi_t = \lambda x_t + \beta E\pi_{t+1} + \gamma_t \qquad \lambda > 0\,,\ 0 < \beta < 1 \qquad (3)$$

$$\gamma_t = \rho_\gamma \gamma_{t-1} + \widehat{\gamma_t} \qquad 0 < \rho_\gamma < 1 \qquad (4)$$

4.2.1.3 Financial Stability Equation

Following the literature we discussed above, there are two indicators which are widely used for the definition of financial stability: an increase in the credit expansion (see among others Tornell and Westermann, 2005; Mendoza 2009, Jorda et. all 2011, Reinhart 2012, Gourinchas and Obstfeld 2012, Schularick and Taylor, 2012) and a disturbance to the current account balance due to an appreciation of the home currency (See Kara, 2012; TCMB Report, 2011; Demirgüç-Kunt and Detragiache, 1998). Several authors consider the leverage rate as a sign of financial instability (Özatay 2011). As for the Turkish case, credit expansion and the exchange rate seem the most appropriate variables as revealed by the analysis in Chapter 2 and 3. In order to cover credit expansions, we add a credit gap k_t expressed as the difference between the current and the desired credit level. An increase in the credit gap leads to an increase in the financial stability gap. The effect of the current account imbalance and Turkish lira's appreciation is captured by a change in the real exchange rate denoted by ΔQ_t. The coefficient of the real exchange rate is given by ξ and is assumed to be negative in order to reflect the current unconventional policy of CBT. As analyzed in detail in Chapter 2, CBT aims to restore financial stability by decreasing the volatility of interest rates when there is a weak capital inflow which causes depreciation in the Turkish lira. In other words, an appreciation of the Turkish lira following a high capital inflow is mainly defined as an increase in financial instability.

$$L_t = \frac{L_t^c - L_t^*}{L_t^*} = E_t L_{t+1} + \tau k_t + \xi \Delta Q_t + \upsilon_t \qquad \tau > 0\,,\ \xi < 0 \qquad (5)$$

In order to cover the credit expansion, we add credit gap (k_t) which is defined as the difference between the current and desired credit level. This allows us to consider a new policy framework which takes into account the excessive volatility in both the credit growth and real exchange rates in order to support macroeconomic and financial stability. In the present setup, financial stability is expressed as a gap between the actual value of the financial stability measure and the desired level as in Özatay (2011). An increase in the financial stability gap translates a worsening of financial indicators.

In contrast to the Woodford (2011) and Özatay (2011), we assume a forward looking evolution of the financial stability gap measure. By this forward looking behaviour, we intend to capture the fact that households and firms take into account the future expected changes in the exchange rate when forming their expectations as we mentioned before. Similarly, financial sector base their decisions on the anticipated reaction of the CBT. We assume that the effect of the credit channel is the main monetary transmission mechanism affecting the output gap and inflation dynamics since we consider the monetary policy implemented in Turkey (see chapter 3). In other words, CBT is assumed to react more to credit expansions rather than to changes in the exchange rate implying that $|\tau| > |\xi|$. In contrast to Woodford (2011) and Gertler, Karadi (2011), our present framework has no constraint on credit supply since we are trying to obtain analytical results.

The term υ_t is assumed to follow an AR(1) process which features a similar process to public shock and is added in order to capture the impact of financial bubbles (for example, housing prices, asset prices etc.). In contrast to Woodford (2011), we assume financial shocks that can affect any type of financial intermediation as exogenous.

$$\upsilon_t = \rho_\upsilon \upsilon_{t-1} + \hat{\upsilon_t} \qquad 0 < \rho_\upsilon < 1 \qquad (6)$$

4.2.1.4 Additional Equations

Equation (7) below establishes a direct link between the credit gap and output gap. As we mentioned before, there is a strong relationship between credit gap and output gap since the ratio of credits to national income has reached to 50 percents as of 2011 in Turkey (see chapter 2). Obviously the effect of the credit gap on output is not one to one. However, in order to obtain interpretable analytical results, we prefer to economize on the parameters retained in the model. Thus, we define the credit gap as follows:

$$k_t = \frac{K_t - K_t^*}{K_t^*} = x_t \qquad (7)$$

Equation (8) below gives the uncovered interest rate parity condition where r_t denotes the Turkish real interest rate while $\bar{r}$ is the world real interest rate which is assumed to be exogenous. The uncovered interest rate parity condition translates the

idea that an individual will be indifferent between buying home currency or foreign currency denominated bonds as long as the rate of return of both bonds are equal when expressed in the same currency, assuming perfect capital mobility and perfect substitution between home and foreign assets.

$$E\Delta Q_{t+1} = (r_t - \bar{r}) \tag{8}$$

Finally, in order to capture the reaction of the CBT (through the nominal interest rate) to increases in the credit gap as well as to inflation deviations, we introduce equation (9) below which relates the nominal interest rate to the credit gap and inflation gap. The reaction of the CBT to changes in the exchange rate is captured by the Fisher equation (Equation 10) together with equation (8).

$$i_t = k_t + \pi_t \tag{9}$$

$$r_t = i_t - E_t\pi_{t+1} \tag{10}$$

Again in the above equations, the reaction of the interest rate to the credit gap and inflation is assumed to be one to one in order to allege the analytical results.

4.3 Optimal monetary policy under financial stability

In the present framework, CBT is assumed to choose the optimal interest rate policy by minimizing the welfare loss function, given below, subject to equation (1), (3) and (5):

$$\text{LOSS} = \frac{1}{2}\ E_t\left[\sum_{j=0}^{\infty} s^j \left(\alpha_1 x_{t+j}^2 + \pi_{t+j}^2 + \alpha_2 L_{t+j}^2\right)\right] \tag{11}$$

With the help of equation (11), CBT can have a control on optimal interest rates rather than any other control instruments such as money supply as we discussed in Moore (1972). As we discussed in the literature, there have been some recent attempts to derive the welfare criterion from the individual utility function of the representative household instead of simply postulating the loss function. There are different types of loss functions depending on the critical assumptions of the related models (see for example equation iv, v, vi and vii). As we can see from equation (11), in contrast to Woodford (2011), there is a concern of monetary authority to

minimize the output gap from a zero value rather than a constant value in the present work.

In the loss function s^j denotes the subjective discount factor while α_1 and α_2 denote respectively the weight CBT attaches to the output and financial stability objectives. The lagrangian of the CBT's problem can be written as:

$$\ell_t = -\frac{1}{2} E_t\left[\sum_{j=0}^{\infty} s^j\left(\alpha_1 x_{t+j}^2 + \pi_{t+j}^2 + \alpha_2 L_{t+j}^2\right)\right] + \mu_{\pi,t} E_t\left[\sum_{j=0}^{\infty} s^j\left(\lambda x_t + \beta E_{t+1} + \gamma_t - \pi_{t+j}\right)\right] + \mu_{L,t} E_t\left[\sum_{j=0}^{\infty} s^j\left(E_t L_{t+1} + \tau k_t + \xi Q_t + \upsilon_t - L_{t+j}\right)\right]$$

In this lagrangian function, $\mu_{\pi,t}$ and $\mu_{L,t}$ are lagrange multipliers on the inflation and financial stability constraints respectively. The first order conditions are given as follows:

$$\frac{\delta \ell_t}{\delta L_t} = \mu_{L,t} = -\alpha_2 L_t \tag{12}$$

$$\frac{\delta \ell_t}{\delta x_t} = \mu_{x,t}\lambda + \mu_{L,t}\tau = -\alpha_1 x_t \tag{13}$$

$$\frac{\delta \ell_t}{\delta \pi_t} = \mu_{\pi,t} = \pi_t \tag{14}$$

Combining equation (12), (13) and (14) yields the following expression;

$$x_t = -\left(\frac{\lambda\pi_t + \alpha_2 \tau L_t}{\alpha_1}\right) \tag{15}$$

Using equations (5) and (15), we can rewrite financial stability equation as below;

$$L_t = \frac{\alpha_1}{\alpha_1 + \alpha_2\tau^2 + \alpha_2\xi\tau} E_t L_{t+1} + \frac{\alpha_1\xi - \tau\lambda - \xi\lambda}{\alpha_1 + \alpha_2\tau^2 + \alpha_2\xi\tau}\pi_t - \frac{\alpha_1\xi}{\alpha_1 + \alpha_2\tau^2 + \alpha_2\xi\tau} E_t \pi_{t+1} - \frac{\alpha_1\xi}{\alpha_1 + \alpha_2\tau^2 + \alpha_2\xi\tau}\bar{r} + \frac{\alpha_1}{\alpha_1 + \alpha_2\tau^2 + \alpha_2\xi\tau}\upsilon_t \tag{16}$$

In order to find the optimal value of the financial stability gap, one can iterate equation (16) forward and solve to obtain;

$$L_t^* = -\frac{\alpha_1\xi}{\alpha_2\tau^2 + \alpha_2\xi\tau}\bar{r} + \frac{\alpha_1}{\alpha_1 + \alpha_2\tau^2 + \alpha_2\xi\tau - \alpha_1\rho_\upsilon}\upsilon_t + \frac{\alpha_1\xi - \tau\lambda - \xi\lambda}{\alpha_1 + \alpha_2\tau^2 + \alpha_2\xi\tau}\pi_t \tag{17}$$

Equation (17) points out to a trade-off between financial stability and inflation. The effect of inflation on the optimal financial stability gap operates through two different channels. First, higher inflation implies lower real interest rates (ceteris paribus) which leads to home currency depreciation because of capital outflows. This in turn increases the output gap. Higher output gap implies higher credit gap and financial stability gap increases. On the other hand, following the currency depreciation, the CBT reacts by narrowing the interest corridor which reduces financial stability gap. The second channel is stronger than the first so that an increase in inflation leads to a reduction in the optimal financial stability gap. This implies that there is lower financial stability in the economy when the CBT chooses a low inflation level. This result is similar to Woodford (2011) in suggesting that central bank should be willing to trade off a greater degree of price and output gap stability for the sake of greater financial stability.

Inserting equation (15) and (16) into the Philips curve given by equation (3) yields the optimal inflation rate as follows;

$$\pi_t^* = \frac{\alpha_2\xi\tau\lambda}{(1-\beta)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+\lambda^2}\bar{r} - \frac{\alpha_2\tau\lambda}{(1-\beta\rho_v)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+(1-\rho_v)(\alpha_2\xi\tau\lambda)+\lambda^2}\upsilon_t$$

$$+\frac{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau}{(1-\beta\rho_\gamma)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+(1-\rho_\gamma)(\alpha_2\xi\tau\lambda)+\lambda^2}\gamma_t \qquad (18)$$

In equation (18), although the sign of the coefficient of the financial stability shock is ambiguous, it is likely to be positive for plausible values of the parameters. This means that an increase in the stability shock induces the CBT to choose a lower inflation. This is because when financial stability gap increases, it is optimal for the CBT to increase the real interest rate. The only way to do this is to lower the inflation. This feature confirms the tradeoff between inflation and financial stability mentioned above.

Introducing the optimal financial stability value given by equation (17) into equation (15) yields the optimal output gap as below;

$$x_t^* = -\frac{(\alpha_2\xi\tau+\lambda)}{(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)}\pi_t - \frac{\alpha_2}{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau-\alpha_1\rho_v}\upsilon_t + \frac{\xi}{\tau+\xi}\bar{r} \qquad (19)$$

In order to derive the optimal interest rate, we need to use equation (1), which requires rewriting $E_t\ x_{t+1}$. For this, we insert equations (17) and (19) into the equation (1). Then, we take the expectations of the resulting expression. This yields;

$$i_t^* = \frac{1}{\phi-1}\frac{\alpha_2\tau\xi+\lambda+\theta\alpha_1\xi-\theta\lambda(\tau+\xi)}{(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)}\ \pi_t + \frac{1}{\phi-1}\left[1-\frac{(\phi-1)\ (\alpha_2\tau\xi+\lambda)}{(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)}\right]E_t\ \pi_{t+1} + \frac{1}{\phi-1}\frac{\theta\alpha_1+\alpha_2\tau(1-\rho_v)}{\alpha_1(1-\rho_v)+\alpha_2\tau^2+\alpha_2\xi}\ v_t + \frac{1}{\phi-1}\ g_t - \frac{1}{\phi-1}\left[\frac{\theta\alpha_1\xi}{\alpha_2\tau^2+\alpha_2\xi\tau}+1\right]\bar{r} \quad (20)$$

Equation (20) states that a higher financial stability shock induces the CBT to increase optimal interest rate in order to reduce the credit gap and thereby improve financial stability. On the other hand, when CBT is concerned about financial stability, the effect of inflation on the interest rate becomes ambiguous due to the fact that there exists several channels which exert effects on opposite directions.

4.4. The impact of financial stability concerns on the optimal monetary policy

We are interested in showing the effect of financial stability concerns of CBT on optimal monetary tools. For this purpose, we compare the optimal interest rate value when CBT is targeting only price stability to that when CBT is targeting both price and financial stability. The first case can be analyzed by imposing $\alpha_2 = 0$ whereas the second case implies that $\alpha_2 > 0$.

The remainder of the section first analyzes the impact of current and expected inflation on the optimal interest rate. Then, it analyzes the output gap, financial stability gap and inflation under optimal monetary policy.

Proposition 1: Optimal interest rate reacts less to the changes in inflation but more to the changes in expected inflation when CBT cares for financial stability.

Proof 1 : If we impose $\alpha_2 = 0$ ***in equation (20), the coefficient of inflation becomes*** $\frac{1}{\phi-1}\frac{\lambda+\theta\alpha_1\xi-\theta\lambda(\tau+\xi)}{\alpha_1}$ ***. Comparing this value with its counterparts in equation (20) shows*** $\frac{1}{\phi-1}\frac{\lambda+\theta\alpha_1\xi-\theta\lambda(\tau+\xi)}{\alpha_1} > \frac{1}{\phi-1}\frac{\alpha_2\tau\xi+\lambda+\theta\alpha_1\xi-\theta\lambda(\tau+\xi)}{(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)}$ ***. Similarly, the coefficient of expected inflation in equation (20) boils down to*** $\frac{1}{\phi-1}\left[1-\frac{(\phi-1)+\lambda}{\alpha_1}\right]$ ***when*** $\alpha_2 = 0$ ***. Comparing this value with its counterpart in equation (20) implies that*** $\frac{1}{\phi-1}\left[1-\frac{(\phi-1)\ (\alpha_2\tau\xi+\lambda)}{(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)}\right] > \frac{1}{\phi-1}\left[1-\frac{(\phi-1)+\lambda}{\alpha_1}\right]$.

Optimal interest rate reacts less to the changes in inflation because of the tradeoff between financial stability and inflation as we mentioned before in section II. First effect of increase in inflation can be seen from equation (9) which will lead to an increase in nominal interest rates. Increase in nominal interest rates will have a positive effect on credit gap which means a decrease in actual credit level from equation (1). On the other hand, a decrease in credit gap leads to an increase in financial stability which means a decrease in the level of L_t as implied by equation (5). With the given credit gap level, decrease in financial stability gap will cause a decrease in interest rates which mitigates the first reaction of nominal interest rate mentioned above. As for the expected inflation, equation (10) implies that an increase in expected inflation level will cause a decrease in real interest rates which means an appreciation of the exchange rate as implied by equation (8). This appreciation will create both financial instability (see equation 5) as well as an increase in output gap (see equation 1). This last effect amplifies the first and the result is increased reaction of nominal interest rate when CBT cares for financial stability. The increased reaction of nominal interest rates to the expected inflation under both price stability and financial stability result is also suggested in Özatay (2011).

Proposition 2: Optimal interest rate reaction to the changes in financial shocks (υ_t) depends on the persistency of the shock when financial stability also matters for CBT.

Proof 2: From the optimal interest rate given by equation (20), the effect of financial shock on the interest rate depends on the autocorrelation coefficient of financial shock since it gives information about the shock persistency. Imposing $\alpha_2 = 0$ ***on the coefficient of*** v_t ***in equation (20) yields*** $\frac{1}{\Phi-1}\frac{\theta\alpha_1}{\alpha_1(1-\rho_U)}$ ***. Although, the autocorrelation coefficient appears both in the nominator and the denominator in the equation (20), it is possible to show that the former is likely to be higher for sufficiently persistent shocks.***

Optimal interest rate reacts less to the changes in financial shocks under financial stability concerns. This result follows from two opposite effects on the interest rate. First, as implied by equation (5) a greater financial shock will increase financial instability which in turn increases the output gap as can be seen from

equation (1). This causes an increase in optimal interest rates. On the other hand, an increase in the optimal nominal interest rate implies, ceteris paribus a higher real interest rate which, in turn, causes a appreciation in the real exchange rate. Consequently, financial stability gap increases as can be seen in equation 5. CBT reacts by decreasing the interest rate which mitigates the first effect. The net effect will depend on the financial shock's magnitude. If financial shock is persistent enough, the second effect dominates the first which means the first effect of increase on nominal interest rates is decreased by second effect. Since we incorporate financial shocks exogenously to the present framework and look for analytical results, it becomes possible to analyze the magnitude of the financial shocks in detail in contrast to the above mentioned works. The ambiguous effect of financial shocks on nominal interest rates due to the persistency of the magnitude of the shock differs from the results of Özatay (2011). Whereas, the effect of financial shock on nominal interest rates is purely positive in Özatay (2011), in the present work, the incorporation of the exchange rate channel to the monetary mechanism leads us to analyze both the credit and exchange rate channel as we mentioned in chapter 2.

Proposition 3: The effect of fiscal policy shock on the optimal interest rate choice of CBT does not depend on the concerns for financial stability. Fiscal policy shock does not put any pressure on financial stability.

Proof 3: As we can see from equation (20), the coefficient of g_t does not include α_2 , there is no change in the effect of fiscal policy shock on the optimal nominal interest rate whether the CBT have financial stability concerns or not.

Due to the additively separable character of g_t in x_t, optimal x_t does not react directly to fiscal policy shocks. Of course, financial stability affects x_t through the credit channel (see equation 5 and 7) which increases output. However this effect is already present in equation (15) through L_t and π_t. At the optimal level of output gap, g_t is irrelevant for the monetary authority as long as it does not have a direct impact on L_t and π_t.

Now, we compare the optimal values of i_t^*, L_t^*, π_t^* and x_t^* when CBT is targeting both price and financial stability to when it is targeting only price stability.

Proposition 4: Optimal level of nominal interest rates will be higher when CBT is targeting only price stability rather than targeting both price and financial stability

Proof 4: In order to analyze the value in optimal level of nominal interest rates, we impose $\alpha_2 = 0$ ***in equation (20). In this case, the optimal nominal interest rate will tend to infinity since the coefficient of the foreign interest rate is infinite[16]. This can be interpreted as a higher value of the nominal interest rate under price stability compared to that under both price and financial stability.***

In the traditional monetary policy implementation, in which price stability is the only objective and the short term policy rate is the single tool, the central bank does not need to have a separate impact on credit and exchange rate channels as we mentioned before. The reason is that, in this case what matters at the end is the net impact of these channels only on inflation. Let us consider a case of traditional inflation targeting regime where inflation overshoots the target due to acceleration in domestic demand. The central bank will raise policy rate to bring inflation back to the target path. Higher interest rate will slow down the credit volume and it will typically lead to an appreciation in domestic currency, both of which will lead to a fall in inflation. Therefore, raising policy rates during times of overheating would be enough since under a conventional inflation targeting regime what matters for the monetary authority is putting inflation back to the target path. However, if the central bank has financial stability concerns, hiking the policy rate may not be as desirable as it would lead to exchange rate appreciation which may conflict with the financial stability objective. Therefore, the presence of financial stability as an explicit objective may require the use of credit and exchange rate channels separately. Accordingly, monetary authority may need to resort to other instruments alongside the short-term policy rate in order to affect both credit and exchange rate channels in the desired direction which may require a milder reaction of the interest rate. The decreased reaction of nominal interest rates under the challenge of CBT's achieving both price and financial stability, mainly results from the trade off between two targets which is also conforming with the findings of Ozatay (2011). Furthermore, we can see also the effect of small open economy assumption's adjustments on

[16] This is probably due to the fact that we have normalized several parameters to one in order to save on the number of parameters.

nominal interest rate reaction by world interest rate level given by $\bar{r}$ in equation (20) which differs from Özatay (2011) because of the closed economy assumption.

Proposition 5: Optimal level of output gap is higher when CBT is targeting both price and financial stability rather than when targeting only price stability.

Proof 5: Inserting the optimal inflation given in equation (18) into equation (19) which gives the optimal output gap yields the reduced form given below.

$$x_t^* = \left[\frac{(\alpha_2\xi\tau+\lambda)}{(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)}\frac{\alpha_2\tau\lambda}{(1-\beta\rho_v)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+(1-\rho_v)(\alpha_2\xi\tau\lambda)+\lambda^2} - \frac{\alpha_2\tau}{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau-\alpha_1\rho_v}\right] v_t + \left[\frac{\xi}{\tau+\xi} - \frac{(\alpha_2\xi\tau+\lambda)}{(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)}\frac{\alpha_2\xi\tau\lambda}{(1-\beta)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+\lambda^2}\right]\bar{r} + \frac{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau}{(1-\beta\rho_\gamma)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+(1-\rho_\gamma)(\alpha_2\xi\tau\lambda)+\lambda^2}\gamma_t \quad (21)$$

Imposing $\alpha_2 = 0$ in equation (21) yields the optimal output gap under both financial and price stability given in equation (22). Comparing equation (21) and (22) proves proposition 5.

$$x_t^* = \left[\frac{\xi}{\tau+\xi}\right]\bar{r} + \frac{\alpha_1}{(1-\beta\rho_\gamma)\alpha_1+\lambda^2}\gamma_t \quad (22)$$

Since the optimal value of nominal interest rates is lower when CBT is targeting both price and financial stability, it is reasonable to have a higher value of optimal output gap. As implied by equation (1), there is a negative relationship between output gap and nominal interest rate. Lower nominal interest rates will lead to an increase in credit volume which directly affects the output gap positively. This result is conforming to the findings of both Özatay (2011) and Bailliu et. al (2012) which suggest that regimes where policy makers respond to financial imbalances and/or the use of macro prudential tools yields a higher welfare.

Proposition 6: Optimal level of financial stability gap is lower when CBT is targeting both price and financial stability rather than when targeting only price stability.

Proof 6: Inserting the expression for the optimal inflation given in equation (18) into the optimal level of financial stability gap given by equation (17) yields the following reduced form for financial stability gap under optimal monetary policy.

$$L_t^* = \left[\frac{\alpha_1\xi-\tau\lambda-\xi\lambda}{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau}\frac{\alpha_2\xi\tau\lambda}{(1-\beta)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+\lambda^2}-\frac{\alpha_1\xi}{\alpha_2\tau^2+\alpha_2\xi\tau}\right]\bar{r}+\left[\frac{\alpha_1}{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau-\alpha_1\rho_U}-\frac{\alpha_1\xi-\tau\lambda-\xi\lambda}{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau}\frac{\alpha_2\tau\lambda}{(1-\beta\rho_U)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+(1-\rho_U)(\alpha_2\xi\tau\lambda)+\lambda^2}\right]\upsilon_t + \left[\frac{\alpha_1\xi-\tau\lambda-\xi\lambda}{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau}\frac{\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau}{(1-\beta\rho_\gamma)(\alpha_1+\alpha_2\tau^2+\alpha_2\xi\tau)+(1-\rho_\gamma)(\alpha_2\xi\tau\lambda)+\lambda^2}\right]\gamma_t \quad (23)$$

Imposing $\alpha_2 = 0$ in equation 23 shows that the optimal level of financial stability gap goes to infinity which can be interpreted as a higher financial stability gap.

In the traditional monetary policy implementation, in which price stability is the only objective and the nominal interest rate is the single tool, the central bank does not need to have a separate impact on credit and exchange rate channels. Therefore, financial indicators except inflation level do not matter for CBT's policy. As we discussed before in the conventional monetary policy section, the only concern of the monetary authority is the price stability because the modern literature on monetary policy generally emphasizes the central bank's role in fostering price stability according to Goodhart (2007). However, a dominant concern for central bankers has been not just price stability, but also financial stability yields wide variety of institutional settings, historical contexts and political environments in which they operate. Thus, the result of higher financial stability under both price and stability target is a highly expected outcome.

Preposition 7: The optimal inflation depends only on cost push shocks under price stability alone whereas it is also a function of the world interest rates and financial stability shocks when CBT is concerned with financial stability.

Proof 7: Imposing $\alpha_2 = 0$ in equation (18) yields equation (24) below which shows that the optimal inflation is insulated from financial instability imported through a change in the world interest rate as well as from financial sector bubbles.

$$\pi_t^* = \frac{\alpha_1}{\alpha_1(1-\beta\rho_\gamma)+\lambda^2}\gamma_t \quad (24)$$

In the traditional inflation targeting framework, central banks mainly aim at keeping inflation in line with the target by using a single instrument (nominal interest rate). In order to control inflation, the output gap and other variables affecting the

medium term inflation outlook are taken into account as implied by equation (3). The monetary authority reacts to variables such as credit growth and asset prices only indirectly through their impact on future inflation. On the other hand, a monetary authority with an explicit financial stability concern can be faced with an optimal inflation represented by equation (18) which depends both on cost push shocks, financial shocks and world interest rate under both price and financial shocks. Since the concern of financial stability requires taking into consideration of both exchange rate channel and expectations channel, the price and financial stability target requires the incorporation of financial shocks and world interest rates. Our findings differ from those of Özatay (2011) due to our small open economy framework. That is, we can analyze the effects of exchange rate deviations resulting from the world interest changes on optimal interest rate reactions. However, since we limit our model to flexible exchange rate framework, we do not reach any conclusions about the effects of other types of exchange rates which can be seen in the work of Ünsal (2011).

CHAPTER 5. CONCLUSION

The present work proposes an analysis on the monetary policy framework that focuses both on price and financial stability for the Turkey case, in order to capture the recent design of monetary policy implemented by CBT which has a broader scope since it considers an inflation targeting strategy that encompasses financial stability. For this, the second and the third chapter give, respectively, a brief explanation on the conventional policy application of CBT between 2002 and 2006 and on the new monetary policy framework applied by CBT since the last quarter of 2010. Then, the first section of the fourth chapter gives a summary overview of the literature on the evolution of monetary policy conception as well as the conventional monetary policy while the literature on the nonconventional monetary policy is discussed in more detail. The second part of the fourth chapter proposes an analytical framework suitable to analyze the policy behavior of CBT.

As we discussed before, the Central Bank implemented an implicit inflation targeting regime under which short-term interest rates were used as the main policy tool between 2002 and 2005. CBT's transition period to full-fledged inflation targeting depends mainly on the effective communication skills of CBT. However, the ultimate result of the global crises in 2008 and implemented policies by advanced economies as well as prevailing global imbalances led to unusual dynamics in the global economy. Major central banks have introduced "unconventional monetary policy measures" to deal with the economic and financial crisis that materialized in the aftermath of the bursting of the global credit bubble. As a reflection of this lesson, the idea that the central banks should attach more weight to financial stability gains more importance. Thus, a monetary authority targeting both price and financial stability needs additional policy tools besides the policy rate because of the tradeoff between price and financial stability. In order to achieve both price and financial stability, CBT diversified its policy tools to enhance the communication about the transmission mechanism and defined two intermediate variables such as credit growth and exchange rates. Monetary authorities' explicit objective of financial

stability requires the use of credit and exchange rate channels separately and the management of the expectations of economic actors.

Our benchmark model Clarida et. al. (1999) is a dynamic general equilibrium model with money and temporary price rigidities. Within the model, monetary policy affects the real economy in the short run as in the traditional Keynesian IS/LM model. The novel feature of the model is that the aggregate behavioral equations are derived explicitly from optimizing households and firms. The monetary authority is assumed to minimize a quadratic loss function which depends on output gap, inflation as well as financial stability gap by using interest rates as a monetary policy tool. This reference model could be modified in order to incorporate concerns for the effects of monetary policy decisions on financial stability. Özatay (2011) extends the setup proposed by Clarida et al. (1999) by adding a financial stability equation to the model. We follow Özatay (2011) by making two modifications. First, we relax the closed economy assumption and adopt an open economy set up in order to analyze the case of small open economy. Second, we modify the financial stability equation by adding the expected future financial instability and the next period expected change in the real exchange rate depending on small open economy assumption. With the help of these extensions, we obtain a framework that is capable of separating the credit and exchange rate channels and incorporating the role of expectations as we mentioned above. Moreover, the model can be solved analytical.

We use this framework, to assess the effect of financial stability concerns of CBT on the optimal monetary policy tool as well as on main economic indicators such as the output gap and inflation. For this purpose, we compare the optimal levels of the relevant variables under two different cases: when CBT is targeting only price stability and when CBT is targeting both price and financial stability. The analytical results show that the optimal interest rate reacts less to the changes in inflation but more to the changes in expected inflation when CBT cares for financial stability. The increased reaction of optimal interest rates to expected inflation is also supported by Ozatay (2011). This proves that our model is capable of capturing the increased importance of expectations under financial stability concerns.

Our framework also shows that optimal interest rate reaction to the changes in financial shocks depends on the persistency of shock when financial stability also matters for CBT. As an example of the shock persistency, regarding the figure 3.11

in chapter 3, growth trend in consumer credits beginning from the end of 2009 has been decided to be sterilized at the end of the 2010 by CBT. The ambiguous effect of financial shocks on nominal interest rates due to the persistency of the magnitude of the shock differs from the results of Özatay (2011). It is also useful to measure the welfare effects of the adjusted framework. Since the model allows for analytical results, it is possible to give an exact evaluation of the loss function under the two cases that are analyzed. However, due to the complexity of the analytical expressions for the solution of several variables, such a computation does not seem practical. Intuitively, higher output gap and inflation under financial stability concerns exert a negative effect on welfare while the lower financial stability gap under financial stability concerns implies a positive effect. Whether the positive effect of lower financial stability gap dominates the negative effect of higher output gap and inflation depends on the parameters of the model.

Furthermore, optimal level of financial stability gap is lower since CBT is targeting both price and financial stability which is highly an expected outcome. As a result of our small open economy assumption, the optimal inflation depends only on cost push shocks under price stability alone whereas it is also a function of the world interest rates and financial stability shocks when CBT is concerned with financial stability. These findings differ from those of Özatay (2011). The closed economy framework of the latter cannot capture the effect of perturbations stemming from the rest of the world. With the help of this framework, we can analyze the effects of exchange rate deviations resulting from the world interest changes on optimal interest rate reactions.

There are several ways in order to improve upon the explanatory capacity of the present model. First, the model cannot capture the use of uncertainty by the CBT to induce the banking system to be more cautious. Indeed, CBT does not reveal information on the duration of the restrictive liquidity management in order to discourage banks from increasing credit volume. However, in our model there is no uncertainty that could affect the formation of expectations by the private sector. The addition of this type of behavior in the model requires introducing model uncertainty as in Rotemberg and Woodford (1997) or introducing asymmetric information as in Paciello and Wiederholt (2010).

Second, the financial sector is considered as exogenous in the present model. It would be interesting to give an explicit modeling of the financial sector. As such it would be possible to see the effect of maturity and exchange rate mismatches on the financial stability.

Third, since we consider the Turkish case, our model considers a small open economy. However, in order to consider the problem in a wider scope, one can assume a two-country framework and evaluate the monetary interactions between FED and ECB. In this context, it would also be interesting to compare the case of fixed and flexible exchange rates as in Ünsal (2011) since ECB operates in a currency union.

Since we try to allege analytical results, we make unrealistic normalizations for the values of several parameters in the model. However, we believe that this does not alter the results qualitatively but only quantitatively. Finally, one might quantify the benefits gained from optimal monetary policy under both financial and price stability. Since the CBT designed and implemented a new adjusted monetary policy framework for almost three years, it can be useful to have an econometric approach with collecting the enough data in order to have an efficient evaluation in the future.

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APPENDICES

APPENDIX A

The standard approach in monetary economics and monetary policy analysis incorporates nominal wage or price rigidity into a dynamic stochastic general equilibrium (DSGE) framework that is based on optimizing behaviour by agents in the model.

Households:

Households maximize the expected present discounted value of utility;

$$E_t \sum_{i=0}^{\infty} \beta^i \left\{ \left[\frac{C_{t+i}}{1-\sigma}\right]^{1-\frac{1}{\Phi}} + \frac{\gamma}{1-b}\left[\frac{M_{t+i}}{P_{t+i}}\right]^{1-b} - \mathrm{X}\,\frac{N^{1+h}}{1+h} \right\} \tag{A1}$$

The composite good that enters the household's utility function is defined as

$$C^t = \left[\int_0^1 c_{jt}^{\frac{\varsigma-1}{\theta}}\right]^{\frac{\varsigma}{\varsigma-1}} \qquad \varsigma > 1 \tag{A2}$$

Household decision problem can be dealt in two stages;

- Regardless of the level of C_t household decides on, it will always be optimal to purchase the combination of individual goods that minimizes the cost of achieving this level of composite goods.
- Given the cost of achieving any level of C_t, the household chooses Ct, N_t and M_t optimally.

First stage;

min $_{cjt} \int_0^1 P_{jt} C_{jt} d_j$

with respect to $$\int_0^1 \left(c_{jt}^{\frac{\varsigma-1}{\varsigma}} d_j\right)^{\frac{\varsigma}{\varsigma-1}} \tag{A3}$$

where P_{jt} is the price of good j. Letting ψ_t be the Lagrangian multiplier. The Lagrangian of the problem given in equation (A3) can be written as follows:

$$\min \mathcal{L} = \int_0^1 P_{jt} C_{jt} d_j - \psi_t \left(\int_0^1 \left(c_{jt}^{\frac{\varsigma-1}{\varsigma}} d_j\right)^{\frac{\varsigma}{\varsigma-1}} - C_t \right) = 0$$

$$\frac{\partial \mathcal{L}_t}{\partial C_{JT}} = P_{jt} - \psi \left(\int_0^1 c_{jt}^{\frac{\varsigma-1}{\varsigma}} d_j^{\frac{\varsigma}{\varsigma-1}} \right) c_{jt}^{-\frac{1}{\varsigma}} = 0$$

Rearranging $c_{jt} = \left(\frac{P_{jt}}{\psi_t}\right)^{-\varsigma} C_t$ from equation 2 implies;

$$C_t = \left(\frac{1}{\psi}\right)^{-\varsigma} \left[\int_0^1 P_{jt}^{1-\varsigma} d_j\right]^{\frac{\varsigma}{\varsigma-1}} C_t$$

Solving for ψ_t;

$$\psi_t = \left[\int_0^1 P_{jt}^{1-\varsigma}\, d_j\right]^{\frac{1}{1-\varsigma}} = P_t \qquad \text{(A4)}$$

The Lagrangian multiplier is the appropriately aggregated price index for consumption;

$$c_{jt} = \left(\frac{P_{jt}}{P_t}\right)^{-\varsigma} C_t \qquad \text{(A5)}$$

Price elasticity of demand for good j is equal to ς (As ς goes to infinite, the individual goods become closer and closer substitutes and consequently individual firms will have less power).

The budget constraint of the households in real terms;

$$C_t + \frac{M_t}{P_t} + \frac{B_t}{P_t} = \left(\frac{W_t}{P_t}\right) N_t + \frac{M_{t-1}}{P_t} + (1 + i_{t-1})\frac{B_{t-1}}{P_t} + \pi_t \qquad \text{(A6)}$$

M_t and B_t are the nominal holdings of money and bonds respectively, yielding an interest of i_t. Real profits is represented by π_t.

In the second stage, households maximize equation (A1) subject to equation (A6) in order to decide the optimal consumption, labor supply, money and bond holdings. First order conditions imply the following equations which in addition to the budget constraint must hold in equilibrium;

$$C_t^{-\frac{1}{\Phi}} = \beta(1 + i_t) E_t \left(\frac{P_t}{P_{t+1}}\right) C_{t+1}^{-\frac{1}{\Phi}} \qquad \text{(A7)}$$

$$\frac{\gamma\left(\frac{M_t}{P_t}\right)^{-b}}{C_t^{-\frac{1}{\Phi}}} = \frac{i_t}{i_{t+1}} \qquad \text{(A8)}$$

$$\frac{\chi N_t^h}{C_t^{-\frac{1}{\Phi}}} = \frac{W_t}{P_t} \qquad \text{(A9)}$$

These conditions represent the Euler condition for the optimal intertemporal allocation of consumption (equation A7), the intratemporal optimality condition setting the marginal rate of substitution between money and consumption equal to the opportunity cost of holding money (equation A8), and the intratemporal optimality condition setting the marginal rate of substitution between leisure and consumption equal to the real wage (equation A9).

APPENDIX B

Firms:

Firms maximize profits, subject to three constraints. The first is the production function summarizing the available technology. In this function, a constant return to scale has been assumed. The term z_t represents aggregate productivity disturbance and N_{jt} stands for labor input.

$E(z_t) = 1$ $\quad\quad$ $c_{jt} = z_t . N_{jt}$

The second constraint on the firms is the demand curve each firm faces (given by equation A5). The third constraint is that in each period some firms are not able to adjust their prices (Calvo, 1983). In this framework, w is a measure of the degree of nominal rigidity. Each period, the firms that adjust their price are randomly selected, and a fraction (1-w) of all firms adjusts while the remaining w fraction does not adjust.

Firm's pricing decision is the cost minimization problem which involves minimizing $W_t N_{jt}$ subject to production;

$$C_{Jt} = z_t N_{jt}$$

$\min \left(\frac{w_t}{P_t}\right) N_t + \varphi_t \left(c_{jt} - z_t N_{jt}\right)$ where φ_t is equal to the firm's real marginal cost, expressed as a percentage deviation around its steady state.

$$\frac{\partial \mathcal{L}}{\partial N_{jt}} \Rightarrow \quad \varphi_t = \frac{{}^{w_t}/_{P_t}}{z_t} \tag{B1}$$

The firm's pricing decision problem involves picking P_{jt} to maximize;

$E_t \sum_{i=0}^{\infty} d^i \Delta_{i,t+i} \left[\left[\frac{P_{jt}}{P_{t+1}}\right] C_{j+i} - \varphi_{t+1} C_{j+i}\right]$ where discount factor $\Delta_{i,t+i}$ is given by $\beta^i \left[\frac{C_{t+i}}{C_t}\right]^{-\frac{1}{\Phi}}$

Using the demand curve (equation A5) to eliminate $c_{jt,}$ this objective function can be written as;

$$E_t \sum_{i=0}^{\infty} d^i \Delta_{i,t+i} \left[\left[\frac{P_{jt}}{P_{t+1}}\right]^{1-\varsigma} - \varphi_t \left[\frac{P_{jt}}{P_{t+1}}\right]^{-\varsigma}\right] C_{j+i}$$

When individual firms produce differentiated products, they all have the same productiın technology and face demand curves with constant and equal demand elasticity. The first order condition for optimal choice of P^* is;

$$E_t \sum_{i=0}^{\infty} d^i \Delta_{i,t+i} \left[(1-\varsigma)\left[\frac{P_t^*}{P_{t+i}}\right] + \varsigma \varphi_{t+i}\right]\left(\frac{1}{P^*}\right)\left(\frac{P_t^*}{P_{t+i}}\right)^{-\varsigma} C_{t+i} = 0 \tag{B2}$$

$$\frac{P_t^*}{P_t} = \frac{\varsigma}{\varsigma-1} \frac{E_t \sum_{i=0}^{\infty} d^i \beta^i C_{t+i}^{1-\frac{1}{\Phi}} \varphi_{t+i} \left(\frac{P_{t+i}}{P_t}\right)^{\varsigma}}{E_t \sum_{i=0}^{\infty} d^i \beta^i C_{t+i}^{1-\frac{1}{\Phi}} \left(\frac{P_{t+i}}{P_t}\right)^{\varsigma-1}} \tag{B3}$$

Consider the case in which all firms are able to adjust their price every period (w=0). Equation (B3) reduces to;

$$\frac{P_t^*}{P_t} = \frac{\varsigma}{\varsigma-1}\varphi_t = \mu\varphi_t \qquad \text{(B4)}$$

Each firm sets its price P^* equal to mark up $\mu > 1$ over its nominal marginal cost. When prices are flexible, all firms charge the same price. In this case, $P_t^* = P_t$ and $\varphi_t = \frac{1}{\mu}$. Using the definition of real marginal cost, this means $\frac{w_t}{P_t} = \frac{z_t}{\mu} < z_t$. From equation (A9),

$$\frac{XN_t^h}{C_t^{-\frac{1}{\Phi}}} = \frac{W_t}{P_t} = \frac{z_t}{\mu} \qquad \text{(B5)}$$

Goods market clearing and the production function imply that $C_t = Y_t$ and $N_t = \frac{Y_t}{Z_t}$. Using equation (B5) and letting Y_t^f denote equilibrium output under flexible prices:

$$Y_t^f = \left(\frac{1}{X\mu}\right)^{\frac{1}{\frac{1}{\Phi}+h}} z_t^{(1+h)(\frac{1}{\Phi}+h)} \qquad \text{(B6)}$$

From equation (A4);

$$P_t^{1-\frac{1}{\Phi}} = (1-w)(P_t^*)^{1-\varsigma} + w\, P_{t-1}^{1-\frac{1}{\Phi}} \qquad \text{(B7)}$$

To summarize, equation (A7), (B1),(B3),(B5) and (B7) represent a system in C_t, Y_t, M_t/Pt, φ_t , P_t, P_t^*, W_t/P_t and it can be combined with aggregate production function, $Y_t = Z_tN_t$ and a specification of monetary policy to determine the economy's equilibrium.

APPENDİX C

New Keynesian Philips Curve

Let $\hat{x}$ denote the percentage deviation of a variable X_t around its steady state and let the superscript f denote the flexible price equilibrium. Equation (B3) and (B7) are used to obtain an expression for the deviations of inflation rate around its steady state level. Let $Qt = \frac{P_t^*}{P_t}$ be the relative price chosen by all firms that adjust their price in period t. The steady state of $Q_t = 1$; this is also the value Q_t equals when all firms are able to adjust every period.

Divide equation (B7) by P_t^{1-Q}.

$$1 = (1-w)Q_t^{1-Q} + w\,(\frac{P_{t-1}}{P_t})^{1-Q}$$

Expressed in terms of percentage deviation around the zero inflation steady state, this becomes

$$0 = (1-w)\hat{q_t} - w\pi_t \qquad \Rightarrow \qquad \hat{q_t} = \left(\frac{w}{1-w}\right)\pi_t$$

To obtain an approximation to equation (B3), note that it can be written as;

$$\left[E_t \sum_{i=0}^{\infty} d^i \beta^i \, C_{t+i}^{1-\frac{1}{\Phi}} \varphi_{t+i} \left(\frac{P_{t+i}}{P_t}\right)^{\varsigma-1}\right] \varphi_t = \mu \left[E_t \sum_{i=0}^{\infty} d^i \beta^i \, C_{t+i}^{1-\frac{1}{\Phi}} \varphi_{t+i} \left(\frac{P_{t+i}}{P_t}\right)^{\varsigma}\right]$$

After the approximation of both left and right hand side, setting two equations equal and noting $\mu\varphi_t = 1$ equals;

$$\left(\frac{1}{1-w\beta}\right)\widehat{q_t} = \sum_{i=0}^{\infty} w^i \beta^i \, (E_t\widehat{\varphi_{t+i}} + E_t\widehat{p_{t+i}}) - \left(\frac{1}{1-w\beta}\right)\widehat{p_t}$$

Multiply both sides $(1-w\beta)$ and adding each equations' corresponding sides;

$$\widehat{q_t} + \widehat{p_t} = (1-w\beta)\sum_{i=0}^{\infty} w^i \beta^i \, (E_t\,\widehat{\varphi_{t+i}} + E_t\,\widehat{p_{t+i}})$$

The left side is the optimal nominal price $(\widehat{P_t^*} = \widehat{q_t} + \widehat{p_t})$ and this is set equal to the expected discounted value of future nominal marginal costs. This equation can be written;

$$\widehat{q_t} + \widehat{p_t} = (1-w\beta)(\widehat{\varphi_{t+i}} + \widehat{p_{t+i}}) + w\beta\,(\widehat{q_{t+i}} + E_t\,\widehat{p_{t+i}})$$

Rearranging this expression yields;

$$\widehat{q_t} = (1-w\beta)(\widehat{\varphi_t}) + w\beta\,(E_t\,\widehat{q_{t+i}} + E_t\,\pi_{t+1})$$

Using $\widehat{q_t} = \frac{w}{1-w}\,\pi_t$;

$$\frac{w}{1-w}\,\pi_t = (1-w\beta)\,(\widehat{\varphi_t}) + w\beta\,(\tfrac{1}{1-w})E_t\pi_{t+1}$$

Multiply both sides by $\frac{1-w}{w}$ produces forward looking New Keynesian Philips curve.

$$\pi_t = \widetilde{\lambda}\,\widehat{\varphi_t} + \beta\,E_t\pi_{t+1} \quad \text{where} \quad \widetilde{\lambda} = \frac{(1-w)(1-\beta w)}{w} \qquad \text{(C1)}$$

Equation (C1) is both forward looking and shows that real marginal cost is the correct driving variable for the inflationary process. In order to write down inflation depends on a measure of the gap between actual output and some measure of potential output or on a measure of unemployment relative to the natural rate as in typical traditional Philips curve.

Equation (C1) implies that inflation depends on real marginal cost and not directly on a measure of the gap between actual output and some measure of potential output or on a measure of unemployment relative to the natural rate, as is typical in traditional Phillips curves. However, real marginal costs can be related to an output gap measure. According to the equation (B1), the firm's real marginal cost is equal to the real wage it faces divided by the marginal product of labor. In a flexible-price equilibrium, all firms set the same price, so equation (B4) implies that real marginal cost will equal its steady-state value of $1/\mu$. Because nominal wages have been assumed to be completely flexible, the real wage must, according to equation (A9), equal the marginal rate of substitution between leisure and consumption. Expressed in terms of percentage deviations around the steady state, equation (A9) implies that

$\hat{w}_t - \hat{p}_t = hn_t + \frac{1}{\Phi}\hat{y}_t$. Recalling that $\hat{c}_t = \hat{y}_t$ and $\hat{y}_t = \hat{n}_t + \hat{z}_t$, the percentage deviation of real marginal cost around its steady-state value is

$$\hat{\varphi}_t = (\hat{w}_t - \hat{p}_t) - (\hat{y}_t - \hat{n}_t) = \left(\frac{1}{\Phi} + h\right)\left[(\hat{y}_t - \left(\frac{1+h}{\frac{1}{\Phi}+h}\right)\hat{z}_t\right]$$

To interpret the term involving$\hat{z}_t$, linearized equation (B6) giving flexible-price output to obtain

$$\hat{y}_t^f = \left(\frac{1+h}{\frac{1}{\Phi}+h}\right)\hat{z}_t \qquad \text{(C2)}$$

Thus equation (C2) can be used to express real marginal cost as,

$$\hat{\varphi}_t = \Gamma(\hat{y}_t - \hat{y}_t^f) \qquad \text{where} \qquad \Gamma = \sigma + h. \qquad \text{(C3)}$$

Using this result, the inflation adjustment equation (17) becomes

$$\pi_t = \beta E_t\pi_{t+1} + \lambda x_t \qquad \text{(C4)}$$

Where $\lambda = \Gamma\,\tilde{\lambda} = \Gamma\frac{(1-w)(1-\beta w)}{w}$ and $x_t = \hat{y}_t - \hat{y}_t^f$ is the gap between actual and flexible price equilibrium output.

APPENDIX D

The Linearized IS Curve

Equation (C4) relates output to inflation in the form of the deviation around the level of output that would occur in the absence of nominal price rigidity. Equation (A7) can be approximated as;

$y_t = E_t\hat{y}_{t+1} - \Phi\,(i_t - E_t\pi_{t+1})$ where $\hat{\imath}_t$ is the deviation of nominal interest rate from its steady state value. Expressing this in terms of output gap $x_t = \hat{y}_t - \hat{y}_t^f$, it can be written as below;

$x_t = E_t x_{t+1} - \Phi(i_t - E_t\pi_{t+1}) + \upsilon_t$ where υ_t is an external productivity disturbance.

Equation (A7) which is the Euler condition for the intertemporal allocation of consumption can be approximated around the zero inflation steady state;

$$\hat{y}_t = E_t\hat{y}_{t+1} - \Phi\,(i_t - E_t\pi_{t+1}) + \upsilon_t \qquad \text{(D1)}$$

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