GALATASARAY UNIVERSITY

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THE RELATIONSHIP BETWEEN CENTRAL BANK POLICY RATE AND PUBLIC BORROWING COST

MASTER THESIS

Semih KILIÇ

Research Director: Assoc. Prof. S. Irem ZEYNELOĞLU

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Declaration of Authorship

I, Semih Kılıç, declare that this thesis titled 'The Relationship Between Central Bank Policy Rate and Public Borrowing Cost' and the work presented in it are my own. I confirm that:

- This study is done wholly or mainly while in candidature for a master degree at Galatasaray University.
- Where any part of this thesis has previously been submitted for a degree or any other qualifications at this University or any other institution, this has been clearly stated.
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Abstract

This thesis develops a dynamic, stochastic, general-equilibrium (DSGE) model for the Turkish economy and evaluates the effects of monetary policy shocks on public borrowing cost.

The first part of the study presents the theoretical model with three main components as households, firms and banking sector. The solution method and interpretation of results are also introduced. The second part introduces an inclusive perspective about different monetary policy practices implemented by the Central Bank and their interactions with public finance over the last years. The third part summarizes and concludes.

In the model, in order to emphasize the importance of foreign flows in terms of borrowing costs, Turkey is characterized as a small open economy and the rest of the world as foreign economy. The structural parameters identifying transmission channels are estimated according to Turkish data between the period 2008-2018.

The results show that a positive monetary policy shock creates an extra pressure on the public borrowing cost in the short term whereas it has an inverse effect in the medium term.

Résumé

Cette thèse développe un modèle dynamique, stochastique, d'équilibre général (DSGE) pour l'économie turque et évalue les effets des chocs de politique monétaire sur le coût de l'emprunt public.

La première partie de l'étude présente le modèle théorique avec trois composantes principales que les ménages, les entreprises et le secteur bancaire. La méthode de résolution et l'interprétation des résultats sont également introduites. La deuxième partie introduit une perspective inclusive sur les différentes pratiques de politique monétaire mises en œuvre par la Banque centrale et leurs interactions avec les finances publiques au cours des dernières années. La troisième partie résume et conclut.

Dans le modèle, afin de souligner l'importance des flux étrangers en termes de coûts d'emprunt, la Turquie est caractérisée comme une petite économie ouverte et le reste du monde comme une économie étrangère. Les paramètres structurels identifiant les canaux de transmission sont estimés selon les données turques entre la période 2008-2018.

Les résultats montrent qu'un choc de politique monétaire positif crée une pression supplémentaire sur le coût de l'emprunt public à court terme alors qu'il a un effet inverse à moyen terme.

Özet

Bu tez, Türkiye ekonomisi için dinamik, stokastik, genel denge (DSGE) modeli geliştirmekte ve para politikası şoklarının kamu borçlanma maliyeti üzerindeki etkilerini değerlendirmektedir.

Çalışmanın ilk bölümünde hane halkı, firmalar ve bankacılık sektörü olmak üzere üç temel bileşen içeren teorik model sunulmaktadır. Ayrıca bu bölümde çözüm yöntemi ve sonuçların yorumlanması da ele alınmaktadır. İkinci bölüm, Merkez Bankası tarafından uygulanan farklı para politikası uygulamaları ve bunların son yıllarda kamu maliyesi ile etkileşimleri hakkında kapsayıcı bir bakış açısı sunmaktadır. Üçüncü bölüm özetlemekte ve sonuçlandırmaktadır.

Modelde dış borçların borçlanma maliyetleri açısından önemini vurgulamak için Türkiye küçük bir açık ekonomi, dünyanın geri kalanı dış ekonomi olarak nitelendirilmektedir. İletim kanallarını tanımlayan yapısal parametreler, 2008-2018 yılları arasındaki Türkiye verilerine göre tahmin edilmiştir.

Sonuçlar, olumlu bir para politikası şokunun kısa vadede kamu borçlanma maliyeti üzerinde fazladan baskı oluşturduğunu, orta vadede ise ters bir etkiye sahip olduğunu göstermektedir.

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List of Abbreviations

BOE: Bank of England

BOJ: Bank of Japan

CBRT: Central Bank of the Republic of Turkey

CDS: Credit Default Swap

CPI: Consumer Price Index

DM: Deutche Mark

DSGE: Dynamic Stochastic General Equilibrium

ECB: European Central Bank

FED: Federal Reserve System

FX: Foreign Exchange

GNAT: General National Assembly of Turkey

IMF: İnternational Monetary Fund

LLW: Late Liquidity Window

MPC: Monetary Policy Committee

NFA: Net Foreign Asset

RBC: Real Business Cycle

ROC: Reserve Option Coefficient

ROM: Reserve Option Mechanism

ROR: Reserve Option Ratio

SDIF: Savings Deposit Insurance Fund

ToT: Terms of Trade

QE: Quantitative Easing

WAFC: Weighted Average of Funding Cost

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Introduction

Analyzing the transmission mechanism of monetary policy has been the subject of interest among several economists for a long while. In this respect, several empirical and theoretical works investigate the matter of transmission mechanisms that give banks an important role. The connection between monetary policy and bank behavior is of particular importance since with the banks' leading role in financing the economic activity, they can provide the connection between the real economy and the monetary policy through several channels namely; credit channel, balance sheet and exchange rate channel etc. By means of these channels, monetary policy has an important impact on public finance and public borrowing cost.

The main purpose of this study is to empirically examine the impact of monetary policy on public borrowing cost, with a special emphasis on the role of banks, in the Turkish economy. For this, the present study introduces the banking sector to a small open economy DSGE model. Indeed, the role of the banking institutions in the transmission mechanism is worth studying for Turkey since it has a bank-based financial system. 1Banks have a pivotal position in the Turkey's financial system, as they hold a considerably important part of public debt. Thus, their asset choice behavior is one of the significant determinants of public borrowing cost. By identifying their reactions following an interest rate shock, we intend to analyze the transmission mechanism of monetary policy through banks.

There is a large body of literature on the determinants of public borrowing cost. One side of the literature corresponds to the conventional view that without taking into consideration the banking sector, a higher debt burden of a country exerts upward pressure on public borrowing cost (Baldaci and Kumar 2010; Poghosyan 2012; Laubach 2019; Kinoshita 2016: Engel and Hubbard 2004; Nickel, Rother and Rülke 2009). Another strand of the literature concentrates on monetary side which claims that the central bank's actions affect the government bond yields, mainly through the effect of the policy rates on short term interest rates and other tools of monetary policy (Akram and Li 2017; Kapur and Mitra 2019; Evans 1997, Piazzesi 2005). Moreover, among the studies that primarily focus on banking sector's role on monetary transmission mechanism (Gerali et al 2010; Casares 2019; Agenor et al 2014), it's seen that they don't address to fiscal side of the economy. This work is expected to contribute to the existing literature by re-examining monetary transmission mechanism in the banking sector in Turkey. With this work, we want to combine monetary and fiscal effects that act on public borrowing cost in the banking sector.

To the best of our knowledge, this thesis is the first one that addresses the relation between central bank policy rate and public borrowing cost in Turkey. In addition to that, by taking into consideration international capital flows, this study offers another novelty in the

[1] At the end of 2011, total assets of the banking system account for 88 percent of total assets of the institutions of financial sector (Özşuca, 2012)

sense that by assessing local and global factors together instead of relying on one particular determinant of public cost of borrowing as done by several studies in related areas. In accordance with the prevailing view that consider banking system as an intermediary in financial sector (Agenor et al 2014; Goodfriend and McCallum; Gerali et al 2014) in our model, banking sector collect deposit in order to produce loans. Similar to Casares 2019, our deposits are subject to required reserve imposed by the central bank but in our setup there is no unemployment. Contrary to Paries (2010), Gerali et al 2010 in our model Turkey is considered as a small open economy with foreign funding channels. Even more to provide a more compatible structure, we use the resource of the central bank as another option of funding for banking sector. In this context, on the liabilities side there are three funding options for banks such as deposit taken from households, foreign funding coming from abroad and central bank funding. In our model, the assets side of the banks consist of two main components: Loans and public bonds. Bond portfolio is the most unique part of this model and provides banks better maneuverability against monetary policy shocks.

This thesis is organized in three chapters. Following the introduction, the first chapter establishes the theoretical framework that is used in this study. The principal goal of this chapter is to explain the decision-making problems of the various agents which make up the model economy. All agents of the model including monetary and fiscal authority are clearly characterized and equilibrium conditions are defined accordingly. The optimal conditions are depicted and the modelling choices are justified in this section. The second section discusses the effect of monetary policy on the cost of public borrowing through banking sector within comparative literature. Following the description of the solution method, steady state and log linearization process are presented. Finally, calibration of model's parameters is made according to the monthly Turkish data for the period 2008-2018 and the numerical results of the model are discussed.

The second chapter presents a wide panorama of public finance and monetary policy in Turkey. In the first section, an overview of past monetary policy practices such as monetary policy based on money supply, exchange rate control and inflation targeting with relevant policy tools by periods is presented in detail. Nevertheless, the principal features of the banking sector are introduced with an emphasis on structural transformation with the new implemented regulatory agency in the aftermath of 2001 financial crisis. The second section presents the evolution of public finance situation in Turkey over last 30 years. Turkey's debt stock and borrowing cost, holders of public debt and the impact of capital flows on the public borrowing cost are analyzed in this section. In the last section, a comprehensive literature review is presented.

The findings of this study about the bank-based channels of monetary transmission on public borrowing cost would have several policy implications. The numerical results from this study are expected to show some fundamental features of the monetary transmission mechanism in Turkey, which could provide helpful information for implementing an appropriate and effective monetary policy. Moreover, the findings of the study would offer

useful insights in analysing the relations among the financial and real sectors of the economy. In this context, chapter 3 concludes the thesis.

Chapter 1) Interactions Between Monetary Policy and Public Borrowing Cost in a Small Open Economy

1.1) The Setup

The main purpose of this study is to examine the relationship between the Central Bank's policy rate and public borrowing cost. To show this relation, the model that is used in this study, contains banking system and international capital flows. The rationale for analyzing this kind of model is that, commercial banks as main holder of public bonds, choose among various financing methods such as deposits, central bank funding and foreign borrowing. In this model only banking sector may hold public bonds.

There are two mechanisms which higher public borrowing cost stemmed from. First, an increase in expected inflation raises the expectation of deposit rate for households. As total deposits stand for %53 of the banks' liabilities account, banks will demand higher yield for public bond holding. In addition, higher inflation expectation will push the Central Bank to raise policy rate and banking sector's funding cost will be higher.

Second, the foreign capital flows play a leading role in terms of determining public borrowing cost. In our setup, foreign funding may be acquired only by means of banks. As long as banks find cheaper sources from foreign countries, they will reduce demand for deposits and the Central Bank funding and yields will decrease accordingly. İn addition, banks will raise the volume of loans and bond holding. By the nature of bond mechanism, the increasing demand will push the yields of public bonds downward.

The structure of the model that we will use in this study is a standard Dynamic Stochastic General Equilibrium model of a small open economy that is characterized by imperfect competition and Calvo type price formation.

New Keynesian models differ from classical monetary models in the sense that there exist nominal rigidities (only price rigidity in this model) and imperfect market structures.

Dynamic-Stochastic General Equilibrium (DSGE) models use modern macroeconomic theory for explaining and predicting comovements of aggregate time series over the business cycle. The term DSGE model encompasses a large class of macroeconomic models which spans the standard neoclassical growth model mentionned in King, Plasser and Rebeto (1988) as well as New Keynesian monetary models with great numbers of real and nominal frictions that are based on the work of Christiano, Eichanbaum and Evans (2005) and Smets and Wouters (2003).

A common characteristic of these DSGE models is that decision rules of economic agents are derived from assumptions about preferences, technologies and the prevailing fiscal and monetary policy regime by solving intertemporal optimization problems. Consequently, the DSGE model paradigm delivers empirical models with a high degree of theoretical coherence that are attractive as a laboratory for policy experiments (Del Negro 2012).

The model that will be presented in chapter one consists of four types of agents. Households maximize their utility subject to their budget constraint. They supply labor to firms and demand loan from banks and allocate their resource to consumption, purchasing of financial assets such as deposits and physical capital. Firms produce differentiated goods with nominal rigidities in the process of setting price by using capital and labor. Banks issue deposits get funding from the Central Bank and foreign sources to produce loans to households and buy government bonds. Finally, the Central Bank follows Taylor type interest rate rule to set nominal interest rate.

1.1.1) Households

By examining the behavior of each representative household, we can see that each consumer agent designed by the index value j ϵ [0,1] gain utility from consumption and has disutility from working as described by the following utility function.

$$\text{Max } E_t \sum_{s=t}^{\infty} \beta^{s-t} U(\ln C_t^j, \psi \ln(1 - N_t)) \quad (1)$$

The time endowment equals 1, and N_t is labor supply to firms and 1-N_t leisure time, $\psi > 0$ determines the weight of leisure on total utility.

C is Cobb-Douglas type composite consumption index which consists of domestically produced goods ($C_{H,t}$) and imported goods ($C_{F,t}$) These goods are produced by monopolistically competitive firms.

$$C = C_{H,t}^{\gamma} . C_{F,t}^{1-\gamma} \quad (2)$$

The variable C_H^j stands for constant-elasticity of substitution (CES) type real consumption index and shown as:

$$C_H^j = \left[\int_0^1 c_H^j(z)^{\frac{Q-1}{Q}} d_z \right]^{\frac{Q}{Q-1}} \quad (3)$$

where c_H^j(z) is the jth Home individual's consumption of good *z* and the price elasticity of demand Q>1.

We define a Cobb-Douglas type price function,

$$P=\frac{P_{H,t}^{\Upsilon}.P_{F,t}^{1-\Upsilon}}{\Upsilon^{\Upsilon}(1-\Upsilon)^{(1-\Upsilon)}} \quad (4)$$

where $P_{H,t}$ is the home price index and $P_{F,t}$foreign country price index.

The price index corresponding to the home composite consumption good is denoted by P_H. This price index is defined as the minimum expenditure required to purchase one unit of composite consumption good. It is given as follows:

$$P_H=\left[\int_0^1 p(z)^{1-Q}d_z\right]^{\frac{1}{1-Q}} \quad [2] \quad (5)$$

where p(z) is the home currency price of good *z* (p^*(z) is the foreign currency price of good *z*). Since there are no impediments to international trade, the price of each good is equal across countries when expressed in the same currency. Then the law of one price holds for each good and we have

$$p(z)=ep^*(z) \quad (6)$$

where *e* represents exchange rate defined as home country price of one unit of foreign currency. Under the law of one price we can rewrite the home price index as

$$P_H=\left[\int_0^1 p(z)^{1-Q}d_z\right]^{\frac{1}{1-Q}}=\left[\int_0^n p(z)^{1-Q}d_z+\int_n^1[ep^*(z)]^{1-Q}d_z\right]^{\frac{1}{1-Q}} \quad (7)$$

Since goods 0 to n are made at home, and the rest are produced abroad. Similarly, foreign price index P^*can be written as

$$P^*=\left[\int_0^1 p^*(z)^{1-Q}d_z\right]^{\frac{1}{1-Q}}=\left[\int_0^n(\frac{p^*(z)}{\epsilon})^{1-Q}d_z+\int_n^1[p^*(z)]^{1-Q}d_z\right]^{\frac{1}{1-Q}} \quad (8)$$

Comparing equations (7) and (8) we see that the Home and Foreign consumer price indexes are related by purchasing power parity

$$P=eP^* \quad (9)$$

2 $P^*=\left[\int_0^1 p^*(z)^{1-Q}d_z\right]^{\frac{1}{1-Q}}$ where $p^*(z)$ is the foreign currency price of good z and $P^*$is the Foreign Money price level.

Given the constant elasticity of substitution consumption index, it is easy to rewrite home individual's demand for z as:

$$c^j(z)=\left[\frac{p(z)}{P}\right]^{-Q} C^j \quad (10)$$

Foreign agent's demand is

$$c^{*j}(z)=\left[\frac{p^*(z)}{P^*}\right]^{-Q} C^{*j} \quad (11)$$

Combining demand for good z across all agents3 (that is taking a population weighted average of Home and Foreign demand) and making use of law of one price (6) and purchasing power parity (9) equations which implies that $\frac{p(z)}{P}=\frac{p^*(z)}{P^*}$ for any good z, total demand for good z takes the constant elasticity of substitution form:

$$y(z)=\left[\frac{p(z)}{P}\right]^{-Q} C^w \quad (12)$$ [4]

The representative agent receives $r_r^k k_t$ from renting capital k_t to firms at the real rate r_r^k, obtain a real interest rate of r_t^d per unit of real deposits d_t.

Income is allocated for consumption, capital accumulation, bank deposits and interest payment for loans.

The stock of capital is one-period predetermined. Regarding the cost of external finance, let r_t^l be the real interest rate on loans and l_t^h the amount of real loans demanded by the household. Thus, the household's budget constraint in real terms becomes

$$r_r^k k_t+w_t N_t+r_r^d d_t=C_t+(d_{t+1}-d_t)+r_r^l l_t+T_t+I_t \quad (13)$$

Investment I_t, increases the capital stock K_t over time according to the following law of motion:

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[3] $C=\left[\int_0^1 c(z)^{\frac{Q-1}{Q}} d_z\right]^{\frac{Q}{Q-1}}$

Subject to nominal budget constraint $\int_0^1 p(z)c(z)dz = Z$ (Where Z is any fixed total nominal expenditure on goods) one can show that for any two goods z and $\dot{z}$

$c(\dot{z})=c(z)\left[\frac{p(z)}{P}\right]^Q$

Combining this expression with nominal budget constraint equation and price level equation (4) shows that the representative agent's demand for good z is shown as

$c(z)=\left[\frac{p(z)}{P}\right]^{-Q}\frac{Z}{P}=\left[\frac{p(z)}{P}\right]^{-Q}C$

where the second equality uses the fact that P is the minimum Money cost of one unit of composit consumption.

[4] $C^w=\int_0^n c^j d_j+\int_n^1 c^{*j} d_j=nC+(1-n)C^*$

$$K_{t+1}=I_t-(1-\delta)\,K_t \quad (14)$$

where $\delta \in (0,1)$ is a constant capital depreciation rate.

It is assumed that there is a mismatch between the time at which household's financial necessities occur and the time at which financial assets actualize. In other words, at the beginning of the period households borrow the amount l_t in order to clear their deficit of financial resources. At the same time, when the financial surplus materializes, households canalize their savings to realize asset portfolio choice for the next period (optimal amount of deposit issuance d_{t+1} and capital k_{t+1}). The liquidity constraint gives rise to the household's demand for real bank loans as below:

$$l_t=\tau_h C_t \quad (15)$$

Where $0 < \tau_h < 1$ is the constant share of spending to be financed externally.

In period t, given a constant discount factor $\beta= (1+\rho)^{-1}$, with a rate of intertemporel preference $\rho>0$, the representative agent chooses C_t, N_t, K_{t+1} so as to maximize intertemporal utility subject to (13) and (15).

The first order conditions of the household maximization problem are:

$$\lambda_t+\lambda_t\tau_t r_t^l+{C_t}^{-1}=0 \quad (C_t) \quad (16)$$

$$\lambda_t W_t+\psi(1-N_t)^{-1}=0 \quad (N_t) \quad (17)$$

$$\lambda_t=\beta E\lambda_{t+1}(r_{t+1}^k+(1-\delta)) \quad (K_{t+1}) \quad (18)$$

Where λ_t denotes Lagrange multipliers associated with the budget constraint.

$$\lambda_t=\frac{{C_t}^{-1}}{(1+\tau_h r_r^l)}$$

In addition, E_t is the expectation operator conditional to the information set available in period t.

When we plug λ_t equation into the (17) and (18) we obtain respectively;

$$N_t=1-\frac{\psi(1+\tau_h r_t^l)C_t}{W_t} \quad (19)$$

$$C_{t+1}=\beta E_t(r_{t+1}^k+(1-\delta))C_t \quad (20)$$

Equation (19) gives labor supply as a positive function of consumption and loan rate and a negative function of wage. By the law of diminishing marginal utility, raising

consumption decreases marginal utility of consumption. Since marginal utility of consumption should be equal to marginal utility of leisure, raising consumption raises leisure and reduce labor supply.

Equation (20) is called the Consumption Euler equation and describes the intertemporal optimal consumption choice of the household between the current and the future period.

$$\frac{C_{future}}{C_{today}}=\beta(1+R)$$

In other words, as long as the interest rate increases, agents will choose to consume more in the future than today in order to smooth their consumption.

In our model, demand of deposit will be determined as a residual variable.

Household's dependence on external finance, as defined by (15) allows to connect the real and financial sectors more tightly and realistically and strengthens the transmission mechanism of monetary policy.

1.1.2) Firms

There is a continuum of identical monopolistically competitive firms in the economy. Each of them produces a differentiated good by using Cobb-Douglas production technology. So ω firm's production function in period t may be written as follows:

$$y_t(\omega)= a.k_t(\omega)^{\alpha}N_t(\omega)^{1-\alpha} \quad (21)$$

where$k_t(\omega)$, $y_t(\omega)$ and $N_t(\omega)$ are respectively, capital demand, the amount of output, labor demand. Moreover, a is an exogenous economy-wide technology shock and $0<\alpha<1$ is a parameter which identifies the capital elasticity of output.

Due to monopolistic competition assumption firms are price makers. In addition, it is assumed that there is price rigidity in the good market. Firms settle their prices according to Calvo price adjustment mechanism. In each period only a randomly selected fraction (1-ζ) of firms gets the chance to adjust their prices while the other fraction ζ of firms doesn't adjust.

In this model, the parameter ζ is a measure of the nominal price rigidity. A higher value of ζ implies that fewer firms get the possibility to change their prices and the expected time between price changes is longer.

When a firm has the chance to adjust, it settles the new value of its price by maximizing the market value of the firm defined as the expected discounted value of current and future profits. The future profits of date t+s is determined by the choice of price in time t to the extent that the firm has had not another chance of adjusting its price until t+s.

In period s, with probability ζ^{s-t} the price defined as new optimal, will be in effect. Letting p_t^0(h) be the new optimal price chosen by a home firm which produces the good h, of

date t, and note that all firms adjusting would fix the same price because they face the same demand function with same technology so that p_t^0(i)= p_t^0 the problem of a typical firm is shown as follows;

$$Max_{p_t^0} E_t \zeta^{s-t} q_{t,s} \left[\left(\frac{p_t^0}{p_{H,s}}\right)^{1-\theta} - MC_s \left(\frac{p_t^0}{p_{H,s}}\right)^{-\theta} \right] . y_t \quad (22)$$

where MC_s denotes the real marginal cost of production and $q_{t,s}$ is the discount factor between dates t and s is given as $\beta^{s-t}(\frac{C_t}{C_s})$. To obtain the above expression, we introduced the value of y_t (12) into the expected discount value of current and future profits of the firm.

5 6 7 $$MC_s = \frac{(r_s^k)^{\zeta}(W_t)^{1-\zeta}}{\zeta^{\zeta}(1-\zeta)^{(1-\zeta)} a_s} \quad (23)$$

Solving the problem above yields the following expression for the optimal price.

$$p_t^0 = \frac{\theta-1}{\theta} \cdot \frac{E_t \sum_{s=t}^{\infty} \zeta^{s-t} q_{t,s} y_s MC_s}{E_t \sum_{s=t}^{\infty} \zeta^{s-t} q_{t,s} y_s p_{H,s}^{\theta-1}} \quad (26)$$

Since a firm will not adjust its price every period, it has to take into account the current and expected future marginal costs when it gets the opportunity to change the price.

When all firms have the chance to adjust their prices each period (ζ =0), prices are completely flexible and we get the usual price definition which is a markup over marginal cost,

$$p_t^0(h) = \dot{p_t^0}(h) \frac{\theta}{\theta-1} w_t \quad (27)$$

The price index $P_{H,t}$ for home goods is an average of the price charged by remaining firms. Since under the Calvo price setting all adjusting firms choose the same price, the home price sub index $P_{H,t}$ can be written as follows,

$$P_{H,t} = [\sum_{s=t}^{\infty} (1-\zeta) \zeta^{s-t} (p_{t-s}^0)^{1-\sigma}]^{\frac{1}{1-\sigma}} \quad (28)$$

Lagging this equation one period gives the following dynamics for the aggregate price level for home goods.

$$P_{H,t}^{1-\sigma} = (1-\zeta)(p_t^0)^{1-\sigma} + \zeta P_{H,t}^{1-\sigma} \quad (29)$$

5 Marginal Cost of Production: İt means the change in total production cost that comes from making or producing one additional unit.

6 Marginal productivity of Kapital $r_t^k = \zeta \frac{y_t}{k_t}$ (24)

7 Marginal productivity of real wage $w_t = (1-\zeta)\frac{y_t}{N_t}$ (25)

After some math it is possible to get New Keynesian Philips Curve:

$$\beta E_t \widetilde{\pi_{H,t+1}} + \frac{(1-\zeta)(1-\zeta\beta)}{\zeta} \widehat{MC}_t = \widetilde{\pi_{H,t}} \quad (30)$$

[8]

1.1.3) Banking Sector

In simple terms, banks are considered as intermediaries between savers and borrowers, which can potentially enhance efficiency of capital allocation by providing economies of scale, reducing asymmetric information issues and presenting risk management expertise. The currently dominant New Keynesian macroeconomic paradigm which is rooted in the neoclassical real business cycle (RBC) modelling tradition with some added market frictions and nominal rigidities, also includes the standard perception of banks as financial intermediaries between savers and borrowers. At its core, the New Keynesian analysis is real, in a sense that it tries to explain the real economy by focusing on real factors. (Borio & Disyatat 2011)

There is a large body of literature concerning monetary policy interaction with banking sector. In order to give an integrated perspective with this study some of them are presented as follows.

Gerali et al (2010) described a closed economy DSGE model with credit frictions, a monopolistically competitive banking sector, borrowing constraints and a set of nominal and real frictions. Gerali defined two types of households as patient and impatient. Patients deposit their savings in the banks while impatient households and entrepreneurs borrow from the banking sector. Both borrowers are subjected to collateral constraints that are tied to their asset portfolio. Banks balance sheet includes loans to entrepreneurs and households as assets while deposits and capital stand for liabilities.

Banks accumulate capital by means of retained earnings and they are subject to capital adequacy ratio imposed by the Central Bank. Banks are considered to have some degree of market power in credit and deposit market. İn credit market banks set different rates for households and entrepreneurs in accordance with banks capital to asset ratio and interest rate stickiness in each market.

Agenor et al (2014) presents a small open economy DSGE model framework with banking sector. In this setup, households may hold foreign asset and evaluate their savings in banks as deposits. Firms borrow from banks and banks borrow from central bank and from the world's capital markets. Concerning foreign funding, they are subjected to Basel type constraint in order to maintain financial stability. Central bank may hold government bonds

8 New Keynesian Philips Curve: The NKPC describes a simple relationship between inflation and real marginal cost, that is the real resources that firms must spend to produce an extra unit of their good or services.

and supply liquidity to banks and alter its policy rate in response to deviations in output, inflation and financial stability.

Goodfriend and Mccallum (2007) presents a kind of liquidity constraint on consumption spending and a loan production technology where loans are produced combining monitoring labor and collateralizing assets. In this setup, banking sector just produce loans and collect deposits.

Banks imply different rates such as collateralized loan rate, uncollateralized loan rate, bond rate. Central bank's policy rate is assumed by interbank rate formed by interbank money lending rate.

Casares et al (2019) introduced a closed economy DSGE model. It examines monetary policy in a business cycle model with sticky prices, financial frictions and unemployment. Banks collect deposits from households to produce loans for firms and households as well. Central bank conducts Taylor type monetary policy rule. Impulse response function is considered under financial, technological and monetary policy shocks and the core finding is that when financial shocks drive the business cycles, the conventional Taylor rule would perform considerably worse than the optimal rule with higher variability in the loan market.

Paries (2010) defined a closed economy DSGE model with financial frictions including a banking sector which faces monopolistic competition and is subject to capital constraints. In this setup, banks operate with capital buffer (compulsory capital adequacy ratios). The presence of monopolistic competition gives rise to some degree of stickiness in banks' adjustment of lending and deposit rates to changes in monetary policy. Banks' interest rate setting behavior is assumed to depend on the degree of competition of banks.

In independent works Andres and Arce (2009), Curdia and Woodford (2008), Aslan and Santaro (2008) and Benes and Lees (2007) have presented models with financial intermediaries and a time varying spread between deposit and loan rates.

Van den Heuvel (2008), Markovic (2007) De Walque et al (2008) and Meh and Moran (2010) have instead worked the role of equity and bank capital for the transmission of financial shocks.

Neither of them includes government bond buying option that we consider in this setup. There are two unconventional assumptions that are made in this thesis. Firstly, foreign funding rate r_t^s is assumed constant. As a small open economy, banks in Turkey may adjust just the amount of foreign funding. Secondly, banks may hold government bonds in their asset portfolio in accordance with the current case in Turkey. (Banks hold %58 of total domestic debt).

There is a perfectly competitive banking sector that supplies external finance to households. Banks use deposits, central bank funding and foreign funding as its source of

funding. By using these sources, banks provide loans to households and buy government bonds. With these continual transactions, banks' balance sheet turns to;

$$b_t+l_t = e_t s_t+(1-\mu)\, d_t+l_t^{CB} \quad (31)$$

Where b_t is government bond, l_t total loans provided to households, s_t is the amount of foreign funding, l_t^{CB} is central bank funding, e_t is the exchange rate and d_t is the total deposit issuance coming from households. $0<\mu<1$ is the required reserve rate. In this model, we assume that deposit demand is determined by the household's deposit supply.

The uncovered interest rate parity (UIP) formula applies for borrowing

$$(1+r_t^s)=(1+r_t^w)\Omega S_t E_t \frac{e_{t+1}}{e_t} \quad (32)$$

[9]

where Ω stands for UIP parameter and Ω>0.

Banks maximize profits under the balance sheet constraint, profits can be expressed as follows:

$$\pi_p=r_t^l l_t +r_t^b b_t -r_t^d d_t -r_t^s e_t s_t -r_t^{CB} l_t^{CB} -\frac{1}{2} D_t^2 -\frac{1}{2} L_t^2 \quad (33)$$

Where r_t^l stands for loan rate, r_t^b bond rate, r_t^s foreign funding rate and r_t^{CB} is the central bank funding rate. $O_c=\frac{1}{2} D_t^2+\frac{1}{2} L_t^2$ is the operational cost function. Introducing the balance sheet given in equation (31) along with the UIP condition allow to rewrite bank's profit maximization function as follows:

$$\pi_p=(r_t^l - r_t^{CB})l_t +(r_t^b - r_t^{CB})b_t -(r_t^d - r_t^{CB})(1-\mu)d_t -(r_t^s - r_t^{CB})e_t s_t -\frac{1}{2} D_t^2 -\frac{1}{2} L_t^2 \quad (34)$$

The first order conditions with respect to l_t, b_t and s_t imply the following equations:

$$r_t^l - r_t^{CB} - l_t = 0 \quad (l_t) \quad (35)$$

$$(r_t^d - r_t^{CB})(1-\mu) - d_t = 0 \quad (d_t) \quad (36)$$

$$2 r_t^w \frac{1}{\Omega} S_t E_t e_{t+1} - r_t^{CB} e_t = 0 \quad (S_t) \quad (37)$$

Equation (35) gives the optimal loan supply which implies that l_t will increase as long as interest rate gap between central bank policy rate and bank's loan rate expand. Similarly, optimal deposit supply is determined by equation (36) which implies that the quantity of deposit supply by households boosts as long as the gap between central bank policy rate and deposit rate augment. In addition, deposit supply is a negative function of required reserve rate (μ) imposed by the central bank.

[9] Uncovered İnterest Rate Parity: UIP theory states that the difference in interest rates between two countries will equal the relative change in currency foreign exchange rates over the same period.

Foreign funding demand equation (37) is a positive function of the central bank's policy rate and negative function of world interest rate r_t^w. It can be clearly seen that, when the policy rate rises, banks prefer to augment foreign funding in their liability accounts.

1.1.4) Fiscal Authority

Government expenses are financed by lump sum taxes and by public borrowing. This gives government budget constraint in period t,

$$(1+r_t^b)\, b_t+G_t=T_t+b_{t+1} \tag{38}$$

In the above equation b_{t+1} stands for government bonds issued in period t arriving at maturity in period t+1. Moreover G_t and T_t stand for public spending and lump sum taxes respectively.

In addition, we have the following equation which gives the no arbitrage condition between bond rate r_t^b and loan rate r_t^l ;

$$(1+r_t^l)=(1+r_t^b)(\chi_t l_t) \tag{39}$$

Where χ_t is the risk premium and it is defined as $\chi_t=\frac{\chi_0}{2} B_t$. This means that risk premium of a country is positively corralated with the aggregate bond issuance. In that case, the risk premium arises in accordance with the cumulative debt level of a country.

1.1.5) Monetary Authority

The Central Bank is assumed to conduct a simple interest rate rule of the Taylor Type

$$\tilde{\mathrm{I}}_{t+1}^{CB}=\theta_i\, \tilde{\mathrm{I}}_t^{CB}+\frac{\theta_\beta}{i}\tilde{\pi}^{CPI}+\frac{\theta_\nu}{i}\tilde{y}_t+\varphi \tag{40}$$

where φ denotes the exogeneous monetary policy shock and $i_t$nominal interest rate, $\theta_i$symbolizes interest rate smoothing coefficient. The higher the interest rate smoothing parameter is, the lower response of nominal interest rate to output gap and inflation exists. Coefficients θ_β, θ_y are set by monetary authority and may be taught as the responsiveness of nominal interest rate to inflation and output gap respectively.

Besides the interest rate policy, in this setup the Central Bank provides funding to banking sector L_t^{CB} with the rate of r_t^{CB} that we call policy rate. Therefore, the Central Bank's balance sheet is formed as following equation:

$$L_t^{CB}=M_t+RR_t \tag{41}$$

Where M_t is the total amount of emission, and RR_t is the required reserve taken from banking sector and they form the monetary base.

1.1.6) General Equilibrium

İn a symmetric equilibrium all firms are identical. They make the same decisions so that k_w(t)=k_t, n_w (t)= n_t , P_w (t)= P_t, y_w (t)= y_w. Let π_t=$\frac{P_t}{P_{t-1}}$ denotes the inflation in period t.

The symmetric equilibrium is a sequence of prices $\{ToT_t, e_t, w_t, p_h, \pi_t, \pi^{CPI}, MC_t\}$, quantities $\{c_t, y_t, l_t, k_t, n_t, d_t, b_t, s_t\}$, interest rates $\{r^l, r^k, r^d, r^b, r^{cb}\}$ and interest rate shock φ that satisfy the households first order conditions (16)to (18), deposit supply rule (36), loan demand equation (35)and foreign funding demand equation(37).

İn this setup, we have a general equilibrium formula for goods market:

$$y_t=C_t+I_t+G_t \tag{42}$$

Where y_t is the total output of an entire economy, C_t is the total consumption, I_t is the investment and G_t is the public spending.

We recall our Cobb-Douglas type price function (4) and we get following parity,

$$P_t=\frac{P_{H,t}^{\Upsilon}.P_{F,t}^{1-\Upsilon}}{\Upsilon^{\Upsilon}(1-\Upsilon)^{(1-\Upsilon)}}=\frac{P_{H,t}^{\Upsilon}.(e_t.P_{F,t}^*)^{(1-\Upsilon)}}{\Upsilon^{\Upsilon}(1-\Upsilon)^{(1-\Upsilon)}} \tag{43}$$

Optimal allocation of consumption across home and foreign goods require equating marginal utilities of both categories of goods which imply,

$$\frac{P_{H,t}}{P_F,t} \tag{44}$$

We plug Cobb-Douglas type price function (43) into our Cobb-Douglas type consumption index (2), we get following equations,

$$C_{F,t}.\,P_{F,t}=\frac{1-\Upsilon}{\Upsilon}.\,C_{H,t}.\,P_{H,t} \tag{45}$$

$$C_{F,t}=\frac{1-\Upsilon}{\Upsilon}.\,C_{H,t}\,\frac{P_{H,t}}{e_t.P_{F,t}^*} \tag{46}$$

where $\frac{P_{H,t}}{e_t.P_{F,t}^*}$ is the terms of trade and we can show it as Tot_t (47)

As (44) we have the same parity for foreign price equation.

$$\frac{P_{H,t}^*}{P_{F,t}^*} \gg \frac{\frac{\Upsilon}{C_{H,t}^*}}{\frac{1-\Upsilon}{C_{F,t}^*}} \tag{48}$$

By the same way, we obtain the similar equations for foreign consumption and price index,

$$C^*_{F,t}.\ P^*_{F,t}=\frac{1-\Upsilon}{\Upsilon}.\ C^*_{H,t}.\ P^*_{H,t} \tag{49}$$

$$C^*_{H,t}=\frac{\Upsilon}{1-\Upsilon}.\ C^*_{F,t}.\ \frac{e_t.P^*_{F,t}}{P_{H,t}} \tag{50}$$

where $\frac{e_t.P^*_{F,t}}{P_{H,t}}$ is $1/Tot_t$ and our general equilibrium formula becomes:

$$y_t=C_{H,t}+C^*_{H,t}+I_t+G_t-C_{F,t} \tag{51}$$

When we put together equations (2), (46), (50) and (51) we get following general equilibrium formula.

$$y_t=C_{H,t}+C^*_{F,t}.(Tot_t)^{-1}\frac{\Upsilon}{1-\Upsilon}+I_t+G_t-\frac{1-\Upsilon}{\Upsilon}.\ C_{H,t}.\ Tot_t \tag{52}$$

where $C_{H,t}$ is the consumption of the home country households, $C^*_{H,t}$ is export and $C_{F,t}$ is import.

1.1.6) Net Foreign Asset Position

In order to derive the relationship between home and foreign economies, we need to aggregate the individual budget constraints across agents. Let S denotes foreign funding. Then we have

$$S_{t+1}-(1+r^s_t)S_t=C_{F,t}-C^*_{H,t} \tag{53}$$

We replace $C_{F,t}$ by (46) and $C^*_{H,t}$ by (50) then we get the following equation which gives the external equilibrium of the model.

$$S_{t+1}-(1+r^s_t)S_t=\frac{1-\Upsilon}{\Upsilon}.\ C_{H,t}.\ Tot_t-C^*_{F,t}.(Tot_t)^{-1}\frac{\Upsilon}{1-\Upsilon} \tag{54}$$

This equation implies that as long as the difference between import and export rises, the need for foreign funding will increase.

1.2) The Effect of Monetary Policy on the Cost of Public Borrowing

In order to solve this nonlinear model numerically, we first need to define a steady state where prices are flexible and then take a first order approximation around this steady

state to linearize this model. This allows us to have a linearized version of the model where all variables are expressed in terms of deviations from their steady state level.

1.2.1) Steady State

A system is in a steady state if the state variables which define the behavior of the system are unchanging in time.

In continuous time, this means that for those properties p of the system the partial derivative with respect to time is zero and remains so:

$\frac{\partial p}{dt}$=0 for all present and future t.

In discrete time, it means that the first difference of each property is zero and remains so:

p_t-p_{t-1}=0 for all present and future t.

The model considers a symmetric steady state where each variable is constant over time and we assume that there is no public spending and capital accumulation in steady state.

As in equation (14) K_{t+1}=I_t-(1-δ) K_t we will assume that K_t =K_{t+1} the equaiton becomes

$$I= \delta K$$

Similarly, imposing C_{t+1}=C_t in Consumption Euler equation (20) C_{t+1}=βE(r^k_{t+1}+(1-δ))C_t yields steady state interest rate as follows

r^k=$\frac{1-\beta}{\beta}$+δ

Moreover, prices are flexible. The same assumptions are valid for the foreign country since we are looking at a symmetric steady state.

1.2.2) Linearizing Around the Steady State

Because of the nonlinear structure of the model we have to consider a linear approximation around the steady state. To get log linearized forms of equations, we take a

first order Taylor approximation then divide them by the respective steady state values of the variables from the steady state. The variables for which we assumed zero initial level will be divided by the steady state value of consumption, in what follows the denotation of the percentage deviation of any variable X from its steady state by hats over that variable so that $X \cong \frac{(X_t - \bar{X})}{\bar{X}}$.

The log linearized consumption Euler equation (20) is as follows,

$$E_t\left\{-\frac{\tau r^l}{1+r^l}\left(\tilde{r}_t^l - \tilde{r}_{t+1}^l\right) + \widetilde{C_t} - \tilde{C}_{t+1} + \frac{r^k}{1-\delta+r^k}.\tilde{r}_{t+1}^k\right\}=0 \qquad (55)$$

Where E_t is the expectation operator conditional on information in period t.

The Calvo price setting equations imply the following path for the price and $\pi_{i,t}=\frac{P_{i,t}}{P_{i,t-1}}$ denotes inflation in period t. New Keynesian Philips Curve (30) and bond demand function(38) are log linearized as follows,

$$\beta E_t\tilde{\pi}_{H,t+1}+\frac{(1-\varphi)(1-\varphi\beta)}{\varphi}\widetilde{MC}_t=\tilde{\pi}_{H,t} \qquad (56)$$

$$\tilde{B}_{t+1}=(1+r^b)\widetilde{b_t}+r^b r_t^b+\frac{G}{B}\tilde{G}_t-\frac{T}{B}\widetilde{T}_t \qquad (57)$$

Terms of trade's (47) and external equilibrium's (54) linearized versions are log linearized respectively,

$$\widetilde{ToT_{t+1}}=\widetilde{ToT_t}+\tilde{e}_{t+1}-\widetilde{e_t}-\tilde{\pi}_{H,t+1} \qquad (58)$$

$$S(\tilde{S}_{t+1} - \tilde{S}_t)=\frac{1-\Upsilon}{\Upsilon}.\widetilde{C_t}+(1-\Upsilon\frac{\Upsilon}{1-\Upsilon})\widetilde{ToT_t} \qquad (59)$$

Capital accumulation function's (14) linearized version is,

$$\widetilde{K}_{t+1}=\frac{I}{K}\widetilde{I_t}+(1-\delta)\widetilde{K_t} \qquad (60)$$

Uncovered interest rate parity (32) and Taylor Rule's (40) linearized versions are shown as,

$$E_t\{\widetilde{r_t^w} - \widetilde{r_t^s} + \widetilde{S_t} + \widetilde{e_{t+1}} - \widetilde{e_t}\}=0 \qquad (61)$$

$$\tilde{\mathrm{I}}_{t+1}^{CB}=\theta_i\,\tilde{\mathrm{I}}_t^{CB}+\frac{\theta_\beta}{i}\tilde{\pi}^{CPI}+\frac{\theta_\nu}{i}\tilde{y}_t+\varphi \qquad (62)$$

Marginal utility of capital (24), labor (25) and marginal cost equation (23) are shown respectively,

$$\widetilde{W_t}=\widetilde{y_t}-\widetilde{N_t} \quad (63)$$

$$\widetilde{r_t^k}=\widetilde{y_t}-\widetilde{k_t} \quad (64)$$

$$\widetilde{MC_t}=\alpha\tilde{r}_t^k+(1-\alpha)\,\widetilde{W_t} \quad (65)$$

Loan demand (15) and production function (21) equations are log linearized as follows,

$$\widetilde{l_t}=\frac{C}{l}\,\widetilde{C_t} \quad (66)$$

$$\widetilde{y_t}=\widetilde{a_t}+\alpha\widetilde{k_t}+(1-\alpha)\,\widetilde{N_t} \quad (67)$$

Labor supply (19) and inflation function are log linearized as follows,

$$\widetilde{N_t}=\widetilde{W_t}\left(\frac{1-N}{N}\right)-\widetilde{C_t}\left(\frac{C}{NW}\right)(1+\tau r^l)-\tilde{r}_t^l\left(\frac{C}{NW}\right)\tau r^l \quad (68)$$

$$\tilde{\pi}^{CPI}=\widetilde{\pi_t} \quad (69)$$

Bond rate (39), credit rate (35), deposit rate (36), policy rate (37) and deposit demand function's (13) log linearized forms are shown respectively,

$$\tilde{r}_t^b=\tilde{r}_t^l\,\frac{r^l(1-r^b)}{r^b(1-r^l)}-\widetilde{b_t}\,\frac{1+r^b}{r^b}-\widetilde{l_t}\,\frac{1+r^b}{r^b} \quad (70)$$

$$\tilde{r}_t^l=\frac{l}{r^l}\,\widetilde{l_t}+\frac{r^{CB}}{r^l}\,\tilde{r}^{CB} \quad (71)$$

$$\tilde{r}_t^d=\frac{r^{CB}}{r^d}\,\tilde{r}^{CB}+\frac{d}{r^d}\,\widetilde{d_t} \quad (72)$$

$$\tilde{r}^{CB}=\tilde{\imath}_t^{CB}+\quad\tilde{\pi}^{CPI} \quad (73)$$

$$\widetilde{d_t}(\mathrm{d}+\mathrm{d}r^{d})\text{-}d\ \tilde{d}_{t+1}=\mathrm{C}\widetilde{C_t}\text{-}\mathrm{k}r^{k}(\widetilde{k_t}\text{-}\ \tilde{r}_t^{k})\text{-}\mathrm{WN}(\widetilde{W_t}\text{-}\widetilde{N_t})+\mathrm{l}r^{l}(\widetilde{l_t}+\tilde{r}_t^{l})\text{-}\mathrm{I}\widetilde{I_t}\text{-}\mathrm{T}\widetilde{T_t} \qquad (74)$$

Finally, log linearized form of general equilibrium (52) formula is shown as,

$$\widetilde{y_t}=\frac{C_H}{Y}\left[\widetilde{C_t}-(1-\Upsilon)\widetilde{ToT_t}\right]+\frac{C_H^*}{Y}(-\widetilde{ToT_t})+\frac{I}{Y}\widetilde{I_t}+\frac{G}{Y}\widetilde{G_t}\text{-}\frac{C_F}{Y}\left[\widetilde{C_t}-(\Upsilon)\widetilde{ToT_t}\right] \qquad (75)$$

1.2.3) Calibrated Parameters

This part gives information about results based on a calibrated version of the analyzed model economy. Some of the parameters in table are provided from steady state values and the remaining parameters are obtained from the related literature.

We assume that discount factor β is set to 0.95.

The fact that the monetary policy rule involves a lagged value of the interest rate implies a sort of interest rate smoothing behavior by the Central Bank.

Following the estimations of Alp and Elekdağ (2011) interest rate smoothing parameter θ_i is calibrated to 0.70, inflation feedback θ_β and output feedback θ_y to Taylor Rule calibrated to respectively 1.5 and 0.25.

Capital depreciation rate δ, the capital share in production α, the measure of the price rigidity ζ are taken respectively 0.025, 0.30 and 0.75 which is in line with the existing literature.

In addition, the Calvo parameter ϒ that measures the degree of price stickiness is set to 0.5, which implies that an average duration of price is two quarters following the Turkish economic literature (Çebi:2011; Bari:2016).

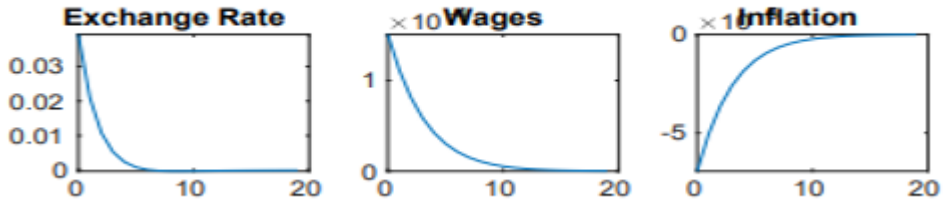
Parameter	Description	Calibrated Value
β	subjective discount factor	0.95
A	capital share in production	0.30

δ	capital depreciation rate	0.025
τ	credit's share on consumption	0.51
ψ	weight of leisure on total consumption	3.5
ϒ	Calvo parameter	0.50
θ	substitution elasticity between home and foreign goods	6
ζ	measure of price rigidity	0.75
Ω	UİP parameter	0.16
μ	required reserve rate	0.10
θ_i	interest rate smoothing parameter	0.70
θ_β	inflation feedback Taylor Rule	1.50
θ_y	output feedback Taylor Rule	0.25
r_{ss}^d	steady state deposit rate	0.0128
r_{ss}^b	steady state bond rate	0.01489
r_{ss}^l	steady state loan rate	0.0175
$\boldsymbol{r_{ss}^{CB}}$	steady state policy rate	0.01013

1.2.4) Effect of an Interest Rate Shock on Main Economic Indicators

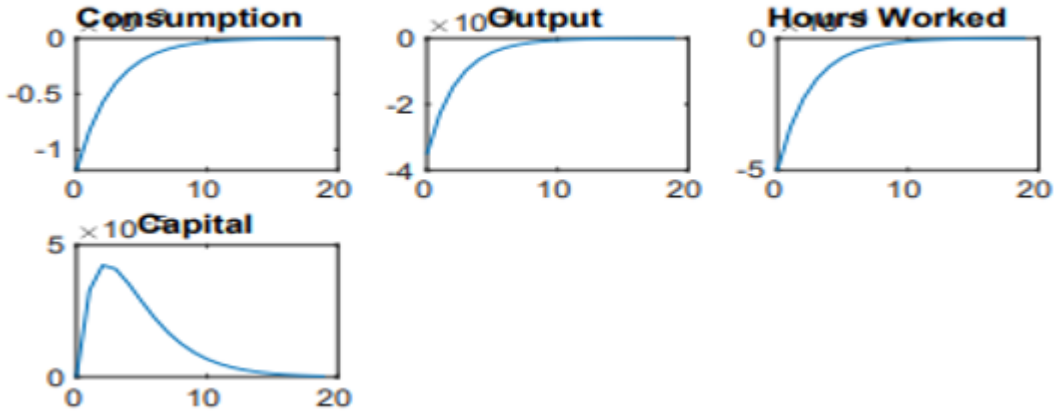
Figures shows the impulse-response functions obtained from a Central Bank policy rate shock of size equivalent to one standard deviation.

Figure 1: The Impact of the Shock on Exchange Rate,Wages and Inflation



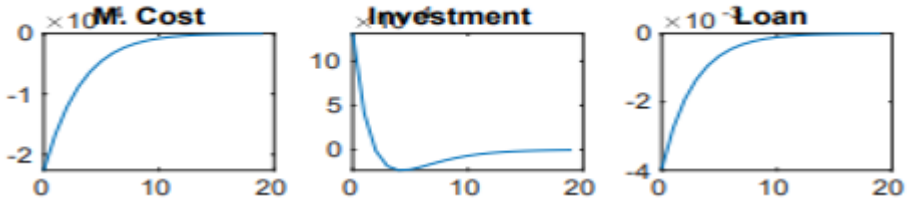
Given in uncovered interest rate parity equation (32), more foreign loans imply a higher risk premium which pulls an upward pressure for the interest rate of foreign borrowing. However, since the cost of borrowing is assumed constant in this setup, this upward pressure must be balanced by an increase in the nominal exchange rate. On the other hand, lower consumption in the real sector reduces imports, while lower home prices imply higher exports. This implies trade surplus which will put a downward pressure on the exchange rate. The first effect dominates the second for 8 periods and afterwards the second effect becomes stronger and the exchange rate appreciates as implied by the evolution of home prices.

Figure 2: The Impact of the Shock on Consumption,Output,Capital and Hours Worked



Shock raises physical capital in accordance with the capital accumulation equation (14), since investment augments as a residual function of equation (13). In external equilibrium equation (54), consumption and exportation fall, but output falls less than them. Because given in production function (21) capital rises.

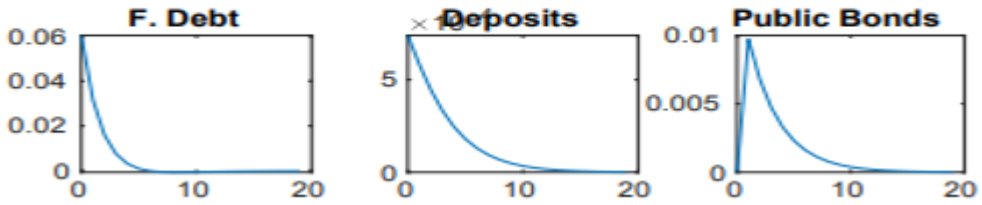
Figure 3: The Impact of the Shock on Marginal Cost,Investment and Loan



Raising policy rate naturally augments funding cost of banks. Then they tend to lean more on alternative funding resources like deposits. This increasing demand for deposits raises the yield of deposits. As shown in equation (36) households put their savings on deposit because of the raising yield.

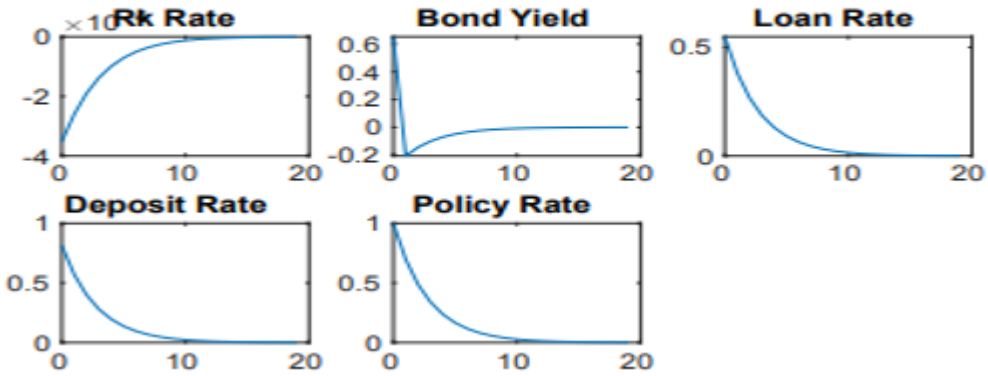
Higher deposit yields push banks to raise the rate of loans in order to keep their profit stable as shown in equation (34). This makes the loans more costly and falls demand for loans as we see in image 3. Furthermore, as a positive function of loan (15) consumption falls. Decreasing consumption ends up with a fall in inflation rate like in image 1. According to marginal cost equation (23) falling rental capital rate also falls marginal cost as seen in image 3.

Figure 4: The Impact of the Shock on Foreign Debt,Deposits and Public Bonds



Following the policy rate shock, deposit rate rises in harmony with no arbitrage condition equation (39). As consumption decreases because of the rising loan rates, households want to save more thanks to rising deposit rates. Combining with marginal utility equilibrium, since marginal utility of leisure is equal to the marginal utility of consumption, diminishing consumption raises the marginal utility of consumption and leisure. Thus, raising marginal utility of leisure reduces labor and output as shown in equation (19). Equation (30) implies price rigidity, so supply is partially demand-determined.

Figure 5: The Impact of the Shock on Rental Capital Rate,Bond Yield,Loan Rate,Deposit Rate and Policy Rate



Because of the fall in loans, banks seek other sources of income such as buying bonds. This increased demand for public bonds raises the price of bonds and reduces the yields of them. However, there is another effect on the yields of bonds in the opposite direction. As rising policy rate and deposit rate make the central bank and household funding more costly, banks cannot accept too low bond yields. As another source of funding, banks apply to foreign funding and reduce the demand for government bonds. Thus, bond yields start to rise.

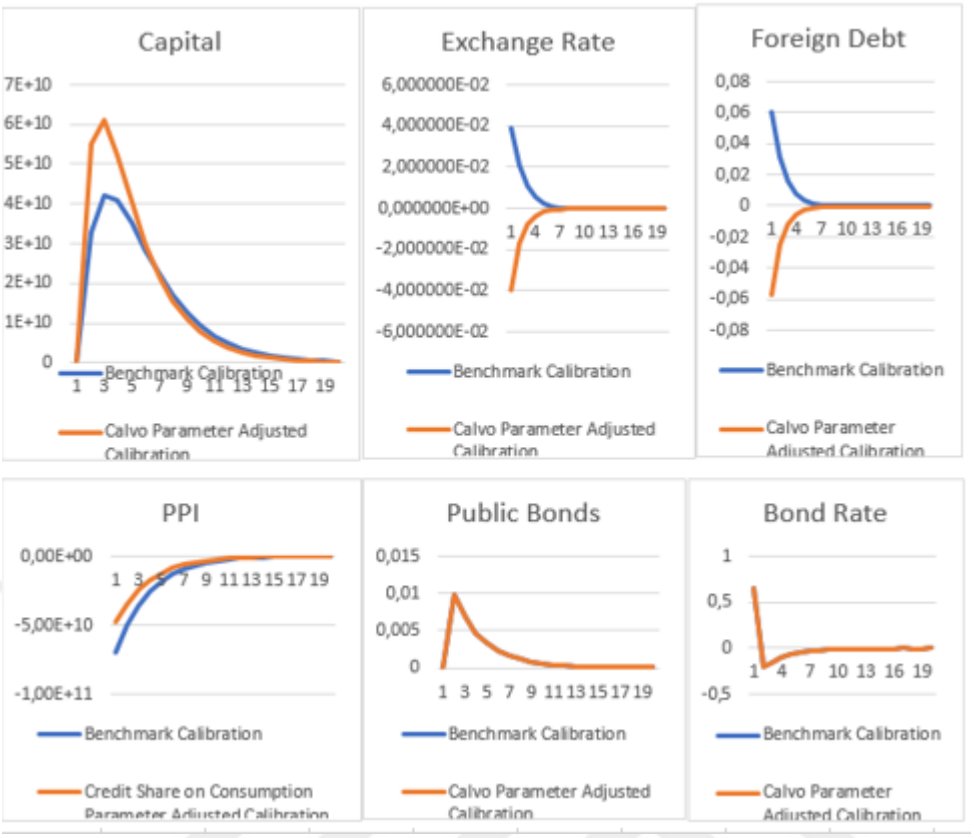
When we assess these two channels together, we can see that in the short run the first effect dominates and bond rates raises, and in the medium run the dominant effect becomes the second effect by reducing bond yield.

Government bond yield r^b is defined as the public borrowing cost, we can assess more precisely that a positive shock on Central Bank policy rate raises the borrowing cost in the short run whereas decreasing it in the medium run.

1.2.5) Sensitivity Analysis

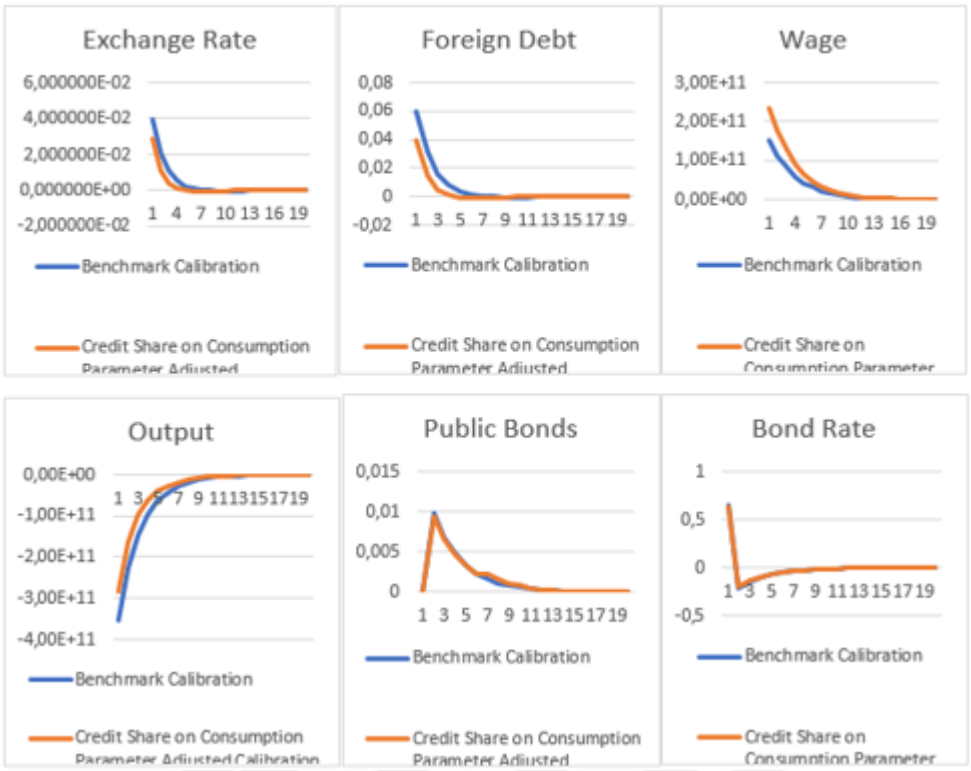
The findings of this robustness check are presented in this section. If we increase the values of some structural parameters such as Calvo parameter, credit's share on consumption and Taylor Rule's reaction parameters by %50, we obtain results that presented as follows:

Figure 6: Benchmark Calibration and Calvo Parameter Relation



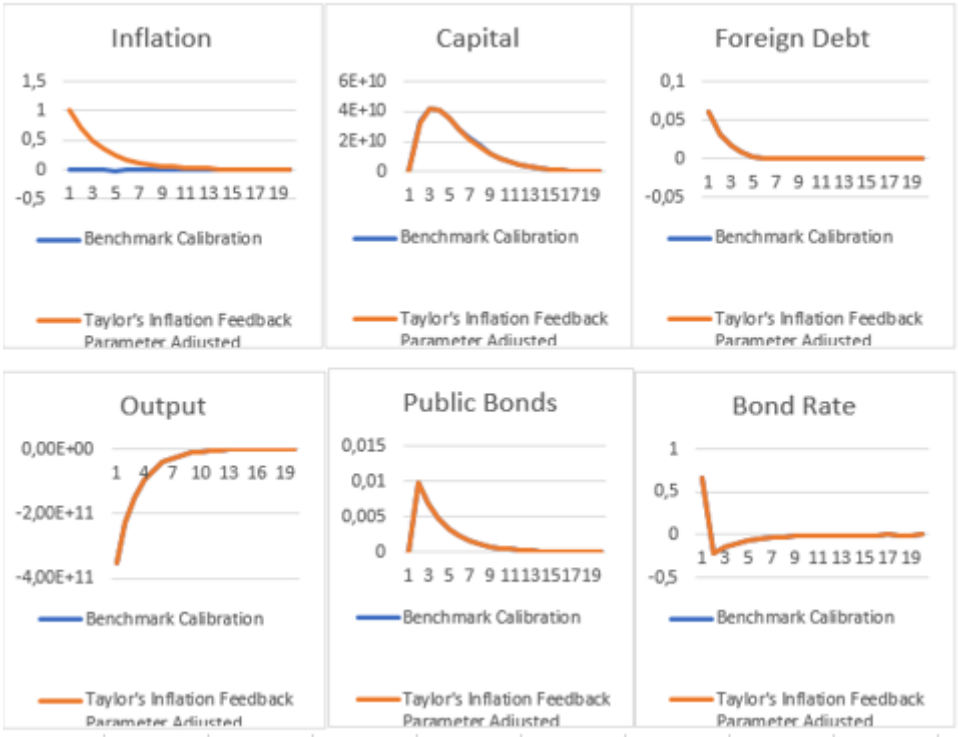
If we raise the value of Calvo parameter by %50, we can see that main changes act on capital, PPI and foreign debt through exchange rate channel. However, this shift doesn't generate any significant impact on bond yields.

Figure 7: Benchmark Calibration and Credit Share on Consumption Relation



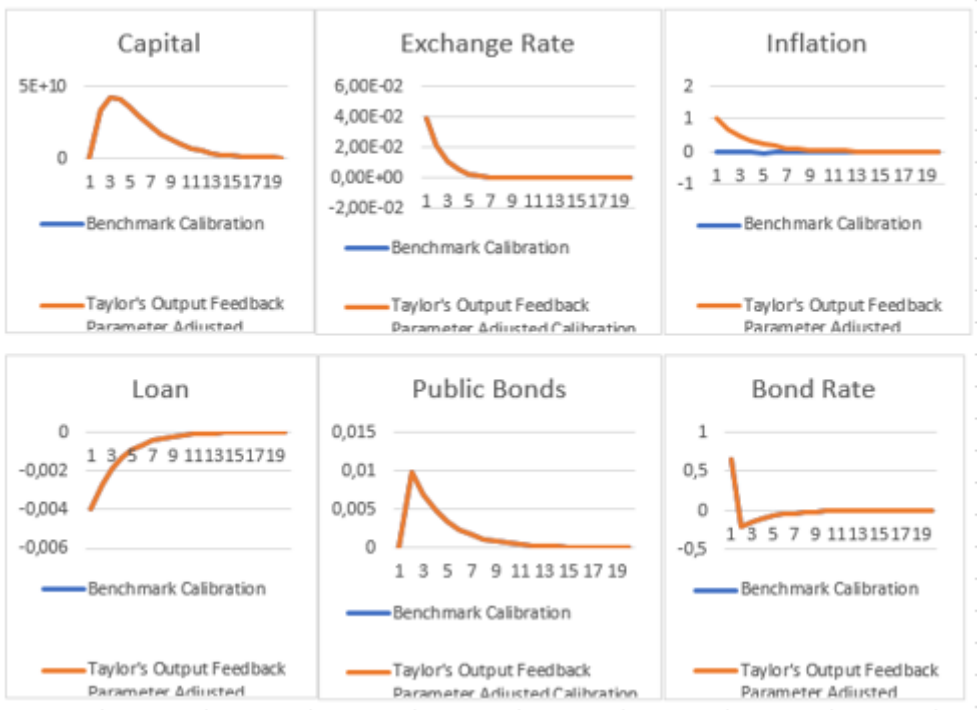
An increase of the credit share on consumption affects primarily wage, output and exchange rate. Nevertheless, this shift doesn't produce any considerable effect on amount and yields of public bonds.

Figure 8: Benchmark Calibration and Taylor's Inflation Feedback Relation



An increase of Taylor's inflation feedback parameter by %50 acts on inflation as expected. This movement has a very little positive impact on public bond yields.

Figure 9: Benchmark Calibration and Taylor's Output Feedback Relation



A rise of Taylor's output feedback parameter triggers a raise on inflation rate. Nonetheless, this shift doesn't produce any impact on public borrowing cost.

According to robustness check results, even the main indicators such as consumption, inflation, wage, labor supply, capital accumulation, credit growth, deposit supply, marginal cost and essential interest rates such as loan rate and deposit rate show reaction to parameter changes, government bond yields, as our main concern in this study, follow broadly the same path as those formulated in our baseline results.

Chapter 2) The Interaction Between Monetary Policy and Public Borrowing Cost in Turkey

Monetary policy objectives and instruments in the world have been developed and shaped according to the needs arising in parallel with economic developments. When evaluated in general, monetary policy objectives can be considered as ensuring and maintaining price stability, bringing potential growth rate closer to its natural level and fostering financial stability (Çetin, 2016).

Central banks conduct their monetary policy by using their monetary policy tools. It is possible to classify monetary policy instruments into two groups: direct and indirect instruments. Direct monetary policy instruments are instruments that are implemented through direct intervention such as credit cap and interest control. Indirect monetary policy

instruments are rediscount policy, open market operations (OMO), provisions policy, interest policy, exchange rate policy and emission policy (Eğilmez, 2012).

Monetary policy in Turkey is determined and conducted by the Central Bank. In Turkey objectives of monetary policy and the tools used to achieve these objectives are modified over time, depending on the overall structure of the economy and global economic developments.

2.1) Monetary Policy Tools and Practices by Periods

If we take a look at monetary policies and instruments by periods, we see that three different monetary policy implementations have been used by CBRT in the last 30 years. While monetary policies based on money supply control were implemented between 1989-2000, the dominant policy was exchange rate control between 2000-2001, and monetary policies based on inflation targeting have been implemented since 2006.

2.1.1) Monetary Policy Based on Money Supply Control

In Turkey as a result of the adoption of open economic model after 1980, floating exchange rate system has been introduced and with the impact of financial liberalization, significant changes have also been made in monetary policy. For example, in order to provide public financing other than the CBRT sources, the Treasury started to borrow with weekly bond auctions in 1985 and created the necessary institutional infrastructure to meet some of the public deficits with short-term portfolio investments. In addition, new market tools have been developed in order to be used by the CBRT to conduct its monetary policy. These are interbank money market transactions and foreign exchange transactions. With the establishment of the interbank money market on April 2, 1986, the CBRT ceased to be the only source in meeting the interbank liquidity needs. The establishment of the foreign exchange market has allowed the banks to regulate their foreign exchange reserves by mediating the determination of foreign exchange rates in the market (Caner, 2007).

The Central Bank made the monetary programming in the period from 1986 to 1989, without announcing it to the public. (Özatay, 2011) However, the period in which financial and price stability was seriously chosen as the main goal, was after 1990. The targets for 1986 were largely accomplished, however, in 1987 there was a serious deviation in the inflation rate, but other variables were in line with the targets.

Table 1: Monetary Program Targets Between the Period 1986-1989

	1986		1987		1988	1989
	Target	Realisation	Target	Realisation	Realisation	Realisation
Growth	5	8,1	5	7,4	4,1	1,8
Inflation Rate	25	25,8	25	51,7	68	70
M2 Increase Rate	35	40	30	36	47,6	83

Source: Oğuz Yıldırım 'Monetary Programming in Turkey After 1990s'

In the following years, the monetary policy based on the supply of M2 money supply failed due to the increasing demand of the advance payment of the Treasury, increasing rates due to the competition in the deposit market and raising the inflation rapidly (Yıldırım, 1990).

Significant structural changes were made in the economy management with the 'Decree No. 32 On the Protection of the Value of Turkish Currency' published on August 11, 198910. Firstly, in financing public deficits, the preference was turned from the Central Bank resources to domestic borrowing and credit expansion was stopped. Another important development is the liberalization of capital movements. Thus, liberty was provided for foreign exchange transactions and capital transfer. In addition, the CBRT started to implement a program based on money supply by changing the monetary policy practices. In this program, instead of targeting monetary aggregates such as 11 M1, M2 and M2Y, the CBRT determined total assets, domestic liabilities, domestic assets and central bank money as targets. With this program, the CBRT aimed to keep inflation under control by managing the expansion of its internal loans. Although the program initially gave positive results, it was interrupted by the negative economic and political environment caused by the invasion of Kuwait by Iraq in in 1990 and implemented loose monetary and fiscal policies due to the early general elections held in October 1991 (Gunalan, 1999).

Immediately after the agreement reached between the Treasury and the Central Bank on the restriction of advance payments following the domestic and foreign financial liberalization in 1989, the CBRT announced its first monetary targeting program to the public on 16 January 1990. The program is based on setting targets on the central bank balance sheet. The program has three objectives in the medium term. The first is to curb the growth of the balance sheet by keeping domestic credit expansion under control, the second is to increase the proportion of the central bank money reserve within the total liabilities by reducing the central bank's foreign exchange liability, and the third aim is to increase the foreign currency asset of the bank (Net International Reserves) to raise the foreign currency risk position of the central bank (Doğru and Savrul, 2013).

In the 1990 program implemented by the CBRT, the targeted growth rate for the balance sheet was 12-22%; for the total internal assets of the CBRT was 6-16%; for domestic liability was 15-25%, and for the central bank money was 38-48% (Ersel and İskenderoğlu, 1990).

10 Official Journal Number 20249
11 M1: demand deposit and currency in circulation
M2: M1+time deposits
M2Y: M2+foreign currency deposits in banks resident in Turkey

Table 2: Monatery Programs					
Year	Period	Target Variable	Target	Realisation	Final Objective
1990	End of Year (%)	Balance Sheet	12,00-22,00	24,1	Reconstruction of Balance Sheet and Financial Stability
		Total Domestic Liabilities	15,00-25,00	21,6	
		Total Domestic Assets	6,00-16,00	11,9	
		Central Bank Money	35,00-45,00	26,9	
1991	End of Year (%)	Balance Sheet	Not Announced	58,9	Financial Stability
		Total Domestic Liabilities		66,6	
		Total Domestic Assets		64,3	
		Central Bank Money		62,6	
1992	End of Year (%)	Balance Sheet	37,00-47,00	85	Financial Stability
		Total Domestic Liabilities	38,00-48,00	101	
		Total Domestic Assets	27,00-39,00	75	
		Central Bank Money	40,00-50,00	100	
1993	End of Year (%)	Balance Sheet	Not Announced	60	Financial Stability
		Total Domestic Liabilities		49	
		Total Domestic Assets		55	
		Balance Sheet		46	
1994	End of Year (%)	Net International Reserves	Not Announced		Price and Financial Stability
	June	Net Domestic Assets	306 Trillion	271	
	September	Net Domestic Assets	296 Trillion	260	
	December	Net Domestic Assets	293 Trillion	272	
	Quarterly	Exchange Rate Basket	Not Announced		
1995	March	Net Domestic Assets	342 Trillion	260	Price and Financial Stability
	June	Net Domestic Assets	367 Trillion	269	
	September	Net Domestic Assets	334 Trillion	217	
	December	Net Domestic Assets	366 Trillion	393	
	End of Period	FX Deposits of Banking Sector	Not Announced	102,6	
	Quarterly	Exchange Rate Basket			
1996	End of Year (%)	Net Foreign Assets	Not Announced	632,2	Financial Stability and Competitiveness
		Net Domestic Assets		331,7	
		Reserve Money		610,4	
		FX Deposits of Banking Sector		353,4	
1997	End of Year (%)	Net Foreign Assets	Not Announced	1791,1	Financial Stability and Competitiveness
		Net Domestic Assets		142	
		Reserve Money		1129,6	
		FX Deposits of Banking Sector		903,5	
1998	March	Reserve Money	18,00-20,00	17,3	Financial Stability and Competitiveness
	June	Reserve Money	14,00-16,00	13,1	
	December	Net Domestic Assets	699 Trillion	579,4	
	Quarterly	Reserve Money	Not Announced	3333,2	
		Net Foreign Assets		2906,1	
		Net Domestic Assets		427,2	
		FX Deposits of Banking Sector		1380	
1999	April	Net Domestic Assets	890 Trillion	369,1	Financial Stability and Competitiveness
	June	Net Domestic Assets	999 Trillion	899,3	
	Quarterly	Reserve Money	Not Announced	4482,7	
		Net Foreign Assets		5710,4	
Source: "Monetary Policy Reaction Function in Turkey " Emir et al (2010)					

As can be seen from the table, the goals have been met to a great extent. The program was not announced due to the effect of the Gulf War the following year and the program announced in 1992 did not achieve the desired success. In 1992, all targeted values were realized with a deviation of 100 percent. The first of two possible causes of this failure is the pressure of public deficits and the second is that the Treasury exceeds the short-term advance payment cap in the sixth month of the program (Yildirim, 1990). The central bank set targets in the MB balance sheet, total domestic liabilities and assets and central bank money again,

without them being announced to the public in 1993. After 1994, along with financial stability, price stability has become the ultimate goal (Doğru and Savrul, 2013).

We see that the practices in the early years deviated from the target, because of the pressures from public finances and the increasing domestic and international debt burden over time. The CBRT chose not to announce its monetary program from the second half of 1995 until the beginning of 1998 after the 1994 crisis. The CBRT, which started to carry out monetary policy according to the rule, also intervened in the markets in line with the basic objectives of price stability and financial stability.

Turkey entered 1996 with the political uncertainty created by the early elections held at the end of 1995, the fragility caused by the stand-by agreement with the IMF coming to an end and the uncertainty that arised in the financial markets because of entering Customs Union. Under these conditions, the central bank chose to conduct a monetary policy that would both reduce inflation and eliminate the uncertainties existing in the financial markets. The basic principles of the monetary policy are the same as in previous years. The Monetary Program has envisaged the limitation of the increase in the domestic assets and the creation of Turkish lira obligation as much as the increase in foreign assets. In this context, the CBRT valued financial stability more than price stability in the period 1996-1997 and used its monetary policy in this direction. In this period, exchange rates were shaped according to the expected inflation, sustainable current deficit and competitiveness with the world were tried to be realized with the CBRT policies (Doğru and Savrul, 2013).

The Central Bank set targets in reserve money with its monetary program announced in 1998. In this program, which emphasized the budget size and balance of payments position, it was aimed to reduce inflation to 70% in the first half of the year and monetary policy targets were established in line with this expected inflation (Erçel, 1998). Realizations at the end of 1998 were below all targeted values and rates. Although the reserve money increase rate was set at 18-20% and 14-16% targets in March and June, the realizations were 17.3% and 13.1%.

With the surveillance agreement signed with the IMF in 1998, a ceiling target was set for net domestic assets. However, thanks to the fall in interest rates, signs of recovery in the economy were observed. However, the 1998 Russian crisis, salary hikes, uncertainty over taxes, and early general elections suddenly turned this trend to negative. Therefore, although there was a loose monetary policy implementation towards the end of the year, the net domestic assets target was increased to a higher value. Real interest rates, which increased towards the end of the year, aggravated the interest service burden of the budget, and this situation disrupted the debt dynamics of 1999 and caused the economy to recess (Emir, Karasoy and Kunter, 2000).

The monetary program, which was planned under the supervision of the IMF in 1999, and whose main objective was to protect international reserves and to reduce inflation, was launched. Accordingly, the fixed exchange system was adopted and the daily value of a

currency basket consisting of 1 US dollar and 0.77 Euro was announced to cover the one-year period. This program, which was successfully implemented until November 2000, lost confidence due to the problems in the banking system that occurred on this date, which led to devaluation expectations in the market. The CBRT sold foreign currency to meet the increasing foreign demand and thus its reserves decreased. When the problems in the real economy and the political crisis added to the existing liquidity problem in the market, the implementation of the fixed exchange rate regime was abandoned and the floating exchange rate regime was introduced on February 22, 2001 (Akat, 2004).

In Turkey, the main reason why monetary targeting didn't give rise to positive results was that, budget deficits increased substantially as fiscal discipline couldn't be achieved during periods of monetary targeting, then the CBRT provided advance payments to the Treasury in order to finance these budget deficits and finally this process increased the internal assets of the CBRT leading to monetary expansion.

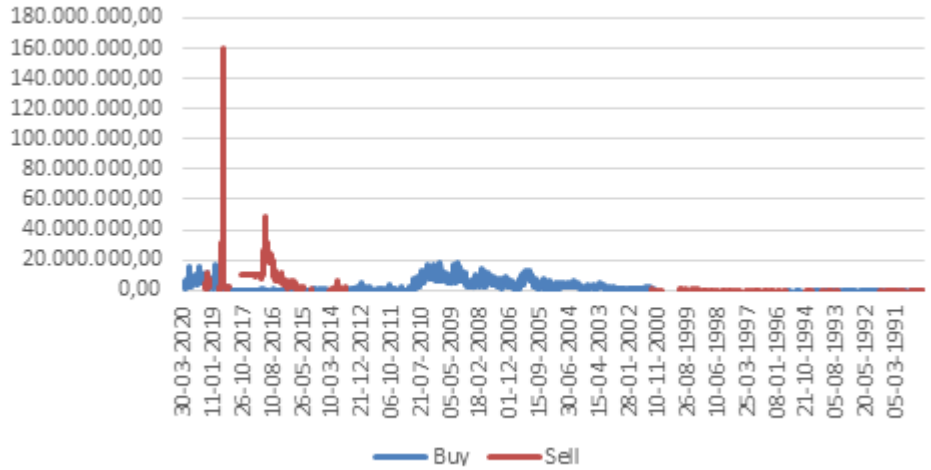
The Central Bank used monetary policy instruments such as reserve requirements, rediscount credits and the OMO during this period.

2.1.1.1) Open Market Operations

In order to effectively regulate the money supply and the liquidity of the economy open market transactions such as the purchase and sale of securities, Turkish Lira deposits repurchase agreements and reverse repurchase agreements are applied in line with the goals of the CBRT's monetary policy. The CBRT, thanks to open market operations ensures short-term interest rates around policy rates and regulates liquidity in financial markets.

A deposit facility is provided by the CBRT for banks against collateral, within their maximum limits, to be paid back with certain maturities. With this facility, banks may lend or borrow in Turkish liras over the interest rates set by the Central Bank during the same day.

Graphic 1: CBRT Deposit Transactions (Thousand TL)

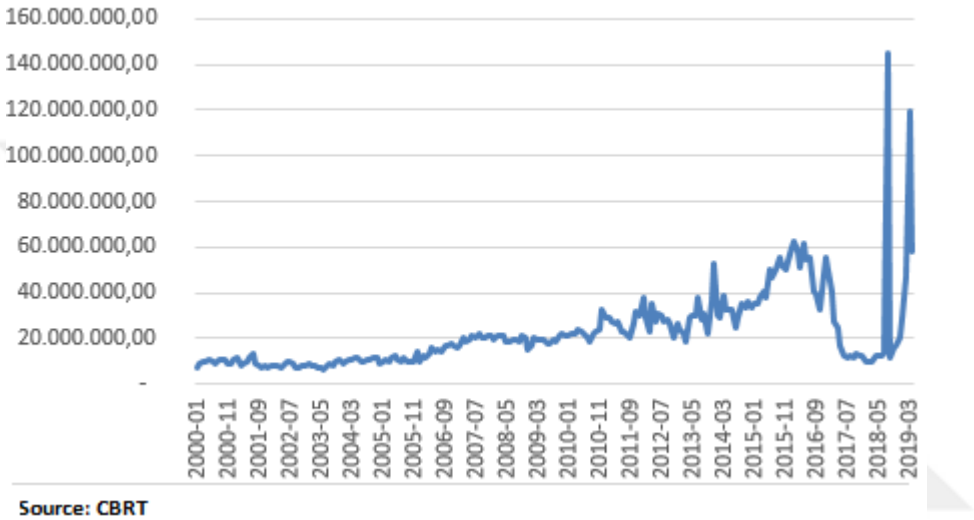


Source: CBRT

The deposit is one of the OMO tools that the CBRT actively uses, and it provides the opportunity to quickly intervene in market liquidity when needed.

Repo transactions are generally carried out to increase the banking system liquidity for a limited time when there is a temporary liquidity shortage in the market. In this framework, the Central Bank buys securities from banks/intermediary institutions authorized to conduct open market operations with an agreement to sell the same securities back on some specified future date.

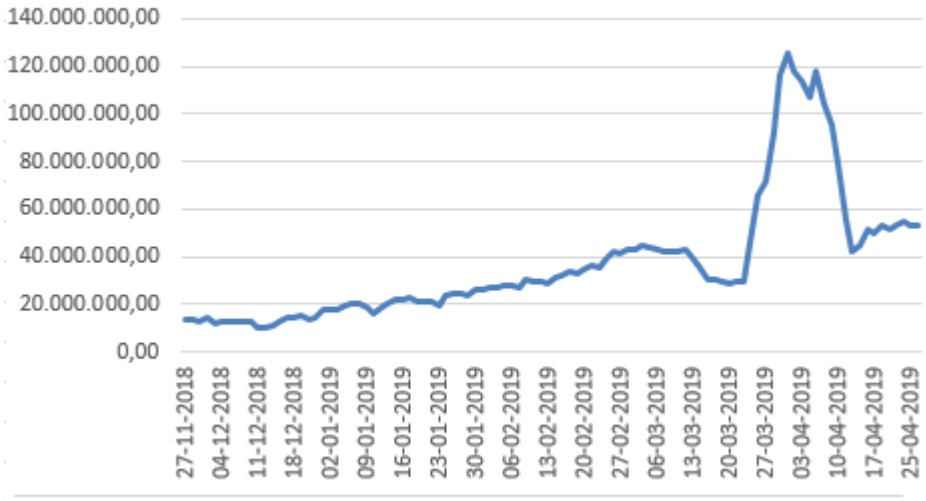
Graphic 2: CBRT Repo Transactions (Thousand TL)



Source: CBRT

Reverse repo is a transaction conducted to withdraw the excess liquidity in case of temporary excess liquidity in the market. The CBRT sells the government securities in its portfolio to the authorized banks/intermediary institutions while making a commitment to repurchase them on some specified date in the future at the price fixed at the time of the transaction.

Graphic 3: CBRT Reverse Repo Transactions (Thousand TL)



Source: CBRT

Outright purchase transactions are generally conducted in case of permanent liquidity shortages in the market. In this type of transaction, the CBRT purchases the government securities in circulation from the authorized banks/intermediary institutions, on the value date, at a price set on the date of the transaction.

Graphic 4: CBRT Securities Portfolio (Thousand TL)

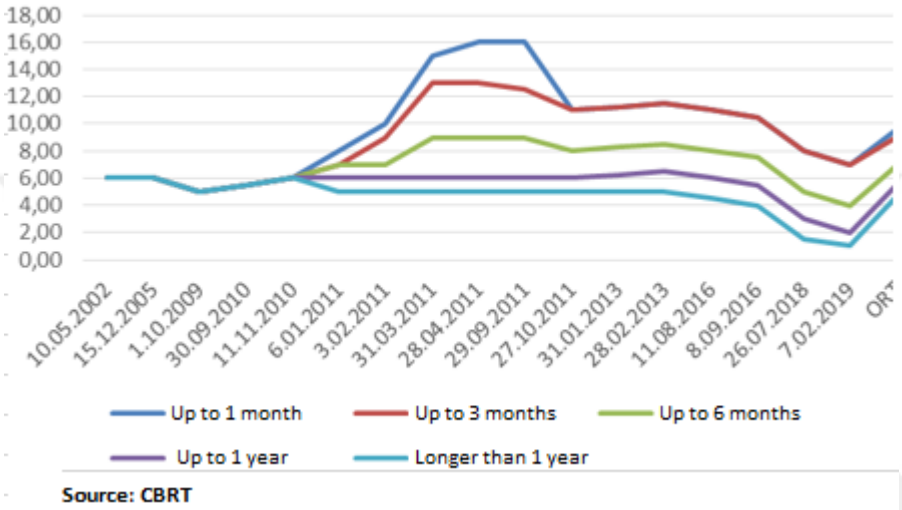
Source: CBRT

Liquidity Bills, it is a tool with a maturity of 91 days, which is used for withdrawing excess liquidity in the market in order to increase the effectiveness of the monetary policy. The Central Bank issued them 4 times in 2007 in order to balance the excess liquidity in the market.

2.1.1.2) Required Reserves

Required Reserves is a monetary policy tool applied by keeping a certain portion of the deposits and similar liabilities in the Central Bank accounts at an interest-free or a certain interest rate. The required reserve mechanism has been an important tool in controlling the money supply, increasing the trust of the depositors in the system against sudden and excessive draws in the banks' deposits. By changing the reserve ratios, the central bank can affect the reserves (monetary base) in the hands of the banks and control deposit expansion of the banking system.

Graphic 5: Required Reserve Ratios



Source: CBRT

While required reserve rates had been determined through a single fixed rate until 2010, with the Reserve Option Mechanism, which has been in operation as of this date, different reserve ratios are determined according to different terms.

2.1.1.3) Rediscount Rates

A transaction that is discounted by banks or is in a bank portfolio before it is due is called rediscount. While the Central Banks offer an important reserve resource to banks with the rediscount policy, the interest rate that they demand in return is the rediscount rate.

Graphic 6: CBRT Rediscount Rates

Source: CBRT

With the rediscount policy, the CBRT provided monetary contraction by drawing money from the market by increasing the rediscount rates during the periods of inflation and provided monetary expansion by decreasing the rates in recession periods. Today, like many central banks, this mechanism has lost its importance as the CBRT preferred OMO transactions as a monetary policy tool.

In Turkey, the monetary policy based on money supply control, applied by the CBRT until the early 2000s, failed for reasons such as insufficient foreign exchange reserves, rising inflation resulted from expansionary fiscal policies and delays in structural reforms after financial liberalization. Following the crisis of 1994 and of 2001, the CBRT went through a paradigm change and implemented monetary policy based on the exchange rate control under the auspices of the IMF.

2.1.2) Monetary Policy Based on Exchange Rate Control

Since monetary policies based on monetary supply control implemented until 1994 could not break the vicious cycle of high public debt, high inflation, high interest rates, alternative monetary policies were brought to the agenda. Following the transition to full convertibility in 1989, domestic residents and institutions were given the permission to purchase, transport and transfer abroad as much foreign currency as they wish. In addition, short-term foreign capital flow to the country has accelerated and the Turkish Lira appreciated. Net capital outflow, which started with the Gulf Crisis and continued with political instabilities, combined with the dense foreign exchange demand of banks in order to close the foreign currency short position in the last months of 1993 and created a significant pressure on TL (Yeldan, 2002). As a part of the stabilization program launched in 1994, since it threatened the stability of the Turkish Lira, the exchange rate policy was envisaged to be used as a nominal anchor in reducing inflation.

In the beginning of 1995, in order to switch to the "Anchor Model" under the supervision of the IMF, it was defined as a currency basket ($ 1 + 1.5 DM) within the framework of the "Stand-by" agreement and it was aimed to increase this basket by the expected monthly inflation rates. In the last two years until 1997, the monthly rate of increase in the currency basket was in line with the inflation rate and fluctuations in the real exchange rate index were kept at a limited level. In 1998, the Central Bank continued to set the monthly nominal devaluation rate in exchange rates in line with the projected inflation rate (Özçam, 2004).

In early 2000, a new standby agreement was signed with the IMF and a 3-year exchange rate-based monetary policy program was implemented. The main objectives of this program were to increase the primary surplus by implementing a tight fiscal policy, to realize of structural reforms and to accelerate of privatization. With this program, it is envisaged to implement monetary and exchange rate policies focusing on reducing inflation and real interest rates. While the exchange rate adjustments were adjusted according to the expected inflation between 1995 and 2000, the rate of increase in exchange rates was determined and applied according to the targeted inflation (Kazgan, Öztürk and Koraltürk, 2000).

The CBRT declared that the rate of increase in basket exchange rate would be realized as 20% annually, as well as the inflation rate targeted for 2000 (20% CPI), and announced that it would trade foreign exchange over the announced basket values in the foreign exchange markets in order to keep this basket value (Erçel, 1999). With this change in the exchange rate regime, the Central Bank switched from the practice of determining the rate of increase in exchange rates determined within the framework of the estimated inflation rates and conducted a rate regime for the targeted inflation.

Within the framework of the 3-year program implemented in 2000, a two-term implementation strategy was developed in the exchange rate regime. While in the first 18 months' period, a basket consisted of 1 $ + 0.77 Euros and the pre-announced rate of increase exchange rate regime was conducted, it was planned to adopt a band system in the following 18 months. It was envisaged to gradually increase the bandwidth projected in the band system. (According to this, it was stated that it would be gradually increased from 7.5 % July to 31 December 2001, to 15% by June 2002 and to 22.5% by 31 December 2002) (Günal, 2001).

The current program lost its credibility since the exchange rate increase was below the inflation rate since the first months and had the first shock in November 2000. The crisis, which started as a liquidity crisis at the beginning of November, caused an increase in both government bond rates and money market rates. With the convenience of additional reserves provided by the IMF, the necessary liquidity was given to the market and the program was sustained with other structural measures (Demirbank SDIF transfer). With the liquidity provided to the market, the interest rates of the government bonds remained high while the money market interest rates decreased and the fact that the real exchange rate continued to be valued was considered as shaking the trust in the applied program. When the crisis, which

occurred as a result of foreign exchange open positions in the banking and real sectors, was added to the political uncertainty on February 19, it was understood that the rate basket, whose rate of increase was previously announced, could not be continued, and the exchange rate regime was once again changed to the free exchange rate regime (Kepenek and Yentürk, 2010).

The CBRT benefited from different policy instruments while implementing monetary policy based on exchange rate control. These are foreign exchange deposit opportunities, foreign exchange selling auctions and direct foreign exchange interventions.

2.1.2.1) Foreign Exchange Auctions

The lack of a planned transition to the floating exchange rate regime in Turkey ended up with the rush to foreign currency. Then because of the rapidly increasing foreign currency exchange rate within a short time banks and other financial institutions had difficulty in fulfilling the short-term foreign currency obligations. Commercial banks demanded foreign currency regardless of their price to cover the correspondent bank deficits (Arat, 2003). In this context, the Central Bank started to hold foreign exchange selling auctions in order to close the foreign exchange liquidity gap in the market and to prevent excessive currency fluctuations.

Table 3:CBRT Foreign Exchange Selling Auction (million usd)	
March 2002	350
April 2002	1.040
May2002	1.130
June 2002	1.198
July 2002	1.035
August 2002	600
September 2002	360
October 2002	420
November 2002	400
Total	6.533
Source: CBRT	

In the 126 foreign exchange sale auctions held from 29 March to 30 November, 6 billion 533 million dollars were sold to the market. The first purpose of these auctions was to increase the foreign exchange liquidity in the market and prevent excessive fluctuations in the exchange rate. The other was to reduce the inflation expansion by reducing the TL expansion in the market following the use of the resources provided by the IMF (stand by 28 May 2001) in the redemption of the Treasury bills (Arat, 2003).

As of April 2002, as a result of the start of reverse currency substitution in the markets and the strong balance of payments, the Central Bank has started to purchase foreign exchange in order to increase its foreign currency reserves in order not to contradict the fluctuating exchange rate regime and distort the long-term trend and natural balance value of

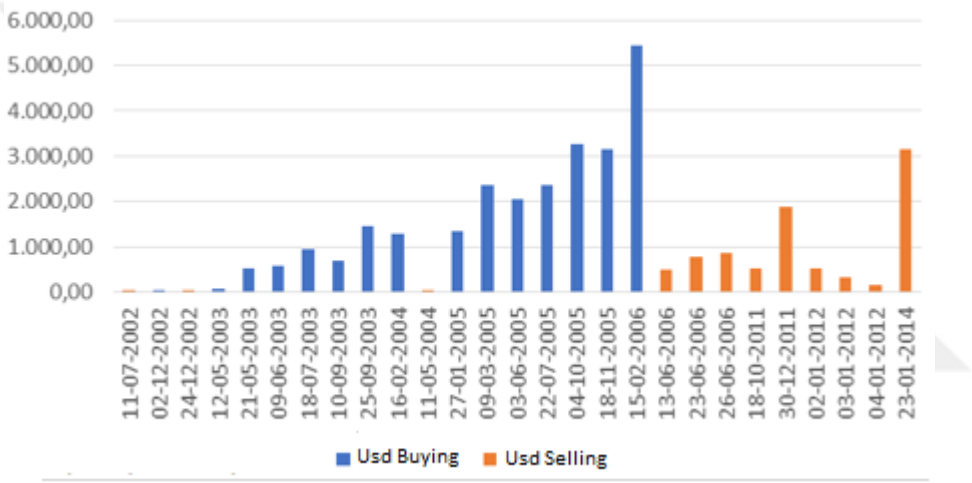
the exchange rate (Arat, 2003). In the 63 auctions held, 582 million dollars were purchased from the market.

Table 4:CBRT Foreign Exchange Buying Auction (million usd)	
April 2002	280
May2002	242
June 2002	60
Total	582
Source: CBRT	

2.1.2.2) Direct Foreign Exchange Interventions

The Central Bank has been making direct foreign exchange interventions since 2002 to eliminate excessive volatility in the value of the Turkish Lira.

Graphic 7: CBRT Direct FX Interventions (Million USD)



Source: CBRT

When we examine the direct foreign exchange interventions of the CBRT between 2002 and 2014, we see that the interventions made until 2006 were generally towards foreign exchange purchase to increase the bank reserve, and in the following years it was sales oriented in order to prevent market fluctuations. Since the CBRT prioritized open market transactions in its market interventions, it did not use this tool again after the sale of $ 3.151 million to the market in 2014.

2.1.3) Monetary Policy Based on Inflation Targeting

The exchange rate-based Stability Program, which was supported by the IMF Stand-by agreement signed in December 1999 and aimed at combating inflation, collapsed in February 2001 as a result of a serious financial crisis and exchange rates were left free to fluctuate. Thus, the Central Bank started implementing the inflation targeting regime as a last resort to combat chronic inflation. With this practice, the CBRT adopted a paradigm change and adopted policy rate implementation instead of direct foreign exchange intervention in monetary policy practices. Inflation targeting is a monetary policy strategy used to ensure

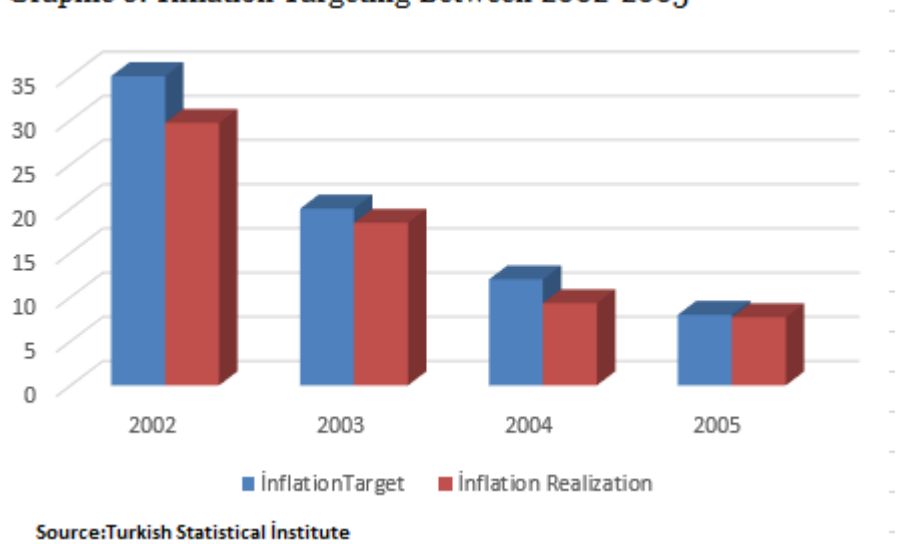
price stability. In this context, its most important difference from exchange rate targeting and monetary targeting is the targeting of the inflation rate directly, without using any intermediate target as a monetary policy strategy.

After the 2001 crisis in Turkey, it was thought to be early for transition to inflation targeting regime because of the problems in the banking sector that were not been fully resolved. In addition, movements in exchange rates were effective in determining inflation and financial dominance was highly effective. For this reason, implicit inflation targeting was preferred between 2002-2005 (Özatay, 2009).

The regime introduced was inflation targeting in terms of the CBRT's main goal of maintaining price stability, sharing the inflation target with the public at the beginning of the year, and giving an account to the Council of Ministers and the TGNA twice a year. On the other hand, the new regime was called implicit inflation targeting because MPC did not take an interest rate decision, future inflation forecasts and the CBRT's possible policy responses were not published. In this period, the CBRT used overnight interest rates as the main policy tool and determined the interest rates according to the difference between its inflation estimates and targets and shared its decisions with the public.

Accordingly, it was aimed to reduce the annual inflation rates calculated on the basis of CPI, below the rates of 35%, 20%, 12%, 8% for the years 2002, 2003, 2004 and 2005, respectively. In this period, fiscal discipline was applied very tightly, since the inflation target was determined with the government, monetary and fiscal policies were in harmony. As a result of budget discipline, primary surplus targets were exceeded and targets were met and financial dominance gradually decreased. As a result, the annual inflation rates in the years when there was a disguised inflation targeting were 29.7% in 2002, 18.4% in 2003, 9.3% in 2004 and 7.7% in 2005 (Özatay, 2009).

Graphic 8: Inflation Targeting Between 2002-2005



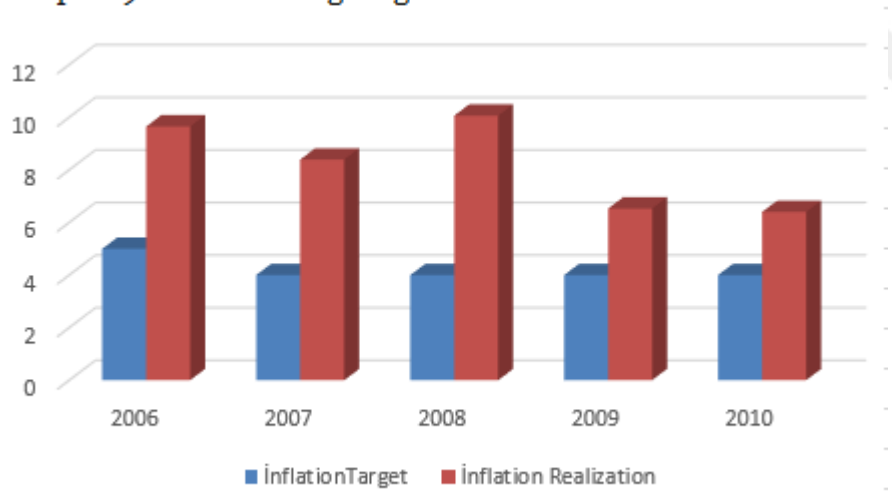
Source:Turkish Statistical İnstitute

In line with the developments in inflation, the average annual growth rate in this period was as high as 7% and production increases were stable. Moreover, a steady development was observed in the financial and capital markets, volatility in exchange rates declined, interest rates decreased and borrowing maturities extended with the decrease in inflation. As a result of all these positive developments, since it was thought that all the prerequisites were met for the transition to inflation targeting, the Central Bank started targeting open inflation by the beginning of 2006 (Peker, 2011).

The general outlines of the full open inflation targeting policy that the Central Bank started to implement can be defined as follows. Using the year-end inflation rate calculated by the annual percentage change of the CPI as the inflation target, it was decided to be announced to the public together with the government with a 3-year target horizon. With this point, the CBRT created an uncertainty of 2 points in both directions, and in case of deviation from these targets, the government and the public were obliged to make a statement. In addition, the decisions regarding the policy interest were started to be taken by the Monetary Policy Committee and announced on the same day together with their justifications.

With the new regime being implemented, the inflation target horizon for the first 3 years was determined as 5% for 2006, 4% for 2007 and 2008, and in the program announced for 2007, the rate of 4% was maintained for 2009 and 2010 (Yazgan, 2015).

Graphic 9: Inflation Targeting Between 2006-2010



Source:Turkish Statistical İnstitute

As a result of decreased appetite for risk taking in global financial markets accelerated capital outflow from developing countries to developed ones in May 2006. As a result of this, Turkey's credit risk was augmented and inflation rates began to deviate from the target. The CBRT reacted to these developments by increasing interest rates and the year-end inflation was above the targets by 9.65%. In 2007, political tension increased because of the early elections and presidential elections and loosening of fiscal policy trends was observed. The increase in world energy and food prices negatively affected Turkey's economy (Özatay, 2011).

The global financial crisis that started in the USA in 2008 increased the uncertainties even more. Exchange rates, interest rates, volatility in Turkey's credit risks arose and this led to significant volatility in both inflation rates and expectations. While the policy rate followed a fluctuating course in the period of 2006-2008, as a result of the economy going down, the CBRT followed the strategy of reducing the policy interest rate from November 2008 and decreased the policy interest rate from 16.75% to 6.5% until November 2009 (Özatay, 2011).

The CBRT used overnight interest rates as a policy tool in its fully open inflation targeting regime between 2006 and 2010. Although he used tools such as reserve requirements, rediscount rates, foreign exchange auctions, the main policy instrument of this period was overnight interest rates.

The global financial crisis that started in the US Mortgage market in 2008 has shaken the economies of both developed and developing countries deeply. One of the lessons learned from the global crisis is that ignoring financial stability may threaten macroeconomic stability and price stability in the medium and long term. The CBRT designed a new monetary policy that could react to shocks in addition to traditional practices to limit the negative effects of the crisis starting from the end of 2010. For this purpose, the inflation targeting regime, which was implemented since 2006, has been developed in a way to take into account financial stability. In the revision, the Central Bank brought a flexible framework based on active liquidity policy with an asymmetric and a wide corridor system where more than one interest rate is used as a vehicle to the current regime.

During the period in question, the CBRT also diversified its policy instruments. In this framework, the Bank took steps to ensure financial stability without compromising price stability, using tools such as reserve requirements and Reserve Option Mechanism.

2.1.3.1) Interest Corridor and 1 Week Repo Rate

After the 2008 global financial crisis period, expansionary monetary policies implemented by developed countries' central banks increased significant capital inflows towards Turkey like other developing countries substantially. The fact that short-term and dense capital inflows negatively affect financial stability through many different channels has led to the adoption of an alternative monetary policy approach that takes into account financial stability as well as price stability (Keskin, 2018).

In this framework, the Central Bank has increased its vehicle diversity by the end of 2010 and created a structure that will affect the credit and exchange rate channels separately. Within the framework of the new policy, the CBRT adopted the interest rate corridor, one-week repo rate, and liquidity management tools and required reserves as policy tools. While implementing the monetary policy, CBRT can provide short-term (daily or weekly) liquidity to the banks in need in the market with the interest rate corridor it uses to influence market interest rates and liquidity, and it can borrow overnight maturity from those with excess funds. The area between the interest rates that the CBRT can borrow and lend from banks overnight is defined as the "interest corridor" (Kara, 2012). However, with the "Monetary

Policy Committee Decision" dated May 18, 2010, the technical interest rate adjustment was made and the 1-week repo auction interest rate between the interest rate corridor was determined as the policy interest rate. (CBRT MPC 2010)

With this new policy implemented by the CBRT, the Bank conducts money market transactions within the scope of open market operations in order to ensure the efficient regulation of money supply and liquidity in the economy. In this context, the CBRT funds money markets through overnight (o / n), late liquidity (LLW) and 1-week repo auctions. Weighted average funding interest occurs as a result of funding made from these different channels in variable amounts.

Graphic 10: Weighted Average Cost of CBRT Funding

Source: CBRT

Thanks to these opportunities, the CBRT had the chance to react more quickly to unusual movements in the market. Without changing the announced interest rates with this system, it is possible to make changes in the short-term interest rates by changing the composition of the funding.

The CBRT actively uses the interest rate corridor tool in monetary policies implemented after the global crisis. In late 2010, the interest rate corridor was expanded downwards because the Turkish Lira, which was overvalued by the impact of short-term capital flows, threatened financial stability. Since 2011, overnight lending rates, which constitute the upper limit of the interest rate corridor, have been increased to ensure that credit growth is consistent with financial stability. In 2013, with the announcement of the end of asset purchasing programs in global markets, the upper band of the interest rate corridor was widened with the effect of significant depreciation in Turkish Lira and the disrupted inflation expectations (Binici et al, 2013).

As a result of decisions taken by MPC in Turkey, the policy rate within the interest rate corridor has been changed 17 times since May 2010 when it was actively used. In the face of changing financial conditions, the CBRT also changes interest rates, thereby reducing excessive volatility in exchange rates and loans, and limiting variability in short-term capital mobility and macro financial risks. In addition to this, the other intermediary used by the CBRT as a complement besides the interest instrument is the reserve requirement.

2.1.3.2) Reserve Option Mechanism

Within the scope of the new monetary policy regime implemented by the Central Bank after 2010, it effectively used the required reserves as well as interest as the main policy tool. In the previous periods, the reserve requirement instrument was used by gradually increasing and decreasing the reserve rates, determining the reserve ratio according to the maturities, changing the interest rate paid against the provisions and changing the scope of the obligations subject to reserve requirement. Recently, Reserve Option Mechanism (ROM) has been used as a policy tool in order to limit the negative effects of excessive volatility in capital movements on macroeconomic and financial stability, to strengthen the CBRT's gross foreign exchange reserves and to provide banks with more flexibility in their liquidity management. (CBRT 2012)

Reserve Option Mechanism is an application that allows banks to establish a certain percentage of the Turkish lira required reserves that they have to keep in the CBRT in foreign currency (dollar and / or euro) and standard gold. With this mechanism, the CBRT, on the one hand, offers banks the opportunity to use their foreign exchange assets at a certain rate in order to meet Turkish Lira liquidity requirements, on the other hand, it has the opportunity to increase its gross reserves.

In the technical dimension of the system, the Central Bank determines the upper limits on the extent to which the opportunity can be used, with the Reserve Option Ratio (ROR). In addition, the coefficients that determine the foreign currency or gold reserve that can be established for each unit of the Turkish lira required reserves are defined as Reserve Option Coefficient (ROC). The extent to which banks will benefit from this opportunity will vary depending on the amount of foreign currency resources that banks can provide and the marginal ROC value (threshold ROK) that leaves the opportunity aside with other funding instruments. The threshold ROC basically depends on the relative costs of foreign currency and Turkish lira resources. (CBRT 2012)

The most important expected effect of the ROM application is to balance the exchange rate volatility created by capital flows domestically and support the application of interest rate corridor. Decrease in foreign exchange borrowing costs during periods of intense foreign capital inflows to the country will encourage banks to benefit more from ROM. In this case, some of the foreign currency entering the country will be entered into the accounts of the CBRT to be used in the establishment of TL required reserves in this way, the appreciation pressure on the TL will be limited, and the rate of conversion of the currency in question into credit will decrease. As the capital inflows slow down, the banks will obtain the foreign

exchange liquidity they need by reducing the ROM usage rate as the foreign exchange costs will increase. In this case, the depreciation pressure of the Turkish Lira will ease.

There has been a remarkable increase in the CBRT's gross foreign exchange reserves since the implementation of the ROM.

Graphic 11: CBRT Gross Reserves (Million TL)

Source: CBRT

A monetary policy implementation designed with appropriate policy components and appropriate policy instruments ensures that the moves expected from monetary policy can be made in a timely and effective manner. In parallel, we see that the Central Bank followed different instruments and different monetary policies for different targets in different periods.

2.2) State of Public Finance

In the first part of this chapter, we analyzed the different monetary policy regimes conducted by the Central Bank and the monetary policy tools used accordingly. In this section we will consider the evolution of macroeconomic indicators such as the public finance situation in Turkey, the need for public borrowing, debt stock and composition of its debt maturities and public borrowing cost.

2.2.1) Debt Stock and Borrowing Cost

In case the government's incomes in a certain period cannot meet the expenditures made in the same period, public sector financing needs to occur. The need for public borrowing arises due to reasons such as inconsistency between income and expenses, financing old debts and financing public investments. The state can show three different reactions in such a situation. It may apply income-increasing policies and increase taxes, apply to the Central Bank resources, print money or choose the way of borrowing. Public borrowing has become the most preferred form of financing by policy makers today, due to the negative impact of income increasing policies on national income and the inflationary

effects of money printing. For this reason, the concept of public debt management, which aims to meet the financing needs of the state with the least cost, comes to the fore.

In Turkey, following the year of 1985, the basic method of public finance shifted from taxation to borrowing and in terms of finding sources, governments preferred domestic borrowing to taxation and emission option. Populist policies followed by governments in fiscal policies in the 1990s caused an increase in domestic debt stocks and created significant negative results in public finance balances as well as the sustainability problem of borrowing. In this period, reasons such as insufficient foreign borrowing facilities, lack of structural arrangements regarding taxation, ease of internal borrowing and adoption of it as a financing instrument caused serious increases in domestic borrowing stocks (Berkay and Ağcakaya, 2016).

Table 5: Public Net Debt Stock (Billion TL)

	Public Gross Domestic Debt Stock	Public Gross External Debt Stock	Total Public Gross Debt Stock	Public Sector Assets	Public Sector Net Debt	Public Sector Net Debt /GDP
2000	54,5	30,3	84,8	14,1	70,7	41,5
2001	125,6	63,4	189	30,1	158,9	64,8
2002	155,2	101,6	256,8	41,6	215,2	59,9
2003	202,1	95,4	297,5	46,7	250,8	53,6
2004	235,1	97,9	333	58,4	274,6	47,6
2005	259,8	91,4	351,2	81	270,2	40,1
2006	268,3	97,3	365,6	107,7	257,9	32,7
2007	273,3	81,8	355,1	107,1	248	28,2
2008	295,8	111,5	407,3	140,2	267,1	26,8
2009	347,4	117,4	464,8	155,8	309	30,9
2010	369,2	127,6	496,8	179,3	317,5	27,4
2011	387,6	158,5	546,1	256,4	289,7	20,8
2012	408,4	154,4	562,8	322,3	240,5	15,3
2013	430,3	192,6	622,9	425,6	197,3	10,9
2014	443,4	206,6	650	463,1	186,9	9,1
2015	474,2	247,8	722	561,1	160,9	6,9
2016	514,7	305,1	819,8	600,6	219,2	8,4
2017	595,6	358	953,6	692,3	261,3	8,4
2018	664,8	505,1	1169,9	662,9	507	13,7

Source: Republic of Turkey Ministry of Treasury and Finance

As can be seen from the table, while the public gross debt stock has been steadily increasing since 2000, the public net debt stock / GDP ratio has been in a downward trend since 2001. As a result of the sudden foreign capital outflow and the rapid devaluation of TL experienced in the 2001 crisis, borrowing was made in the short term and with high interest rate from the domestic market and the ratio of net debt stock to GDP increased to 64.8%. Another important indicator to consider when examining the public debt stock is the need for public borrowing.

Table 6: Public Borrowing Requirement (Million TL)

	Public Borrowing Requirement	Public Borrowing Requirement/GDP(%)
2000	12,19	7,1
2001	28,31	11,5
2002	37,75	10,5
2003	35,94	7,7
2004	22,75	3,9
2005	397	0,1
2006	-10,17	-1,3
2007	1.678	0,2
2008	15.662	1,6
2009	52.026	5,2
2010	32.991	2,8
2011	4.601	0,3
2012	14.618	0,9
2013	11.672	0,6
2014	10.640	0,5
2015	2.279	0,1
2016	36.166	1,4
2017	57.323	1,8
2018	88.305	2,4
Source: Republic of Turkey Ministry of Treasury and Finance		

If we examine the Public Borrowing Requirement data, which is the sum of the financing deficits of each component of the public sector and defined as the measure of public borrowing needs, we can observe that it goes quite parallel to the Public Net Debt Stock data.

In the period following the 2001 crisis, along with the stabilization programs and fiscal discipline, significant improvements were observed in the borrowing requirement and net debt stock / GDP ratios in the process of the public sector, especially in the central government budget. In addition to taxation measures and privatization revenues, the change in the quality and quantity of public expenditures was effective in reducing the public borrowing requirement. The ratio of the borrowing requirement of the central government budget to GDP decreased from 11.5% in 2001 to 0.1% in 2015, and the public net debt stock / GDP ratio decreased from 64.8% in 2001 to 6.9% in 2015. In this improvement, in the first part the implementation of the fiscal discipline mentioned in 2002-2005 during the implicit inflation targeting period, and the discipline of the units that have a share in the budget by reducing their expenditures plays a role. In addition, the preference of cooperation models with the private sector in high-cost investment expenditures has reduced the public spending burden, and the efforts to create financial areas have yielded positive results. As a result of these efforts, the effect of the decrease in the public debt burden manifested itself as a decrease in interest expenditures and borrowing costs (Berkay and Ağcakaya, 2016).

In financial markets, the concept of cost is a factor that generally acts in the opposite direction with the risk factor. Indicators that endanger the sustainability of public debt, such as high debt stock, high public borrowing requirement, high debt roll-over rates, high inflation and current account deficit increase the risk premium and increase the borrowing cost. Especially in Turkey, the economic situation, which has been observed since the early 2000s confirms this principle.

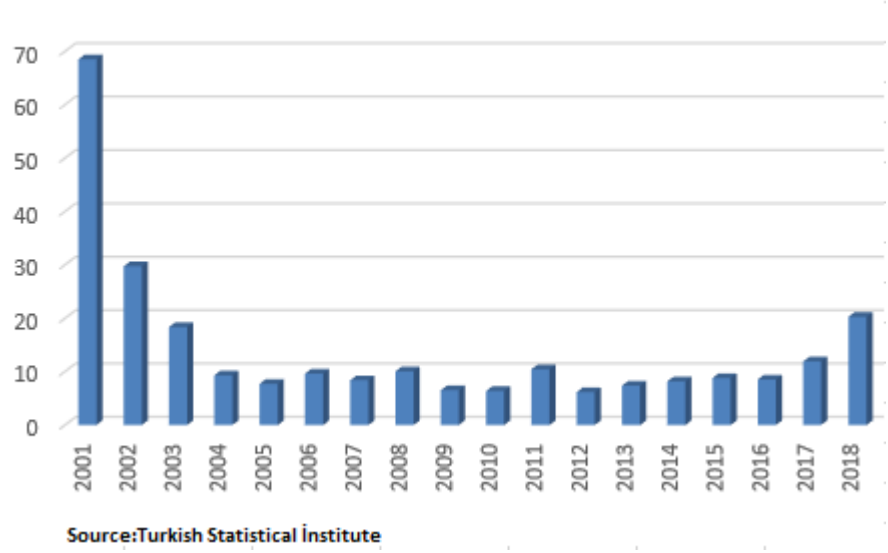
Table 7: Average Cost of Domestic Borrowing (Annual Compound %)

	Zero Coupon		Fixed İnterest		Cash Borrowing	
	Monthly Average Cost	Cumulative Cost	Monthly Average Cost	Cumulative Cost	Monthly Average Cost	Cumulative Cost
2003	27,93	46,05	27,58	45,44	21,52	40,21
2004	23,12	24,74	23,12	24,64	18,92	22,75
2005	14,2	16,3	13,44	16,07	13,75	16,22
2006	21,47	18,08	21,47	17,95	21,47	18,12
2007	16,52	18,43	16,54	18,37	16,54	18,01
2008	18,64	19,23	18,64	19,18	16,44	19,19
2009	9	11,61	9	11,56	9	12,81
2010	7,68	8,12	8	8,48	7,91	8,49
2011		8,45	10,34	8,74	10,34	8,62
2012		9,02	5,77	8,79	5,77	8,75
2013		6,97	9,23	7,65	9,09	7,88
2014	8,81	9,48	8,81	9,75	8,81	9,62
2015		9,58	10,93	9,46	10,93	9,17
2016		9,94	11,42	10,14	11,42	9,95
2017		11,59	13,02	11,35	13,02	11,03
2018		19,92	18,62	17,49	17,09	16,06

Source: Republic of Turkey Ministry of Treasury and Finance

When we examine the situation in Turkey after the 2001 financial crisis, we observe an improvement in the borrowing costs in the economy, like in many different areas. It is observed that the cumulative borrowing cost decreased due to the decrease in public borrowing requirement and the debt stock after the post-crisis period in which tight fiscal policies were followed.

Graphic 12: Inflation Rate



Source:Turkish Statistical İnstitute

One of the most probable causes of the decrease in public borrowing costs is the decrease in debt stock rates and the need for public borrowing due to fiscal discipline, as well as the inflation rates that have entered the downward trend as a result of monetary policies implemented by the Central Bank in the period after 2001 crisis. Following the decline in inflation, the increasing real return that Turkey presented in financial markets, accelerated foreign capital flows into country. Parallelly the Treasury gain access to longer term foreign capital at lower costs. While creating a public debt management strategy, it takes into account the source of borrowing as well as the cost of borrowing. Borrowing market and currency preference changes according to market conjuncture and directly affects borrowing cost.

2.2.2) Public Debt by Source

The government has several ways to apply for borrowing. One of these is internal and external borrowing. At this point, the factors affecting the preference come to the fore. In the first phase, domestic and foreign market preference comes to the agenda in the state's debt composition. Both preferences have their own advantages and disadvantages. While domestic borrowing can have positive effects on growth, inflation and savings through local capital markets, it can have a crowding out effect on private investments. While external borrowing has the advantage of providing long-term and cost-effective outsourcing without creating a threat to exclude private investments, it adds value to the local currency and adversely affects foreign trade, and creates a foreign currency risk in debt repayment along with devaluation in sudden capital outflows. (Demir, 2008)

In Turkey, even if public debt is mainly in the form of internal borrowing, as an alternative source, the weight of the external borrowing in the total debt composition is increasing day by day.

Table 8:Public Gross Debt Stock (Million TL)					
	Domestic Debt Stock	Domestic Debt Stock /GDP	External Debt Stock	External Debt Stock / GDP	Total Debt Stock
2003	194.387	68,6	88.847	31,4	283.234
2004	224.483	70,8	92.489	29,2	316.972
2005	244.782	73,7	87.157	26,3	331.939
2006	251.470	72,8	94.032	27,2	345.502
2007	255.310	76,5	78.552	23,5	333.862
2008	274.827	72,2	106.002	27,8	380.829
2009	330.005	74,7	112.044	25,3	442.049
2010	352.841	74,4	121.305	25,6	474.146
2011	368.778	71	150.291	29	519.069
2012	386.542	72,5	146.359	27,5	532.901
2013	403.007	68,8	183.185	31,3	586.192
2014	414.649	67,7	197.868	32,3	612.517
2015	440.124	64,9	238.121	35,1	678.245
2016	468.644	61,7	291.306	38,3	759.950
2017	535.448	61,1	341.045	38,9	876.493
2018	586.142	54,9	480.971	45,1	1.067.113
Source: Republic of Turkey Ministry of Treasury and Finance					

As the public net debt stock and borrowing requirement decreased after 2001, while the pressure on interest rates decreased, in the domestic and foreign borrowing preference, there was a shift from domestic debts to external debts and it was also seen that this shift was from public to private sector. In public domestic borrowing, public debt to the public decreased gradually, and the debt to the market increased. This means that the private sector preferred to use the funds in the public sector.

Table 9: Composition of Domestic Debt Stock by Holders (Million TL)															
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residents	224	241,7	236,2	243	267,7	335	346,1	326,8	336	331,3	361	379,1	410,8	462,8	544
Banking Sector	108,3	126,8	134,2	145	164,1	232	249,1	223,9	221	211,6	219	224,3	236,3	270,3	340
Public Banks	61,6	63,8	66,1	65,6	77,9	98,5	101,2	94,9	89	88,2	88,6	85,6	93,3	101,6	141
Private Banks	43,1	57,1	58,7	65,8	69,7	113	120,9	100,3	103	91,9	97	104	84,2	102,2	121
Foreign Banks	2,5	4,1	7,9	11,5	14,5	17,8	21,6	22,4	22,3	23,6	24,6	25,7	48,9	55,9	61,5
Development and Investment Banks	1,1	1,8	1,5	2,3	2	2,9	3,9	4,3	5	3,8	4	4,1	3,9	4,3	7,2
Participation Banks	0	0	0	0	0	0	1,5	2	2,1	4,1	5,2	4,9	6	6,3	9
Non-Banking Sector	97,3	96,6	83,2	81,1	90	93,8	89,1	95,3	107	110,7	132	145,8	160,6	178	191
Retail Investors	34,8	28,3	24,1	16,5	16,4	10,6	6,1	6,3	2,9	3,7	1,8	1,5	0,9	1,3	3,5
Corporate Investors	45,8	46,7	49,5	51,9	59,4	67,7	67	74,1	86,8	87,2	107	115,9	128	143,2	154
Securities Mutual Funds	16,7	21,6	9,6	12,7	14,2	15,5	16	14,9	17	19,8	23,6	28,4	31,7	33,5	34,2
CBRT	18,4	18,4	18,8	16,9	13,6	8,5	8	7,8	8,5	9	9,2	9	13,9	14,5	13,6
Non-Residents	17,2	27,8	37,2	37,5	30,7	31,4	49,2	68,2	102	90,9	99,1	79,4	86	111,3	88,9
Total	241,2	269,5	273,4	281	298,4	366	395,3	395	438	422,2	460	458,5	496,8	574,1	633
Source: Republic of Turkey Ministry of Treasury and Finance															

As can be seen from the table, the main sources referenced in domestic borrowing in Turkey can be listed in general as banks, households, public institutions, other financial institutions and central banks. Although the share of public banks (public sector) has increased very slightly in the distribution of central government debt stock since 2004, the weighted increase has been observed in non-residents, foreign banks and private banks. Such a transformation is due to the high returns offered by Turkey's real interest to the outside world. Stimulated by high interest rates, the foreign financial capital’s entry to the country reduces the value of foreign currency and thus leads to an increase in imports. In parallel to these, Turkey's current account deficit showed a significant increase in the period after 2000.

Table 10: Current Account Balance (Million USD)	
2000	-9.920
2001	3.760
2002	-626
2003	-7.554
2004	-14.198
2005	-20.980
2006	-31.168
2007	-36.949
2008	-39.425
2009	-11.358
2010	-44.616
2011	-74.402
2012	-47.963
2013	-63.642
2014	-43.610
2015	-32.145
2016	-33.139
2017	-47.347
2018	-27.633
Source: CBRT	

External borrowing trend in Turkey, began with the substitution process of domestic debt with foreign debt in 1999, due to the standby agreement process carried out with IMF. Moreover, prohibition of giving advance payment to the Treasury in accordance with the Central Bank Law in 2001 has created an increase in the foreign debt volume (Ünsal, 2004).

Since the beginning of the 2000s, Turkey has steadily increased its share in total external debt of the private sector, and since 2005, the share of the private sector's external debt has exceeded the share of the public. The share of loans received from international official institutions in external borrowing instruments has decreased while the share of short-term debt instruments like bonds has increased.

Table 11: Central Government External Debt Stock (Million USD)																	
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Loan	33.699	36.584	38.855	33.083	30.230	28.377	30.851	33.155	33.900	32.657	30.501	30.010	26.988	24.294	22.664	23.477	22.016
Multilateral Agencies	20.721	23.629	26.361	22.189	19.424	17.280	18.912	21.385	20.868	18.808	17.722	18.411	17.206	16.071	15.132	16.427	16.054
IMF	13.941	13.941	16.732	18.445	14.647	10.759	7.144	8.563	7.935	2.885	864	0	0	0	0	0	0
SDR Allocation	0	0	0	0	0	0	0	1.499	1.478	1.476	1.474	1.477	1.389	1.330	1.289	1.365	1.334
Bilateral Lenders	6.688	6.877	6.550	5.267	5.077	4.932	5.538	5.657	6.307	6.510	5.940	5.175	4.755	4.356	4.097	4.290	4.015
Others	6.290	6.079	5.943	5.627	5.729	6.165	6.401	6.113	6.725	7.339	6.838	6.423	5.028	3.867	3.435	2.759	1.948
Bond Issues	23.074	26.762	29.729	31.560	36.347	38.744	38.907	40.899	44.185	46.527	51.209	55.654	58.175	57.444	59.951	66.764	69.229
Total	56.773	63.346	68.584	64.643	66.577	67.121	69.758	74.054	78.085	79.184	81.710	85.664	85.163	81.738	82.615	90.241	91.245
Source: Ministry of Treasury and Finance, General Directorate of Public Finance																	

The increase in the current account deficit was the basis of the increase in foreign debt and the most obvious reason for the current account deficit in the post-2003 period was the private sector borrowing. The reason for the increase in private sector debt is not the rapid

increase of private sector investments, but the decrease in private savings as a result of low exchange rate policies applied. The fact that the external borrowing of the private sector is in the form of speculative capital inflows from the non-financial sectors creates a fragile economic structure against the global crisis and shocks (Yeldan, 2010).

Table:12 Gross External Debt Stock of Turkey (million USD)

	Public Sector	CBRT	Private Sector	Gross External Debt Stock	Gross External Debt Stock /GDP
1989	29.446	7.827	6.638	43.911	30,8
1990	33.268	8.342	10.770	52.380	26,1
1991	35.280	7.215	11.128	53.623	26,7
1992	36.476	6.730	15.390	58.596	27,8
1993	39.640	7.293	23.579	70.512	29,6
1994	41.741	9.777	17.186	68.704	38,8
1995	42.003	12.171	21.774	75.948	33,6
1996	40.192	12.381	26.725	79.298	32,6
1997	39.068	11.765	33.523	84.356	33,2
1998	41.339	12.986	42.026	96.351	34,7
1999	44.107	11.006	48.011	103.124	40,7
2000	50.081	14.090	54.431	118.602	43,6
2001	47.129	24.351	42.112	113.592	56,5
2002	64.553	22.003	43.066	129.622	54,8
2003	70.844	24.373	48.962	144.179	45,9
2004	75.668	21.410	64.082	161.160	40
2005	70.411	15.425	84.945	170.781	34,2
2006	71.587	15.678	120.743	208.008	38
2007	73.525	15.801	160.605	249.931	36,9
2008	78.334	14.066	188.472	280.872	36,2
2009	83.513	13.162	172.197	268.872	41,6
2010	89.109	11.565	191.107	291.781	37,8
2011	95.830	9.334	200.252	305.416	36,7
2012	106.307	7.088	228.896	342.291	39,3
2013	118.936	5.234	268.639	392.809	41,3
2014	121.268	2.484	282.132	405.884	43,4
2015	116.638	1.327	282.327	400.292	46,4
2016	123.374	1.110	285.245	409.729	47,5
2017	136.577	1.761	317.207	455.545	53,5
2018	140.562	5.922	298.393	444.877	56,7

Source: Ministry of Treasury and Finance, General Directorate of Public Finance

While the ratio of the private sector's external debt to public foreign debt stock was 37% in 2001, it reached 67% in 2018.

Another important development that increased the debt stock was after the mortgage crisis in the USA in 2008, the central banks in developed countries started a large asset

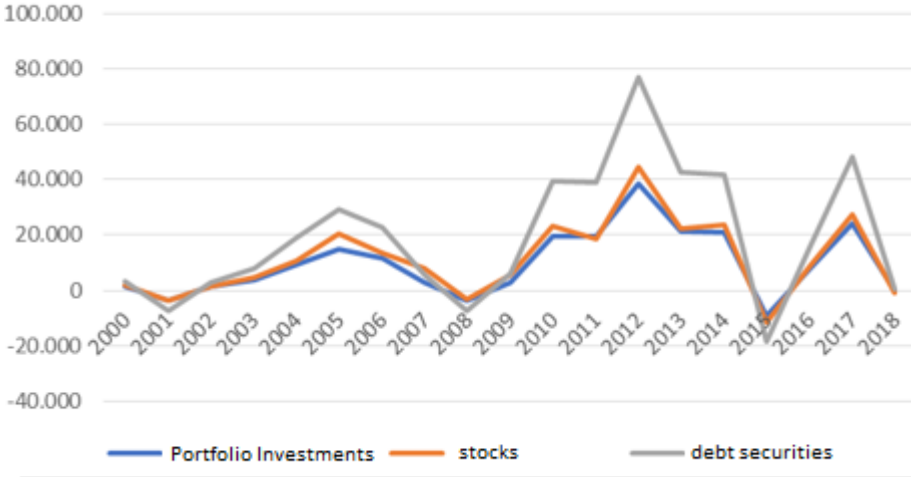
purchase program. As a result, capital flows to developing countries accelerated, and considerable decreases began to be observed in foreign currency borrowing costs of companies and governments. Companies that had access to cost-effective and long-term credit regularly increased their external debt stocks until mid-2013, when it was announced that the asset purchase program would end.

Table 13: Current Account Deficit Financing (Million USD)

	Foreign Direct İnvestment	Portfolio İnvestment	Other investment
2000	982	1.615	10.389
2001	3.352	-3.727	-12.296
2002	1.082	1.503	1.603
2003	1.702	3.851	4.461
2004	2.785	9.411	14.657
2005	10.031	14.670	20.834
2006	20.185	11.402	29.492
2007	22.047	2.780	33.482
2008	19.851	-3.770	34.529
2009	8.585	2.938	-8.343
2010	9.099	19.617	29.379
2011	16.182	19.516	19.933
2012	13.744	38.372	22.559
2013	13.563	21.419	37.195
2014	13.337	20.962	17.874
2015	19.274	-9.329	27.111
2016	13.950	7.850	11.818
2017	11.546	24.082	13.283
2018	12.984	255	947

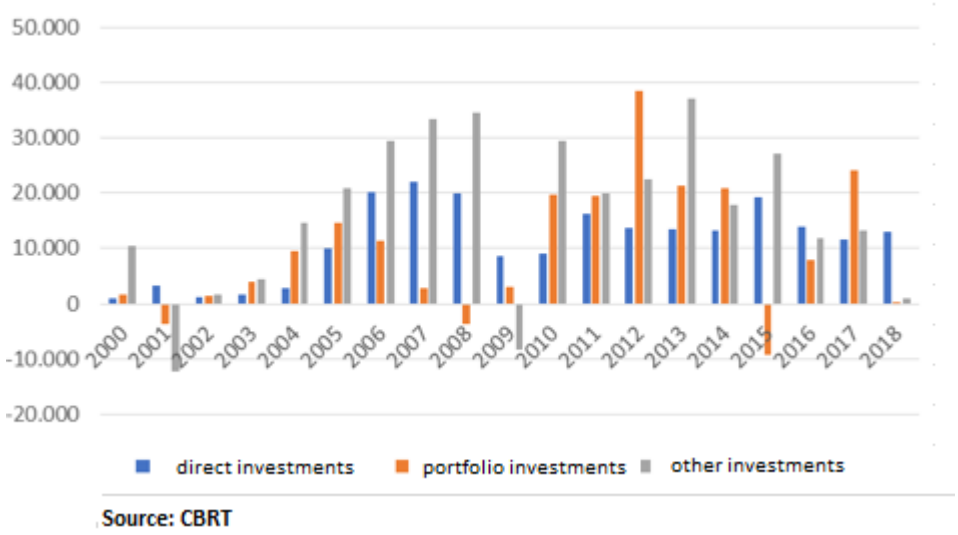
Source : CBRT

Graphic 13: Portfolio Investments (Million USD)



Source: CBRT

Graphic 14: Capital Flows (Million USD)



Source: CBRT

Capital flow from abroad to the country can be realized through many different channels such as direct indirect investments, credit to companies, mergers and portfolio investments. While direct investments are long-term cross-border investments made by an investor settled in an economy to establish a permanent relationship with a business in a different country, portfolio investments mean that investors purchase securities such as short-term bonds and stocks in different countries in anticipation of return. Turkey has also become increasingly important in portfolio investment in recent years and plays an important role in financing the current account deficit. Another main benefit of portfolio investment is their positive impact on public borrowing. In addition to the demand from the domestic residents, the demand from the domestic residents increases the price of the bonds and decreases the interest, and thus the public borrowing costs decrease. It is remarkable that the years between 2010-2013, when non-residents entered the trend of increasing their government securities were also the times when the public borrowing costs remained at the lowest levels (Küçükkırımlı, 2017).

In literature, the conventional view is that elevated public debt, fiscal deficits and public spending crowds out private investment and raises interest rates on government bonds. From this perspective, an increasing number of studies point out the role of macroeconomic conditions as explanatory variables of public borrowing cost. These studies support the view that higher public debt ratios and fiscal deficit ratios lead to higher government bond yields because of raising concerns about country's debt sustainability.

Poghosyan (2012) analyzed the main determinants of public bond yields in 22 advanced economies between 1980-2010 by applying panel cointegration techniques. His findings showed that government bond yields rise by about 2 basis points in response to a 1 percentage point increase in public debt-to-GDP ratio and by about 45 basis points in response to a 1

percentage point increase in potential growth rate in the long run and public bond yields deviate from the level determined by the long-run fundamentals.

Laubach (2009) analyses the relationship between long-horizon expectations of both fiscal variables and interest rates in the USA. The findings show that 1 percentage-point increase in the projected deficit to GDP ratio raises the 5-year-ahead 10-year-forward rate by 20–29 basis points while 1 percentage point rise in the projected debt-to-GDP ratio raises the forward rate by about 3–4 basis points.

Engel and Hubbard (2004) examined the effect of the fiscal determinant on sovereign yields in the United States between the period 1953-2003. Concerning the magnitude of the effect, the broad finding appears to be that a rise in deficits by 1 percent of GDP augments long-term interest rates by 30–60 basis points, while an increase in the debt-to-GDP ratio of 1 percentage point is associated with an increase in interest rates of between 2 and 7 basis points.

Kinoshita (2006) presents a model linking public bond yields to government debt and examines its assumptions using a panel data of 19 advanced economies. The findings suggest that a 1 percentage point rise in the public debt-to-GDP ratio raises the real long-term public bond yield by about 2-5 basis points. This impact is comparable to the 3-5 basis points effect found in Engen and Hubbard (2004) and Laubach (2009) for the U.S.

Baldacci and Kumar (2010) develop a sample of 31 emerging and advanced economies between the period (1980-2008) and presents debt-to-GDP ratios into the specification in both linear and quadratic fashion. Their estimations suggest that a 1 percentage point increase in the public debt-to-GDP ratio raises the real long-term government bond yield by about 0.8 basis points in G-20 economies (both advanced and emerging) and by about 1.7 basis points in advanced G-20 economies. They also discuss that the precise magnitude of the impact depends on the initial fiscal position, institutional and other structural conditions, and spillovers from global financial markets.

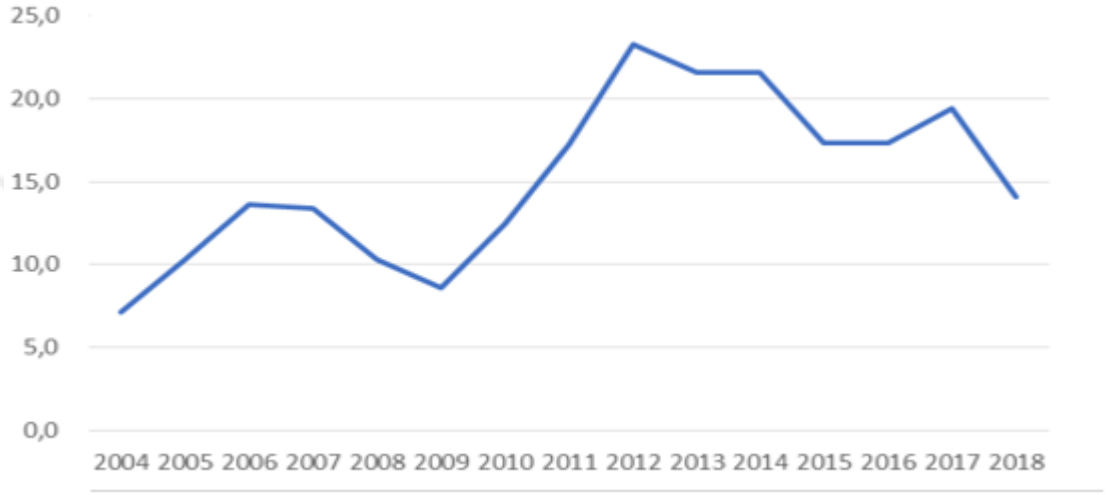
Nickel, Rother and Rülke (2009) analyzed the impact of fiscal variables on bond yield spreads relative to US Treasury bonds in the Czech Republic, Hungary, Poland, Russia and Turkey from May 1998 to December 2007. They came to conclusion that the role of the individual explanatory variables, including the importance of fiscal variables, varies across countries. Concerning Turkey, the regression suggests that only global investor sentiment as measured by the EMBI spread and the external debt ratio help to explain the behavior of sovereign bond spreads, while the expected deficit ratio and the remaining control variables do not come out as significant.

Çulha, Özatay and Şahinbeyoğlu (2006) investigated short-run and long-run determinants of the sovereign spreads in 21 emerging countries within the period 1998–2004 by using daily and monthly data and estimate individual country and panel regressions. Their findings suggest that domestic (such as debt, net foreign assets, the fiscal balance, gross reserves all as ratios to the GDP of the country, debt service ratios, credit ratings) and global

factors (such as Fed target rate, credit rating) affect sovereign bond spreads, and the most important common determinant of the spreads is the risk appetite of foreign investors.

In line with the literature, in chapter 1 we defined a risk premium formula (39) for our model ($\chi_t = \frac{\chi_0}{2} B_t$). This means that risk premium of a country has a positive correlation with the aggregate bond issuance and it arises in accordance with the cumulative debt level of the country.

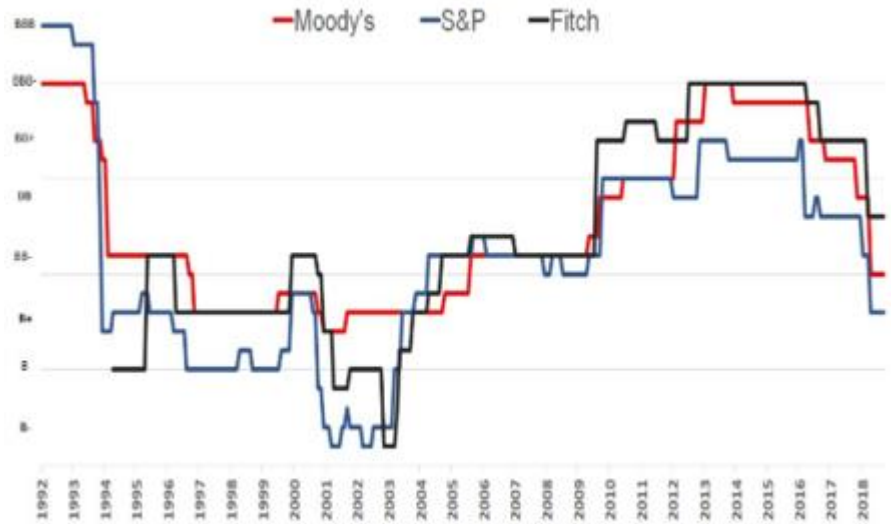
Graphic 15: Domestic Debt Security Portfolio Held by Non Residents (Million USD)



Source: CBRT

Other important factors to consider in relation to portfolio investments and borrowing cost are CDS and the country's credit rating, which shows the country risk premium.

Graphic 16: The Evolution of Turkey's Credit Rating



Source: Bloomberg

A credit rating is an indicator that measures the capacity of a borrower (government or company) to pay its debt, or in other words, the risk of not being able to pay its debt. A high credit rating indicates that the borrower is reliable and the risk of having problems during debt collection is low, while a low score means that the debtor's default risk is high. Therefore, there is a direct relationship between credit rating and borrowing costs. When Turkey's situation is examined, the steady increase in its credit rating since 2003 has been reflected as a decrease in borrowing costs. We see that the borrowing costs were single digits between 2013 and 2016, when the credit rating was highest, and then the borrowing cost increased with the decrease in the rating.

Like the credit rating, Credit Default Swap CDS premiums are one of the most important indicators that international investors analyze when making investment decisions. it directly affects the resource costs of the country. An increase in the premiums of credit default swaps indicates an increased probability of falling into default and hence borrowing costs increase, causing concerns in markets. It can negatively affect investments in the country under financial stress by causing an increase in economic uncertainty regarding the macroeconomic outlook (Kılcı, 2019).

Graphic 17: Turkey's 5 Year CDS Premium

Source: Bloomberg

In Turkey, there is a significant relationship between CDS premia and public borrowing cost (Koy, 2014). While CDS premiums remained low in the years when capital flows from abroad was strong and borrowing costs were relatively low, since 2018 when , macroeconomic indicators started to deteriorate and exchange rate shock was encountered, CDS premiums started to rise and the borrowing costs reached the highest level in the last 10 years.

Besides the fiscal and monetary factors, international capital flows and credit rating have become one of the main determinants of public borrowing cost. Financial globalization in recent years has allowed more capital to flow into sovereign bond markets and the access to

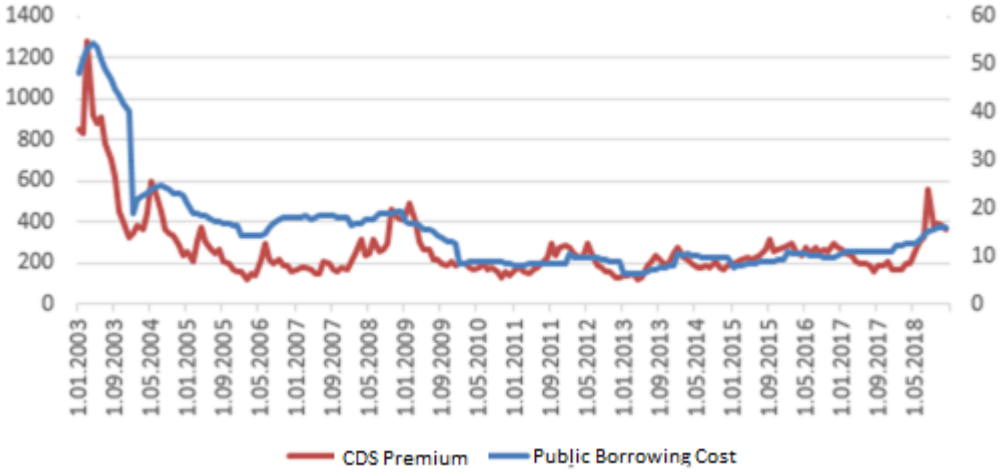
foreign capital has been profited especially emerging market public bonds. Integration of government bond markets has also stimulated more efficient pricing of sovereign credit risk in many countries thus sovereign yields have become increasingly more dependent on global conditions. This means that factors such as global risk appetite, global savings, and investment have become more important in the pricing of sovereign bonds. Recently the effect of these capital flows on government bond yields has been the focus of a large strand of literature.

Gueye and Sy (2013) investigate emerging market country's public bond spreads within the period 2000-2009 and they conclude that sovereign credit ratings, the fed funds future rates as a proxy of global liquidity, the EMBIG composite, the slope of the yield curve, the VIX index and the oil prices significantly explain individual country sovereign spreads.

Chowdhury (2003) examines the effects of foreign direct investment and major macroeconomic fundamentals on emerging market bond index spreads by using a panel of 25 emerging market countries' bond index spreads and a set of macroeconomic indicators for the period 2000 and 2009. The results of this work reveal that there is a positive relationship between bond index spread and foreign direct investment, inflation and a negative relationship between bond index spread and GDP, reserve in total external debt.

Ayben Koy (2014) in her study examines the relationship between Credit Default Swaps (CDS) and government bond yields between the period January 2009-November 2012. The relationship among CDS premiums and Eurobond premiums from eight selected countries have been analyzed with unit root test and Granger causality analysis. The econometric findings reveal that CDS premiums give direction to bond yields in Turkey.

Graphic 18: The Relationship Between 5 Year CDS-Public Borrowing Cost



Source: Bloomberg-Ministry of Treasury and Finance

In the second section of the second chapter of the study, we examined the effects of public fiscal policies on borrowing costs and analyzed the dynamics affecting the cost. In section 3, we will examine the interaction of the monetary policy that we examined in section 1 and the borrowing cost that we examined in section 2.

2.3) Public Borrowing Cost and Monetary Policy Interaction

Monetary policy implementations may affect public borrowing cost through several mechanisms. In this context, we can consider two potential mechanisms. Firstly, when the central bank raises policy rate, foreign capital flow to country accelerates and this appreciates the local currency. Moreover, external borrowing becomes more favorable than internal borrowing. Decreasing supply makes public bonds more expensive and their yields falls. Consequently, raising policy rate decreases public borrowing cost.

Secondly, the central bank raises policy rate, banks lift credit rates because of the higher funding costs. More expensive credits discourage households and firms. Nevertheless, banks prefer to buy more public bonds. As a result, increased demand lowers the yields of bonds and public borrowing cost falls as well.

In the first chapter, the theoretical model that we built to assess the impact of policy rate shocks on the borrowing cost of Turkey and the results of impulse response functions indicate that these two mechanisms hold for Turkish economy in period 2008-2018. For the first mechanism, as we see in image 4 following a policy rate shock, banks prefer to get more foreign funding. Image 5 shows the impact of rate shock on public borrowing cost. When we assess together these two images, first mechanism hold. Moreover, when table 8 indicates that Turkey's external debt stock augments regularly since 2008, table 7 shows that Turkey's borrowing cost falls dramatically since 2008 until 2017.

For the second mechanism, image 5 shows us that, following a rate shock loan rate augments simultaneously because of the raising funding cost of banks. As we see in image 4, banks choose to head towards bonds than supply credits. In table 9, we can see that banks become the biggest public bond holder since 2004 while table 7 indicates a clear fall in public borrowing cost. As a result, according to results of our model, second mechanism also hold for Turkish economy for the 2008-2018 period.

In literature, there are several works which concentrate on relationship between monetary policy transmission mechanisms and government bond yields. The monetary approach to understanding the drivers of government bond yields has been formally modelled and these models have been empirically tested by a number of researchers.

Akram and Li (2016 and 2017) have developed theoretical models aligned with the Keynesian and modern money theory of long-term interest rates on sovereign bonds. Their numerical results support the idea that short-term interests have the most important impact on long-term interest rates in several countries

Given the key role played by sovereign bond yields in the transmission of monetary policy, the study of Kapur and Mitra (2019) empirically studies the main determinants of sovereign bond yields in India. Policy rate is found to be a major driver of public bond yields of short-term securities, and the influence on yields weakens as the maturity of the bonds increases. Estimates in this work reveal that a rise of 100 basis points (bps) in the policy rate could, over time, lead to an increase of around 95 bps in yields of 15-91 days' residual maturity Treasury Bills and around 20 bps for 10-year public securities. The size of the government's borrowing program, foreign portfolio investments in the domestic bond market and foreign bond yields are also found to move domestic government bond yields, although the impact of these factors differs across maturities.

Mbarek,Marfatia and Juko (2017) studies the response of Treasury bond yields to monetary policy shocks in Tunisia under a heterogeneous economic environment. Using a conventional fixed coefficient model, the work estimates the effect of monetary policy changes on the term structure of interest rates for the whole period from January 2006 to December 2016. The findings reveal that the spontaneous impact of monetary policy changes on Treasury yields is statistically significant only for the short end of the yield curve, 1-year T-bill. While lagged changes of monetary policy have a significant impact on the 1-year, 7-year, and 10-year Treasury bond yields, the lead of the policy instrument is not significant in any case. The total impact of monetary policy changes for 1-year T-bill yield is 0.48, which is two times stronger than 0.22 for the 10-year T-bond yield, which is in line with the expectation theory. For medium-term maturities, monetary policy does not exert any significant impact on Treasury yields.

In view of multiple instruments used by many central banks in emerging market economies, Sensarma and Rudra (2015) develop a composite measure of monetary policy for India and measure its impact on the yield curve. Empirical findings reveal that while monetary policy has the dominant impact among macroeconomic variables on the entire term structure, it is especially strong at the shorter end and on credit spreads. Shifts in the level of the sovereign yield curve and credit spreads also allow to changes in monetary policy.

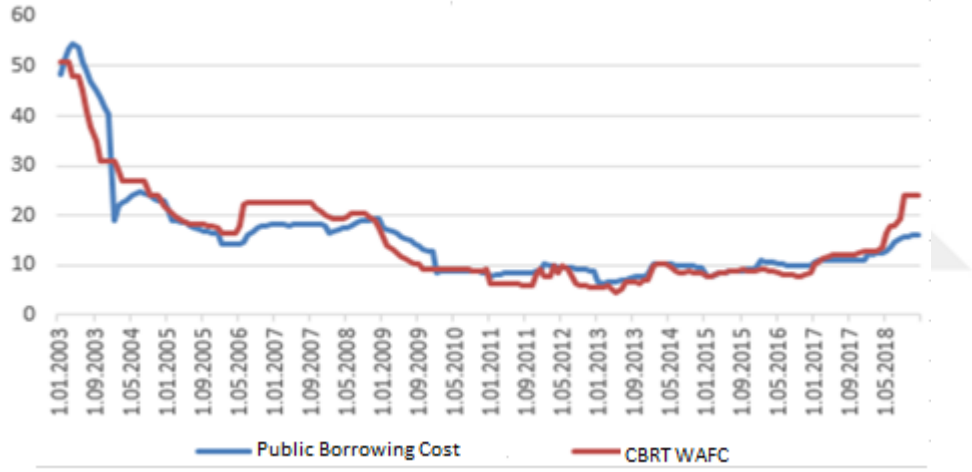
Evans (1997) examines how exogenous impulses to monetary policy affect the yield curve for nominally risk-free bonds. This work identifies monetary policy shocks using three distinct variants of the identified VAR methodology. All three approaches imply similar patterns for the effect of monetary policy shocks on the term structure: A contractionary policy shock induces a pronounced positive but short-lived response in short term interest rates, with a smaller effect on medium-term rates and almost no effect on long term rates. Because of their transitory impact, monetary policy shocks account for a relatively small fraction of the long-run variance of interest rates.

In order to learn about bond yields response to policy decisions by the Federal Reserve Piazzesi (2005) model a high-frequency policy rule based on yield curve information and an arbitrage-free bond market. Econometrical analysis suggests that A 1 percentage-point shock

to the target shifts the one-month yield by 90 bp, the one-year yield by 60 bp, the two-year yield by 41 bp, and the five-year yield by 19 bp.

Szczerbowicz (2015) analyses the influence of the ECB's unconventional policies on bank and public borrowing costs. In the study, event-based regressions have been used to evaluate and compare the effects of asset purchases and exceptional liquidity announcements on money markets, covered bond markets, and sovereign bond markets. The empirical findings reveal that (i) exceptional liquidity measures considerably reduced persistent money market tensions and that (ii) asset purchases were the most effective in lowering refinancing costs of banks and governments in the presence of high sovereign risk. The most striking result in the euro zone is the effect of the ECB longer-term sovereign bond purchase program (SMP), which reduced the spreads by 16 basis points. The impact is particularly strong for the countries where sovereign risk reached the highest levels: Greece (−485 bp), Ireland (−121 bp), and Portugal (−202 bp).

Graphic 19: The Relationship Between Public Borrowing Cost-WAFC



Source: CBRT

When we examine the chart, we see that there is a close relationship between CBRT weighted average cost of funding (WAFC) and cost of borrowing in the years 2003-2018 in Turkey. The borrowing cost, which declined since 2003, started to rise again after receiving the lowest values of the series between 2010 and 2016 together with the weighted average interest rate of the CBRT.

3) Conclusion

İn this study we tried to understand the role of the central bank's policy rate, especially in the presence of foreign capital flows, on public borrowing cost. To this end, we formed a small open economy DSGE model, incorporating banking sector and foreign funding channels. The model features imperfect competition and Calvo type nominal rigidity in prices. In addition, the Central Bank as the monetary authority follows Taylor Rule in reacting to inflation and output gap. To calibrate the model, we made use of Turkish data between the period 2008-2018.

We have found out that a positive interest rate shock initially results in a fall in household's consumption, triggered by a raise in loan rates imposed by banks. This causes a reduction in the aggregate output, inflation and labor but a rise in nominal wages in the real side of economy. Diminishing consumption enable agents to save more and accumulate capital while reducing demand for loans.

In addition, our findings of this study indicate that interest rate shock puts a pressure on banks in terms of funding cost and leads them to change their funding composition, in other words it reshapes their liabilities side. Rising demand augments foreign funding amount and increases deposit rates. In order to balance the changes in the liabilities side, banks adjust asset composition accordingly. Raising deposit rates ends up with raising rates for loans and this reduces demand for loans and banks prefer to buy more government bonds. In the short run, bond yields fall because of the rising demand, but in the medium run it starts to be balanced because of the foreign funding flows.

Finally, it is clear that a number of potential extensions could affect the results presented in this study. In particular, the model could be extended to take into account the investment cost and household's bond holding option. Moreover, it would be useful to introduce further constraints such as capital adequacy ratio to maintain the banking sector's solvency.

Appendix

In period s, with probability ζ^{s-t} the new price will be in effect. Letting p_t^0(h) be the optimal price chosen by the home firm that produces the good h, of date t and note that all firms which adjuste would choose the same price because they face the same demand function with the same technology thus p_t^0(i)= p_t^0 the problem of a typical firm is shown as follows;

$$Max_{p_t^0} E_t \zeta^{s-t} q_{t,s} \left[\left(\frac{p_t^0}{p_{H,s}}\right)^{1-\theta} - MC_s \left(\frac{p_t^0}{p_{H,s}}\right)^{-\theta} \right] . y_t \qquad (21)$$

where MC_s denotes the real marginal cost of production and $q_{t,s}$ is the discount factor between dates t and s is given as $\beta^{s-t}(\frac{C_t}{C_s})$. To obtain the above expression, we introduced the value of y_t into the expected discount value of current and future profits of the firm.

$$MC_s = \frac{(r_s^k)^{\zeta}(W_t)^{1-\zeta}}{\zeta^{\zeta}(1-\zeta)^{(1-\zeta)}a_s}$$

If we solve the problem above, it yields the following equation for the optimal price.

$$p_t^0 = \frac{\theta-1}{\theta} \cdot \frac{E_t \sum_{s=t}^{\infty} \zeta^{s-t} q_{t,s} y_s MC_s}{E_t \sum_{s=t}^{\infty} \zeta^{s-t} q_{t,s} y_s p_{H,s}^{\theta-1}}$$

Since a firm will not adjust its price every period, it has to take into account expected future marginal costs when it gets the opportunity to change the price.

When all firms have the chance to adjust their prices each period (ζ =0), prices are completely flexible and we get the usual price definition which is a markup over marginal cost,

$$p_t^0(\text{h}) = \dot{p_t^0}(\text{h}) \frac{\theta}{\theta-1} w_t$$

The price index $P_{H,t}$ for home goods is an average of the price charged by remaining firms. Since under the Calvo price setting all the adjusting firms choose the same price, the home price sub index $P_{H,t}$ can be written as follows,

$$P_{H,t}=[\sum_{s=t}^{\infty}(1-\zeta)\zeta^{s-t}(p_{t-s}^{0})^{1-\sigma}]^{\frac{1}{1-\sigma}}$$

Lagging this equation one period gives the following Dynamics for the aggregate price level for home goods.

$$P_{H,t}^{1-\sigma}=(1-\zeta)(p_t^0)^{1-\sigma}+\zeta P_{H,t}^{1-\sigma}$$

Dividing this equation by $P_{H,t}^{1-\theta}$ yields,

$$1=(1-\zeta)Q_t^{1-\theta}+\alpha\pi_{H,t}^{\theta-1}$$

Dividing both sides of (17) by $P_{H,t}$ and using the definition of $q_{t,s}$ yields,

$$Q_t=\frac{\theta}{\theta-1}\frac{\sum_{s=t}^{\infty}(\zeta\beta)^{t-s}(y_s/c_s)MC_s(p_{H,s}/p_{H,t})^{\theta}}{\sum_{s=t}^{\infty}(\zeta\beta)^{t-s}(y_s/c_s)(p_{H,s}/p_{H,t})^{\theta-1}}$$

We need to approximate the equation around zero inflation steady state with flexible prices. This implies $\check{Q}=1$ and $\widetilde{MC}\frac{\theta}{\theta-1}=1$

$$\frac{Q_t}{1-\alpha\beta}=\sum_{s=t}^{\infty}(\zeta\beta)^{s-t}\left\{\widetilde{MC}_s+\widetilde{P_{H,s}}\right\}-\widetilde{P_{H,t}}$$

Multiplying the equation by (1- ζ β) and adding $\widetilde{P_{H,t}}$ both sides, we get

$$\widetilde{Q_t}+\widetilde{P_{H,t}}=\widetilde{p_t^0}=(1-\zeta\beta)\sum_{s=t}^{\infty}(\zeta\beta)^{s-t}E_t\left\{\widetilde{MC}_s+\widetilde{P_{H,s}}\right\}$$

$$\widetilde{Q_t}+\widetilde{P_{H,t}}=\zeta\beta E_t(\widetilde{Q_{t+1}}+\widetilde{P_{H,t+1}})+(1-\zeta\beta)\left\{\widetilde{MC}_s+\widetilde{P_{H,s}}\right\}$$

After some math it is possible to get

$$\widetilde{Q_t}=(1-\zeta\beta)\widetilde{MC}_t+\zeta\beta E_t\widetilde{\pi_{H,t+1}}+\zeta\beta E_t\widetilde{Q_{t+1}}$$

Steady State Versions of Model's Equations

1) No arbitrage condition: $(1+r_0^l)=(1+r_0^b)(\chi l_0^t)$ where $\chi=\frac{\chi_0}{2}B_0$
2) Labor supply: $N_0=1-\frac{C_0(1+\tau r_0^l)}{W_0}$
3) Loan supply: $l_0=\tau C_0$
4) Production function: $Y_0=ak_0^{\alpha}n_0^{\alpha}$
5) Bond demand: $(1+r_0^b)b_0+G_0=T_0+b_0$
6) Marginal Cost: $MC_0=\alpha r_0^k+(1-\alpha)W_0$

7) New Keynesian Philips Curve: π_H=$MC_0 \frac{(1-\xi)(1-\xi\beta)}{\xi}$+βE π_H
8) Marginal productivity of labor: W_0=(1-α)$\frac{Y_0}{N_0}$
9) Marginal productivity of capital: r_0^k=α$\frac{Y_0}{k_0}$
10) Deposit supply: d_0=(1-μ) (r_0^d-r_0^b)
11) Loan demand: r_0^l=(l_0-l) + r_0^{CB}
12) PPI: $\pi_0^{cp\iota}$=(1-γ)π_0
13) Capital accumulation function: I_0=k_0-(1-δ)k_0
14) Consumption Euler: r_0^k=$\frac{1-\beta}{\beta}$+δ
15) Taylor Rule: I^{cb}=Q_iI+$Q_\beta \pi^{cp\iota}$+$Q_y Y_0$+ξ_t
16) General equilibrium: Y_0=$C_{H,0}$+$C_{F,0}^*(ToT)^{-1}\frac{\gamma}{1-\gamma}$+$I_0$+$G_0$-$\frac{1-\gamma}{\gamma}C_{H,0}$ToT

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