THE SUSTAINABILITY ANALYSIS OF TURKISH DOMESTIC DEBT

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ABSTRACT

THE SUSTAINABILITY ANALYSIS OF TURKISH DOMESTIC DEBT

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In this thesis, sustainability of the Turkish domestic debt is analyzed within the "sustainability indicators" perspective. The fiscal targets of Maastricht Treaty (1992) are imposed on the Turkish fiscal policy and it is investigated whether these targets are the indicators for sustainability in the medium term. Uctum and Wickens' (2000) methodology is followed in assessing the sustainability of the current fiscal policy and the efficiency of the Maastricht Treaty (1992) targets. Moreover, the vector auto regression (VAR) approach of Garcia and Rigobon (2004) is utilized in deriving the econometric model for the debt dynamics of Turkey. The results suggest that domestic debt of Turkey has been unsustainable within 1994-2008. Furthermore, the Maastricht Treaty (1992) fiscal targets are binding for Turkey and gaining more significance in the recent years.

Keywords: Fiscal Policy; Sustainability; Turkey; Vector Auto Regression

ÖZ

TÜRKİYE'NİN İÇ BORCUNUN SÜRDÜRÜLEBİLİRLİK ANALİZİ

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Bu tezde Türkiye'nin iç borcunun sürdürülebilirliği "sürdürülebilirlik göstergeleri" yaklaşımı perspektifinde ele alınmıştır. Mastricht Antlaşması'nda belirtilen mali hedefler Türkiye için benimsenmiş ve bu hedeflerin orta vadede sürdürülebilirliği sağlamadaki etkinliği araştırılmıştır. Uygulanan maliye politikasının sürdürülebilirliği ve Mastricht kriterlerinin etkinliği incelenirken, Uctum ve Wickens (2000)'ın metodolojisi takip edilmiştir. Ayrıca, Türkiye'nin borç dinamiklerine ilişkin ekonometrik modelin oluşturulmasında Garcia ve Rigobon (2004)'ın vector otoregresif regresyon (VOR) yaklaşımından yararlanılmıştır. Sonuç olarak, Türkiye'nin iç borcunun 1994-2008 yılları arasında sürdürülebilir olmadığı belirtilmektedir. Bununla beraber, Mastricht mali kriterlerinin Türkiye için etkin olduğu ve öneminin son yıllarda artmakta olduğu ifade edilmektedir.

Anahtar Kelimeler: Maliye Politikası; Sürdürülebilirlik; Türkiye; Vektör Otoregresif Regresyon

To My Family

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CHAPTER 1

INTRODUCTION

Sustainability of the public debt has been a controversial issue among the policy makers who are facing with the treat of accumulating public debt in the recent years. Different measures are taken in order to control the adverse effects of this over-sizing debt stocks on the macro economic balances. However, debt-related economic crises of the recent years open a new debate on whether these measures have been effective at all or other motives should be developed. Therefore, debt sustainability is a subject that is increasingly getting popular in the literature.

The need for controlling the debt accumulation and bring the debt stock in a sustainable structure has become urgent with the rise of the debt-related problems across countries. White (2000) states that the frequency and the severity of the crisis are increasing over the last years which are mostly associated with the high debt levels of the countries. Similarly, as Shirai (2004) claims, East Asian crises of 1997-1999 as well as the Russian (1998), Brazilian (1999) and Argentinean (2001) crises have stemmed from the external debt problems. Indeed, the very recent international financial crisis has also brought to the agendas the significance of an efficient debt management. Fiscal balances deteriorated due to the adverse effects of the recent crisis. Several measures, taken by governments in order to encourage economic activity and to cure the liquidity problems in the international markets, created extra burden on the fiscal balances. Horton et al. (2009) estimate that discretionary measures taken by Turkey between September 2008 and March 2009 have caused 3.7 percent deterioration in fiscal balances (as a ratio to GDP) when

compared to the level in pre-crises year 2007[1]. As a result of the severe effects of these developments on the public fiscal balances and the debt stocks, countries felt the need to announce new fiscal rules for the medium term. Germany announced the fiscal target of 0.35 percent for the federal government budget deficit by the year 2016.[2] Moreover, as stated by Horton et al. (2009), UK intends to decrease fiscal deficit/GDP by about 1.33 percent on average every year from 2010 to 2014.

Apart from the recent financial crisis, Turkey has painful experiences due to the very frequent crises periods in its economic history and several maneuvers have been taken against adverse effects of these crises. Turkey agreed on several programs with IMF in order to stabilize the economy which was for long years hit by the chronic inflation and the poor public balances. The exchange rate stabilization program with IMF agreed upon in 2000, did aim to decrease inflation rate and moreover included fiscal measures to cure the primary balances. The target was to give budget surplus in year 2009 and this fiscal measure was estimated to be sufficient to stabilize the debt/GDP ratio as well (Akyüz and Boratav, 2003). However, this program has been very short lived with the burst of the 2001 crises. Nevertheless, the lessons taken from this crisis have claimed to be the main cushion against the effects of recent crises. 2001 crisis was mainly driven by the heavily accumulated external liabilities of the banking sector which were hardly carried when the external funding sources began to retreat. Therefore some measures are taken on the banking balance sheets to decrease the risk exposures[3].

[1] Horton, Kumar, Mauro (2009). The estimates for Turkey are based on the EU Pre Accession Program Document in which Turkish authorities' policy intentions are stated.

[2] See Horton, Kumar, Mauro (2009) for more information. In the report, the fiscal measures of other countries such as Japan and US are also stated. (pp. 21-22)

[3] Banking Regulation and Supervision Agency (BRSA), pp. (15-25). The relevant link is; http://www.bddk.org.tr/WebSitesi/turkce/Kurum_Bilgileri/Yillik_Raporlar/4783bddk_yillik_rapor_2001.pdf

Moreover, risk management techniques are developed in the Turkish Treasury in order to foresight and take precautions against the risky states. These actions can be accepted to be successful when the path of the fiscal balances and debt stocks are examined since then. Public sector gross debt stock (in European Union definition) is decreased from the level of 73.7 percent of GDP in 2002 to 39.5 percent of GDP in 2008[4]. Besides, European Union (EU) defined general government budget deficit to GDP ratio decreased from the level of 10.2 percent in 2002 to 2.2 percent in 2008. These improvements in the public finances can be furthered through well-defined and actively-managed fiscal rules.

A widely known fiscal rule is built by the European Union Maastricht Treaty (1992) which aims at keeping the public debt stock of the member countries under an acceptable level while managing this with reasonable public deficits. The Treaty proposes that the countries should keep a maximum 60 percent level of debt/GDP ratio while preserving a budget deficit of a maximum 3 percent[5]. These targets have been criticized for many scholars in terms of their efficiency for providing the fiscal sustainability of the member countries with various economic characteristics. Menguy (2008) criticizes these targets in that every member country with different macro fundamentals should have distinct targets, since a unique target can provide sustainability in one while having no effect on the others. In fact, these targets are already satisfied by some of the member states but violated by the others. Public deficit to GDP ratios of Ireland and Spain has increased rapidly in year 2008, exceeding the level of 3 percent[6]. Furthermore, fiscal balances of Greece, France and Malta have been negative since 2005 and their budget deficit reached above 3

[4] Source: Turkish Treasury website. The relevant link is;
http://www.hazine.gov.tr/irj/go/km/docs/documents/Treasury%20Web/Statistics/Economic%20Indicators/egosterge/Sunumlar/Ekonomi_Sunumu_ENG.pdf

[5] The Maastricht Treaty, 1992, Article 104c (2). For more information follow the link;
http://www.eurotreaties.com/maastrichtprotocols.pdf

[6] Public deficit and debt statistics of the member countries are obtained from the website of the European Central Bank (ECB)

percent in 2008. Furthermore, by 2008 debt stock to GDP ratios of Germany, France, Malta, Austria and Portugal have overridden the ceiling of 60 percent. Those ratios are about 90-100 percent for the Belgium and Greece, whereas it exceeded 100 percent level in Italy. Therefore efficiency of these criteria is being criticized and policy makers are seeking for alternative country specific fiscal rules. Being a nominee for the European Union membership, Turkey is also following closely the EU fiscal targets and has already managed to satisfy these targets, while some member countries do not. However, at the time of the frequent discussions on the efficiency of these targets in providing a sustainable path for each EU member, the effectiveness of these targets should also be interrogated for Turkey within the sustainability perspective.

Sustainability is analyzed in different perspectives all of which are concentrating on the very common aim of providing the solvency of government in the intertemporal framework. Menguy's (2008) definition of solvency is to assure that the debt stock does not reach so high levels that would endanger government's ability to refund its obligations. Indeed, Menguy (2008) defines sustainability as the long-term solvency of the government. The definition implies that government may be insolvent in the short term but this does not jeopardize sustainability as long as revenues in the latter periods are sufficient to pay the debt. This proposition is very much related to the widely known finance theory of Minsky (2008) and the "No- ponzi game" restriction for sustainability. "Ponzi game" can be defined as financing the interest payments on the existing debt stock by further borrowing, in which principal of the debt is not paid but ever accumulates. In order to be solvent, primary surpluses should be generated with which the principal should be repaid. Therefore, sustainability literature is based upon the "no-ponzi game" restriction, which implies that the principal of the debt stock will be paid one day in the future. This is basically to propose that the debt stock will eventually vanish in the infinite horizon. Moreover, current debt stock will be paid by the primary surpluses generated in the following periods. As a result, sustainability work is basically done

on examining the path of the debt series and the financing capacity of the government.

As a traditional approach to sustainability, the discounted debt to GDP series should show a stationary path and have a zero mean in the infinite horizon (Uctum and Wickens, 2000). Moreover, other analyses are mainly concerned with the path of the primary surpluses and other financing sources of government (Bravo and Silvestre (2002), Greiner and Kauermann (2007), Kia (2008)). Since the debt is financed by the future primary surpluses in a sustainable policy, positive response of primary surplus to the debt stock gives a signal of a sustainable structure. The common approach is to analyze reaction of the primary surplus or other financing sources of the government; such as tax or export revenues, as a response to the movements of the debt stock or to the changes in the government expenditures. A third approach takes into account the stochastic characteristics of the debt dynamics and incorporate uncertainty in analyzing the sustainability of the fiscal policy (Garcia and Rigobon (2004), Tanner and Samake (2006). Furthermore, rather than only to assess if the fiscal policy is sustainable or not, some studies aim at proposing fiscal targets or indicators that would provide a sustainable path in the medium term (Uctum and Wickens (2000), Menguy (2008)). Lastly, in analyzing the sustainability of the fiscal policies, other decision making units in the economy are also taken into account and the fiscal policy is evaluated in a general equilibrium framework (Yakita (2008)).

This thesis undertakes the sustainability analysis of the Turkish domestic debt following the sustainability indicators approach of Uctum and Wickens (2000). The main aim is to assess sustainability of the current fiscal policies as well as to discuss the efficiency of the fiscal targets of the Maastricht Treaty (1992) in providing sustainability of the Turkish fiscal policies. First, sustainability of the existing fiscal policies is analyzed within the Present Value Budget Constraint (PVBC) framework. The discounted debt to GDP series are investigated for stationarity and for zero mean in order to assess the long term sustainability of the Turkish domestic

debt. Secondly, medium term fiscal policies are monitored and the deviations from the PVBC in certain periods are assessed by Uctum and Wickens' (2000) method. These deviations give a signal for a need for extra fiscal action in order to reach intertemporal balance and therefore a sustainable fiscal policy. Furthermore, the similar analysis is conducted by imposing the Maastricht Treaty (1992) fiscal targets for the medium term and calculating the necessary fiscal adjustment in order to reach these targets while staying in a sustainable fiscal path. The fiscal adjustment needs in these two analyses are compared in order to assess the sustainability implications of imposing these fiscal targets. The basic propositions of Uctum and Wickens (2000) in this analysis are;

-Positive fiscal adjustment need in the medium term means that more fiscal revenues should be generated or fiscal expenditures should be cut in order to reach a sustainable path in the medium term. If the adjustment need is negative, fiscal policy has been strict enough and therefore even a looser policy could be followed while fiscal sustainability is not jeopardized.

- In case of the fiscal targets, adjustment need should be positive (the need for fiscal contraction) in order to have a binding constraint. Furthermore, the fiscal contraction need in case of fiscal targets should be higher than the no target case in order to qualify the Maastricht Treaty (1992) targets to be effective in drawing a sustainable path for the fiscal policy.

Moreover, this study includes an econometric analysis in order to assess the relationships of the macro variables affecting the debt accumulation process and to make a short term forecast for the debt dynamics. The Vector Auto Regression (VAR) model of Garcia and Rigobon (2004) is utilized in this work. The impulse response analysis is conducted in this VAR model in order to assess the direction and magnitude of the movements in the variables as a response to changes in the others. The inference from the impulse response analysis together with the forecast results of the model are utilized in the further analysis of the sustainability of the

Turkish fiscal policy with the Uctum and Wickens' (2000) methodology. The outline of the thesis is as follows;

In chapter two, the intertemporal budget constraint (IBC) of the government is driven. "No-ponzi game" restriction imposed on the IBC and the conditions for sustainability are put forth.

Chapter three reviews the literature on debt sustainability. Five different approaches to sustainability are introduced. In the first section, the traditional approach on PVBC is explained. Then, the reaction function analyses for sustainability are presented. Thirdly, some examples of the studies that incorporate uncertainty are given. Afterwards, the sustainability indicator approach is familiarized. Lastly, other works with the general equilibrium analysis are shared.

Chapter four makes a general overview of the economic history of Turkey. The evolution of the debt dynamics as well as other macro economic variables is illustrated by figures and the macro framework of Turkey is evaluated.

Chapter five is the theoretical part of this thesis. In the first step, the relationships of the macro variables are explained via an econometric model. The VAR approach of Garcia and Rigobon (2004) is taken as the reference point. The model is used to make one year forecast of the endogenous macro variables which will be used in the further work. Moreover, the impulse response analysis is carried out in order to assess if the model findings are reasonable and in order to suggest policies depending upon the reactions of these variables to each other.

In chapter six, sustainability analysis is done using the methodology of Uctum and Wickens (2000). The analysis starts within the PVBC framework and then the finite period IBC is derived in order to assess the medium term sustainability of the Turkish fiscal policy. The aim is to find the necessary fiscal adjustment for following a sustainable path in the medium term. Next, the sustainability indicators approach for sustainability is followed by incorporating the fiscal targets of Maastricht Treaty (1992) in the analysis. The aim of this study is to assess if these

targets are binding in providing sustainability in the medium term, and to find out the required adjustment to reach these targets while staying in the sustainable path in the medium term.

Final chapter makes a summary of the work done throughout the thesis and underlines the results of the analysis carried out. The strengths of the thesis are remarked while some suggestions are pointed out for further research as well.

CHAPTER 2

GOVERNMENT BUDGET CONSTRAINT

Fiscal sustainability analysis starts with the derivation of the government intertemporal budget constraint (IBC). IBC can show slight differences according to the definition of the public sector and the revenues and expenditures of government. In this chapter, we will first derive the IBC in an extensive form and then reduce it to fit to the assumptions in our analysis. We will basically deal with the central government domestic debt of Turkey and therefore the budget constraint will include the domestic debt items accordingly. Afterwards, starting form the two-period budget constraint, we will derive the IBC for the infinite horizon and use this constraint to define the conditions for the sustainability for the domestic debt in the infinite horizon.

2.1 DERIVATION OF INTERTEMPORAL BUDGET CONSTRAINT

Public expenditures are financed through public revenues and other non-borrowing sources. When the non-borrowing sources are not as much as required, extra financing need is met through borrowing. Budget constraint of the government can be written in different forms according to the definition of the public sector in question or the financing sources of the public sector. In Turkey, public sector is defined by the "Public Financial Management and Control Law, No. 5018". This Law encompasses the regulations regarding the general government administrations which are categorized into three groups of agencies as; central government, social security institutions and local administrations. Central government definition consists of the general budget, special budget and the regulatory and supervisory

agencies. As an example to the analysis regarding different definitions of government, Goyal et al. (2004) discuss fiscal sustainability of the central and state governments which points out different pictures for the fiscal paths of two types. Furthermore; in the budget constraint of Hamilton and Flavin (1986), capital gains as well as seignorage revenues are included as the financing sources of the government[7]. Moreover, the budget constraint can have a more complex form when the external sector is included in the analysis.

Uctum and Wickens (2000) derive the following budget constraint for the government;

$$G_t - T_t + i_t B_{t-1} = \Delta B_t + \Delta M_t \qquad (2.1.)$$

where G refers to the government expenditures, T denotes government revenues (taxes net of transfers and other public revenues), i is the nominal interest rate, B refers to the government debt at the end period and M denotes the monetary base[8]. Equation (2.1) summarizes expenditures of government on the left-hand side and the financing sources on the right-hand side. Actually, budget constraint of (2.1) assumes that non-interest public expenditures net of public revenues (actually the primary deficit, which we will denote as F_t) and the interest payments on the existing public debt are financed through new borrowing (ΔB) and through seigniorage revenues (ΔM). When internal and external borrowing is separately analyzed, equation (2.1) can be extended to the following form;

$$F_t + i_t^d B_{t-1}^d + i_t^f B_{t-1}^f \Delta e_t = \Delta B_t^d + \Delta B_t^f + \Delta M_t \qquad (2.2)$$

[7] See Chapter 3 for the details of the budget constraint proposed by Hamilton and Flavin (1986)

[8] In some equations, privatization revenues are denoted under a separate item. Here, it is included in revenues item. Moreover, notations of Uctum and Wickens (2000) and Garcia and Rigobon (2004) are utilized throughout the thesis.

In which i^d and i^f denotes the domestic interest rate and foreign interest rate, B^d and B^f are the domestic and external debt respectively. Furthermore, interest payments on external debt are factored by the change in nominal exchange rates (Δe_t) since increase in the exchange rate will increase the external liability in terms of domestic currency.

Equation (2.2) can also be represented, as Uctum and Wickens (2000) do, as a ratio to the nominal GDP, which is denoted by PY.[9]

$$(F_t/P_tY_t) + i_t^d (B_{t-1}^d /P_tY_t) + i_t^f (B_{t-1}^f /P_tY_t)\,\Delta e_t = (\Delta B_t^d /P_tY_t) + (\Delta B_t^f /P_tY_t) + (\Delta M_t/P_tY_t) \quad (2.3)$$

If the real GDP growth is denoted by g and the inflation rate is symbolized as π, then the following equations hold (Uctum and Wickens, 2000);

$$\Delta P/P = \pi \text{ and } \Delta Y/Y=g$$

Actually, when we define b=B/PY, as Uctum and Wickens (2000) do, the following differential equation holds;

$$\Delta b_t=\Delta(B/PY)=\Delta B_t/(P_{t-1}Y_{t-1})-(\Delta P_t/P_{t-1})*(B_{t-1}/P_{t-1}Y_{t-1})-\Delta Y_t/Y_{t-1}(B_{t-1}/P_{t-1}Y_{t-1}) \quad (2.4)$$

Since;

$$\Delta P_t/P_{t-1} = \pi_t \text{ and } \Delta Y_t/Y_{t-1}=g_t$$

we rewrite equation (2.4) as;

$$\Delta b_t = \Delta B_t / P_{t-1}Y_{t-1} - (\pi_t + g_t)\,(B_{t-1}/P_{t-1}Y_{t-1})$$

[9] Uctum and Wickens' (2000) notations are used. Here P is used to denote the price level and Y denotes the real GDP.

or equivalently as;

$$\Delta B_t / P_{t-1}Y_{t-1} = \Delta b_t - b_{t-1}(\pi_t + g_t) \quad (2.5)$$

Multiplying both sides of (2.5) by $P_{t-1}Y_{t-1}/ P_tY_t$ we get;

$$\Delta B_t / P_tY_t = [\Delta b_t - b_{t-1}(\pi_t + g_t)]\,[P_{t-1}Y_{t-1}/ P_tY_t] \quad (2.6)$$

Moreover;

$$g_t = (Y_t - Y_{t-1})/ Y_{t-1} \quad (2.7)$$

$$\pi_t = (P_t - P_{t-1}) / P_{t-1} \quad (2.8)$$

From (2.7) and (2.8) we get

$$(Y_{t-1} / Y_t) = 1 / (1+g_t) \quad (2.9)$$

$$(P_{t-1} / P_t) = 1 / (1+ \pi_t) \quad (2.10)$$

and combining the two will give

$$(P_{t-1}Y_{t-1} / P_tY_t) = 1 / [(1+g_t)(1+ \pi_t)] \quad (2.11)$$

Inserting equation (2.11) into (2.6) will give,

$$\Delta B_t / P_tY_t = [\Delta b_t - b_{t-1}(\pi_t + g_t)] / [(1+g_t)(1+ \pi_t)] \quad (2.12)$$

Similar analysis can be done for the money balances;

$\Delta m_t = \Delta(M/PY) = \Delta M_t/(P_{t-1}Y_{t-1}) - (\Delta P_t/P_{t-1}) * (M_{t-1}/P_{t-1}Y_{t-1}) - \Delta Y_t/Y_{t-1}\,(M_{t-1}/P_{t-1}Y_{t-1})$

and following expression can be reached;

$$\Delta M_t / P_tY_t = [\Delta m_t - m_{t-1}(\pi_t + g_t)] / [(1+g_t)(1+ \pi_t)] \quad (2.13)$$

In (2.13) M_t denotes money supply whereas m_t is the ratio of money supply to the nominal GDP at time t ($m_t = M_t/P_tY_t$).

After combining (2.12) and (2.13) and rearranging the terms in equation (2.3) we end up with;

$$(F_t/P_tY_t) + i_t^d\ (B_{t-1}^d/P_{t-1}Y_{t-1})\,(P_{t-1}Y_{t-1}/P_tY_t) + i_t^f\ (B_{t-1}^f/P_{t-1}Y_{t-1})\,(P_{t-1}Y_{t-1}/P_tY_t)\,\Delta e_t$$
$$= [\Delta b_t^d - b_{t-1}^d\,(\pi_t+g_t) + \Delta b_t^f - b_{t-1}^f\,(\pi_t+g_t) + \Delta m_t - m_{t-1}\,(\pi_t+g_t)] / [(1+g_t)\,(1+\pi_t)]$$

which is equivalent to;

$$(F_t / P_tY_t) + [i_t^d\ (b_{t-1}^d) + i_t^f\ (b_{t-1}^f)\,\Delta e_t] / [(1+g_t)\,(1+\pi_t)]$$
$$= [\Delta b_t^d - b_{t-1}^d\,(\pi_t + g_t) + \Delta b_t^f - b_{t-1}^f\,(\pi_t+g_t) + \Delta m_t - m_{t-1}(\pi_t + g_t)]/[(1+g_t)(1+\pi_t)] \qquad (2.14)$$

Since $\Delta b_t = b_t - b_{t-1}$, we arrange the terms in (2.14) in the following way:

$$f_t + b_{t-1}^d\ (1+i_t^d - \pi_t - g_t) + b_{t-1}^f\,(1+i_t^f - \pi_t - g_t)\,\Delta e_t = b_t^d + b_t^f \qquad (2.15)$$

using the small letters f_t, b_t, and m_t in order to denote the ratios of the variables F_t, B_t and M_t to the nominal GDP; PY[10].

[10] f_t is the notation used to denote primary deficit (including seignorage revenues) as a ratio to the nominal GDP, $-f_t = (F_t / P_tY_t)\,[(1+g_t)\,(1+\pi_t)] + \Delta m_t - m_{t-1}\,(\pi_t + g_t)$. Note that $[(1+g_t)\,(1+\pi_t)]$ is the adjustment item for F_t which includes all primary deficit generated within period t-1 and t. Primary deficit is adjusted by the amount of inflation and real growth rate valid for the aforementioned period.

Using the Fisher (1930) equation for the real interest rate $r_t = i_t - \pi_t$, in which r_t denotes the real interest rate, equation (2.15) can be rewritten as the following intertemporal budget equation:

$$f_t + b^d_{t-1}(1+r^d_t - g_t) + b^f_{t-1}(1+r^f_t - g_t)\,\Delta e_t = b^d_t + b^f_t \qquad (2.16)$$

In this study, we will deal with the domestic debt of Turkey and therefore ignore the external borrowing side of the budget constraint. As a result, our analysis will be based on the following intertemporal budget constraint;

$$f_t + b^d_{t-1}(1+r^d_t - g_t) = b^d_t \qquad (2.17)^{11}$$

2.1 SUSTAINABILITY CONDITIONS

In the previous section, two period-intertemporal budget constraint is derived in the following form;

$$f_t + b_{t-1}(1+r_t - g_t) = b_t \qquad (2.18)$$

in which f_t and b_t denote primary deficit and debt stock as a ratio to the nominal GDP and r_t and g_t denotes real interest rate and the real growth rate of GDP respectively.

Uctum and Wickens (2000) analyze the stability conditions for this one period intertemporal budget constraint. Assuming a constant real interest rate and real growth rate for all periods, magnitudes of these macro variables have some implications regarding the stability of the equation (2.18). As Uctum and Wickens

[11] Uctum and Wickens (2000), p:200

(2000) state, if the real interest rate is smaller than the real growth rate, (2.18) is a stable equation and a finite b_t can be found for any finite level of f_t (p.200). The steady state level of b_t is found as; $b_t = -f_t / (r_t - g_t)$. However, they add that if the real interest rate is higher than the real growth rate, the debt to GDP ratio explodes unless a positive primary balance ($f_t<0$) is reached.

The analysis can be continued by rewriting Equation (2.18) in ex-ante terms as;

$$b_{t-1} = E_t [(b_t - f_t) / (1+r_t - g_t)]$$

or equivalently as;

$$b_t = E_t [(b_{t+1} - f_{t+1}) / (1+r_{t+1} - g_{t+1})] \qquad (2.19)^{12}$$

In Equation (2.19), E_t is the expectations operator at time t and "$1/(1+r_{t+1}-g_{t+1})$" is the real discount rate for one period ahead of period t, which we will denote as $\gamma_{t,1} = 1/(1+r_{t+1}-g_{t+1})$. One period discount rate from period t+k to t+k-1 can be generalized in the form as $\gamma_{t,k} = 1/ 1+r_{t+k}-g_{t+k})$, in which r_{t+k} is the real interest rate and g_{t+k} is the real growth rate between period t+k-1 and t+k. Therefore (2.19) is rewritten in the form;

$$b_t = E_t [(b_{t+1} - f_{t+1}) \gamma_{t,1}] \qquad (2.20)^{13}$$

Similarly, since $b_{t+1} = (b_{t+2} - f_{t+2}) \gamma_{t,2}$, equation (2.20) is equivalent to;

[12] We follow the procedure of Uctum and Wickens (2000) in deriving the IBC. Since right hand side of the equation includes the macro variables of the following period, it is unrealized part for the time being, t. Therefore, we include the expected values of those macro variables at time t.

[13] Uctum and Wickens (2000), p.200

$$b_t = E_t\left[\left(\left(b_{t+2} - f_{t+2}\right)\gamma_{t,2} - f_{t+1}\right)\gamma_{t,1}\right]$$

or more explicitly;

$$b_t = E_t\left(b_{t+2}\,\gamma_{t,1}\,\gamma_{t,2}\right) + E_t\left(-f_{t+1}\,\gamma_{t,1} - f_{t+2}\,\gamma_{t,1}\,\gamma_{t,2}\right) \tag{2.21}$$

The budget constraint for the infinite horizon can be expressed in the following way;

$$b_t = \lim_{n\to\infty} E_t\left(b_{t+n}\prod_{m=1}^{n}\gamma_{t,m}\right) - \lim_{n\to\infty} E_t\left(\sum_{k=1}^{n} f_{t+k}\prod_{m=1}^{k}\gamma_{t,m}\right) \tag{2.22}$$

We define the n period discount factor for time t, $\prod_{m=1}^{n}\gamma_{t,m,}$ as Uctum and Wickens (2000) do, and denote this discount factor as $\Psi_{t,n}$ [14]. Inserting this notation into (2.22), we end up with the infinite horizon government budget constraint;

$$b_t = \lim_{n\to\infty} E_t\left(b_{t+n}\,\Psi_{t,n}\right) - \lim_{n\to\infty} E_t\left(\sum_{k=1}^{n} f_{t+k}\,\Psi_{t,k}\right) \tag{2.23}$$ [15]

The budget constraint in (2.23) implies that existing debt stock will be financed through the primary surpluses in the following periods as well as by new borrowing. If the economy can not generate enough primary surplus to repay the existing debt (i.e. $\lim_{n\to\infty} E_t\left(-\sum_{k=1}^{n} f_{t+k}\,\Psi_{t,k}\right) \le b_t$), the difference is financed by borrowing in the following periods therefore debt accumulation continues and the debt is never repaid in the infinite horizon ($\lim_{n\to\infty} E_t\left(b_{t+n}\,\Psi_{t,n}\right) \ge 0$). On the other hand, if

[14] $\Psi_{t,n}$ is the discount factor from period t+n to t, i.e. $\prod_{m=1}^{n}\gamma_{t,m,} = \Psi_{t,n}$

[15] Uctum and Wickens (2000), p.200

existing debt is more than offset by the future primary surplus; (i.e. $lim_{n\to\infty} E_t$ ($-\sum_{k=1}^{n} f_{t+k} \Psi_{t,k}$) $\geq$ b_t), debt stock vanishes in present value terms ($lim_{n\to\infty} E_t$ $(b_{t+n} \Psi_{t,n}) \leq 0$). In practice, public debt does not vanish in the finite horizon, for those countries which have well-working borrowing market.[16] However, the private sector can not continually be the creditor of the public sector in an infinite time horizon and sustainability literature is based on the proposition that government will in the end be able to pay its existing debt.[17] In fact, Akyüz (2007) states that further debt accumulation can only be supported by continuing increase in the tax rates or the decline in government expenditures, which are the policies that can not be pursued in the infinite horizon. This is followed by the expectation that, debt stock as a ratio to GDP and in present value terms, will decline and vanish at a time in the future; which is followed by the proposition;

$$\ell im_{n\to\infty} E_t (b_{t+n} \Psi_{t,n}) = 0 \qquad (2.24)^{18}$$

Equation (2.24) is known in the literature as the no-ponzi game restriction (or the transversality condition as Uctum and Wickens (2000) state), which prohibits borrowing in order to finance interest payments. No-ponzi game restriction prevents further accumulation of the debt stock and therefore assures that the principal amount will be paid at a time in the future. On the basis of this proposition,

[16] Governments try to keep an active borrowing market in order to decrease the refinancing risk and to decrease the risk premiums on government debt. In an active borrowing market, it is easy to roll-over existing debt and this reduces the refinancing risk; which is defined as the inability of government to find the necessary borrowing/nonborrowing source when the obligation is due. Moreover, since the borrowing instruments are actively traded, the liquidity premiums and thus the costs of these borrowing instruments decrease accordingly.

[17] Akyüz (2007), p.3

[18] Uctum and Wickens (2000), p.201

intertemporal budget constraint for the infinite horizon, i.e. equation (2.23), is reduced to the following form;

$$b_t = \ell im_{n\to\infty} E_t \left(-\sum_{k=1}^{n} f_{t+k} \Psi_{t,k} \right) \qquad (2.25)^{19}$$

Equation (2.25) underlines the condition for sustainability that expected sum of all future primary surpluses, in present value terms, should be enough to finance existing debt stock (Uctum and Wickens, 2000, p.201). Therefore sustainability conditions can be summarized as the following two propositions[20];

(i) Discounted debt stock/GDP series should be stationary with zero-mean.
(ii) Expected value of the sum of discounted primary surplus/GDP series should be equal to the value of existing debt stock.

[19] Uctum and Wickens, 2000, p.201

[20] Uctum and Wickens, 2000

CHAPTER 3

LITERATURE ON THE DEBT SUSTAINABILITY ANALYSES

This chapter discusses studies on the fiscal sustainability of the various countries. Since this subject is very popular among the scholars, the wide range of sustainability analysis in the literature are conducted through different methods and/or taking into account different fiscal definitions. The following part will present an overview of the different methodologies followed in analyzing fiscal sustainability.

3.1 THE PRESENT VALUE BUDGET CONSTRAINT (PVBC)

The condition for sustainability in this approach is defined as having a balanced budget in present value terms (Lima et al., 2008, p.315). In other words, current debt stock levels and the revenues and expenditures are evaluated together with the future revenues and expenditures which are discounted to the same time period (Uctum and Wickens, 2000). With this aim, the intertemporal budget constraint derived in Chapter 2, is the starting point of the analysis.[21]

Hamilton and Flavin (1986) derive the conditions for public debt sustainability using the US data in the analysis. They derive the present value budget constraint and they also include the seignorage revenues and the capital gains as a source of

revenue in the budget constraint. They propose the budget equation of the following form;

$$B_t = (1+r)\, B_{t-1} - S_t + V_t$$

in which B_t denotes the debt stock at time t whereas S_t is an expression of the budget surplus including the seignorage revenues and V_t denotes the capital yields on bonds.

The results of their study highlight the conditions for sustainable borrowing policies which basically have an "intertemporally balanced budget".

Özatay (1997) analyzes sustainability of Turkish debt under the present value budget framework and by taking into account both the fiscal and the monetary policy. In constructing the present value borrowing constraint, he takes into account the seignorage revenues and the net external borrowing besides the present value of the future budget surpluses. Under a condition that the constraint is not met, the three suggested policies are primary surplus generation, external financing and the monetization of debt through seignorage (Özatay, 1997, p.669). By referring to the monetization alternative, Özatay (1997) states that monetary policy can not be qualified as a robust policy. Therefore he makes a stability analysis by combining the fiscal and monetary framework. Then, "maximum level of sustainable budget deficit" is investigated by searching for the highest available domestic and the foreign financing sources and the seigniorage revenues that are compatible with the stable economic environment (Özatay, 1997, p.670). Turkish fiscal policy is found to be unsustainable up to the year 1994. Moreover in order to derive the maximum level of sustainable budget deficits, he built two scenarios regarding the credibility of the stabilization policies (credible and incredible stabilization scenarios) and the credibility is inferred from the longer maturity of domestic borrowing. The results suggest that in a credible policy with the significant decline in inflation rates in four

[21] See Chapter 2 for details in deriving the present value (intertemporal) budget constraint and the corresponding conditions for sustainability proposed in order to have a balanced intertemporal budget.

year time period, financeable deficit must be maximum 1.4 percent of GDP after four years time (Özatay, 1997, p.677) On the other hand, under the incredible scenario, decline in inflation after four periods is less when compared to the credible scenario suggesting a 4.6 percent of financeable deficit / GDP for the four years ahead (Özatay, 1997, p.678).

Goyal et al. (2004) analyzes sustainability of the Indian fiscal policy within the perspective of different definitions of government; "Central Government" and "State Government". They use a similar method as Önel and Utkulu (2006) with the difference that rather than external debt, they analyze fiscal sustainability as a whole. Therefore, their analysis focuses on the government revenues and expenditure (as a percentage to GDP) where cointegrating relationship constitutes the core of the sustainability analysis. They take into account the structural breaks and use the "Gregory-Hansen (1996) cointegration test"[22]. Their study not only investigates sustainability under structural breaks, but also extends the analysis for different definitions of government and for the "Union Government" as a whole. Results suggest that although for both types of government the fiscal policy is unsustainable (with or without structural break); the union government shows a sustainable path with the structural breaks taken into account. (Goyal et al*.,* 2004, p.417)

Mounts and Sowell (2005) investigate sustainability of the US fiscal policy in the intertemporal budget constraint framework. Depending upon the fact that a government fiscal policy is sustainable as long as it satisfies the intertemporal budget constraint, they analyze how the "institutional structure of the budgeting process" and "House governance rules" affect fiscal sustainability (Mounts and

[22] "Gregory-Hansen (1996) cointegration test" is a unit root test which incorporate a break date for the cointegrating relationship (Rao and Kumar, 2007). The test is applied by assigning a break date for the intercept, trend or the slope term and the hypothesis of no cointegration in case of structural breaks is tested against a cointegrating relationship (Rao and Kumar, 2007, pp: 6-7).

Sowell, 2005, p.199). From the intertemporal budget constraint, they set a VAR model consisting of the variables; debt, government revenues, government expenditures and deficit. In order to assess if data in all periods are consistent with the whole period, they investigate the break periods and explore whether all data match with the sustainable path or not. The breakpoint is found to be at year 1975, which overlaps with the period in which "The Congressional Budget and Impoundment Control Act of 1974" takes place (Mounts and Sowell, 2005, p.204). In order to see if the previous and the post regime periods differ in terms of the budget balance terms, they analyze the two different periods in order to see if the debt has different informational content for revenues and expenditures[23]. For the two sub samples (whole sample versus the sample prior to the Budget Act), they conclude that informational content of debt on the future path of revenues and expenditures are different. However, they find that in both sub-samples debt has an explanatory power on the future paths of the revenues and expenditures, therefore the fiscal policy is sustainable for the whole period. On the other hand, the results of their study show that, changes in the budget regimes have some implications regarding the sustainability of the fiscal policy.

Önel and Utkulu (2006) analyze sustainability of the Turkish external debt, deriving the intertemporal external budget constraint. Relying on the solvency condition that the debt stock vanishes at the end of the infinite future, the external budget constraint is reduced to the equation of the following form;

$$X_t = a + b\ MM_t + u_t$$

where X_t is the export revenues including the net transfer receipts whereas MM_t is the sum of imports and the foreign currency reserves of the central bank (Önel and Utkulu, 2006, p.673). Their analysis is based on the cointegration relationship between X_t and MM_t series, stated as the necessary condition for sustainability

[23] The basic argument here is that in order for providing the long term balance for the budget, the evolution of debt should give information regarding the path of the revenues and expenditures (Mounts and Sowell, 2005, p.205).

(Önel and Utkulu, 2006, p.673). Önel and Utkulu (2006) state that "If MM and X are nonstationary, I(1) process, then a cointegration relationship between these two variables is a necessary condition for the country to be solvent (i.e. weak form of sustainability)" (p.673). Apart from analyzing the cointegrating relationship of the two series, they incorporate the structural breaks in their analysis of sustainability, as they state that "Structural breaks in time series may result in traditional tests of external debt sustainability being biased towards rejecting sustainability" (Önel and Utkulu, 2006, p.669). Therefore, they apply "Zivot-Andrews (1992) unit root test" and "Gregory-Hansen (1996) cointegration test" to reduce bias in case of structural breaks (Önel and Utkulu, 2006, p.680). As a result of their analysis Turkish external debt is found to be weakly sustainable in case of no structural breaks and in cases when the structural breaks are taken into account.

Baharumshah and Lau (2007) analyze fiscal sustainability of the five East Asian Countries (Thailand, South Korea, Philippines, Malaysia and Singapore) using the intertemporal government budget constraint and applying causality analysis. They analyze causality between government revenues and expenditures in order to assess the weak or strong form of sustainability. The unidirectional causality from the expenditures to revenues are commented as a sign for the strong sustainability since any increase in expenditures would lead to a fiscal adjustment through revenues without any need for a policy change, implying that current fiscal policy is sustainable[24]. The bidirectional causality is, on the other hand, an implication of a weak form of sustainability, since policy decisions are needed on determining the level of expenditures and revenues[25]. They conclude that while fiscal policies of South Korea, Singapore and Thailand display strong sustainable properties, those of Malaysia and Philippines are weakly sustainable.

[24] Baharumshah and Lau (2007) refer to the "spend and tax hypothesis" of Barro (1979)

[25] Baharumshah and Lau (2007*)* refer to the "fiscal synchronization hypothesis" of Musgrave (1966)

3.2 RELATIONSHIP-REACTION ANALYSIS

Leachman and Francis (2000) analyze sustainability of the US external debt using cointegration and multicointegration approach. The main proposition implied by the external intertemporal budget constraint is that exports and imports must have a positive and negative relationship respectively with the external debt in order to have a sustainable path (Leachman and Francis, 2000, p.213). However, if the imports and exports are nonstationary, they investigate the cointegration relationship among the two series, They suggest that for the period 1947-1973 imports and exports have a cointegrating relationship, indicating the external debt sustainability. However, within 1974-1994, they conclude that there is no cointegrating relationship, imports reaching higher levels than exports, and US is a net borrower country in the international economy.

Bravo and Silvestre (2002) use the stationarity and cointegration analysis under the present value budget framework to assess the sustainability of the fiscal policies of the European Union countries within the period 1960-2000. The analysis is based on the proposition that the sufficient condition for sustainability is the cointegration of government revenues/GDP and government expenditures/GDP (p.518)[26]. Moreover, they state the necessary condition for sustainability which implies a cointegrating vector of [1,-1] between revenues and expenditures and also apply a weaker condition regarding the cointegrating vector. The weaker condition they propose implies a proportionately lower response of expenditures to revenues rather than a one-to-one response. According to the existence of cointegration, they find the fiscal policy of the UK, Austria, France, Netherlands and Germany sustainable. Moreover, they did not reach cointegrating vectors of [1,-1] for any countries, but rather they observe a revenue response to one unit increase in expenditures of on average 0.6 to 0.8.

[26] Bravo and Silvestre (2002) refer to Trehan and Walsh (1988)

Greiner and Kauermann (2007) study the sustainability of the US public debt within the perspective of detecting the relationship among the primary surplus/GDP to debt/GDP levels. In analyzing the relationship, they use "time-varying coefficient model" which shows the movements of primary surplus/GDP ratio as a result of the movements in the debt/GDP ratio[27]. The model analyzed is in the following form;

$$s_t = a_0 + f_1 (b_t) + f_2 (GVAR_t) + f_3 (YVAR_t) + e_t ,$$

$$e_t \sim \text{iid } (0, \sigma^2)$$

in which s_t denotes the primary surplus to GDP ratio, b_t is the debt / GDP ratio, GVAR denotes the temporary level of government spending, YVAR denotes the business cycle indicator and f_i (.)'s denote the "smooth non-parametric functions (i=1,2,3). (Greiner and Kauermann, 2007, p.354). They propose that for s_t being a linear and increasing function of b_t, the fiscal policy shows a sustainable pattern. Furthermore, Greiner and Kauermann (2007) add that for a nonlinear relationship among primary surplus/GDP and the debt/GDP, a convex function of f_1 (.) indicates that the fiscal policy is sustainable. The results of their study up to the year 1995 indicate that primary surplus/GDP ratio is a convex function of debt/GDP ratio, meaning that the US fiscal policy is sustainable.

Greiner and Kauermann (2008), analyze sustainability of the debt structure of Italy and Germany using the penalized spline smoothing[28]. They state that positive reaction of primary surplus to changes in the public debt is the intuition of fiscal sustainability. Their study results suggest that Germany's fiscal policy seems

[27] Greiner and Kauermann (2007) refer to the model which is introduced by Hastie and Tibshirani (1993)

[28] Greiner and Kauermann (2008) again use "time varying coefficient" model for the regression of primary surplus/GDP to the debt to GDP ratio. They parameterize the reaction coefficient of primary surplus/GDP to the debt/GDP ratio in "high dimensional basis" in time, t, as well as the "low dimensional basis" of t. Moreover, this high dimensional basis is selected to be a "cubic spline basis function" which, due to the high dimension, causes highly variable estimates of the coefficient; and they add a penalty factor for these variations during the OLS estimation procedure (Greiner and Kauermann, 2008, p.1152).

sustainable, although the evidence is getting weaker. They add, on the other hand, that for Italy, fiscal policy is unsustainable, although they reach the results with low significance.

Kia (2008) focuses on the fiscal sustainability of Iran and Turkey in both stochastic and nonstochastic environments using cointegration and multicointegration techniques. Kia (2008) analyzes cointegrating relationship between government revenues and expenditures. Kia (2008) analyzes no multicointegration between revenues and expenditures and finds the fiscal policy of Iran unsustainable in stochastic and nonstochastic environments. Moreover, he finds that although Turkey's government expenditures and revenues display cointegrating relationship, the fiscal policy unsustainable in the stochastic environment. Kia (2008) declares the reason by the following proposition that although the revenues and expenditures have a cointegrating relationship, expenditures have a tendency to move faster than revenues.

3.3 RISK-BASED LITERATURE

Garcia and Rigobon (2004) analyze sustainability of Brazilian debt in a risk management perspective. Their proposition is that the variables in the debt accumulation equation are stochastic and the approach to take steady values for these variables can be misleading. Their methodology to assess the relationships among these variables and to derive the future paths is the VAR approach, in which they incorporate six macro variables in the following form;

$$Xt = c + B(L)Xt + v_t$$

$$Xt \equiv (r_t, g_t, ft, e_t, s_t, \pi_t)$$

$$v_t \sim N(0, \Omega)$$

where they denoted c as the constant term, B(L) as the coefficients of lags, X_t as the matrix of endogenous variables, r_t, g_t, ft, e_t, s_t, π_t, which are used to denote in their study as the real interest rate, real growth rate, fiscal deficit/GDP, debt shock/GDP, real exchange rate and the inflation rate respectively with v_t defined as the

multinomially distributed residuals with mean zero and variance Ω (Garcia and Rigobon, 2004).

Garcia and Rigobon (2004) use VAR model to assess the relationships among these macrovariables and to conduct corresponding impulse response analysis. Moreover, they run Monte Carlo Simulations for the following ten years to see the frequency by which debt/ GDP levels reach a certain level thought to be risky.

Garcia and Rigobon (2004) state that Brazilian public debt is sustainable when risky cases are not taken into consideration. However, they find that when risks are incorporated in the analysis Brazilian public debt shows unsustainable pattern in some periods. The other important finding of their study is that the probability level of the debt/GDP ratio to reach a specified risky level is highly related with the EMBI+ spreads.

Lewis (2004) works on the sustainability of the Jamaican public debt within the risk management perspective using a similar method to the Garcia and Rigobon's (2004). VAR modeling approach of the Garcia and Rigobon (2004) is employed with the key difference that the Lewis (2004) takes into account "contingent liabilities" and "off-balance sheet items" when deriving the path for the debt dynamics. Lewis (2004) analyzes sustainability of debt under certainty and under the environment incorporating the random shocks given to the macro variables. He assesses the probability level of the debt/GDP ratio reaching a certain risky level and associates this probability with the spreads on the Eurobonds. Apart from doing impulse response analysis and generating forecasts for the debt dynamics, Lewis (2004) also does stress tests, regarding the effects of the changes in the debt shocks and the primary surplus on the level of the debt stock. Lewis (2004) finds that under debt/GDP levels show a sustainable path no uncertainty, but increasingly unsustainable under uncertainty. As a result of the sensitivity analysis, he reaches the level of 7 percent for the debt shock/GDP level and 11.4 percent for the primary surplus to GDP level as the nondistorting levels for a sustainable debt structure.

However, Lewis (2004) points out that debt shock higher than 12 percent and the primary surplus below the level of 8 percent is jeopardizing the sustainable structure of the debt/GDP ratio. Lastly, Lewis (2004) states that probability of the debt/GDP ratio being in excess of a certain risky level has an explanatory power for the spreads of the Eurobonds, thus, he adds that risk management perspective is right method to use in the sustainability analysis.

Qin et al. (2006) analyze the sustainability of the Philippines public debt within the perspective of no-ponzi game requirement derived under "infinite-horizon representative agent model". Their proposition is that ponzi-game can be possible as long as government finance its borrowing need at a lower cost than the existing market rates. Moreover, Qin et al. (2006) define the sustainability conditions for public debt as follows;

i) increasing rate of the government debt should be lower than the interest rate factor in the infinite horizon,
ii) growth rate in the economy should be lower than the infinite horizon interest rate factor[29].

Moreover, Qin et al. (2006) base the feasibility of the government debt upon the fact that the interest factor of the government debt in the infinite horizon (shocks are incorporated) should be lower than the average growth rate. Their methodology is to derive the future paths for the debt dynamics and the associated variables by incorporating the upper and lower limits in order to assess the risky cases. They also perform sustainability and feasibility analysis under an adverse exchange rate shock.

They conclude that Philippine public debt is unsustainable in the present time. Qin et al. (2006) state that government is playing ponzi-game since the borrowing rates are lower than the market rates. However, they find government debt is not feasible

[29] See the dynamic efficiency assumption, Qin et al., 2006, p.68

under an exchange rate shock, and they conclude that government can run into debt crises under an adverse shock case.

Tanner and Samake (2006) analyze fiscal sustainability of the three countries Mexico, Brazil and Turkey, in the risk management perspective. They incorporate uncertainty to the model with a very similar way to Garcia and Rigobon's (2004) study. However, rather than finding the probability of the debt reaching a risky level, (Garcia and Rigobon's (2004) approach), Tanner and Samake (2006) are interested in determining the level of fiscal adjustment to prevent further accumulation of debt. Under no uncertainty, they find Turkey's fiscal policy unsustainable until the 2001 crisis. When uncertainty is incorporated in the analysis, Tanner and Samake (2006) give shocks to the primary balance and real interest payments and assess the corresponding evolution of the debt stock and the debt stabilizing parameters in the five-year time period from 2005 to 2010. As a result of the analysis, they observe that under no shock scenario debt/GDP level falls from 55.5% to 32 percent in year 2010, whereas falls to only 39.4 percent under the shock scenario. Moreover, when shocks are taken into consideration, Tanner and Samake (2006) reach the %10 probability level with which debt/GDP reaches at least 58.9 percent in year 2010. Furthermore, they find the debt stabilizing primary surplus for the five year period on average about 7 percent.

3.4 SUSTAINABILITY INDICATORS APPROACH

Chalk (2000) investigates the maximum level of the deficit that does not jeopardize sustainability using the "Overlapping Generations Approach" on the US data. The analysis of Chalk (2000) is based upon the necessary condition that the interest rates are lower than the growth rate for which the permanent deficit does not jeopardize sustainability. However, Chalk (2000) states that since this is not the sufficient condition for sustainability there is a limit on the deficit and the stock level in order to stay in the sustainable path. Chalk (2000) solves the consumer's utility problem,

firms profit function, the capital and labor market clearing points and the government's debt accumulation equations simultaneously in order to find the profit maximizing level of deficit for the economy as a whole.

Koo (2002) conducts the sustainability study of Korean debt using the sustainability indicators approach and uses "primary gap indicator" and "tax gap indicator" in order to assess if the applied fiscal policy is sustainable.

The primary gap indicator (G^P) and the tax gap indicator (G^T) are proposed as follows (Koo, 2002, p.664);

$$G^P = d^* - d = (n-r)\, b - d$$

$$G^T = t - t^* = t + (n-r)\, b - g$$

In the above formulations of Koo (2002); d* denotes maximum level of primary deficit/GDP ratio which would provide debt sustainability, d is the current primary deficit/GDP ratio, n denotes real growth of GDP, r is the real interest rate, b denotes debt/GDP ratio, t is the current tax/GDP, t* denotes minimum level of tax/GDP ratio for debt sustainability and g is the (government expenditures other than interest payments)/GDP. Koo (2002) makes the assessment of sustainability and, thus, recommends policies according to the signs of the primary gap and the tax gap indicators. Koo (2002) states that when the primary gap indicator or the tax gap indicator takes a value smaller than zero, this gives a sign of unsustainable path for the fiscal policy.

According to the study results of Koo (2002), fiscal policy of Korea is sustainable within the period 1970-1996. However after the year 1997, Koo (2002) finds that the value of both of the indicators are decreasing, giving the sign that the probability of reaching an unsustainable path increases.

Voyvoda and Yeldan (2005) discuss the efficiency of fiscal targets that IMF proposes for Turkey within the program named "Turkey's Transition to a Strong Economy". They conduct their analysis on a "General Equilibrium Framework" with integrating the household, production sector, intermediaries and the international capital markets in the analysis. They discuss the welfare effects of the

fiscal targets proposed by the IMF and investigate the sensitivity of these targets in case of shocks on growth rate. Voyvoda and Yeldan (2005) find that "… the path of aggregate public debt as a ratio to GNP displays significant degree of inertia and would be brought down only gradually and slowly." (p.763). Moreover, they analyze how the primary surplus to GDP target should be adjusted in case of adverse growth shocks. Voyvoda and Yeldan (2005) show that in case of an adverse growth shock, the primary balance/GDP target should be about 2 percent higher for the period 2010-2023 in order to stay in the sustainable path for the fiscal policy. Moreover, they criticize the policy proposals based upon a contraction of the fiscal policies generated with less reference to the effects of the fiscal contraction on the growth capacity of the economy. Voyvoda and Yeldan (2005) comment that fiscal contraction will adversely affect the growth capacity of the economy via decreased public investments.

Lima (2008) et al. (2008) use Quantile Auto Regression (QAR) model in order to derive the maximum level of debt that Brazilian public debt should not go beyond in order to stay in a sustainable path. Their argument for sustainability is based upon the proposition of Uctum and Wickens (2000) that the debt/GDP series should be stationary with zero mean. Lima et al. (2008) run the QAR model for the debt/GDP series in order to separate the stationary series from the nonstationary ones. They define the critical conditional quantile that is used to separate the series with unit root and with the stationary series[30]. The study of Lima et al. (2008) incorporates the risk management perspective and resembles to the Value at Risk methodology of Garcia Rigobon's (2004). However, the originality of their study is that apart from assessing the probability of the debt/GDP level reaching to a certain risky level, they try to define that risky level. Lima et al. (2008) define the maximum level of debt (debt ceiling) for sustainability as the critical conditional

[30] They propose that for the debt/GDP series with unit root, the critical conditional quantile of the series will be lower than the series itself (Lima et al., 2008, p.318).

quantile of the debt/GDP series. They show that Brazilian public debt is beyond the debt ceiling proposed by their study and thereby conclude that Brazilian public debt is unsustainable.

Menguy (2008) discusses the European Union Maastricht Treaty (1992) targets of 60% for the public debt/GDP ratio and 3% for the budget deficit/GDP within the framework of public debt sustainability. What is proposed his study is that the higher the real growth rate of an economy and the lower the interest rate, the closer the economy to the sustainable fiscal path. Based upon this idea, Menguy (2008) discusses the same target level proposed by the Maastricht Treaty (1992) to all European countries. In his study, Menguy (2008) derives the "debt stabilizing primary balance" which is dependent on the debt dynamics of the country itself, and which will differ across countries. Based on the intertemporal budget constraint for the government, he ends with the following formula for the "debt-stabilizing primary balance";

$$-d^* = b^* (i-g-\pi) / (1+g+\pi)$$

in which d* is the "debt-stabilizing long-run primary deficit", b* is the long run debt/GDP ratio, i is the nominal interest rate, g is the real growth rate and π is the inflation rate (Menguy, 2008, p.5). As seen from the above expression, he underlines that an economy with higher real rate of growth and lower interest rates may have a lower level of primary surplus/GDP ratio required to reach a sustainable path.

3.5 GENERAL EQUILIBRIUM FRAMEWORK

Drudi and Prati (2000) analyze fiscal stabilization within a game theory perspective and use "signaling model" in order to investigate the incentives of the governments to default or to move away from taking debt-stabilizing measures. They construct a

two-period budget constraint taking into account the probability of default and defining the incentives of the governments to default according to the government type as "dependable" and "weak" governments. The countries they analyze are Ireland, Denmark, Belgium and Italy. Drudi and Prati (2000) propose that the timing of the action for debt stabilization ("tax smoothing" process) is determined by minimizing the expected cost of the "distortionary taxes" put in practice to meet the debt accumulation equation. Moreover, they analyze the effect of low primary surplus or higher debt accumulation on the reaction differentiation of different types of governments by solving the pooling equilibria and separating equilibria for the two type-two period signaling model. Next, Drudi and Prati (2000) analyze the effect of primary surplus and the debt accumulation on the credit ratings of the governments. They end up with the results that credit ratings are positively related with the primary surplus level and negatively related with the debt stock levels. Furthermore, Drudi and Prati (2000) suggest that debt/GDP and the primary surplus/GDP are "complementary inputs" in the credit rating model, since the importance of the primary surplus increases as the debt stock/GDP level rises. They explain this in the way that, as the debt accumulation rises; weak governments are the first to have a tendency to delay the stabilization and the equilibria moves from the pooling to the separating equilibrium, a case of which the primary balance has gained a significant signaling power. Moreover, Drudi and Prati (2000) state that the signaling model for the credit ratings explains the reason for which even dependable governments delay stabilization processes. Afterwards, they add that this is because the signaling power on the credit ratings of the governments is higher as the debt/GDP levels increase. Therefore, Drudi and Prati (2000) conclude that even dependable governments can be reluctant to take stabilization measures until the debt levels accumulate to a certain level.

Akemann and Kanczuk (2005) analyze the relationship between the default on government debt and the interest rates. The basic argument they propose is that higher interest rates are increasing the interest payment obligation of the government and thereby increases the probability of default. Therefore, they state

that higher interest rates cause the demand of households for the government debt to decrease. Akemann and Kanczuk (2005) use "endogenous growth model with linear technology" in their analysis and derive household budget constraint as well as the government budget constraint.

They try to formulate determinants of the household preference between the production sector and the government debt. Rather than assessing the sustainability of the government debt, the main aim of Akemann and Kanczuk (2005) is to assess the constraint of the demand of the household for the government debt which is proposed to be a function of the default risk.

Yakita (2008) uses overlapping generations model within the general equilibrium framework in order to derive the theoretical basis of the sustainability of the fiscal deficits with incorporating public capital stock in the analysis. Yakita (2008) derives the general equilibrium of the endogenous growth model by considering the household, government and production sector, with the assumption of two-period life cycle of households and with including capital formation in the analysis. Yakita (2008) aims to derive the threshold level of initial debt stock for a sustainable fiscal policy. The results of Yakita's (2008) study indicate that the threshold level of initial public debt stock is higher for the countries with higher capital accumulation. In other words, Yakita (2008) concludes that even though the debt stocks are heavily accumulated, the fiscal policy of a country with high level of capital accumulation can be sustainable, while having deficits. Moreover, Yakita (2008) underlines that this result stresses a different point in the sustainability literature when compared to the other studies that do not take into account the capital formation.

3.6 A COMPARISON OF THE DIFFERENT METHODOLOGIES

The different methodologies followed in assessing sustainability have several advantages and disadvantages. The traditional method of PVBC provides a long-term assessment of sustainability basing on the historical path of the debt to GDP series. Although the method is simple to apply and works well in a considerably stable macro environment, it does not take into account unexpected changes in the economy. The methodology of "Reaction Analysis" focuses on the response of certain macro variables to movements of the debt stock and therefore better incorporates the changes in the economy. However, the reaction function is already derived on the basis of the historical response behavior. Therefore, these two methodologies are backward-looking and do not tell much about the future prospects for the debt stock and the relevant macro variables (Burnside, 2004). Menguy (2008) states that the traditional tests on sustainability are wrongly assuming that the fiscal policy will stay the same in the future. The "Risk Based Studies" are conducted for a stochastic environment in which the future paths of the debt stock and the related macro variables are derived under some confidence level. The aim is not only to assess whether the path of the debt seems sustainable in the current environment, but to reach concrete probability levels for which debt will reach certain risky levels in the future under different macro scenarios (Garcia and Rigobon, 2004). The main drawback of the risk-based analyses is that the "risky level" of debt is arbitrarily defined (Lima et al., 2008, p.314). Therefore, apart from assigning probabilities for reaching risky debt levels, these studies should give a better assessment of the debt level for which fiscal sustainability is jeopardized. The "Sustainability Indicators" approach assesses certain levels for the macro variables for which fiscal sustainability is not endangered. Garcia and Rigobon (2004) critize the analyses focusing on the gap between the actual and the predetermined level of a certain macro variable for which debt is stabilized, such as the studies of "debt stabilizing primary balance". The main argument of Garcia and Rigobon (2004) is that the aim of public borrowing is to smooth consumption rather than the debt/GDP level. Moreover, Garcia and Rigobon (2004) claim that if a country is

already under a huge burden of debt, stabilizing this level would not provide fiscal sustainability. Still, these studies are advantageous in that they set concrete targets for the fiscal policy. Moreover, following a sustainability indicators approach, the scholars propose the need for fiscal adjustment and the direction to move. In the study of Uctum and Wickens (2000), rather than to propose debt stabilizing fiscal targets, already suggested targets of Maastricht Treaty (1992) are criticized. The attractive point in their study is that apart from assessing whether the policy is sustainable in the long-term, medium term policy fiscal adjustments for sustainability are also suggested. We also utilize Uctum and Wickens' (2000) methodology in order to discuss the efficiency of the Maastricht Treaty (1992) targets for the fiscal sustainability of the Turkish policy.

CHAPTER 4

A HISTORICAL REVIEW ON TURKEY'S DEBT DYNAMICS

Turkish economy has undergone significant changes from 1994 to 2008 with two severe economic crises in 1994 and 2001. Despite the generally volatile picture of the macro dynamics and two serious economic crises in only fifteen years period, the improvement in the economy has been enormous. Gross domestic production was about 6 billion TL in 1994 increased to the level of approximately 950 billion TL in 2008[31]. The annual inflation rate, which was about 132 percent in year 1994, has generally followed a declining trend and reached to about 70 percent in 2001. The fall in the inflation rate, since then, has been enormous and declined to one digit level in years 2004 and 2007, about 8 percent. By the end of year 2008, annual inflation rate was about 10 percent, an almost 92 percent decrease in the annual rates when compared to the end of 1994. The significant decline in inflation rates is an indication of the fact that the economy has indeed experienced a noteworthy growth in real terms. Nominal interest rates followed a similar pattern with the inflation rates. Annual interest rates based on the weighted average cost of the discounted bond/bill auctions of Turkish Treasury was about 164 percent in year 1994 and after a serious jump to a weighted average level of approximately 99 percent in 2001, decreased to almost 19 percent in 2008 on average. Primary

[31] These are the GDP values at current prices. Moreover, the GDP data for the given years are available in different base years, 1987 and 1998 respectively. Therefore, nominal GDP data for year 1994, given in the text, is adjusted to 1998 base, by using the nominal growth rates on 1987-based data.

surplus revenue of the economy, as a non-borrowing source, was almost 33.592 billion TL in 2008, which was only 147 million TL in year 1994. Correspondingly, debt stock as a percentage to the nominal GDP level did not increase to extreme levels, which was about 13 percent in year 1994, increasing to almost 51 percent in year 2001 and following a declining trend thereafter due to the growth capacity of the economy. The debt stock to GDP ratio reached to the level of approximately 29 percent by the end of 2008.

This chapter will focus on the path of the debt dynamics and the associated macro variables within year 1994 and 2008. Since the theoretical model that will be discussed in the next chapters will be based on quarterly data, the path of the variables will be displayed on quarter basis in the following part.

4.1 MACROECONOMIC FRAMEWORK

Debt dynamics in Turkey moved in a floating pattern within the period of 1994-2008 in which serious jumps were observed mostly due to the crises in 1994 and 2001. Domestic debt stock, as seen in Figure 4-1, was about 357 million TL at the end of 1993, increased to 275 billion TL by the end of 2008. The debt accumulation process had a break in the second quarter of 2001 as a result of currency crisis in Turkey. Not only the rise in the financing needs due to the increase in interest rates led to a significant rise in the debt stocks, but also issuance of certain borrowing instruments in order to cure financial sector losses also created a burden on the public finances[32].

[32] Actions taken in order to cure the balance sheet of the banking sector in 2001 are explained in detail in the Public Debt Management Report of year 2003 which is published on the Turkish Treasury website. The relevant link is;
http://www.hazine.gov.tr/irj/go/km/docs/documents/Hazine%20Web/Arastirma%20Yayin/S%c3%bcreli%20Yay%c4%b1nlar/KBYR%20Ar%c5%9fiv/2003/Kamu%20Bor%c3%a7%20Y%c3%b6netim%20Raporu%20%2c%20Nisan%202003.pdf
See page 126, Appendix 7

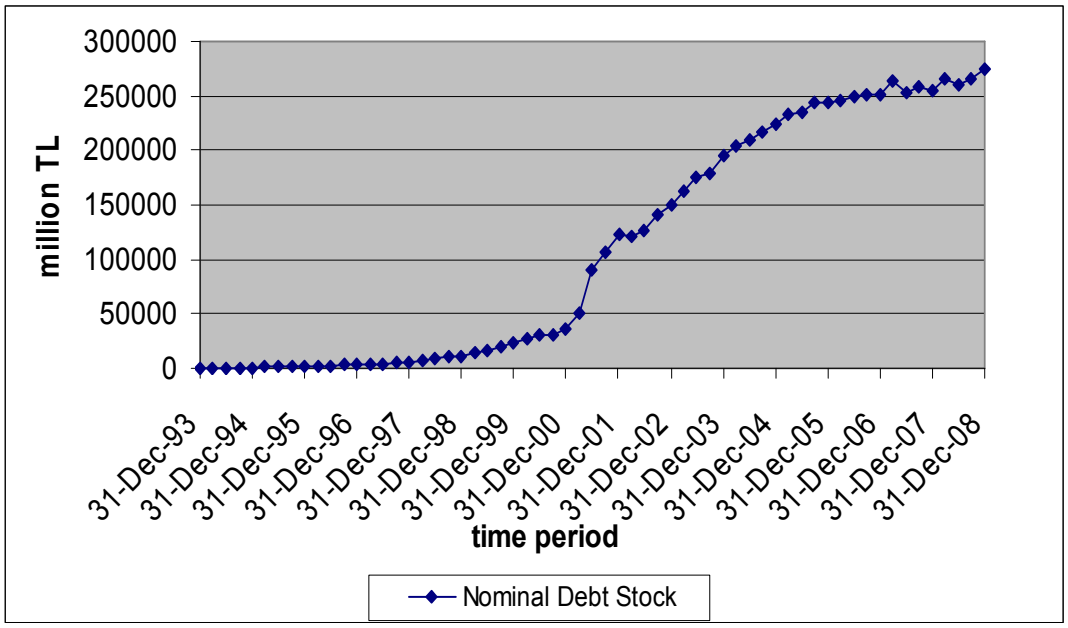

Figure 4-1 Evolution of Domestic Debt Stock

Path of the nominal level of debt stock should be evaluated together with the evolution of the production or the growth capacity of the economy. Whether further debt generation is associated with an enhancement of the production capacity within the country is of core issue in evaluating the public borrowing policies. Therefore, the domestic debt stock as a percentage of nominal GDP will provide a better insight for the structure of the public financing needs.

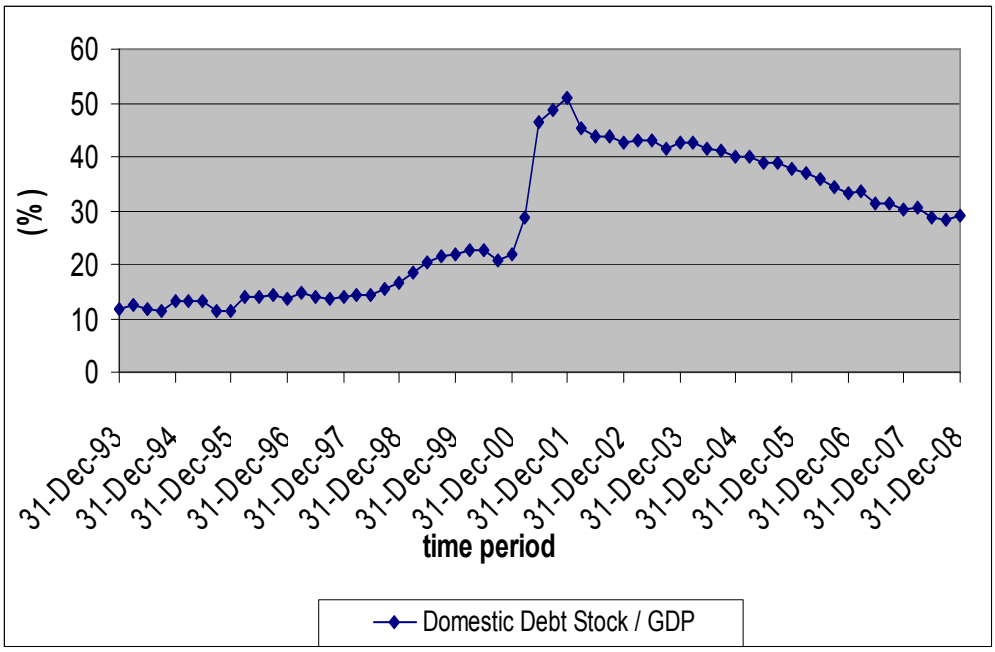

Figure 4-2 Domestic Debt Stock as a Ratio to GDP

Figure 4-2 shows the path of domestic debt stock as a ratio to GDP level within the time period under consideration. Domestic debt / GDP levels display an increasing trend up to year 2001, where it shows a significant jump in this year. In the first quarter of 2001 domestic debt / GDP ratio rises from about 21.8 % to about 28.6%. The rise in the second quarter of 2001 is even more enormous, the ratio reaches to the level of about %46.4 with a rise of a nearly 18% in only one quarter. The currency crises in year 2001 has caused the deterioration of the balance sheets in the financial sector which were partly cured by the public sector intervention, mainly by issuing special instruments that do not add to the cash balances of the central government but rather had the purpose of curing the balance sheets of the financial sector.[33] Therefore, while causing an increase in the central government domestic

[33] See the "non-cash domestic debt stock" in year 2001 which is given in the Turkish Treasury website.
The relevant link is;
http://www.treasury.gov.tr/irj/portal/anonymous/DomesticDebt/?guest_user=treasury.
See Domestic Debt Statistic 2001 / Non-Cash- Stock.

debt stock, these instruments did not add to the production capacity of the country. Apart from that, rising interest rates did increase financing needs, curbing the aggregate production at the same time. Therefore, domestic debt/GDP level has a significant jump in period 2001 and shows a declining pattern thereafter. By the end of 2008, domestic debt/GDP ratio is reduced to about 30 percent.

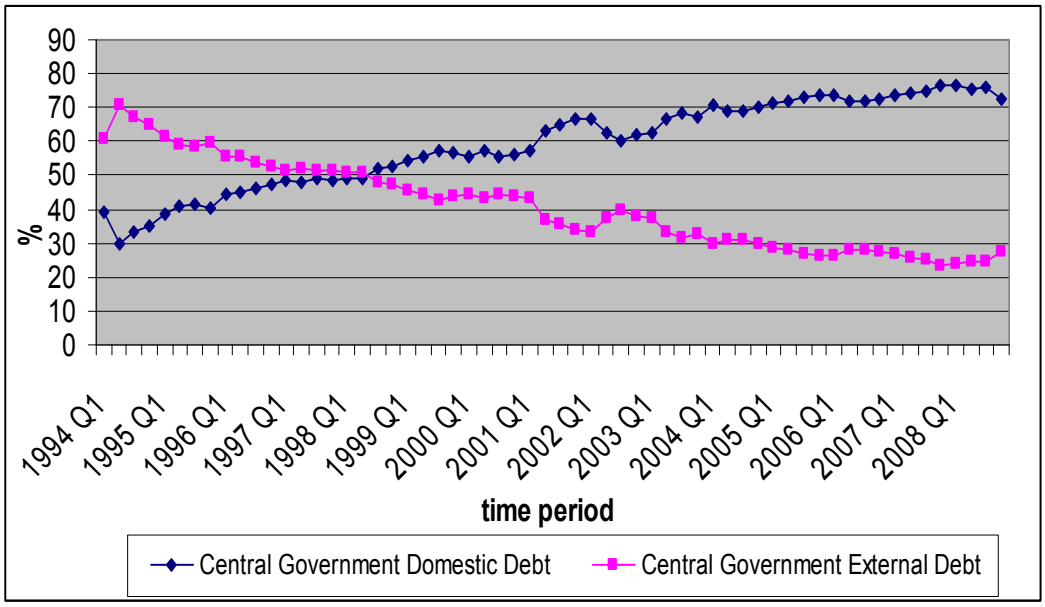

Figure 4-3 Ratios of Domestic and External Debt Stock as a Ratio of Total Central Government Debt Stock

Figure 4-3 shows the domestic and external portions of the central government debt stock within 1994 and 2008. The respective ratios are almost reversed, i.e. central government external debt stock which was about 70 percent in the second quarter of 1994, is reduced to about 30 percent by the year 2008. With the development of the risk management perspective of Turkish Treasury, the exposure of debt to the risks arising from the volatility of the market variables is tried to be reduced[34]. In line

[34] For more information regarding risk management perspective see "Annual Public Debt Management Report" published by Turkish Treasury on 2009. Moreover, the realizations regarding certain indicators of the risk exposure of Turkish public debt is published regularly in the "Monthly Public Debt Management Report". Both reports are available on the website of Turkish Treasury (www.treasury.gov.tr) as well as the published documents.

with this aim, the ratio of central government domestic debt to the total central government debt is tried to be increased in order to decrease the foreign exchange rate risk exposure of public debt. As seen in Figure 4-3, ratio of domestic debt to the total central government debt has successfully been increased from the level of about 30-40 percent in 1994 to about 70 percent in year 2008.

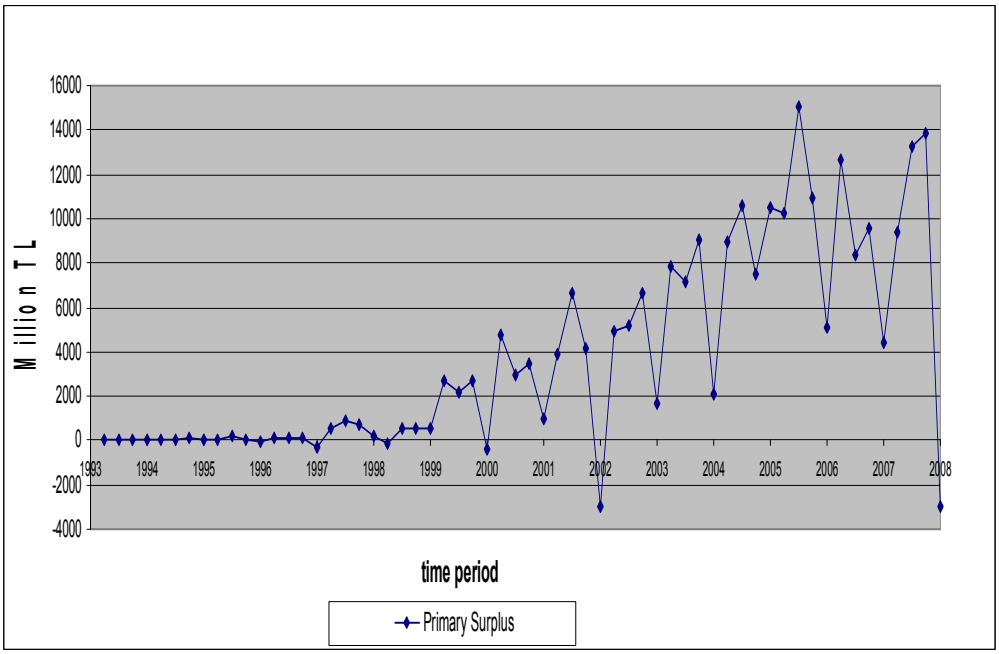

Figure 4-4 Nominal Primary Surplus

Figure 4-4 exhibits the quarterly values for the primary surplus in nominal values. Primary surplus is mostly positive but in negligible values up to year 1999, but shows a volatile picture thereafter. From the year 1999 onwards, primary surplus follows a generally increasing trend. The primary balance has been generally positive with the exception of noticeable negative values at the end of 2002 and 2008. The significant decline in the primary balance at the end of year 2008 follows the global trend that the global financial crises has adversely affected the production performance and revenue generating mechanisms of the countries.

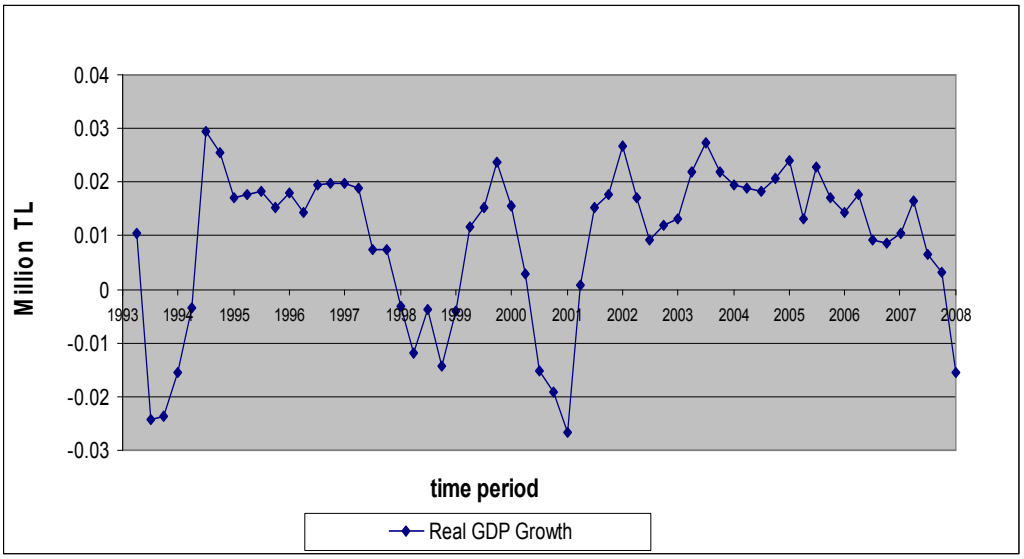

Figure 4-5 Real Growth[35]

Evolution of the macro variables gives a better insight to the performance of the economy throughout the history. The quarterly growth performance of Turkey in real terms is seen on Figure 4-5. Real growth is mostly positive with several negative values corresponding to the unfavorable economic periods; 1994, 1999, 2001 and the end of year 2008.

[35] The figure shows quarterly real GDP growth with the horizontal axis displaying the time period from the first quarter of 1994 to the last quarter of 2008. (Each point on the x axis corresponds to a quarter of the relevant year, while the point under which the year is displayed is the last quarter of the year.) Quarterly GDP growth is proxied from the difference between the annualized real GDP of the succeeding quarters. Annualized real GDP's are calculated by the moving average method; by summing up the real GDP of the current quarter and the former three quarters.

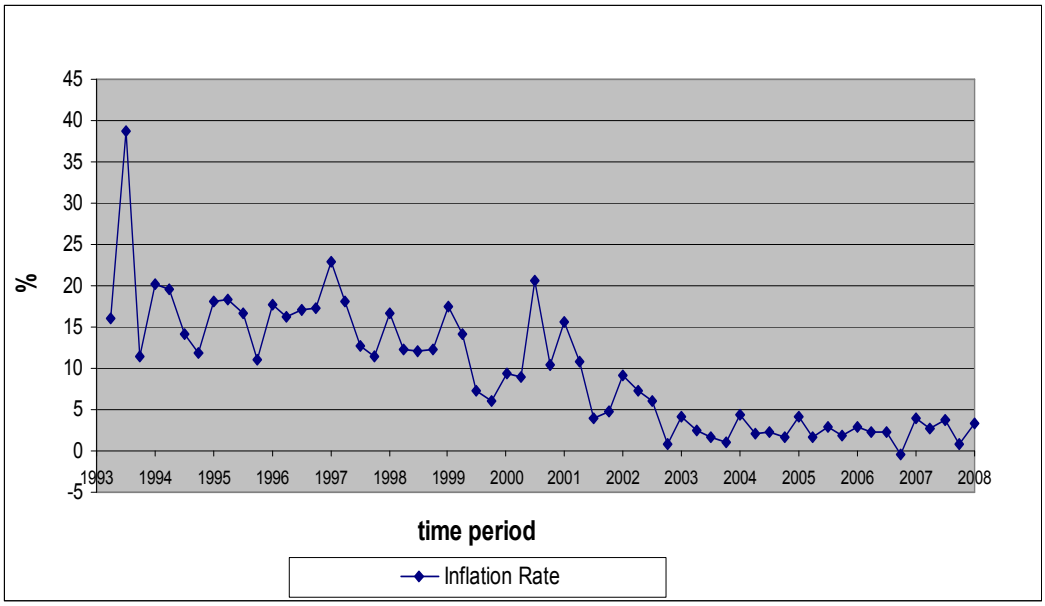

Figure 4-6 Quarterly Figure for Inflation Rate

Inflation rate showed a decreasing trend during the same period. As seen in Figure 4-6, the significant rise in inflation corresponds to the crisis years 1994, 1997 and 2001. However, high inflation periods did not last long and the quarterly inflation rate has reached one digit levels after the second quarter of year 2002. Moreover, the recent global financial crises did not hit the domestic inflation rates as it hit the global growth rates, but rather the rates stayed below the level of 5 percent within the year 2008.

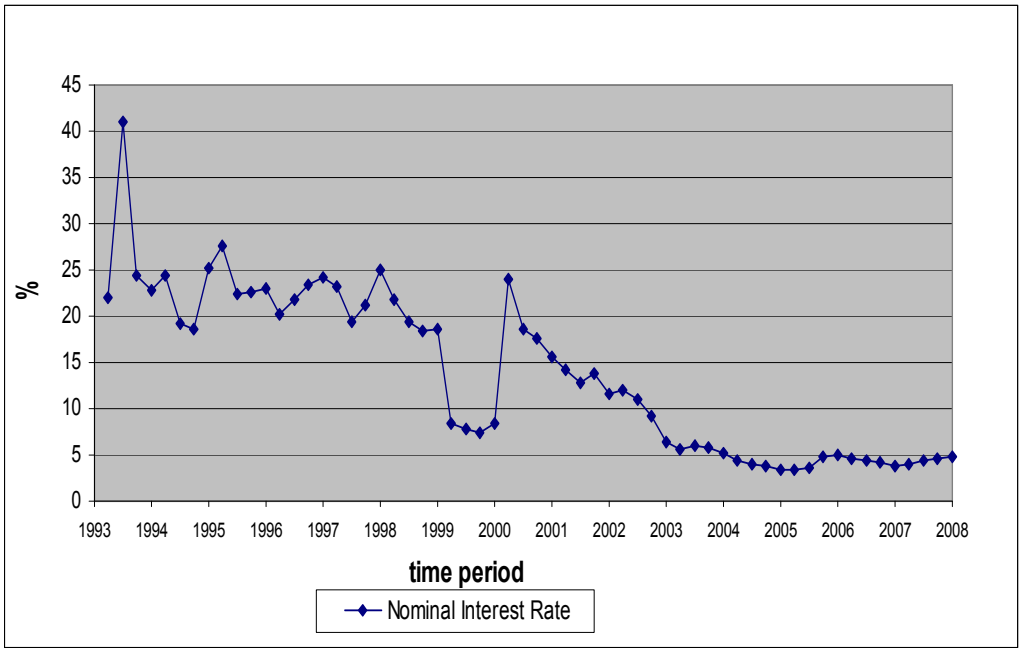

Figure 4-7 Quarterly Figure for Nominal Interest Rates[36]

Figure 4-7 underlines the general declining trend of the nominal interest rates, as observed in the inflation rates. The quarterly rates are displayed in the figure, which were about 40[37] percent in year 1994 and fluctuated around 20-25 percent until the year 1999. After a slight decrease in year 2000, it jumped again to levels of nearly 25 percent with the currency crises in 2001. However, the declining trend after year 2001 has continued and nominal quarterly rates has started to fluctuate around five percent since year 2004.

[36] Weighted average of the compound annual interest rates accepted in the discounted bonds / bills auctions are taken and then annual rates are converted to the quarterly rates.

[37] Since this is the term rate for a quarter, the annual figures for the interest rates were much higher since the rates are compounded for four periods. The annual compound rate equivalent for the 40 percent quarterly rate is calculated by $[(1+0.40)^4-1]*100$, which implies that the annual average compound rates converges the level of 250-300 at that period. With the same calculation, 20-25 percent nominal quarterly compound rate also implies that annual rates were in three digits at that time.

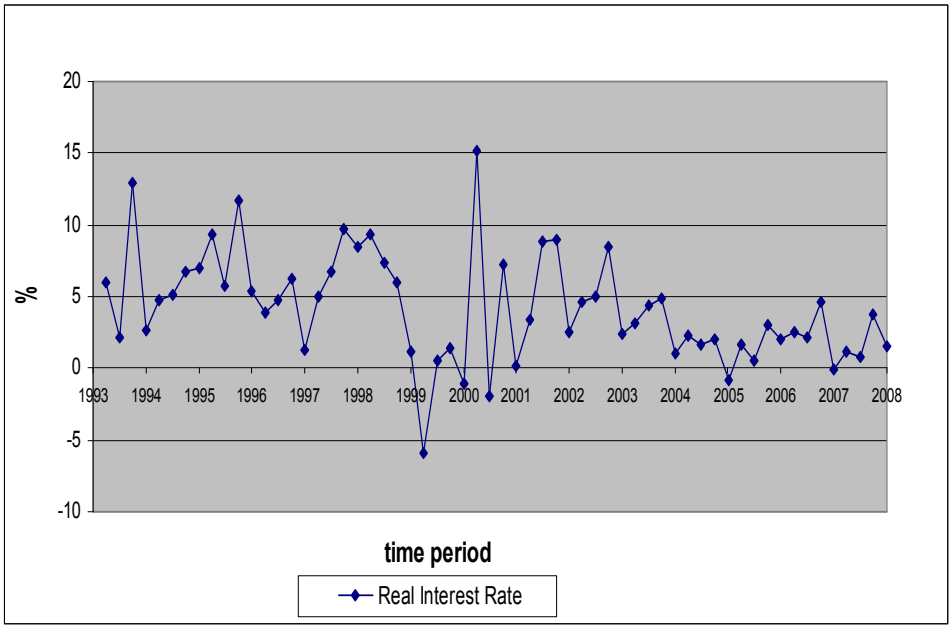

Figure 4-8 Quarterly Figure for Real Interest Rates[38]

Real borrowing costs are displayed in Figure 4-8. Since the real interest rates exclude the inflationary pressures, the values are well below the nominal rates. Higher real interest rates correspond to the peaks in the nominal interest rates in general. The real interest rates reach negative values in year 2000 where inflation levels exceed the nominal rates. Although the path for quarterly real interest rates does not follow a decreasing path in the whole period, it fluctuates below the level of 5 percent since the year 2004, implying a lower risk premium attributed to the Turkish Treasury Bills in the recent years.

The picture for the real growth rates and the real interest rates in the economy is the key determinant for the necessary policy action to establish fiscal sustainability[39]. The higher the difference between the real growth rates and the real interest rates is

[38] Weighted average of the compound annual interest rates accepted in the discounted bonds / bills auctions are taken and then annual rates are converted to the quarterly rates.

[39] See Chapter 4, Menguy (2008) discusses the needed fiscal correction for the countries with different levels of real growth of GDP and the real interest rates.

an indication of the government's future capacity to repay its obligation[40]. The higher gap is desirable since it provides the opportunity for the government to borrow in higher amounts without jeopardizing the fiscal balances within the longer term sustainability perspective. The higher margin is also an implication of lower comparative borrowing costs, so the lower burden on the economy, which is an implication of a lower risk default of the government in the eyes of investors.[41] Therefore, the higher is the real growth of the economy in comparison to the real interest rates, the higher is the investors' confidence, thereby leading to higher the demand for the government bonds. Under this perspective which is explained in more detail in Chapter 4, the path for the real growth rates and the real interest rates for the Turkish economy are depicted in Figure 4-9. Real interest rates are in general above the real growth rates, with the line representing the gap between these macro variables, lying below the zero line almost all the time. The gap widens, parallel to the adverse economic conditions in the years 1994 and 2001, follows a declining trend after year 2001. The gap was closing until the mid 2006 when a foreign exchange triggered fluctuation occurred in the internal financial market. Although the difference was below the level of five after 2004, it worsened with the burst of global financial crises following the declining pattern of real growth rates. The policy response of decline in interest rates in order to boost aggregate demand at the beginning of 2008 has led the gap line to move in the positive area until the real growth rates entered in the negative phase leading to a negative gap again. The dominance of negative gap between the real growth rates and the real interest rates in almost all periods in Turkey is giving signal for the need for extra fiscal measure according to the Menguy's (2008) approach, such as generation of higher primary surplus, in order to stay in a sustainable path. As will be seen in the next chapters,

[40] See Chapter 4, Chalk (2000) states that lower steady state interest rates a comparison to the growth rates is a necessary condition for sustainability.

[41] See Chapter 4, the study of Akemann and Kanczuk (2003) on default probabilities of government and the demand for government debt.

the traditional approach to debt sustainability regarding the stationarity of the debt/ GDP series also supports the view of seemingly unsustainable debt structure of the Turkish fiscal policy within the time under consideration.[42]

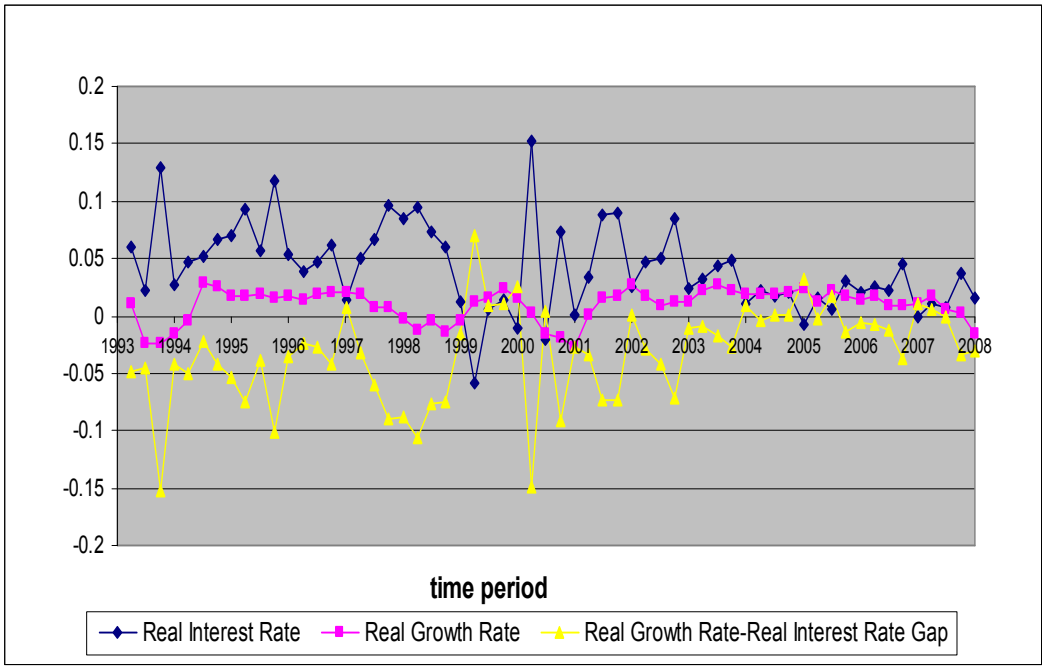

Figure 4-9 Quarterly Figure for Real Growth Rate and Real Interest Rate

4.2 CONCLUDING REMARKS

Central government domestic debt of Turkey as a ratio of GDP has been following a decreasing pattern since year 2001. The increasing trend up to year 2001 has successfully been reversed by the help of the robust monetary and fiscal polices that have helped to improve the macroeconomic conditions. Credible policies followed after the severe 2001 currency crises and certain regulations were set on the financial sector and the corresponding increase in the confidence in financial and borrowing markets, do explain more or less the concomitant decrease in the levels of inflation and the interest rates. Moreover, the increasing path of the GDP in the

[42] Uctum and Wickens' (2000) traditional stationarity test, see chapter five for details.

economy supported by the declining interest and inflation rates has helped to reduce the share of domestic debt stock with respect to the gross domestic production of the economy. The structure of the public debt is also improved thanks to the sensible risk management policies based on increasing borrowing in the domestic market rather than the external market. It is worth to note that this study focuses on the domestic debt of Turkey which is increasing in share and neglects the external part because of its decreasing share.

Besides the enormous improvement in the macro environment, domestic borrowing cost is still above the real growth rate in most periods. However, declining gap between the real interest rate and the real growth rate is a promising sign for the future sustainability of the public domestic debt. Moreover, declining path of the domestic debt stock to GDP series in the recent years is qualitative indicator of a convergence to a sustainable path.

CHAPTER 5

THEORETICAL MODEL

In this chapter, we construct a Vector Auto Regression (VAR) model using the variables that enter in the debt accumulation equation. Turkey's data is utilized in the model and the relationships among macro variables of interest are uncovered. VAR model is used to reveal the interrelations among the variables and to forecast the short-term paths of them.

At the first step, the general VAR representation is introduced. Next, VAR is run by using the data of Turkey. After checking certain diagnostics, impulse response analysis is made and the paths of the macro variables are forecasted for the following four quarters.

5.1 VECTOR AUTO REGRESSION MODEL

The Vector Auto Regression (VAR) is a model in which all the endogenous variables are treated as both dependent and independent and regressed to each other within a system of linear equations. For a system of j endogenous variables, j regressions are generated in which each one variable is treated as the dependent variable respectively. A VAR model containing j equations with k lags for each variable requires j*k parameters to be estimated.

To start with a simple VAR model with two variables and one lag (j=2, k=1), where y_{1t} and y_{2t} denoting the endogenous variables, we end up with the following two regressions;

$$y_{1t} = c_{10} + c_{11}\, y_{1,t-1} + c_{12}\, y_{2,t-1} + u_{1t} \quad (5.1)$$

$$y_{2t} = c_{20} + c_{21}\, y_{1,t-1} + c_{22}\, y_{2,t-1} + u_{2t} \quad (5.2)$$

where the variables y_{1t} and y_{2t} are stationary variables and the disturbance terms $\{u_{1t,}\, u_{2t}\}$ are the white noise disturbance terms (Enders, 1995, p.294) The advantage of the VAR model is that, as stated in Enders (1995), the immediate effects of a change in one variable on the other and the lag with which the effect occurs can be specified separately through the estimation of the coefficients of the VAR model. For example, c_{11} denotes the effect of one unit change in the variable y_{1t} on itself in the following period and similarly c_{12} will denote the aforementioned effect on y_{1t} for the one unit change in y_{2t} in the former period (Enders, 1995, p.294).

Equations (1) and (2) can be incorporated into a matrix representation of the form (Enders, 1995, p.295);

$$Y_t = C_0 + C_1 Y_{t-1} + u_t$$

where Y_t is the matrix representation of the endogenous variables, C_0 and C_1 are the coefficient matrices and u_t is the matrix of residuals.

$$Y_t = \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix},\ Y_{t-1} = \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \end{bmatrix},\ C_0 = \begin{bmatrix} c_{10} \\ c_{20} \end{bmatrix},\ C_1 = \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix},\ u_t = \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix}$$

Here, the error terms are defined as the exogenous shocks given to the system, i.e., u_{1t} is the shock given to the variable y_{1t} and u_{2t} is the shock to the variable y_{2t}. Moreover, the disturbances are mutually independent and normally distributed white noise variables with[43]

[43] Enders (1995), pp: 296-297.
Hendry and Nielson (2007), p.204.

$$E(u_t) = 0,$$

$$\text{cov}(u_{1t}; u_{2t}) = \sigma_{12} = \sigma_{21},$$

$$\text{var}(u_{1t}) = \sigma_{11}^2 \text{ and var } (u_{2t}) = \sigma_{22}^2 \text{ are time independent}$$

$$u_t \sim N(0, \sigma^2)$$

The variance-covariance matrix of residuals are displayed in a variance-covariance matrix of σ which is[44]

$$\sigma = \begin{bmatrix} \sigma_{1,1}^2 & \sigma_{1,2} \\ \sigma_{2,1} & \sigma_{2,2}^2 \end{bmatrix}$$

The VAR model can be generalized for a system of j variables with k lags as;

$$Y_t = C_o + C_1 Y_{t-1} + C_2 Y_{t-2} + \ldots\ldots\ldots + C_k Y_{t-k} + u_t,$$

where the representations refer to the following matrices;

$$Y_t = \begin{bmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ \vdots \\ y_{jt} \end{bmatrix}, \; Y_{t-I} = \begin{bmatrix} y_{1t-i} \\ y_{2t-i} \\ \vdots \\ \vdots \\ y_{jt-i} \end{bmatrix}, \text{ where } i=1,...,k, \; C_0 = \begin{bmatrix} c_{01} \\ c_{02} \\ \vdots \\ \vdots \\ cj \end{bmatrix},$$

[44] Enders (1995), pp: 296-297.

$$C_i = \begin{bmatrix} c_{11}^i & c_{12}^i & \cdots & \cdots & c_{1j} \\ c_{21}^i & c_{22}^i & \cdots & \cdots & c_{2j}^i \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ c_{j1}^i & c_{j2}^i & \cdots & \cdots & c_{jj}^i \end{bmatrix}, \; i=1,..,\, k\,, \quad \text{and } u_t = \begin{bmatrix} u_{1t} \\ u_{2t} \\ \vdots \\ \vdots \\ u_{jt} \end{bmatrix}$$

The system of VAR with j variables and k lags can be reduced to the following form[45];

$$Y_t = C_0 + C\,(L)\, Y_t + u_t$$

$$Y_t \equiv (Y_{1t}, \ldots, Y_{jt})$$

$$u_t \sim N\,(0, \sigma^2)$$

where C(L) denotes the coefficient matrix of the lags of Y_t and u_t is the matrix of normally distributed residuals with mean zero and variance σ^2.

VAR analysis can be used to analyze impulse responses of each variable. This can be defined for y_{1t} as $\kappa_{1i\,(m)}$, meaning the effect of a one unit change in shocks in y_{it} on $y_{1,t+m}$ (Enders 1995, p.306). Cholesky ordering of the variables is significant in a VAR model. Cholesky decomposition of a matrix M is defined as the upper triangular matrix N for which product of matrix N and its transpose (N^T) gives matrix M. Therefore, any matrix N for which $NN^T = M$ holds is the Cholesky factor of matrix M[46]. As Garcia and Rigobon (2004) states, the variance covariance matrix of the residuals has several triangular factorizations, changing in accordance with the ordering of the variables in the VAR. Any Cholesky ordering of variables produces the same variance covariance matrix, ($\sigma = N_i N_i^T$, all N_i represent the different Cholesky orderings), however the impulse responses will differ according

[45] See Garcia and Rigobon (2004).

[46] Gatu and Kontoghiorghes (2006), p.723

to the ordering of the variables. The shock given to one variable in a VAR system will directly affect that variable, and indirectly will evolve to other variables within certain time periods (or after certain lag). The way of transmission of the shocks to the other variables will change according to the ordering of the variables. In other words, although the ordering is irrelevant for the risk management perspective (Garcia and Rigobon, 2004), it is important for impulse response analysis.

The use of VAR model in this thesis is built upon the following advantages of this model. In a VAR model, there is no need to investigate which variable to regress to the other (i.e. the direction of causality) but all included endogenous variables are regressed to each other and purely exogenous variables such as trend and seasonal factors can also be included[47]. Since the effect of a change in any endogenous variable on the others can be separately revealed in the VAR model, change in the value of an endogenous variable can be decomposed into the separate effects stemming from the changes in all variables in the model. This can be managed through the impulse response analysis. Furthermore, since impulse response analysis is done for a number of following periods, the analysis provides a better economic intuition regarding the relationships among the variables. Moreover, the estimation of the VAR model is done through the simple OLS procedure and the forecast performance of the VAR model is found better than the other models such as simultaneous equation models. (Gujarati, 1995, p.749).

One of the problems with the VAR model arises when choosing the appropriate lag length. For a VAR model with k lags and j variables, k*j +1 parameters need to be estimated for each equation and j*(kj+1), i.e. kj^2+j, for the whole system of equations including the intercept terms. As $j+kj^2$ parameters to be estimated in a VAR model, unless the sample size is large enough, one should be conservative in choosing the appropriate lag length. Juselius (2006) discusses the challenge

[47] Gujarati (1995), p.749.

introduced by the lag number and the number of variables in the VAR model[48]. It is stated that adding one variable to an j variable VAR model with k lags will cause k(2j+1) + 1 new parameters to be estimated. Furthermore, when the lag length is increased by one, j^2 new parameters should be estimated. Thus, for a quarterly model with sample size of 50 to 100, it is suggested to keep the number of parameters to be estimated as low as possible (Juselius, 2006). Moreover, although it is preferred to increase the lag length in some cases such as to decrease autocorrelation, Juselius (2006) suggests adding a relevant variable instead, to conserve degrees of freedom.

Another problem arises in the stationarity analysis of the variables in VAR. Gujarati (1995) states that all j variables in a VAR should be stationary and the nonstationary ones should be transformed in an appropriate way (differencing; etc). However Sims (1980) does not recommend differencing in VAR and claims that differencing will cause loss of information regarding the co-movement of variables. Sims (1980) argues that the main aim in VAR is not the parameter estimation but to asses the relationships among variables and thus, do not recommend differencing even in cases of unit root. One problem proposed by Garcia and Rigobon (2004) is that when the variables in VAR are nonstationary but cointegrated an Error Correction Model should be run. However, the data set should be lengthy enough to use this alternative. Although none of the variables in the model of Garcia and Rigobon (2004) are stationary, they do not run an error correction model due to the narrow sample size and refer to the proposition of Rothenberg and Stock (1997) that VAR produces consistent estimates even in near unit root steps.

Finally, what Gujarati (1995) proposes further is that, in VAR, the interpretation of the individual coefficients are usually difficult. Therefore, impulse response functions that show the effect of the shock given to a variable on the others provide

[48] Juselius, 2006, p.78

a more meaningful interpretation. Moreover, the individual coefficients in a VAR model may not be significant, the reason of which can be multicollinearity, as pointed out by Gujarati (1995). It is further stated that rather than the individual t tests on the coefficients, the F tests may give a more comprehensive picture, because the variables may be collectively significant.

5.2 VAR MODEL FOR TURKEY

In this part, we define the variables and specify the VAR model for Turkey. The estimates of the VAR model are used to uncover the relationships of the macro variables and to generate future paths.

5.2.1 Model Specification

The following VAR model is used in the estimation for the macro variables of Turkey, using the quarterly data within the period 1994Q1 and 2008Q4.

$$Y_t = C_0 + C(L)\, Y_t + u_t$$[49]

$$Y_t \equiv (g_t, r_t, f_t, p_t)$$

$$u_t \sim N(0, \sigma^2)$$

where Y_t is the matrix of the endogenous variables which are selected as in Garcia and Rigobon (2004). C_0 is the matrix of intercept terms, C is the matrix of coefficients and L is the lag operator. The residual term is denoted by u_t, which is normally distributed with mean zero and variance σ^2. In our VAR model, we incorporate four endogenous variables; that are real growth rate (g_t), real interest rate (r_t), primary deficit/GDP ratio (f_t) and the debt shock (p_t) respectively. In determining the ordering of the variables, we take Garcia and Rigobon (2004) as

[49] See section 5.1 for the reduced form of VAR representation.

our reference point, with a slight difference in the order of g_t and r_t. Unlike Garcia and Rigobon (2004), we use g_t in the first order, as recent negative global growth performance had a significant effect on the macro balances. Garcia and Rigobon (2004) have included six variables in their model, including the inflation rate and the real exchange rate depreciation. However, in our analysis, the sample size is not large enough to run a six variable VAR model. In order to conserve degrees of freedom, we reduced the number of endogenous variables in the analysis and we excluded real exchange rate depreciation since it does not enter in the debt accumulation equation in our central government debt analysis[50]. Moreover, inflation rate is not also included in our analysis, besides the fact that it is utilized in calculating the values of the real interest rate. "p_t" is defined as the debt shock by Garcia and Rigobon (2004), which is simply the difference between the actual debt to GDP ratio of period t and the derived debt to GDP ratio using the former period's data in the debt accumulation equation as follows;

$$p_t = b_t - (1 + r_t - g_t)\, b_{t-1} - f_t$$

We do not use variable b_t (debt to GDP ratio at period t) but instead include p_t in our analysis. The reason for this is that debt / GDP ratio is nonstationary within the period and can not be used in the VAR model without differencing. As discussed in the previous part, in a VAR model it is better to include stationary variables as a whole and differencing is not suggested. Since p_t follows stationary path within the period, it is included in the model derived in levels.

[50] We first run the VAR model with all six variables however the diagnostic results were not satisfactory. (See Appendix A) Then, we continued with the other five variables, excluding s_t. Some alternative models with five variables are also illustrated in Appendix A. However, we also had to exclude inflation rate from the analysis and continued with four endogenous variables in the VAR; g_t, r_t, f_t, p_t

In the analysis quarterly data are used for the period 1994Q1-2008Q4. The data for the real GDP is taken from the Turkish Statistical Institute website. The quarterly real GDP values are annualized in a moving average method, as summarized in Figure 5-1 and the following calculations.

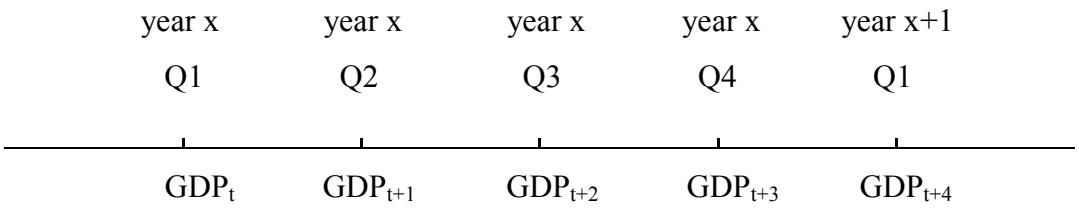

Figure 5-1 Timeline and the Quarterly GDP

Based on the timeline and the data in Figure 5-1;

Annualized GDP for year x, Q4 = $GDP_t + GDP_{t+1} + GDP_{t+2} + GDP_{t+3} = Y_{t+3}$

Annualized GDP for year x+1, Q1 = $GDP_{t+1} + GDP_{t+2} + GDP_{t+3} + GDP_{t+4} = Y_{t+4}$

Real GDP growth for year x+1, Q1 is proxied by the formula;

$$g_{x+1,q1} = (Y_{t+4} - Y_{t+3}) / Y_{t+3}$$

Weighted average nominal interest rates accepted in Treasury bill/bond auctions in that quarter is the nominal interest rate input ($i_{nominal}$) and real interest rate (r_t) is calculated through the Fisher Equation (1930);

$$(r_t = i_{nominal} - \text{inflation rate})$$ [51]

[51] Weighted average interest rates for the discounted bonds/bills accepted in Treasury auctions are available on the Turkish Treasury website, starting from the year 2005. Data of the former years are calculated (by simply weighting the interest rate accepted in an auction with the amount sold) using the information regarding the Treasury auctions available on Electronic Data Delivery System (EDDS) of Central Bank of Republic of Turkey (CBRT).

Primary deficit data is found from the website of General Directorate of Public Accounts and the inflation rate is calculated by the changes in the Consumer Price Index (CPI) (available on the Turkish Statistical Institute website). Finally, the debt shocks are computed with the Garcia and Rigobon's (2004) method, using the debt accumulation equation:

$$p_t = b_t - (1 + r_t - g_t)\, b_{t-1} - f_t$$

The statistical properties of the variables are given in Table 5-1 and the graphs of the variables are presented in Figure 5-2

[52] We included "inflation rate" also in the analysis at first. However, as explained in the next part, we excluded it from the analysis later on and continued the VAR analysis with the remaining four variables.

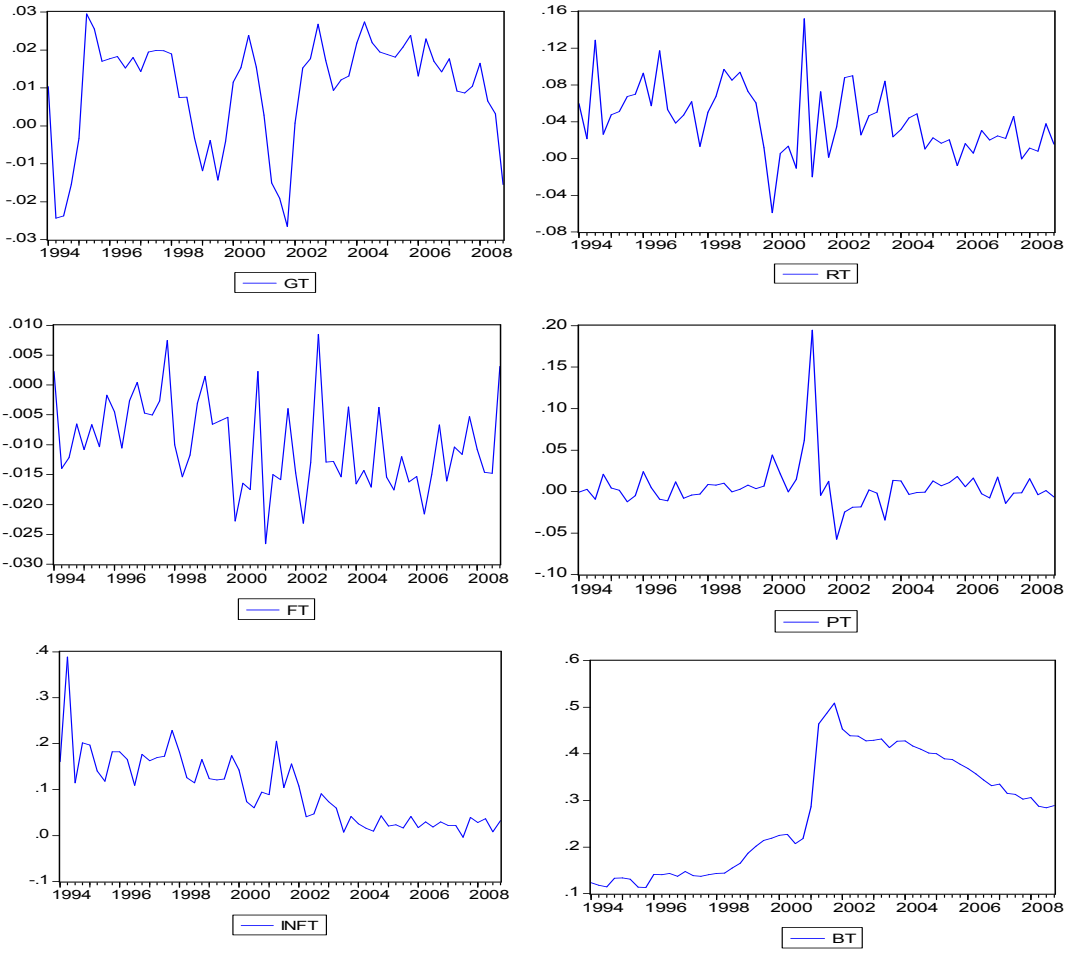

Figure 5-2 Graphs of the Macrovariables

(GT is real growth rate, RT denotes the real interest rate, FT is the fiscal deficit/GDP ratio, PT denotes the debt shock, INFT is the inflation rate and BT denotes debt stock GDP ratio).

Variable	Real GDP Growth Rate	Real Interest Rate	Primary Deficit/GDP	Debt Shock	Inflation Rate	Debt Stock / GDP
Number of Observations	60	60	60	60	60	60
Mean	0.0095	0.0419	-0.0099	0.0054	0.0978	0.2778
Median	0.0147	0.0381	-0.0112	0.0016	0.0926	0.2869
Maximum	0.0295	0.1520	0.0085	0.1947	0.3880	0.5085
Minimum	0.0266	-0.0590	-0.0266	-0.0575	-0.0037	0.1131
Std. Dev.	0.0142	0.0378	0.0075	0.0299	0.0759	0.1249
Skewness	1.0634	0.4145	0.3312	4.2329	0.9801	0.1274
Kurtosis	3.1622	3.6389	2.7787	28.3233	4.6296	1.5332

Table 5-1 Descriptive Statistics of the Variables

Variable	Unit Root Test	Test Statistic	Number of Lags
Real Growth Rate	ADF	-3.711772	1
	PP	-2.868660*	1
Real Interest Rate	ADF	-6.630737	0
	PP	-6.699831	3
Primary Deficit/GDP	ADF	-15.11849	2
	PP	-8.999322*	2
Debt Shock	ADF	-6.137366	0
	PP	-6,137366	0
Inflation Rate	ADF	-7.086616	0
	PP	-7.155253	2
Debt Stock/GDP	ADF	-1.498880*	1
	PP	-0.958014*	1

Table 5-2. Unit Root Test Statistics of the Variables

" * " implies the presence of unit root at 5 percent significance level.

Augmented Dickey Fuller (ADF) and Philips Perron (PP) tests with trend and intercept are applied to the macro variables to check for the unit root after taking into account seasonality. The critical values for %5 significance level for the tests are approximately "-3.49" for both of the tests and the null hypothesis is that the variable has a unit root. As seen in Table 5-2, debt stock/ GDP ratio (b_t) is not stationary according to both of the tests while other variables are indicated to be

stationary by at least one of the tests. It is worth to note that, as seen in Figure 5-2, there are outliers corresponding to years 1994 and 2001 due to two severe macroeconomic crises and ADF and PP tests may be misleading as these outliers are not taken into account because of the highly erratic structure of the variables. Variable b_t is nonstationary for both of the tests and we excluded b_t from the analysis but included debt shock (p_t) instead.

We could have transformed the nonstationary variables through differencing; however, it would cause a loss in degrees of freedom. Furthermore, differencing in a VAR model is not usually recommended by scholars, but rather it is preferred to work in levels (See Section 5.1. for comments on VAR model). .Therefore, rather than to transform b_t, we have included p_t, which is stationary, in the analysis.

As a result, the VAR analysis for Turkey starts with incorporating the variables; real growth rate of GDP (g_t), real interest rate (r_t), primary fiscal deficit / GDP ratio (f_t) and the debt shock (p_t)[52]. Moreover, since we are working on quarterly data, seasonal dummies are incorporated to the model. Lag length of the model is selected according to various criteria; such as Likelihood Ratio, Final Prediction Error, Akaike Information Criterion, Schwarz Information Criterion and the Hannan-Quinn Information Criterion.

Estimation is done in two ways, each of them incorporating the seasonal effects. Firstly, the model is estimated using the seasonally adjusted data for the real GDP and the consumer price index (CPI). Seasonal adjustment is done using the "Tramo Seats" interface of EViews. Secondly, the estimation is done through incorporating seasonal dummies as exogenous variables. We selected the model by comparing the diagnostic results for the different models alternatives that are given in Appendix A.

[52] We included "inflation rate" also in the analysis at first. However, as explained in the next part, we excluded it from the analysis later on and continued the VAR analysis with the remaining four variables.

We run both five variable and four variable models (with seasonal dummies or with seasonally adjusted data)[53]. Depending upon the diagnostics, we decided on a model including four endogenous variables; g_t, r_t, f_t, p_t. and three seasonal dummies. As can be seen in Appendix A, models with five endogenous variables have some problems since increasing the lag length causes nonnormality in residuals whereas decreasing the lag length increases degree of autocorrelation. Therefore, we opted to exclude one variable from the model and dropped inflation rate[54]. As a result, the model used in the analysis includes four endogenous variables; rate of real growth, real interest rate, primary deficit/GDP ratio and the debt shock/ GDP; with the given order.

5.2.2 Model in Detail

The VAR model estimated for Turkey has four endogenous variables; g_t, r_t, f_t, p_t as well as six exogenous variables which are the constant term c, the trend term t, the dummy variable at the first quarter of the year 2000 and three seasonal dummy variables. The optimal lag length of the model is chosen taking into account various lag length selection criteria and these are Likelihood Ratio, Final Prediction Error, Akaike Information Criterion, Schwarz Information Criterion and the Hannan-Quinn Information Criterion.

[53] See Appendix A for details.

[54]Fisher equation (1930) which is used in the calculation of the real interest rate gives the linear relationship of real interest rate and the inflation rate, by which the effect of the inflation rate is already included in the analysis.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	622.637	NA	4.15e-15	-21.7686	-20.8926	-21.4298
1	673.353	82.9910	1.19e-15	-23.0310	-21.5711	-22.4664
2	706.264	49.0674	6.62e-16	-23.6459	-21.6021*	-22.8556*
3	721.823	20.9336	7.10e-16	-23.6299	-21.0021	-22.6137
4	746.286	29.3564*	5.70e-16	-23.9377	-20.7259	-22.6957
5	769.931	24.9340	4.96e-16*	-24.2156*	-20.4200	-22.7478
* *indicates lag order selected by the criterion*						
LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Table 5-3 Lag Selection Criteria

According to the results in Table 5-3 final prediction error and Akaike information criterion suggest lag order of five, whereas Schwarz information criterion and Hannan-Quinn information criterion suggest lag order of two. In our analysis we keep our lag length as small as possible to prevent loss of degrees of freedom. Therefore, we decided not to increase the lag length beyond four (Since the data is seasonal, increasing the lag length up to four seasons is reasonable). Furthermore, our analysis shows that a model with two lags provides better diagnostics than a model with higher lags and therefore we stick to the model with two lags. In fact, Palardy (2002) claims that Akaike information criteion is biased towards selecting a higher lag.[55]

[55] Palardy (2002) defines the Scwarz Information Criterion as "Log (σ^2) + m log (T) /T" and the Akaike Information Criterion as "Log (σ^2) + 2m / T" in which σ^2 is the estimated variance of residuals and T is the sample size and m is the number of parameters. Moreover Palardy (2002) continues that left hand sides of these crieteria are the "goodness-of-fit" measures and the right hand sides are the penalty terms for addition of parameters. Furthermore, Palardy (2002) states that for large sample size, AIC puts less penalty for additional parameter and suggests higher lags than SC.

We estimate the following model with four endogenous variables; g_t, r_t, f_t and p_t, a constant (c), a trend term (t), a dummy variable (d5) at the first quarter of 2000 and three seasonal dummies (@seas). Estimation results are given in Table 5-4.

Vector Autoregression Estimates
Sample (adjusted): 1994Q3 2008Q4
Standard errors in ( ) & t-statistics in [ ]
Included observations: 58 after adjustments

	g_t	r_t	f_t	p_t
g_t (-1)	0.722997	-0.875623	0.065432	0.114487
	(0.11368)	(0.42978)	(0.07802)	(0.34849)
	[6.35974]	[-2.03739]	[0.83868]*	[0.32852]*
g_t (-2)	-0.068983	0.986119	0.017764	0.186640
	(0.11437)	(0.43237)	(0.07849)	(0.35059)
	[-0.60317]*	[2.28075]	[0.22632]*	[0.53236]*
r_t (-1)	-0.083472	-0.053239	0.026086	0.502816
	(0.03384)	(0.12792)	(0.02322)	(0.10372)
	[-2.46695]	[-0.41620]*	[1.12341]*	[4.84766]
r_t (-2)	0.035377	0.219201	0.079850	-0.474466
	(0.04081)	(0.15426)	(0.02800)	(0.12509)
	[0.86698]*	[1.42096]*	[2.85143]	[-3.79310]
f_t (-1)	0.044846	0.360850	-0.026492	-0.745549
	(0.21163)	(0.80007)	(0.14524)	(0.64875)
	[0.21191]*	[0.45102]*	[-0.18240]*	[-1.14920]*
f_t (-2)	-0.829556	-1.013180	0.150173	1.162327
	(0.20188)	(0.76319)	(0.13854)	(0.61884)
	[-4.10924]	[-1.32757]*	[1.08395]*	[1.87822]

p_t (-1)	-0.152010	-0.387714	-0.036646	0.627379
	(0.04667)	(0.17645)	(0.03203)	(0.14308)
	[-3.25680]	[-2.19729]	[-1.14407]*	[4.38485]
p_t (-2)	-0.064574	-0.064528	0.030255	-0.014820
	(0.03918)	(0.14813)	(0.02689)	(0.12012)
	[-1.64796]*	[-0.43561]*	[1.12512]*	[-0.12338]*
c	0.001725	0.036818	-0.005389	-0.007016
	(0.00558)	(0.02111)	(0.00383)	(0.01712)
	[0.30892]*	[1.74400]	[-1.40616]*	[-0.40986]*
t	-0.000208	-0.001019	-3.61E-05	1.94E-05
	(7.9E-05)	(0.00030)	(5.4E-05)	(0.00024)
	[-2.62545]	[-3.40116]	[-0.66387]*	[0.07984]*
d5	0.013354	-0.093591	-0.009770	0.032095
	(0.00787)	(0.02975)	(0.00540)	(0.02412)
	[1.69704]	[-3.14600]	[-1.80905]	[1.33048]*
@seas(1)	-0.001241	0.018629	-0.010450	0.043156
	(0.00358)	(0.01355)	(0.00246)	(0.01098)
	[-0.34633]*	[1.37528]	[-4.24976]	[3.92920]
@seas(2)	0.013241	0.036224	-0.010493	-0.006630
	(0.00394)	(0.01488)	(0.00270)	(0.01207)
	[3.36363]	[2.43403]	[-3.88411]	[-0.54940]*
@seas(3)	0.001878	0.048198	-0.009121	-0.003665
	(0.00291)	(0.01100)	(0.00200)	(0.00892)
	[0.64538]*	[4.38020]	[-4.56637]	[-0.41080]*
R-squared	0.788945	0.613555	0.660220	0.597949
Adj. R-Squared	0.726588	0.499378	0.559831	0.479161

Sum sq. Resids	0.002257	0.032253	0.001063	0.021206
S.E. Equation	0.007162	0.027074	0.004915	0.021954
F-statistic	12.65207	5.373729	6.576589	5.033760
Log Likelihood	212.1760	135.0448	234.0120	147.2045
Akaike AIC	-6.833654	-4.173958	-7.586621	-4.593258
Schwarz SC	-6.336306	-3.676609	-7.089273	-4.095910
Mean Dependent	0.010086	0.041942	-0.010031	0.005576
S.D. Dependent	0.013696	0.038265	0.007408	0.030420

Determinant Resid Covariance (dof adj.)	2.64E-16
Determinant resid covariance	8.75E-17
Log likelihood	743.0676
Akaike information criterion	-23.69199
Schwarz criterion	-21.70259

Table 5-4. Estimation Output for the Model

("*" indicates the variables which are insignificant at the %5 significance level.)

We apply t-test for the individual significance of the variables. The critical t-statistic for 5% level of significance and 63 degrees of freedom is between 1.671 and 1.664. Fiscal deficit/GDP ratio of the previous period is insignificant in explaining the movements of any variable in the existing period. However, it has explanatory power on the variables g_t and p_t with a lag of two. Therefore, fiscal performance of the economy is felt with lag on the macro balances of the economy, the economic growth and the debt stock. Moreover, debt shock is significant in explaining the behavior of the variables g_t, r_t and p_t with one lag, but fails to explain any of them with two lags. Thus, movements in the debt stock is immediately reflected on the growth performance, real cost of borrowing and also feeds itself for the next period. Basing upon these results, macro balances of the economy is

promptly responsive to the debt accumulation which stresses the significance of taking the changes in the debt stock under control.

Besides the diagnostics, various tests are applied in order to test the performance of the model. Firstly, as we see in Table 5-5, all roots of the characteristic polynomial are inside the unit circle and thus, VAR satisfies the stability condition.

Roots of Characteristic Polynomial Endogenous variables: g_t, r_t, f_t, p_t Exogenous variables: c t d5 @SEAS(1) @SEAS(2) @SEAS(3) Lag specification: 1 2	
Root	**Modulus**
0.711642 - 0.383716i	0.808500
0.711642 + 0.383716i	0.808500
0.599972	0.599972
-0.476606 - 0.103826i	0.487784
-0.476606 + 0.103826i	0.487784
0.062260 - 0.341195i	0.346829
0.062260 + 0.341195i	0.346829
0.076080	0.076080
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

Table 5-5 Roots of the Characteristic Polynomial

VAR Granger Causality/Block Exogeneity Wald Tests are applied in order to check if any of the endogenous variables in the model should be treated as exogenous. The null hypothesis for the test is that excluded variable does not have any influence on the dependent variable. Rejection of the null hypothesis for at least one variable implies that dependent variable is explained by at least one other variable, thus regressing that dependent variable against others is meaningful. However, if null hypothesis is not rejected for any variable (i.e. all variables other than the dependent one can be excluded) then that dependent variable should be treated as exogenous. Table 5-6 shows the test result for the significance of the lags of the endogenous variables other than the dependent variable, in explaining the value of the dependent

variable. Since all the dependent variables are influenced by the lags of at least one of the other endogenous variables, all variables in the model are endogenous for the 5% significance level.

VAR Granger Causality / Block Exogeneity Wald Tests
Sample: 1994Q1 2008Q4
Included observations: 58

Dependent Variable: g_t			
Excluded	**Chi-sq**	**Df**	**Prob.**
r_t	6.171167	2	0.0457
f_t	16.88792	2	0.0002*
p_t	18.05696	2	0.0001*
All	29.10718	6	0.0001*
Dependent Variable: r_t			
Excluded	**Chi-sq**	**Df**	**Prob.**
g_t	5.529576	2	0.0630
f_t	1.920580	2	0.3828
p_t	6.113658	2	0.0470*
All	10.05710	6	0.1223
Dependent Variable: f_t			
Excluded	Chi-sq	Df	Prob.
g_t	2.125776	2	0.3455
r_t	11.55283	2	0.0031*
p_t	1.988626	2	0.3700
All	12.12077	6	0.0593
Dependent Variable: p_t			
Excluded	Chi-sq	Df	Prob.
g_t	1.329808	2	0.5143
r_t	30.92193	2	0.0000*
f_t	4.681531	2	0.0963
All	48.50701	6	0.0000*

Table 5-6 Granger Causality/Block Exogeneity Wald Tests

("" denotes the variables, the lags of which are significant in determining the values of the dependent variable for the 5% level of significance.)*

VAR residuals are tested for the serial autocorrelation by using the LM test. The null hypothesis that there is no residual autocorrelation up to the lag order h

(maximum length tested here is chosen as twelve) is not rejected for any of the lag order at the %5 significance level. [56]

VAR Residual Serial Correlation LM Tests H0: no serial correlation at lag order h Sample: 1994Q1 2008Q4 Included observations: 58		
Lags	**LM-Stat**	**Prob**
1	26.06036	0.0532
2	19.40475	0.2482
3	13.29021	0.6514
4	11.30146	0.7905
5	15.85019	0.4635
6	14.88544	0.5330
7	17.14661	0.3762
8	20.26163	0.2087
9	21.70883	0.1528
10	8.138019	0.9447
11	12.87654	0.6818
12	17.35074	0.3633
Probs from chi-square with 16 df.		

Table 5-7 LM Test Statistics

In order to test the normality of the residuals, Cholesky (Lutkepohl) normality test is applied. The test results in Table 5-8 show that all the variables are individually and jointly multivariate normal with 5% level of significance.

[56] We have chosen the lag length for VAR model by comparing the values of the various information criteria up to the lag length of five. Actually, we did not prefer to increase the lag length of the model beyond four in order to conserve degrees of freedom and according to the criteria suggestions we decided on a lag length of two. LM test results here show that there is no autocorrelation problem, indeed, up to the lag length of twelve.

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Sample: 1994Q1 2008Q4
Included observations: 58

Component	Skewness	Chi-sq	Df	Prob.
1	-0.107537	0.111786	1	0.7381
2	0.553660	2.963209	1	0.0852
3	0.295447	0.843793	1	0.3583
4	0.289152	0.808221	1	0.3686
Joint		4.727010	4	0.3165

Component	Kurtosis	Chi-sq	Df	Prob.
1	1.928868	2.772699	1	0.0959
2	2.450784	0.728960	1	0.3932
3	1.855292	3.166693	1	0.0752
4	2.219182	1.473387	1	0.2248
Joint		8.141739	4	0.0865

Component	Jarque-Bera	Df	Prob.	
1	2.884486	2	0.2364*	
2	3.692169	2	0.1579*	
3	4.010486	2	0.1346*	
4	2.281608	2	0.3196*	
Joint	12.86875	8	0.1164*	

Table 5-8 Residual Normality Test
(denotes normality at 5% level of significance)*

VAR residuals are tested for heteroscedasticity using the White Heteroscedasticity Test. The joint test results are suggesting that there is no heteroscedasticity at %5 significance level (p-value is 0.1930)

VAR Residual Heteroscedasticity Tests:
Sample: 1994Q1 2008Q4
Included observations: 58

Joint test:		
Chi-sq	**Df**	**Prob.**
237.9860	220	0.1930

Table 5-9 Residual Heteroscedasticity Test

5.2.3 Impulse Response Analysis

Since individual coefficients are difficult to interpret in a VAR model, we analyze the impulse response functions. Figure 5-3 shows impulse response of the macrovariables; g_t, r_t, f_t and p_t to Cholesky one standard deviation innovations for the following ten periods. Impulse response of each variable is presented in Appendix B. Moreover, for ease of understanding, the impulse responses of all variables to the innovation in a variable are presented in the following figures.

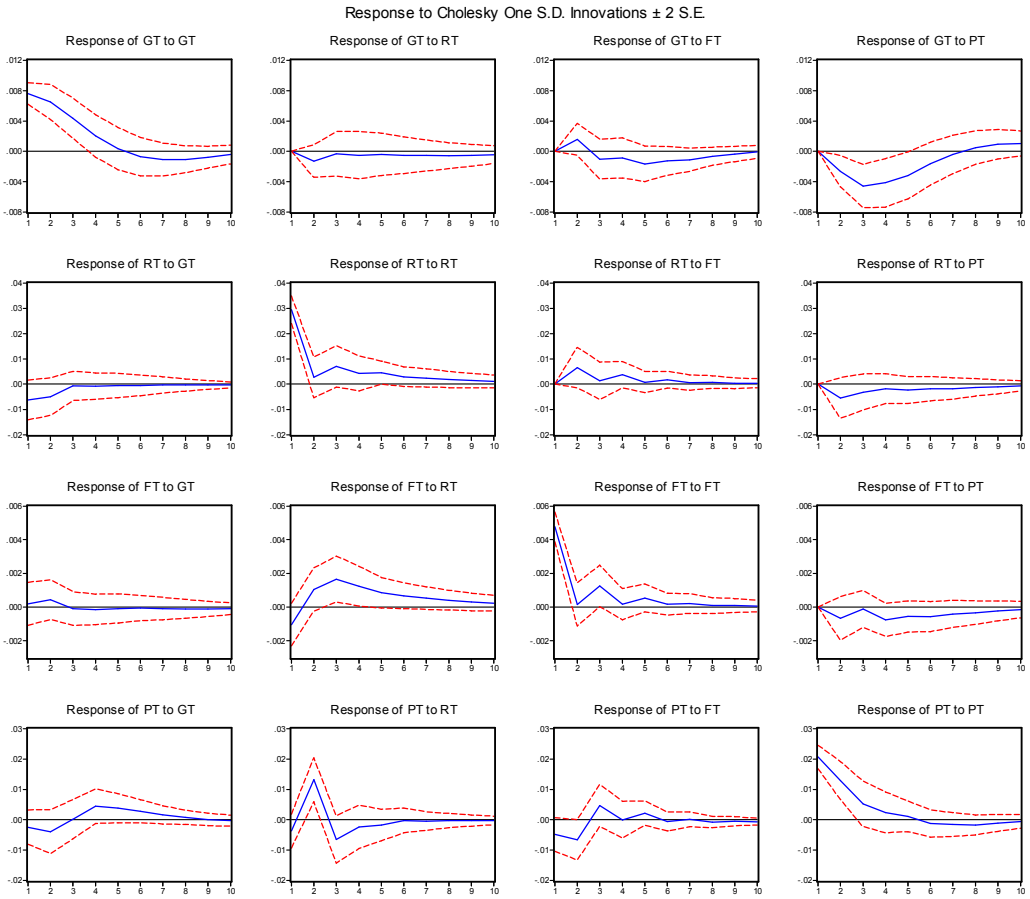

Figure 5-3 Impulse Response Function of Each Variable to Cholesky One Standard Deviation Innovation for the Following 10 Periods

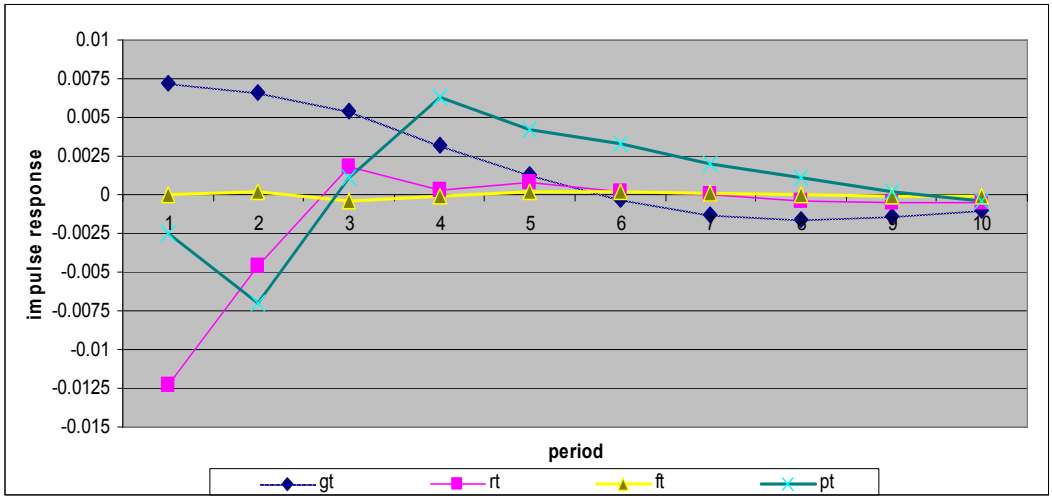

Figure 5-4 Response to One Standard Deviation Change in Variable g_t

Figure 5-4 shows impulse response of the macro variables to changes in real growth rate for the following ten quarters. Real growth response to changes in itself is positive in the first five quarters and then falls to negative values. Real interest rate responds in a negative way in the first two quarters to the positive growth performance and jumps to positive values in the third quarter. However, positive response of real interest rate follows a declining pattern in the following periods. Fiscal deficit does not have a significant response to a positive growth shock in the whole period. After a positive response of the first two quarters, fiscal deficit response is negative in the third and fourth quarter as a result of the positive effect of growth performance on the fiscal balances. Response of fiscal deficit is again negative in the last three quarters. Negative response of debt shock to a positive real growth shock lasts for at least two quarters and then rises to positive levels and follows a declining trend until reaching a negative value on the last quarter again. In the first periods, the realizations of debt/GDP falls more than the expected fall in the debt/GDP as a result of the increase in real growth rate. Therefore, the debt shock, which is the difference between actual and the expected debt/GDP, (calculated from the debt accumulation equation) responds negatively at first.

Afterwards, the expectations are adjusted for the rise in the real growth rate and the debt shock rises to positive levels.

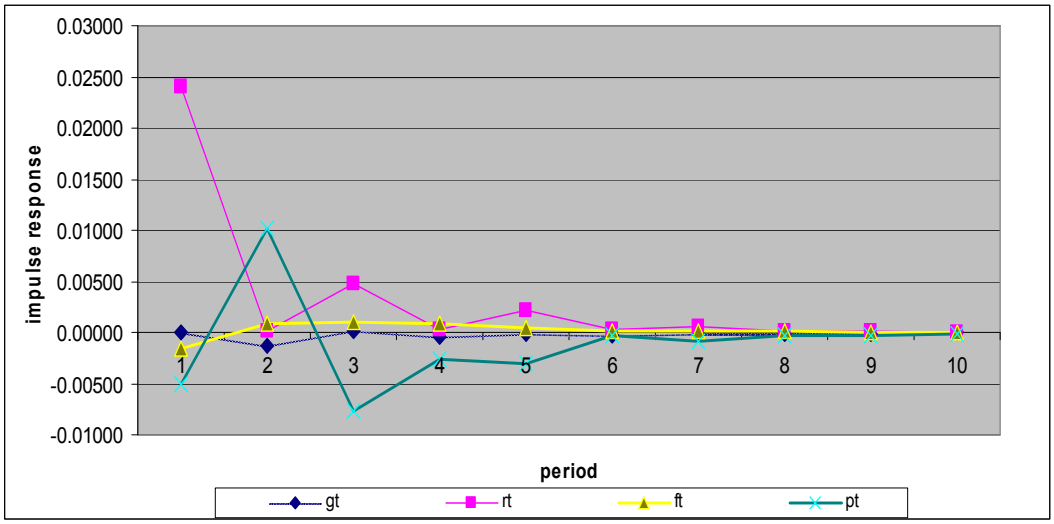

Figure 5-5 Response to One Standard Deviation Change in Variable r_t

Impulse responses of the variables to one unit change in the real interest rates are seen in Figure 5-5. Real growth rates are mostly negative in response to an adverse real interest rate shock, which can be explained by the contraction of the economy due to the crowding out of the private expenditures by the high real interest rates. Real interest rate response as a result of the initial shock to itself is positive in the ten quarter period. Real interest rates move in huge and positive amounts in the beginning as a response to the adverse signal in the economy and the responses decline in the following periods, nearly vanishing in the last periods. After an initial negative response of fiscal deficit, it responds positively in the following periods. Rise in real interest rates causes a decrease in aggregate production and thus a decline in public revenues (and correspondingly primary balances). Therefore, fiscal deficit response is positive in nearly whole period. Impulse response of debt shock to a rise in real interest rates is mostly negative in the following ten periods. This negative response is not unexpected since debt shock is not the actual debt stock/GDP ratio but rather a differential term between the realizations of debt stock

and the expectations driven from the debt accumulation equation. Since debt shock is the unexpected part of the existing debt stock, negative response of e_t can be interpreted in a way that expectations are adjusted for the adverse effect of a real interest rate shock on the debt stocks.

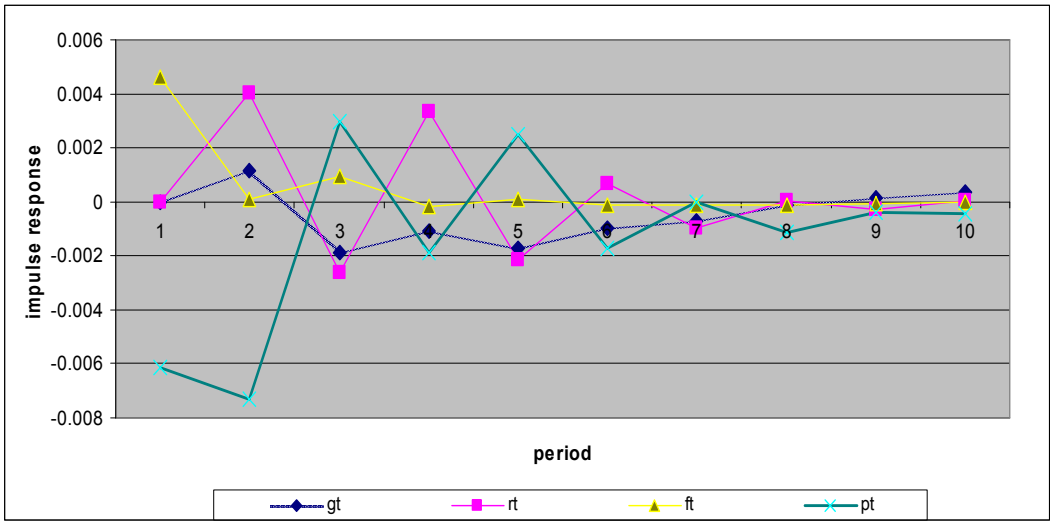

Figure 5-6 Response to One Standard Deviation Change in Variable f_t

Figure 5-6 shows the impact of one standard deviation change in fiscal deficit on the macro variables. The real growth response is negative on the third quarter and this negative response lasts for six quarters. Negative impulse response of real growth rate to a fiscal deficit shock reflects negative impact of fiscal deficit on the growth performance, i.e. showing the crowding out of the private expenditures by the rising financing need of the public sector. Fiscal deficit response is positive in the first three quarters and then declines to negative values in some periods in which there is no significant response at all. Impulse response of the real interest rate and the debt shock to a fiscal deficit shock follows a volatile path; in which negative response of real interest rate mostly coincide with positive response of the debt shock. This result is consistent with the negative response of debt shocks to real interest rates which was explained in Figure 5-5.

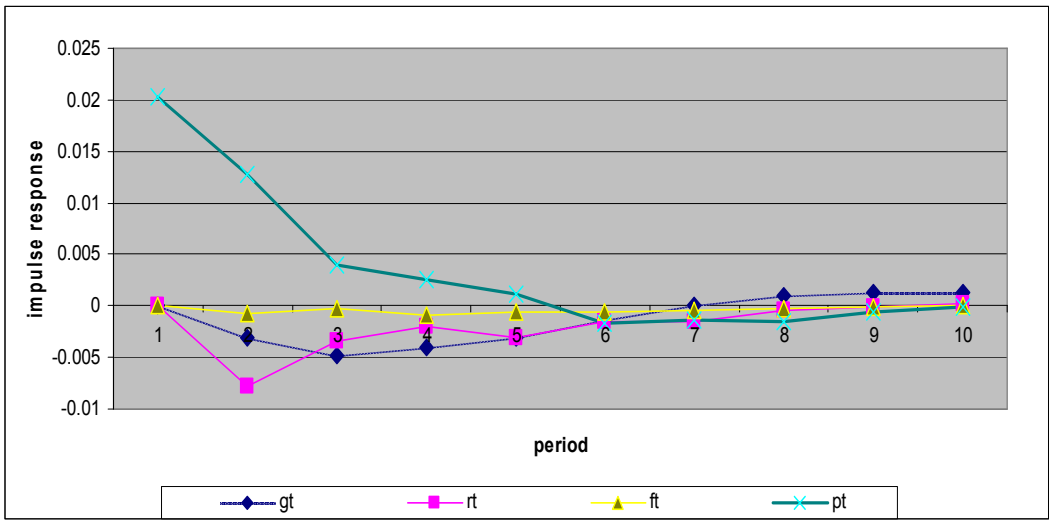

Figure 5-7 Response to One Standard Deviation Change in Variable p_t

As seen in Figure 5-7, debt shock response to itself is positive for at least five periods. Real growth response to the debt shock is negative for six periods, due to the negative effect of debt accumulation on the growth performance of the economy. Impulse response of real interest rate and the fiscal deficit to the debt shock stay negative in most of the periods since the debt shock is unexpected in at first. In the last periods expectations are adjusted to the positive debt shocks and the real interest rate and the fiscal deficit response turn to positive.

5.2.4 Model Forecast

The aim in this section is to forecast future values of the macro variables within 2009Q1-2009Q4 period using the model specified in the previous section. Before obtaining the forecast for this period, forecast performance of the model is tested for the real interest rate and the fiscal deficit/GDP ratio by applying in-sample forecast for the period 2006Q1-2008Q4. The forecasted and the actual values are plotted on the graphs in Figure 5-8 below in order to see how the forecast values match with the actual ones. As can be seen in the figures, the forecasted and actual values are

parallel and especially the forecasted values for the fiscal deficit (f_t) are nearly following the same path with the actual values.

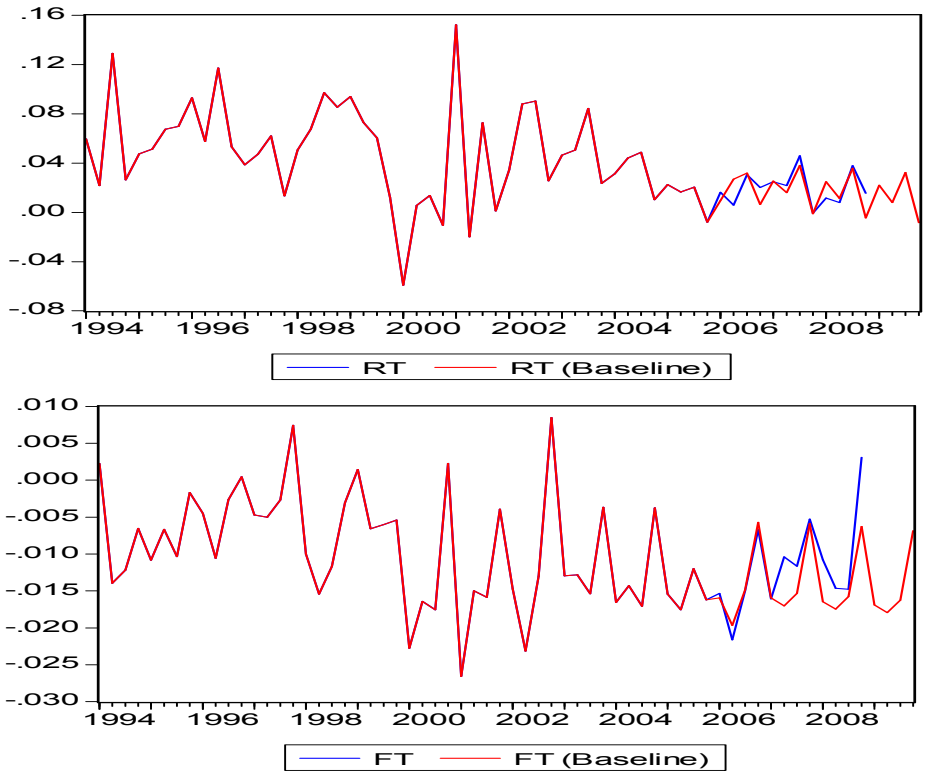

Figure 5-8 In-Sample Forecast for Real Interest Rate (RT) and Fiscal Deficit/GDP (FT)*

("Baseline" shows the forecast values whereas the other line is displaying the actual values.)*

Root Mean Squared Error (RMSE) of the forecast sample is analyzed in order to see the bias in the in sample forecast values. RMSE values for g_t, r_t, f_t and p_t are 0.008793, 0.010681, 0.004006, 0.015065 respectively. RMSE is actually the square root of the average bias in the forecast values from the actual data. Zero value of RMSE indicates that forecast values actually match with the original data and smaller values of RMSE are desirable since it is an indication of smaller bias in

forecast and thus a good forecast performance of the model. RMSE values indicate that forecast bias is smaller for the variables g_t and f_t. Moreover, we apply t-test on the forecast bias in order to check if the average forecast bias would be zero for this model. The null hypothesis for the test is zero mean for the forecast bias and the associated p-values are 0.1097, 0.0302, 0.0619, and 0.0444. For a 5 percent level of significance, forecast bias is zero for g_t and f_t whereas it is zero at only 1 percent significance level for r_t and p_t. Actual and forecasted values for the macro variables are given in Appendix C.

Furthermore, RMSE of forecast of our model is compared with the model with trend and a dummy variable in the second quarter of 2002 in order to evaluate forecast performance of our model[57]. RMSE for the forecasted g_t, r_t, f_t and p_t are 0.009462, 0.013514, 0.004166 and 0.015749 respectively which are higher than those of our model, implying that the forecast performance of our model is better Therefore we conclude that forecast results of our model is more reliable than that of the second alternative.

Appendix C shows the data set and the forecast values for the macro variables. Since model forecast is very dependent on the path of the historical data but does not incorporate the very recent macroeconomic events in economy, the forecasted values more or less match with the historical trend in the variables. Nonetheless, the path of some variables in year 2008 has been effective on the trend in 2009. As an example, the model forecast is parallel with the recent trend in the real growth rates. Real growth rate is forecasted to be negative in the first three quarters but have an upward trend and catching up a positive value at the end of the year. Model forecast

[57] In choosing our model we have compared the diagnostics of the different model alternatives summarized in Appendix A (See the diagnostic results of the model with two lag and the exogenous variables; constant term, trend, a dummy variable at 2002Q2 and three seasonal dummies). This alternative is the closest substitute to our model and therefore we applied in-sample forecast for the same time period also for this alternative.

successfully incorporated the declining signs in real growth rates in year 2008. Forecast results of real growth rate is consistent with the recent downward trend due to the financial crises and in the last quarter positive growth is expected as sign of recovery after the crisis period.

Debt shock is expected to be positive in the first half of 2009. Fiscal deficit is turning to positive at the end of 2008, however in doing forecast model does not incorporate this sign of worsening of fiscal balances in the recent periods since primary balance had been positive for most of the periods throughout the history. Although the recent expectations are in the direction of a negative primary balance, we are basing our analysis upon the positive balance forecast. According to the forecast results, it is expected to have positive debt shock in the first two quarters of the following year consistent with the expectation of a declining growth rate. Debt stock/GDP ratio is forecasted to rise above the expected levels as a result of the declining growth rates (the denominator effect). In the second half of 2009, debt shock is negative since the expectations are adjusted to the higher debt accumulation whereas the economy enters into recovery towards the end of 2009 which causes the actual debt stock/GDP ratio to move downwards. Therefore the debt shock (unexpected debt/GDP ratio) which is the difference between the actual and the expected debt/GDP ratio has negative values in the second half of 2009. Real interest rates are positive in the first and third quarters whereas negative in the second and fourth quarters. These forecast results seem to match with the path of real interest rates in the recent years. Real interest rates follow a volatile path with a rise in the first and third quarters and a fall in the second and last quarters at least for the last three years. This trend in real interest rate is very much correlated with the recent route of the inflation rate. Quarterly inflation rates are increasing in the second and last quarters since the year 2005. This rise in the inflation rates is a factor that can cause a decline in real interest rates for the related periods. However, to make a more comprehensive comment of the path of real interest rates, we should mention about the movements in the nominal interest rates. Here, we can refer to the Tobin's (1965) proposition that rise in nominal interest rates in an inflationary

environment is less than the rise in inflation, that is, real interest rates decrease with higher inflation. Therefore, we can comment that rise in inflation rates in the second and last quarters in the recent years cause a decline in real interest rates in these periods, thereby explaining the forecast on the real interest rates which are consistent with this proposition.

CHAPTER 6

TEST OF FISCAL SUSTAINABILITY IN TURKEY

In this chapter, Uctum and Wickens' (2000) sustainability criteria for sustainability are introduced and analyzed. Fiscal sustainability is investigated with and without imposing target levels for the debt stock and the fiscal deficit. Urgency of fiscal action, i.e. discretionary policy needs, is assessed under no constraint, debt constraint and deficit constraint and the necessary fiscal adjustment for sustainability is calculated in each case.

6.1 UCTUM AND WICKENS' SUSTAINABILITY CRITERIA

Based on the sustainability analysis in the infinite time period, Uctum and Wickens (2000) propose that the expected value of the discounted debt to GDP series should be stationary zero mean process. They also argue that, in the short term, debt-GDP series can reach non zero values without jeopardizing the sustainability structure if the required primary surplus is generated or the adjusted interest rate is lowered. This short- medium term sustainability depends on the existing debt structure of the country, as well as its growth rates, revenues (basically the primary balances) and the existing borrowing costs in the economy. Although it is difficult to decrease the debt stock to GDP ratio to zero level in the medium term, it is a significant issue to pursue a sustainable path meanwhile. Therefore, depending upon the macro fundamentals of the economy, countries are developing fiscal targets that would not jeopardize sustainable structure of their fiscal policy. Besides the country-specific

measures, European Union proposes a general fiscal target for all the candidate countries as a convergence criterion among countries. The fiscal targets proposed by the Maastricht Treaty (1992) are[58];

-European Union (EU) defined general government budget deficit as a ratio to GDP should be kept below %3,
-EU defined public sector gross debt stock to GDP ratio should be at a maximum of %60 percent.

As discussed in the previous chapters, macro dynamics of a country are the main determinants of the sustainability of the fiscal policy and a specified fiscal target can be binding for a country whereas that target may not be efficient for the others in providing sustainability. Thus, the studies in the literature are increasingly focusing on developing country-specific targets for the fiscal sustainability and the efficiency of the targets proposed for a wide range of countries with different macro dynamics is criticized by the scholars.

In this chapter, we inspire from Uctum and Wickens (2000) and discuss the debt-GDP and the deficit ceiling proposed by the European Union Maastricht Treaty (1992) (%60 and %3) within the perspective of medium term fiscal sustainability, taking into account extra fiscal pressure implied by these targets. Then, their methodology is applied in analyzing medium term sustainability of the Turkish fiscal policies.

6.1.1 Debt Ceiling

Uctum and Wickens (2000) base their analysis on the intertemporal budget constraint (IBC) driven for n periods from t;

[58] See chapter 1, footnote 5 for the source

$$b_t = \ell im_{n\to\infty} E_t\,(b_{t+n}\,\Psi_{t,n}) - \ell im_{n\to\infty} E_t\,(\sum_{k=1}^{n} f_{t+k}\,\Psi_{t,k})$$

where;

$\Psi_{t,n} = \prod_{m=1}^{n} \gamma_{t,m}$ is the discount factor for n periods from t,

$\gamma_{t,m} = (1+r_{t,m} - g_{t,m})^{-1}$ is the discount factor from period t+m to t+m-1,

b_t is the debt stock/GDP ratio,

E_t is the expectations operator,

f_t is the primary fiscal deficit/GDP ratio,

$r_{t,m}$ is the real interest rate valid between period t+m-1 and t+m

$g_{t,m}$ is the real growth rate of GDP from period t+m-1 to t+m[59].

The intertemporal budget constraint implies that; difference between the present value of the expected debt stock/GDP level of n periods from now and the sum of discounted primary deficits (as a ratio to GDP) generated throughout the period should give the debt/GDP ratio of the current period. In other words, adding up all primary deficits/GDP expected to be generated in n periods time (in present value terms) to the existing debt stock / GDP, we reach the expected debt stock/GDP ratio for n periods ahead (in present value terms). If this intertemporal budget constraint holds, current fiscal policy is regarded as sustainable. In the infinite horizon, debt to GDP ratio, b_t, is expected to converge to zero for a sustainable policy. Imposing this condition to the IBC above, current debt to GDP ratio, in order to be sustainable, should be equal to the sum of all primary surpluses (in present value terms) that is expected to be generated in the infinite horizon. Moreover, this IBC may not hold for the finite horizon and the deviations from the IBC give clue about the fiscal policy to be applied in order to meet the constraint requirements.

[59] Derivation of the intertemporal budget constraint is given in Chapter 2.

The analysis of Uctum and Wickens (2000) is actually based on the deviations from this intertemporal budget constraint, within five year periods, and the policy implications of these deviations. Moreover, expected debt/GDP level and expected fiscal deficit/GDP level is set as %60 and %3 respectively (the Maastricht Treaty (1992) targets) in order to assess and compare the deviations from the intertemporal budget constraint and to interpret on the efficiency of the Maastricht Treaty (1992) targets within the medium-term sustainability perspective.

According to Uctum and Wickens' (2000) analysis, if expected (or target) level of debt to GDP ratio at period t+n is denoted by b^{*}_{t+n}, the present value budget constraint becomes

$$b_t = E_t \ \Psi_{t,n} \ b^{*}_{t+n} - E_t \sum_{k=1}^{n} \ \Psi_{t,k} \ f_{t+k}$$

or

$$b_t - E_t \ \Psi_{t,n} \ b^{*}_{t+n} = - E_t \sum_{k=1}^{n} \ \Psi_{t,k} \ f_{t+k} \qquad (6.1)$$ [60]

Equation (6.1) indicates that a desired level of debt to GDP ratio, b^{*}_{t+n}, can be attained at period t+n if the IBC is satisfied. If the debt to GDP ratio is aimed to be lowered in n period's time, the difference should be financed either by extra primary surplus or by decreasing the interest rate ($-E_t \sum_{k=1}^{n} \Psi_{t,k} f_{t+k}$ should be positive).

[60] Notations of Uctum and Wickens (2000) and Garcia and Rigobon (2004) are utilized

When the discounted future primary surpluses are not sufficient to meet the budget constraint, extra revenue should be generated. This extra revenue can be gained through either fiscal tightening; such as an increase in tax revenues or a decrease in fiscal spending, or by monetary expansion as Uctum and Wickens (2000) suggest.

Uctum and Wickens (2000) try to find out the necessary fiscal adjustment in order to reach the target level of debt / GDP. They show that this extra revenue should be equal to the difference between the right hand side (RHS) and the left hand side (LHS) of equation (6.1), In other words, in order to decrease the debt to GDP ratio to a target level of b^{*}_{t+n} at period t+n, "$-E_t \sum_{k=1}^{n} \Psi_{t,k} f_{t+k}$" amount of total primary surplus (as a ratio to GDP) should be generated in n periods' time. However, if (RHS) of equation (6.1) higher than (LHS), it implies that primary surpluses that will be generated in n period's time will not be sufficient to reach to the target level of debt/GDP. Therefore, this insufficient primary surplus revenue should be compensated with other revenues, which can be gained through further fiscal tightening. Thus, we denote this amount of fiscal tightening as R, which is equal to the difference between RHS and the LHS of equation (6.1). The extra fiscal pressure (R) generated by the ceiling on debt-GDP ratio is calculated by:

$$R = E\left(\sum_{k=1}^{n} \Psi_{t,k}\right)^{-1} \left(b_t - E_t \Psi_{t,n} b^{*}_{t+n} + E_t \sum_{k=1}^{n} \Psi_{t,k} f_{t+k}\right) \qquad (6.2)$$

The calculation of equation (6.2) is very straightforward. Total fiscal contraction need is given as $(b_t - E_t \Psi_{t,n} b^{*}_{t+n} + E_t \sum_{k=1}^{n} \Psi_{t,k} f_{t+k})$. This total amount is attained through fiscal contraction in every period up to n. If an equal amount of fiscal revenue, R, is gained in every period up to n, the present value of their sum should give $(b_t - E_t \Psi_{t,n} b^{*}_{t+n} + E_t \sum_{k=1}^{n} \Psi_{t,k} f_{t+k})$ in order to meet the IBC. Uctum and Wickens (2000) calculate how much this fiscal revenue, R, should be. The sum of all R's generated in every period should give the total desired level of contraction in

present value terms. $R * E (\sum_{k=1}^{n} \Psi_{t,k})$ gives the sum of the present value of extra fiscal revenues generated in every period, which will be equal to the total contraction need;

$$R * E (\sum_{k=1}^{n} \Psi_{t,k}) = (b_t - E_t \Psi_{t,k} b^{*}_{t+n} + E_t \sum_{k=1}^{n} \Psi_{t,k} f_{t+k})$$

Positive values of R in equation (6.2) indicate that, extra fiscal contraction of an amount R is needed every following period on average in order to reach the desired debt to GDP target. This extra revenue is plotted on the y axis against the years on the x axis of the figure displaying the path of the fiscal measures in the following years. The line above the x axis shows that the target creates positive fiscal pressure (additional tax revenue or lower fiscal spending) and it is concluded that the debt ceiling is binding. On the other hand, line below the x axis implies that fiscal policy can even be loosened since the debt target is already satisfied i.e. the debt ceiling is not binding. In this analysis of Uctum and Wickens, debt / GDP target (b^{*}_{t+n}) is set as %60 for the European countries, in order to see the fiscal policy implications of this Maastricht Treaty (1992) target.

6.1.2 Deficit Ceiling

Uctum and Wickens (2000) further analyze extra fiscal pressure a deficit ceiling creates within the medium term sustainability perspective. In this case, additional fiscal revenue needed to meet the IBC is calculated by focusing on the fiscal deficit/GDP ratio for n periods ahead. The need for fiscal contraction is analyzed, firstly by setting the actual (or expected) budget deficit/GDP to period t+n. Then, the similar analysis is continued by imposing %3 of budget deficit/GDP target for the period t+n. They also study the fiscal sustainability of US by imposing %0 of budget deficit/GDP target which was proposed by the US government by the year 2002. Here, it should be underlined that these constraints are imposed on the budget

deficit as a whole, including the interest payments. The relevant equations are as follows;

One period present value budget constraint

$$b_t = f_t + (1 + i_t - g_t - \pi_t)\, b_{t-1}$$

where b_t is the debt stock/GDP ratio, f_t denotes primary deficit / GDP, i_t denotes the nominal interest rate, g_t is the real growth rate and π_t denotes the inflation rate.

Uctum and Wickens (2000) aggregate the whole budget deficit in a separate variable. z_t denotes the aggregate budget deficit($z_t = f_t + i_t * b_{t-1}$) and end up with the budget constraint below[61]:

$$b_t = z_t + [\, 1 - (\, g_t + \pi_t\,)]\, b_{t-1}$$

or equivalently

$$b_{t+1} = z_{t+1} + [\, 1 - (\, g_{t+1} + \pi_t)]\, b_t \qquad (6.3)$$

The rewritten version of equation (6.3) is thus;

$$b_t = (b_{t+1} - z_{t+1})\, [\, 1 - (\, g_{t+1} + \pi_{t+1})]^{-1}$$

where $(\, g_{t+1} + \pi_{t+1})$ is the nominal GDP growth at period t+1 and $[\, 1 - (\, g_{t+1} + \pi_{t+1})]^{-1}$ is the discount factor for one period ahead. The discount factor for n periods from period t can be stated as $\Omega_{t,n} = \prod_{s=1}^{n} [\, 1 - (\, g_{t+s} + \pi_{t+s})\,]^{-1}$. Solving for n periods ahead of period t, the following n period budget constraint is obtained;

[61] z_t is denoting the budget deficit which is calculated by Uctum and Wickens (2000) as the sum of primary deficit and the interest payments on the existent debt stock.

$$b_t = E_t \, \Omega_{t,n} \, b_{t+n} - E_t \sum_{i=1}^{n} \Omega_{t,i} \, z_{t+i} \qquad (6.4)$$

where E_t is the expectations operator and $\Omega_{t,n}$ is the discount factor for n periods ahead.

The remaining analysis is very similar to the one in the previous section. The difference between the right hand side (RHS) and the left hand side (LHS) of equation (6.4) gives the signal for the total need for additional revenue, TR, to be generated to meet the intertemporal sustainability condition;

$$TR = -b_t + E_t \, \Omega_{t,n} \, b_{t+n} - E_t \sum_{i=1}^{n} \Omega_{t,i} \, z_{t+i} \qquad (6.5)$$

Uctum and Wickens (2000) assume that revenue TR in equation (6.5) is generated at equal amounts in all periods from t to t+n, thus the average amount of extra revenue to be generated in all periods from t to t+n are denoted as R.[62] Therefore, by generating extra revenue of R, either by expenditure cut or generation of tax (and/or nontax) revenues, the following IBC holds;

$$R = E \left(\sum_{i=1}^{n} \Omega_{t,i} \right)^{-1} \left(b_t - E_t \, \Omega_{t,n} \, b_{t+n} + E_t \sum_{i=1}^{n} \Omega_{t,i} \, z_{t+i} \right) \qquad (6.6)$$

A positive R, as in the debt ceiling analysis, indicates the need for extra fiscal revenue, whereas a negative value implies there is room for further fiscal loosening. The amount of extra revenue is analyzed in case of no deficit ceiling and in case of a deficit ceiling of %3 for the period t+n, which is denoted as z^{*}_{t+n}. In case of a

[62] In the extra revenue analysis of Uctum and Wickens (2000), it is assumed in all periods from t to t+n, equal amounts of revenue R are generated, the discounted sum of which will give the desired total revenue amount TR, i.e., $R^* E\left(\sum_{i=1}^{n} \Omega_{t,i} \right) = TR$

deficit ceiling, the amount of extra revenue needed per period to satisfy the budget constraint can be found by the following equation:

$$R = E\left(\sum_{i=1}^{n} \Omega_{t,i}\right)^{-1}\left(b_t - E_t \Omega_{t,n} b_{t+n} + E_t \sum_{i=1}^{n-1} \Omega_{t,i} z_{t+i} + E_t \Omega_{t,n} z^{*}_{t+n}\right) \qquad (6.7)$$

The aim is to analyze and compare the amount R, in case of a deficit ceiling and no deficit ceiling and to assess the necessity and/or the importance of a deficit ceiling in the medium term of five-year period.

6.2 ANALYSIS OF TURKEY WITH UCTUM AND WICKENS' APPROACH

Uctum and Wickens (2000) analyze the fiscal sustainability of the European economies and discuss the efficiency of the 3% budget deficit/GDP and 60% debt stock/GDP targets proposed by the Maastricht Treaty (1992) within the sustainability perspective. Firstly, debt stock/GDP series are tested for stationarity as a traditional approach to sustainability in the long term. Second and the original part of their study is the investigation of the medium term fiscal sustainability, setting the Maastricht Treaty (1992) targets for the following five years.

Following Uctum and Wickens (2000), the aim of this chapter is to assess fiscal sustainability of Turkey for the long and medium term. The data for the period 1994Q1-2008Q4 and the forecast results for 2009Q1-2009Q4 will be used in this analytical study[63].

[63] See Chapter 5

6.2.1 Sustainability in the Long Term

The traditional approach for the sustainability in the long term is to analyze the path of debt / GDP series. The common view is that for a fiscal policy to be sustainable, the discounted debt / GDP series should be stationary with zero mean[64].

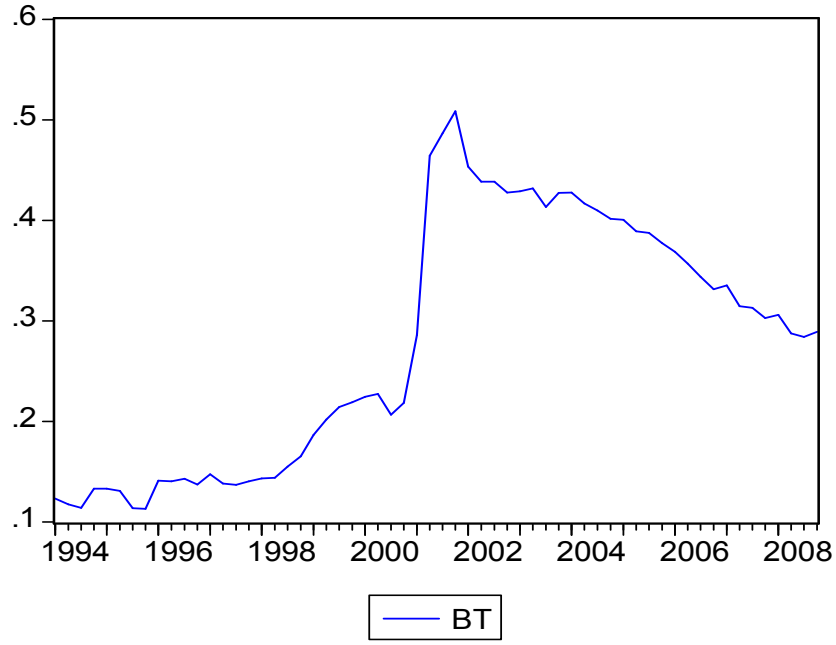

Figure 6-1 Undiscounted Debt Stock/GDP series

The path for the undiscounted debt stock/GDP series is shown in Figure 6-1. The series has an increasing trend up to 2002 with a significant jump in 2001. The path of debt to GDP series up to year 2002 jeopardizes sustainability until the series catches up a declining path afterwards. Augmented Dickey Fuller (ADF) unit root test with trend and intercept is applied to the series in order to test for stationarity. The null hypothesis for the test is that the variable, debt to GDP (BT), has a unit root and the test statistic is"-1.4661". The critical values for %1, %5 and %10

significance levels are "-4.1242", "-3.4892" and "-3.1731" and thus the null hypothesis is not rejected for all significance levels, implying that the series are nonstationary. However, as it is seen on Figure 6-1, there is a structural break in year 2001 and thus ADF test results can be misleading since the test does not incorporate this structural shift.

Debt to GDP series are also tested for zero mean within the same period. The null hypothesis of the applied t-test is "mean equals zero". The probability level for this test is 0.0000 implying that mean of the series are not converging to zero. The same test is applied to the sample 2002Q1-2008Q4, the period after the structural break in year 2001. Although debt/GDP series are following a declining path after year 2001, t-test does not still support a mean of zero for the series. This test result is because of the sample mean of 0.375171 which is high and because of the small sample size to support a convergence to zero mean.

Nevertheless, the interest rates, inflation rate and the real growth of the economy matter in order to comment on the sustainability. Therefore, we include the discount factor which incorporates the effects of these factors in the analysis and analyze the path of discounted debt to GDP series for sustainability. In order to assess sustainability, the discounted (to 1994Q1) debt to GDP series of the extended sample is tested for stationarity. Figure 6-2 shows the path of the discounted debt / GDP series for the extended sample, which is denoted by BT3, within the period 1994Q1-2009Q4. Although the t statistic (-2.275671) is higher in absolute value when compared to that of undiscounted debt to GDP series, the discounted debt-GDP series are still nonstationary. The probability value for the series regarding the test for zero mean is also 0.0000, implying that the discounted debt to GDP series have non-zero mean. Although can not be backed by the statistical tests, the

[64] See Chapter 2 for the intertemporal budget constraint and the theoretical approach to infinite horizon debt sustainability. Moreover, Chapter 3 provides a review of the literature on this traditional approach.

declining trend of debt to GDP series after year 2001 is a qualitative measure of converging to sustainability.

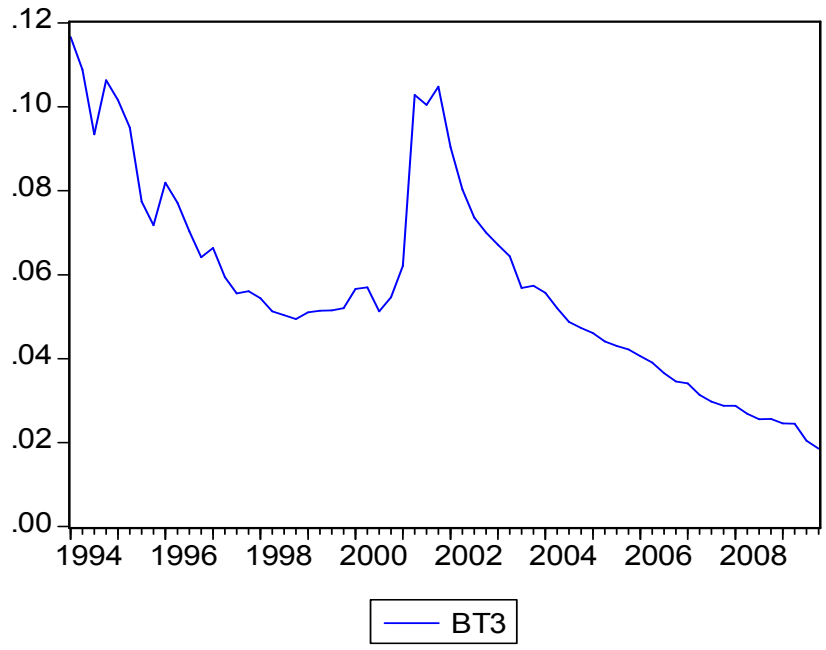

Figure 6-2 Discounted Debt Stock / GDP Series (Extended sample)

6.2.2 Debt and Deficit Ceiling

The condition for sustainability of a fiscal policy is that the discounted debt / GDP series should be stationary and should converge to zero mean (i.e. the borrower should be able to repay the debt in the end). In the infinite time horizon the debt can be paid by the future revenues, mainly by generating enough primary surpluses. Apart from the infinite time analysis of sustainability, Uctum and Wickens (2000) investigate sustainability in the medium-term periods, proposing that although fiscal policy can show an unsustainable pattern in the short-medium term, it may in fact not jeopardize sustainability in the long term. In other words, while applying a sustainable fiscal policy in the long-term perspective, the intertemporal budget constraint may not hold in some short / medium-term periods. Depending upon this fact Uctum and Wickens (2000) analyze medium-term (five year) fiscal policies of

the European countries depending on the five year intertemporal budget constraints of these countries and impose fiscal targets of the Maastricht Treaty (1992) for the five years ahead to investigate the fiscal implications of these targets.

In the following parts, Uctum and Wicken's (2000) sustainability analysis is applied to Turkish fiscal policy within the period 1994Q1-2009Q4 by setting the Maastricht Treaty (1992) targets of %60 for debt/GDP ratio and %3 for the fiscal deficit/GDP. Uctum and Wickens (2000) do this analysis for the five year intertemporal budget constraint. However, five year period is too long for our analysis since the timeline is only fifteen years long. Thus, two year analysis (eight quarters) is thought to be suitable in the study for Turkey. The analysis aims to assess efficiency of these targets and to show how these targets affect sustainability structure of Turkish fiscal policy in the medium term.

6.2.2.1 Imposing Debt Ceiling

This part aims to investigate medium term debt sustainability of Turkish central government debt within the period 1994Q1-2009Q4. For every quarter, debt stock / GDP after two years (eight quarters) and primary deficits in each of the following eight quarters are discounted to the existing quarter (i.e. intertemporal budget constraint of eight quarters is generated for each quarter)[65]. Then, the difference

[65] Since we are working on a quarterly data, debt/GDP series are discounted quarterly. Here we give an example to our calculation: For the analysis of 1994Q1-1995Q4 (eight quarter's time), all primary surpluses generated in every quarter are discounted to the end of 1993Q4. Present value of the debt/GDP level at the end of 1995Q4 is also discounted to the end of 1993Q4. The difference between the present value of the debt/GDP level at the end of 1995Q4 and the discounted sum of all primary deficits generated within this period should be equal to the actual debt / GDP level at the end of 1993Q4 according to the present value budget constraint. However, in practice there occur some differences. Actual debt / GDP level, which is lower than the discounted differences between the future primary surpluses and the future debt/GDP levels, implies that fiscal policy, within the period, has a room for further expansion without jeopardizing the two year sustainable path. The reverse would imply that the fiscal policy should be more contractionary in order to reach medium term sustainability. This two year analysis is repeated by replacing the debt / GDP level at the end of 1995Q4 with the 60% Maastricht Treaty target. The fiscal policy responses are compared in the two cases. This two-way, two-year analysis is continued up to the end of 2009Q4, by moving one quarter ahead every time. (i.e. Next analysis is done for the period 1994Q2-1996Q1 and so on)

between the actual debt/GDP ratio and the sum of the discounted values of all future primary surpluses (as a ratio to GDP) and the discounted debt/GDP ratio of eight quarters ahead is calculated. The difference shows if the followed fiscal policy has any room for further expansion or if further contraction is required for medium term sustainability.

The same procedure is repeated with a slight difference that in deriving the eight quarter IBC, the debt/GDP level for the end of the eighth quarter is set as %60[66]. The room for fiscal policy is generated also in this step. Finally, the necessary fiscal action for a sustainable policy in a two year period is compared in the two cases; with and without debt/GDP targets.

[66] The Maastricht Treaty of %60 is actually set on the European Union (EU) defined general government gross debt stock. However, calculation for this definition of debt stock is started at the end of year 2000 in Turkey. Since the data does not go back to year 1994, we have used the central government debt stock in our analysis. Moreover, since we are concerning with domestic debt in the analysis, the %60 target should be customized for the domestic debt analysis. Therefore, we have calculated the ratios of domestic debt stock in the total central government debt stock on a quarter bases. This weight of domestic debt is used to derive a target for the domestic debt stock, i.e. for every quarter the weight of domestic debt is multiplied with 60, in order to define a target level for domestic debt stock which is used as an approximation to the target of %60.

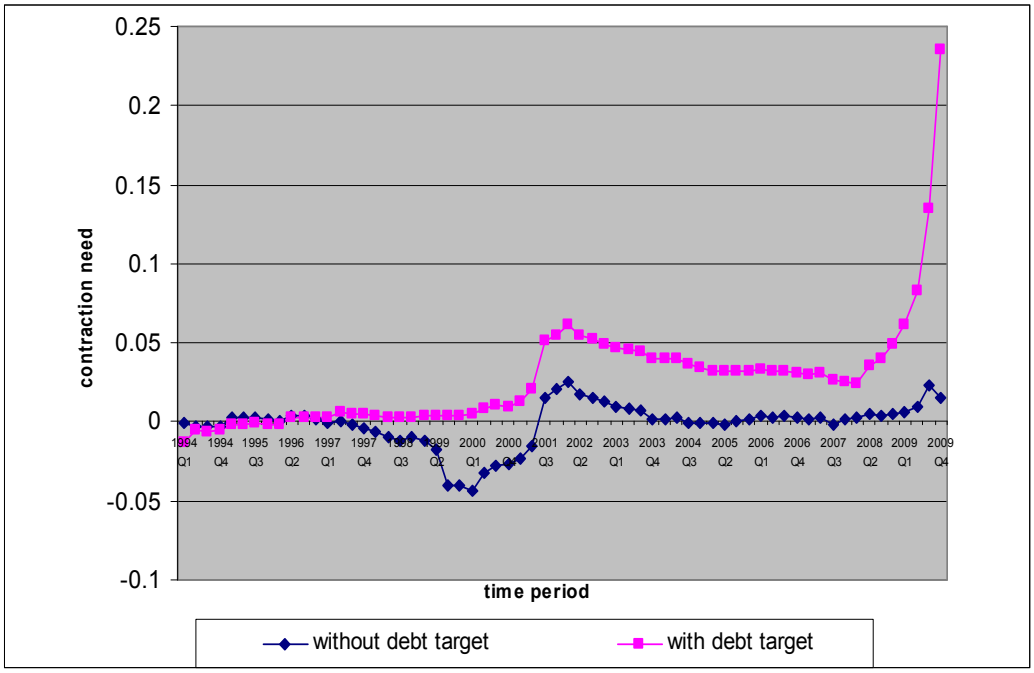

Figure 6-3 Amount of the Extra Revenue Needed to Satisfy Two Year IBC

Figure 6-3 shows amount of the extra revenue that should be generated in the following eight quarters in order to satisfy the two year present value budget constraint in each quarter. The need for further fiscal contraction without a debt ceiling and in case of a debt ceiling is illustrated in Figure 6-3. The analysis focuses on the following eight quarters when deriving the extra fiscal contraction need for medium term sustainability. However, the extended data set ends at 2009Q4. Therefore the analysis focuses on the following seven quarters from the beginning of 2008Q2, the following six quarters from the beginning of 2008Q3 and so forth.

Figure 6-3 shows how much fiscal contraction (additional revenue) is needed at every quarter in the following medium term period to meet the IBC. First, actual debt/GDP data at time "t=t+n" is used to derive the n period intertemporal budget constraint and the resultant contraction need is represented by the series named "without debt target". Then, n period intertemporal budget constraint is constructed by setting the target level of debt to GDP ratio at period "t=t+n" and the contraction need is shown by the series named "with debt target".

In Figure 6-3, line above the x axis implies that there is a need for additional revenue (fiscal contraction) in the following eight quarters to match with the IBC. On the other hand, line below the x axis shows that there is room for additional fiscal expansion, i.e. the present value budget constraint could be satisfied even though a looser fiscal policy was applied in the following quarters. Therefore, for the periods in which the line "with debt target" is below the x axis, there is no need for fiscal contraction in order to reach debt/GDP target of the Maastricht Treaty (1992)[67]. Moreover, for the periods in which the line "with debt target" is below the line "without debt target", the Maastricht Treaty (1992) target of %60 of debt/GDP level is not binding.

In case of no debt/GDP target, the fiscal contraction is needed in most of the periods to provide medium term sustainability. Need for fiscal contraction corresponds to the periods; 1995Q1-1996Q4, 2001Q3-2004Q2, 2005Q3-2007Q2 and 2007Q4-2009Q4, in which the urgency of fiscal action is mostly correlated with the crises periods, jumps in the mid of year 2001 and in the year 2009.

In case of the debt / GDP target of 60%, there is need for fiscal contraction almost for all periods. Moreover, the line "with debt target" is above the line "without debt target" for most of the periods, meaning that imposing the %60 target for the debt/GDP level exerts additional pressure on the fiscal policy. This shows that 60% of debt/GDP target of the Maastricht Treaty (1992) is binding for Turkey. Furthermore, with/without targets, the two series show parallel movements up to the year 2009, but diverge apart since then, implying that the Maastricht Treaty (1992) debt/GDP target is gaining significance for Turkish fiscal policy in the recent years.

[67] The Maastricht Treaty (1992) target is adapted for the central government domestic debt as explained in footnote "51". We are analyzing the efficiency of the Maastricht Treaty target under this approximation.

6.2.2.2 Imposing Deficit Ceiling

In this part, medium term sustainability of Turkish central government domestic debt is analyzed with or without imposing deficit targets. As in part 6.2.2.1 medium term analysis focuses on the following eight quarters.[68] The extended sample of 1994Q1-2009Q4 (including the forecast data for the year 2009) is used in the analysis. The aim is to derive the "eight-quarter present value budget constraint" for each time period and to comment on the type of fiscal policy that should be applied in order to meet the constraint requirements. The analysis resembles to the one in section 6.2.2.1 however with the crucial difference that this section derives the present value budget constraint by focusing on the budget deficit (rather than the primary deficits). Therefore the present value budget constraint of Uctum and Wickens (2000) for the deficit ceiling analysis, which is,

$$R = E\left(\sum_{i=1}^{n} \Omega_{t,i}\right)^{-1}\left(b_t - E_t \Omega_{t,n} b_{t+n} + E_t \sum_{i=1}^{n-1} \Omega_{t,i} z_{t+i} + E_t \Omega_{t,n} z^{*}_{t+n}\right)$$

is used in this section[69].

R is the extra fiscal revenue that should be generated in each of the following eight quarters in order to meet the medium term present value budget constraint. R is actually equivalent to the difference between the debt / GDP ratio of the time being (b_t) and the discounted debt/GDP ratio at the end of the next eight quarters net of the present value of the sum of the following eight quarters' budget deficit ($E_t \Omega_{t,n} b_{t+n} - E_t \sum_{i=1}^{n} \Omega_{t,i} z_{t+i}$). Positive R indicates the need for fiscal contraction whereas

[68] Since the data is up to 2009Q4, in 2008Q2 following seven quarters, in 2008Q3 following six quarters,..., in 2009Q4 following one quarter (the realizations of that quarter) is of interest. However, as a generalization, the methodology is explained in a way as if for all time periods the following eight quarter is analyzed.

[69] See chapter 6.1. for details.

negative values imply that the PVBC is already satisfied and even a further fiscal expansion up to an amount of R in every following eight quarters would not jeopardize fiscal sustainability in the medium term.

The budget deficits for all quarters are generated by adding the nominal interest payments of the former debt stock to the primary fiscal deficit of the corresponding quarter. ($z_t = f_t + b_t * i_t$)[70]. The discount factor for n periods ahead of quarter t is[71] ,

$$\Omega_{t,n} = \prod_{s=1}^{n} [\, 1 - (g_{t+s} + \pi_{t+s})]^{-1}$$

In order to derive this discount factor, the data for the nominal inflation and the real growth rate are needed. There is no forecast data of the nominal inflation in our VAR model for the last year, so the end year expectation of CBRT (Central Bank of the Republic of Turkey) is taken as a base.[72]

The need for fiscal contraction is calculated by using the original data and by setting %3 of fiscal deficit/GDP target for all the years. Since this is a quarterly work, quarterly targets should be imposed in order to do this analysis. Therefore, in all of the years, share of the budget deficit generated in every quarter to the yearly total is

[70] The formula for budget deficit is used that is expressed in section 6.1, that Uctum and Wickens (2000) use. This formula includes a generalization of the interest payments, incorporates the assumption that interest payments on the previous year's stock is all paid in the existing quarter, with the same interest rate on all types of borrowing instruments. Since there is no detailed information on the instrument type and the maturity profile of the existing stock, this type of generalization is acceptable in order to derive the interest payments. However, this type of a generalization may cause overestimation of the interest payments, since the formula takes into account interest payments for the same instrument every quarter up to the time it matures. (Interest is paid every year on the same instrument as long as it stays in the stock)

[71] See Chapter 6.1. for details.

[72] At the time the analytical work is being done, The CPI of the first two quarters of year 2009 has been realized. Given the realizations and the end year expectation of CBRT, the CPI of the last two quarters is calculated. In calculating the CPI of these quarters, the CPI rate of the last two quarters of year 2008 is taken as a reference.

calculated. Then every quarter's budget deficit target is generated by distributing the %3 yearly targets to every quarter with the relevant share.[73] In comparing the two analyses, it is commented on how the fiscal deficit target affects the fiscal policy. Positive difference in the PVBC is again implying a need for further fiscal contraction in order to match with the constraint. However, when the difference is negative, there is room for further fiscal expansion without jeopardizing the PVBC for the medium term fiscal sustainability. Furthermore, when the series with the deficit target move below the series without deficit target, the fiscal deficit target is not binding for Turkey.

[73] For example; in 1994Q4, the budget deficit generated was about %19 percent of all of the deficit realized in year 1994. Taking the yearly target %3 and weighting this target with the share %19; 0.19*0.03=0.0058, 0.0058 is set as the target budget deficit/GDP ratio for the last quarter of year 1994. Actually, according to the %3 target, total amount of fiscal deficit that should be generated through the year should be calculated by simply multiplying the yearly GDP by %3. Then, quarterly fiscal deficit targets should be set by using the weights of the nominal fiscal deficit in each quarter to the year sum. Afterwards this nominal target should be converted to the ratio target by dividing the nominal target by that quarter's GDP. In this study, quarterly targets are simply found by weighting the %3 target directly with the fiscal deficit/GDP performance of that quarter. This is because the GDP of each quarter is annualized by the moving sum of the quarter productions. Nominal GDP's of the succeeding quarters differ in insignificant amounts; therefore the denominator of the fiscal deficit/GDP ratio is thought to be kept as constant in setting the quarterly target to simplify the analysis.

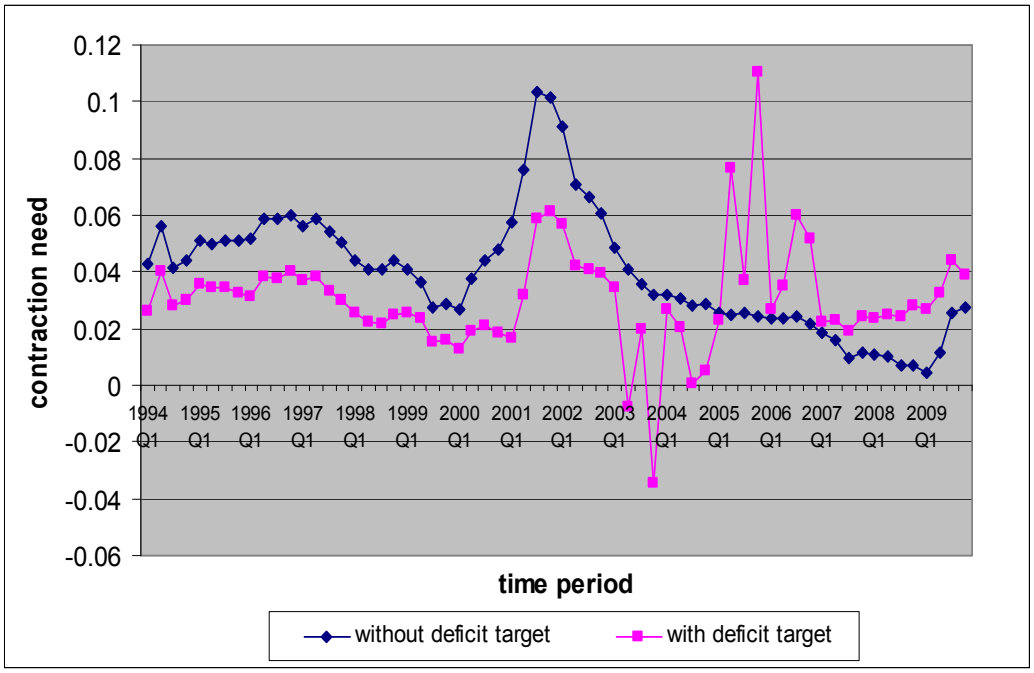

Figure 6-4 Amount of the Extra Revenue Needed to Satisfy Two Year IBC Constraint

Figure 6-4 pictures out the need for fiscal contraction in order to meet the medium term present value budget constraint (PVBC). Line above the x axis represents a need for extra revenues in order to match with the PVBC at that period. Line below the x axis represents that the fiscal policy in the following eight quarters are tight enough that there is some room for further fiscal expansion without jeopardizing the PVBC. The two series (with and without deficit target) are plotted against each other in order to assess whether the deficit target is binding and whether the target distorts the fiscal balances.

As seen in Figure 6-4 both of the series are above the x axis for almost the entire period, implying that the fiscal policy has been loose within the time and that fiscal policy should be in the direction of generating more revenues. The need for fiscal contraction jumps at 2001-2002 period and then decreases up to year 2009. In 2009, with the distortion of the fiscal balances, the need for fiscal contraction starts to increase again.

When the path of the series with deficit target is analyzed, until beginning of 2003, the series follow a parallel path, although settled below the series with no deficit target. This shows that setting a target does not cause a policy change and does not distort the fiscal policies. The target is not binding since following the target does not require further contraction. After the year 2003, the series with fiscal target does not move in a parallel way with no target series and shows a volatile picture, complicating the policy decisions. With the year 2005, the series with fiscal target moves above the series with no target, showing that the fiscal deficit target is binding starting from the year 2005. Another point that captures attention in the figure is that, with the recent global financial crisis, the need for a tighter fiscal policy increases.

6.3 CONCLUSIONS OF THE SUSTAINABILITY ANALYSIS

One of the most popular approaches to debt sustainability in the literature is the definition of target levels for certain variables which would provide a sustainable fiscal path. These targets can be on revenues or expenditures of government or on certain macro variables entering the debt sustainability equation, such as the primary fiscal deficit or the levels of debt stock. These target levels are derived using the fiscal sustainability equation and deriving the present value / future value of fiscal revenues and expenditures within the context of the changing macro environment and the corresponding change in the macro variables entering in the debt accumulation equation.

In chapter 6, the fiscal targeting approach of Uctum and Wickens (2000) is followed in analyzing the fiscal sustainability of Turkey within 1994-2009 period. They discuss the efficiency of debt stock/GDP target of 60% and the budget deficit/GDP target of 3% Maastricht Treaty (1992) for the European Union countries by investigating how these targets affect the medium term policy decisions of the countries. The starting point in this discussion is that, each country with different levels of debt stock, growth rates, inflation rates or the interest rates would have a

different response to these targets and therefore Maastricht Treaty (1992) target for some of the countries would be effective but for some others would have no significant effect at all in providing a sustainable fiscal path.

This study analyzes the efficiency of these targets for Turkey, which is a candidate for the European Union membership. What is different in this study from the Uctum and Wickens' (2000) work is that the analysis has been on quarter basis rather than on annual basis. Another original part in this study is the definition Maastricht Treaty (1992) targets. Since EU defined general government gross debt data is available after 2000 for Turkey, implications of the debt/ GDP target of Maastricht Treaty (1992) can be analyzed on a very limited sample. However, we have customized this target for the available data for Turkey and conducted our analysis for a fifteen year period. Moreover, since the fiscal deficit is a flow variable, 3% target could not be imposed at the end of each of the quarter. In this study, every quarter in a year is imposed a different level of fiscal deficit/GDP ratio parallel to the quarterly fiscal performance that would indeed give an approximation to the yearly 3% of budget deficit/GDP target.

The results show that the debt/GDP target of 60% is binding for Turkey in the two year base analysis. Indeed the debt stock/GDP target of 60% is already attained for Turkey. However the study has tried to investigate if imposition of this target has any implications on the medium term fiscal policies of Turkey in attaining long term sustainability. The medium term analysis has showed that 60% target is imposing more fiscal pressure on the medium term fiscal policies when compared to a case when no target is imposed. Moreover, the significance of the debt/GDP target is increasing especially in year 2009

There are some implications of the 3% fiscal deficit/GDP target on the medium term fiscal policy decision of Turkey especially after the year 2003. With the current fiscal policies the fiscal surplus has not been enough to generate a sustainable path for Turkey, since there has been a need for further contraction to catch up with the PVBC for sustainability. With the 3% deficit ceiling, the need for

fiscal contraction decreases at least up to the year 2005. The target puts medium term policy in a sustainable path in some parts of the year 2003 since PVBC is satisfied even with a room for further fiscal expansion in two quarters of this year. However starting from the year 2003, 3 % target has very volatile implications on the fiscal policy decisions, even reaching too high levels of fiscal contraction to be applied at the end of 2005 especially. However starting from the year 2007, fiscal deficit target is both a binding and an attainable target. The target stresses the need for fiscal contraction above the levels attained by the currently held fiscal policies. Average quarterly contraction need from the year 2007 to 2009 proposed by the fiscal target of 3% is about 1.4% higher than the fiscal contraction need suggested by the currently held policies. However, three years' sum of proposed fiscal contraction of 17.3% by the target shows that following this target should necessitate a need of huge amount of revenue generation.

As a conclusion, both the 60% debt/GDP target and 3% of fiscal deficit/GDP target of Maastricht criteria are binding for Turkey within the medium term fiscal sustainability framework. However, 3% level of fiscal deficit/GDP target of Maastricht criteria is binding since year 2005 and has gained importance in recent years. Existing fiscal policies regarding the public deficits is already unsustainable in the medium term since fiscal action for further contraction is needed almost throughout the period. However imposition of the Maastricht Treaty (1992) fiscal deficit target calls for more fiscal contraction and therefore is a binding target after 2005 for the sustainability in the medium term. The analysis on debt/GDP target has also shown that current policies do not necessitate a significant fiscal pressure. On the other hand, imposition of a debt/GDP target of 60 % distorts the path to the medium term fiscal sustainability unless additional measure is taken. Therefore, although this target is already attained in the long term, imposing this medium term target puts additional fiscal pressure and is a binding fiscal rule to follow in the medium term. Another striking conclusion is that these targets are gaining significance for the medium term sustainability of Turkish domestic debt at the time of an increasing criticism on the efficiency of these targets.

CHAPTER 7

CONCLUSION

Developments in the international borrowing markets and the easier access to the funding sources have facilitated governments to finance their obligations. The extended borrowing resources has been in favor of the governments which could readily roll-over the debt on due until it posed the challenge of the accumulating debt stocks and the variety of risk exposures embedded in. Therefore, the popular debate among policy makers has turned out to be on how to manage the debt stock in pursuing a sustainable fiscal path. Fiscal stance is now drawn in a longer-term perspective, looking for the answers to the questions "How can the public debt be sustained hereafter" or "Which actions should be taken in order to keep government solvent in years ahead". In an attempt to answer these questions, scholars are studying sustainability in different aspects. Some studies are assessing sustainability of the existing fiscal policies within the framework of intertemporal solvency whereas others are incorporating future uncertainties in their analysis. Furthermore, rather than just to assess whether the current policies are sustainable, an increasingly popular approach is to propose a target level for the debt dynamics which would provide sustainability.

This paper attempts to assess sustainability of the domestic debt of Turkey. Apart from analyzing intertemporal solvency of the fiscal policy, the thesis also investigates sustainability of the currently applied short-medium term fiscal policies as well as the policy implications of imposing the fiscal targets of Maastricht Treaty (1992) in the medium-term period. The methodology of the Uctum and Wickens

(2000) is followed in assessing the necessary fiscal adjustment for each period in order to stay in the sustainable path. Furthermore, in deriving the relationships of the debt dynamics, Garcia and Rigobon's (2004) theoretical model is utilized.

In this study, firstly the conditions for sustainability are set forth, based on an intertemporal analysis of the government budget. With this aim, present value government budget constraint is introduced in the finite and the infinite horizon. The sustainability condition for the infinite horizon is that the discounted debt to GDP series should be stationary with zero mean. Furthermore, since it is proposed that the debt to GDP is converging to zero level in the infinite horizon, discounted sum of the future primary surpluses should be as much as the value of the existing debt stock in order to provide the intertemporal balance. Therefore, a positive response of the primary surplus to the debt stock is accepted as an indicator of the sustainability in the finite horizon.

Secondly, the literature on fiscal sustainability is reviewed which is quite comprehensive in terms of the methodologies adopted. The traditional approach to sustainability uses intertemporal government budget constraint to assess if the fiscal policies are sustainable in the long term. According to this approach, sustainability is provided as long as the government budget is intertemporally balanced. Another approach is to derive the reaction functions of certain macro variables to the movements in the debt stock and to evaluate if the reactions are consistent with the intertemporal budget constraint. Some studies undertake the analysis in a stochastic environment and derive the probabilities to enter into a risky state in terms of sustainability. Beyond, in further research, target levels are proposed for the macro variables; such as the primary surplus, deficit or the tax rate, which could balance the budget constraint intertemporally. An alternative approach makes use of general equilibrium framework in evaluating the sustainability of the fiscal policy.

Next, the historical evolution of the macro dynamics of Turkey is received for the period 1994-2008. Domestic debt stock is in a declining pattern after the serious upward movement in the crises year of 2001. Evolution of the macro variables in

the same period also gives a sign of the general improvement in the economy, except the two years of macroeconomic crises; 1994 and 2001. Apart from these periods, inflation rate and interest rate have followed a declining path and primary surplus has caught up at quite high levels. Besides a once and for all deterioration at the crises periods, recovery in the economy proceeds until the recent breakdown as a result of the financial crises. The real GDP growth and the primary surplus have declined sharply at the end of 2008 and the debt stock has shown a little increase consequently. Despite the general historical upturn in the economy, the decay in the last year should not be disregarded when suggesting policies for the following periods.

Afterwards, the relationships of the certain macro variables are derived; employing the VAR approach of Garcia and Rigobon (2004). The model includes the real growth rate, the real interest rate, the primary fiscal deficit / GDP and the debt shock/GDP as the endogenous variables and the estimation is based on the quarterly data. Although the data set is very limited for the all macro variables, the forecast performance of the model appears to be sound when compared to the alternatives. Moreover, impulse responses of the variables to one standard deviation change in the others have been reasonable for most of the periods. Though, the macro model could be improved in further research on sustainability of the Turkish debt. The data set available for the macro variables in Turkey does not go back to very past and this was the main challenge in deriving the relationships among the variables due to short period of time with two severe economic crises. The small sample size also narrowed down the variety of the variables that could be included in the analysis. A wider data set would make it possible to include other macro variables which are significant in explaining the movements in debt dynamics, such as the exchange rate or the inflation rate. Even so, the diagnostics of the model have supported the model set-up and the results of the impulse response analysis have been instructive in suggesting policies. Debt shocks are considerably responsive to the movements in the real growth rate and the fiscal deficits. The sizable response of debt shocks to these variables pointed out that policy proposals for debt sustainability should be

concentrated on increasing the production capacity of the economy and/or increasing the primary balance of the government.

The VAR model results were used to forecast the path of the aforementioned macro variables for the following year. The forecast results together with the findings from the impulse response analysis are utilized in implementing the sustainability analysis of Turkish domestic debt. The methodology of Uctum and Wickens (2000) is used in evaluating the medium-term as well as long-term performance of the fiscal policy within the context of sustainability. Initially, discounted debt to GDP series are tested for stationarity and zero mean. Although the series did not show any of these characteristics, the series have caught up a declining pattern since the year 2001 and have a trend of converging to the zero level in the following periods. The stationarity test did not support sustainability of the Turkish domestic debt; however there have been two structural breaks throughout the period which make the traditional tests unreliable. On the other hand, a qualitative analysis of the path of the series especially after 2001, imply that the fiscal policy is getting closer to a more sustainable structure. Moreover, short-medium term sustainability analysis is carried out on the fiscal policy of Turkey, by checking-out the two year intertemporal budget constraint throughout the period. Sustainability in the infinite horizon is provided as long as the present value budget constraint is satisfied. In the finite horizon, however, there may be some deviations from the constraint which may be cured in the following periods. Due to the narrow sample size, two year intertemporal budget constraint is derived for Turkey and fiscal contraction is assessed in every two year period that is required to satisfy the budget constraint in present value terms. The similar analysis is repeated by setting the fiscal targets of Maastricht Treaty (1992) (60% of debt to GDP and 3% of fiscal deficit targets) for the two-year period. The latter study is conducted in order to reveal if these targets impose more restrictions on the fiscal policies or the targets are not binding at all. The results have shown that imposing the debt target has necessitated more fiscal pressure than the no target case suggested. Deficit target also calls for additional fiscal contraction since year 2005. Conclusively, the targets are binding for Turkey

in most of the periods and the policy implications of these targets are gaining importance in the recent years. The results show that although these targets have been already reached in Turkey, at least in some periods, underlying fiscal policies do not necessarily exhibit a sustainable structure for the medium term. Therefore, in generating fiscal policies for the medium term, Maastricht Treaty (1992) targets can be considered as a binding fiscal rule for Turkey. Combining the impulse response results and the additional fiscal contraction need suggested by the Maastricht Treaty (1992) targets for the recent years, policymakers should concentrate on promoting the real growth capacity and encouraging a higher primary surplus for the economy.

This thesis evaluates the sustainability of the Turkish domestic debt in a medium and long term perspective. The originality of the study is that different methodologies are incorporated in the analysis. Apart from the traditional tests on the PVBC, the maneuver of the debt dynamics is tried to be expressed through the VAR model and the impulse response analysis. Primarily, the sustainability indicators approach is adopted, in which the fiscal targets of Maastricht Treaty (1992) are criticized within the framework of sustainability. Accordingly, another peculiarity of this paper is that, the aim is not only to assess whether the current policies in Turkey are sustainable, but also to suggest policy responses to achieve a sustainable path in the medium term. Although this is accomplished through following the methodology of Uctum and Wickens (2000), originality of this study is actually the application of this methodology for Turkey. Further work on this topic may focus on suggesting new fiscal targets rather than the evaluation of the existing ones. Uctum and Wicken's (2000) methodology is proper for this kind of a study in that, those targets can be set at the point where there is no further fiscal pressure in the medium term. This type of a study could not be practiced in this paper, since the historical data set allow to forecast the macro framework of the only a very near future by which a new fiscal target can not be assessed.

BIBLIOGRAPHY

Akaike, H. (1973) *Information Theory and an Extension of the Maximum Likelihood Principle.. in* B.Petro & Cs`aki, eds, '2nd International Symposium on Information Theory', Akad`emiai Kiad`o, Budapest, pp. 267–281.

Akemann, M., and Kanczuk, F. (2005) *Sovereign Default and the Sustainability Risk Premium Effect*. Journal of Development Economics 76: 53-69.

Akyüz, Y., and Boratav, K. (2003) *The Making of the Turkish Financial Crisis*. World Development 31(9): 1549-1566.

Akyüz, Y. (2007) *Debt Sustainability in Emerging Markets: A Critical Appraisal.* DESA Working Paper 61 (November)

Baharumshah, A. Z., and Lau, E. (2007) *Regime Changes and the Sustainability of Fiscal Imbalance in East Asian Countries*, Economic Modeling 24: 878-894.

Banking Regulation and Supervision Agency (BRSA). (2001) *Annual Report*

Barro, R. L., (1979) *On the Determination of the Public Debt.* Journal of Political Economy 87: 940–971.

Bravo, A. B. S., and Silvestre, A. L. (2002) *Intertemporal Sustainability of Fiscal Policies: Some Tests for European Countries.* European Journal of Political Economy 18: 517-528.

Burnside, C. (2004) *Assessing New Approaches to Fiscal Sustainability Analysis.* Worldbank

Chalk, N. A. (2000) *The Sustainability of Bond-Financed Deficits: An Overlapping Generations Approach*. Journal of Monetary Economics 45: 293-328.

Drudi, F., and Prati, A. (2000) *Signaling Fiscal Regime Sustainability*. European Economic Review 44: 1897-1930

Enders, W. (1995) *Applied Econometric Time Series.* John Wiley and Sons, Inc.

Fisher, I. (1930). *The Theory of Interest*. New York: A. M. Kelly.

Garcia, M., and Rigobon, R. (2004) *A Risk Management Approach to Emergent Market's Sovereign Debt Sustainability with an Application to Brazilian Data*. National Bureau of Economic Research (NBER) Working Paper 10336.

Gatu, C., and Kontoghiorghes, E. J. (2006) *Estimating All Possible SUR Models with Permuted Exogenous Data Matrices Derived from a VAR Process.* Journal of Economic Dynamics and Control 30: 721-739

Goyal, R., Khundrakpam, J. K., and Ray, P. (2004) *Is India's Public Finance Unsustainable? Or, are the Claims Exaggerated?* Journal of Policy Modeling 26: 401-420.

Gregory, A. W., and Hansen, B. A. (1996) *Residual-Based Tests for Cointegration in Models with Regime Shifts*. Journal of Econometrics 70: 99-126.

Greiner, A., and Kauermann, G. (2007) *Sustainability of US Public Debt: Estimating Smoothing Spline Regressions*. Economic Modelling 24: 350-364.

Greiner, A., and Kauermann, G. (2008) *Debt Policy in Euro Area Countries: Evidence for Germany and Italy Using Penalized Spline Smoothing.* Economic Modelling 25: 1144-1154

Gujarati, D. N. (1995) *Basic Econometrics.* Third Edition. Mc Graw Hill, USA,

Hamilton, J. D., and Flavin, M. A. (1986) *On the Limitations of Government Borrowing: A Framework for Empirical Testing*. The American Economic Review 76 (September): 808-819.

Hastie, T. J., and Tibshirani, R. J. (1993) *Varying-Coefficient Models.* Journal of the Royal Statistical Society. Series B, Statistical Methodology 55: 757-796

Hendry, D. F., and Nielsen, B. (2007) *Econometric Modeling: A Likelihood Approach.* Princeton, N. J. :Princeton University Press

Horton, M., Kumar, M., and Mauro, P. (2009) *The State of Public Finances: A Cross-Country Fiscal Monitor*. International Monetary Fund (IMF) Staff Position Note SPN/09/21: 361-364.

Juselius, K. (2006) *The cointegrated VAR Model: Methodology and Applications.* Oxford; New York: Oxford University Press

Kia, A. (2008) *Fiscal Sustainability in Emerging Countries: Evidence from Iran and Turkey*. Journal of Policy Modeling, doi:10.1016/j.jpolmod.2008.01.004

Koo, C. M. (2002) *Fiscal Sustainability in the Wake of the Economic Crisis in Korea*. Journal of Asian Economics 13: 659-669.

Leachman, L. L., and Francis, B. B. (2000). *Multicointegration Analysis of the Sustainability of Foreign Debt*. Journal of Macroeconomics 22(2) (Spring): 207-227.

Lewis, J. (2004) *Sovereign Debt Sustainability in Jamaica: A Risk Management Approach*. Working Paper, Financial Stability Department Research and Economic Programming Division. Bank of Jamaica.

Lima, L. R., Gaglianone, W. P., and Sampaio, R. M. B. (2008) *Debt Ceiling and Fiscal Sustainability in Brazil: A Quantile Autoregression Approach.* Journal of Development Economics 86: 313-335

Menguy, S. (2008) *A Dynamic Rule Applied to the Threshold Imposed on the European Budgetary Deficits*. Journal of Policy Modeling 30: 1093-1105.

Minsky, H. P. (2008) *Stabilizing an Unstable Economy*. McGraw-Hill.

Mounts, W. S. Jr., and Sowell, C. B. (2005) *Budget Regimes and Internal Governance: Considerations for the Sustainability of Fiscal Policy.* Economics of Governance 6: 199-209

Musgrave, R. (1966) *Principles of Budget Determination*. In: Cameron, H., Henderson,W. (Eds.), Public Finance: Selected Readings. Random House, New York, pp. 15–27.

Önel, G., and Utkulu, U. (2006) *Modeling the Long-Run Sustainability of Turkish External Debt with Structural Changes*. Economic Modelling 23: 669-682.

Özatay, F. (1997) *Sustainability of Fiscal Deficits, Monetary Policy, and Inflation Stabilization: The Case of Turkey.* Journal of Policy Modeling 19 (6): 661-681.

Palardy, J. (2002) *Autoregressive Lag Selection Criteria and Random Contamination Models.*

Qin, D., Cagas, M. A., Ducanes, G., Magtibay-Ramos, N., and Quising, P. (2006) *Empirical Assessment of Sustainability and Feasibility of Government Debt: The Philippines Case*. Journal of Asian Economics 17: 63-84

Rao, B. B., and Kumar, S. (2007) *Cointegration, Structural Breaks and the Demand for Money in Bangladesh.* Munich Personal RePEc Archive 1546

Rothenberg, T., and Stock, J. (1997) *Inference in a Nearly Integrated Autoregressive Model with Nonnormal Innovations.* Journal of Econometrics 80: 269-286

Shirai, S. (2004) *Trends in Recent Debt Management and the Nature of Economic Crises*. Keio University.

Schwarz, G. (1978) *Estimating the Dimension of a Model*. The Annals of Statistics 6: 461–464.

Sims, C. (1980) *Macroeconomics and Reality*. Econometrica 48: 1-49.

Statistical Data Warehouse. (2009) *Monthly Bulletin.* Euro Area Statistics Online. European Central Bank (ECB). (August)

Tanner, E., and Samake, I. (2006) *Probabilistic Sustainability of Public Debt: A Vector Autoregression Approach for Brazil, Mexico, and Turkey.* IMF Working Paper.

The Maastricht Treaty. (1992) *Protocol on the Excessive Deficit Procedure*, Article 104c(2)

Tobin, J. (1965) *Money and Econometric Growth.* Econometrica 33: 671-684

Trehan, B., and Walsh, C. (1988) *Common Trends, the Government Budget Constraint, and Revenue Smoothing*. Journal of Economic Dynamics and Control 12: 425– 444.

Uctum, M., and Wickens, M. (2000) *Debt and Deficit Ceilings and Sustainability of Fiscal Policies: An Intertemporal Analysis.* Oxford Bulletin of Economics and Statistics 62(2): 197-222

Undersecretariat of Treasury. (2003) *Public Debt Management Report*. Republic of Turkey Prime Ministry.

Undersecretariat of Treasury. (2009) *Annual Public Debt Management Report*. Republic of Turkey Prime Ministry.

Voyvoda, E., and Yeldan, E. (2005) *Managing Turkish Debt: An OLG Investigation of the IMF's Fiscal Programming Model for Turkey.* Journal of Policy Modeling 27: 743-765.

White, W. R., (2000) *What Have We Learned From Recent Financial Crises and Policy Responses?* Bank for International Settlements (BIS) Working Papers 84 (January): 1-29.

Yakita, A. (2008) *Sustainability of Public Debt, Public Capital Formation, and Endogenous Growth in an Overlapping Generations Setting*. Journal of Public Economics 92: 897-914.

Zivot, E., and Andrews, D.W.K. (1992) *Further Evidence on the Great Crash, the Oil Price Stock, and the Unit Root Hypothesis.* Journal of Business and Economic Statistics 10: 251-270.

APPENDICES

APPENDIX A: MODEL ALTERNATIVES AND THE DIAGNOSTICS

(*) "√" indicates that no problem is detected for the related diagnostic.

(**) The variable written in this column is found to be exogenous as a result of the Block Exogeneity Test.

(***) Numbers in the fourth and sixth column denote the lags for which autocorrelation and/or Heteroscedasticity problem is detected (under % level of significance) by the LM Test and the White Test respectively.

(****) A dummy variable is included for the written quarters in the column.

(*****) The variables in this column are not normal under %5 level of significance.

(#) "X" indicates that a problem is detected for the related diagnostic.

Column Titles;V: Exogeneous Variables

S: Stability

E: Exogeneity

A: Autocorrelation (LM Test)

N: Normality

H: Heteroscedasticity (White's Test)

The variables are; g_t: real growth rate

r_t: real interest rate,

f_t: fiscal deficit / GDP

p_t : debt shock / GDP

6 VARIABLES:_ GT, RT,FT, PT, ΠT, AND ST_(GT, FT AND ΠT ARE SEASONALLY ADJUSTED)					
V	**S**	**E**	**A**	**N**	**H**
4 LAGS					
T	√*	S_{T**}		X(#)	
T , S_T	√	R_T			
T , S_T, R_T	√	Π_T			
T, S_T, R_T, Π_T	√	G_T, F_T, P_T			
3 LAGS					
T	√	√	1^{ST}, 8^{TH}, 11^{TH}(***)	X	√
T, 2001Q2 (****)	√	R_T			
T, R_T, 2001Q2	√	√	1^{ST}	X	√
2 LAGS					
T	√	√	1^{ST},4^{TH},8^{TH}	√	√
1 LAG					
T	√	F_T, R_T	1^{ST}, 2^{ND}, 4^{TH}, 5^{TH}		

5 VARIABLES (GT, RT, FT, PT, IIT)_ (GT,FT AND IIT ARE SEASONALLY ADJUSTED)					
V	**S**	**E**	**A**	**N**	**H**
4 LAGS					
T	√	√	1^{ST}	X	
T, 2001Q1	√	R_T			
T, 2001Q2	√	R_T			
T, 1998Q4	√	√	√	X	√
T, 1999Q1	√	√	1^{ST}, 4^{TH}, 5^{TH}	**RT** (*****)	
T, 1998Q4, 1999Q1	√	√	√	X	
T, 2001Q4	√	√	1^{ST}, 7^{TH}	X	√
T, 2000Q4, 2001Q4	√	R_T	1^{ST}	X	
3 LAGS					
T	√	R_T	1^{ST}, 3^{TH}, 11^{TH}		
T, 1994Q1, 2001Q2	√	R_T			
2 LAGS					
T	√	√	1^{ST}, 4^{TH}	R_T	1^{ST}, 2^{ND}
1 LAG					
T	√	F_T, R_T			

5 VARIABLES (GT, RT, FT, PT, ΠT)_ (ONLY GT AND ΠT ARE SEASONALLY ADJUSTED)					
V	**S**	**E**	**A**	**N**	**H**
4 LAGS					
-	√	F_T, G_T			
T, 2000Q4, 2001Q1	√	√	**1ST**	X	
T	√	G_T			
T, 2001Q2	√	F_T, G_T			
T, 2001Q1	√	F_T, G_T			
T, 2000Q4	√	√	1^{ST}, 7^{TH}	X	
T, 2001Q1	√	G_T	1^{ST}	X	
T, 1994Q4, 2000Q4	X				
T, 2000Q4, 2001Q2	√	R_T, G_T			
T, 2000Q4, 2001Q3	√	√	√	X	
T, 2000Q4, 2001Q3, 2001Q4	√	√	√	X	
T, 1994Q3, 2000Q4, 2001Q3, 2001Q4	X				
T, 2000Q4, 2001Q2, 2001Q3, 2001Q4	√	R_T, G_T			
T, 2000Q4, 2001Q1, 2001Q3, 2001Q4	√	√	1^{ST}	X	
T, 2000Q4, 2001Q3, 2001Q4, 2002Q4	√	√	1^{ST}	X	
3 LAGS					
-	√	√	4^{TH}	R_T	√

T	√	√	3^{TH}, 11^{TH}	√	4^{TH}
T, 2001Q1	√	√	1^{ST}, 11^{TH}	Π_T	√
T, 2000Q1	√	R_T			
T, 2000Q1, 2001Q4	√	R_T, F_T			
T, 2001Q1, 2000Q4	√	√	1^{ST}	√	√
T, 2000Q1, 2001Q1, 2000Q4	√	√	1^{ST}	R_T, PT, F_T	
T, 2001Q1, 2001Q2, 2000Q4	√	Π_T	√	Π_T	√
1994Q2, 2000Q4, 2001Q1, 2001Q2	X				
T, 2001Q1, 2001Q2, 2000Q4, 1997Q4		Π_T			
T, 2000Q4, 2001Q1, 2001Q4	√	√	1^{ST}	PT, Π_T	√
T, 2000Q4, 2001Q1, 2001Q3	√	√	1^{ST}	PT, Π_T	√
T, 1994Q4, 2000Q4, 2001Q1	√	√	1^{ST}	Π_T	√
T, 1994Q4, 2000Q4, 2001Q1, 2001Q4	√	√	1^{ST}	X	
T, 2000Q4, 2001Q3, 2001Q4, 2002Q4	√	√	1^{ST}	PT, R_T	4^{TH}
T, 2000Q4, 2001Q4, 2001Q1	√	√	1^{ST}	PT, Π_T	
T, 2000Q4, 2002Q4, 2001Q1	√	√	1^{ST}	Π_T	

T, 1997Q4, 2000Q4, 2001Q1	√	√	1^{ST}	X	
T, 1994Q4, 2000Q4, 2001Q1	√	√	1^{ST}	Π_T	
2 LAGS					
-	√	√	4^{TH}	R_T	4^{TH}
T	√	√	1^{ST}, 4^{TH}	√	
T, 2001Q2	√	√	1^{ST}, 4^{TH}	PT, R_T	
T, 2000Q4	√	√	1^{ST}, 4^{TH}		
T, 2001Q1	√	√	1^{ST}	√	
T, 2000Q4, 2001Q1	√	√	1^{ST}, 12^{TH}		
T, 2000Q4, 2001Q1, 2001Q2	√	PT		PT	
T, 2000Q4, 2001Q1, 2001Q4	√	√	1^{ST}	√	
T, 1994Q3, 2000Q4	√	√	1^{ST}	√	
T, 1994Q3, 2000Q4, 2001Q1	√	√	1^{ST}	√	
1994Q3, 2000Q4, 2001Q1	√		1^{ST}		
T, 1994Q3, 2000Q4, 2001Q1, 2001Q4	√	√	1^{ST}	R_T	
T, 1994Q3, 2000 Q1, 2000Q4, 2001Q1, 2001Q4	√	√	1^{ST}	R_T, F_T	4^{TH}
T, 1994Q3, 2000 Q1, 2000Q4, 2001Q1	√	F_T	1^{ST}		3^{RD}
T, 1994Q3, 2000 Q1, 2000Q4, 2001Q1, F_T	√	√	1^{ST}		3^{RD}

T, 2000 Q1, 2000Q4, 2001Q1	√	√	1^{ST}	Π_T	3^{RD}
1 LAG					
-	√	√	1^{ST}, 4^{TH}	G_T, R_T, PT, Π_T	
T	√	R_T	1^{ST}, 2^{ND}, 4^{TH}		
T, 2001Q2	√	G_T, R_T, PT			

5 VARIABLES (GT, RT,FT, PT, ΠT)_WITH SEASONAL DUMMIES					
V	**S**	**E**	**A**	**N**	**H**
4 LAGS					
-	√	F_T	1^{ST}	X	
T	√	FT, RT			
2001Q1	X				
2001Q2	X				
2001Q4	√	F_T			
F_T, 2001Q4	X				
1994Q2	X				
2001Q1, 2001Q2	X				
2001Q1, 2001Q4	X				
1994Q2, 2001Q1	X				
2001Q1, 2001Q2, 2001Q4	X				
2001Q2, 2001Q4	X				
1994Q2, 2001Q2,	X				
T, 2001Q1, 2001Q2, 2001Q4,	√	RT , FT			
T, 2001Q2, 2001Q4,	X				
T, 2000Q4	√	GT, RT , FT			
T, 2001Q1, 2001 Q4	√	FT			
T, 2001Q1, 2001 Q4, F_T	√	GT			
T, 2001Q1, 2001 Q2	√	RT , FT			
T,1994Q2, 2001Q1,	X				

2001 Q2					
T, 2000Q1, 2001Q1, 2001Q2,, 2001 Q4	√	FT			
T, 2000Q1, 2001Q1, 2001Q2,, 2001 Q4, 2002Q4	√	GT, FT			
T, 2000Q1, 2001Q1, 2001Q2,, 2001 Q4, 2002Q2, 2002Q4	√	GT, FT			
T, 1997Q4, 2000Q1, 2001Q1, 2001Q2,, 2001 Q4, 2002Q2, 2002Q4	√	GT, FT ПТ			
T, 2000Q4, 2001Q1, 2001Q4	√	GT, FT			
3 LAGS					
-	√	FT RT			
T	√	FT RT			
T, 2001Q2	√	FT RT, ПТ			
T, 2000Q1	√	PT			
T, 2001Q1,FT, RT	√	RT, FT			
T, 2001Q4	√	FT RT			
T, 2002Q4	√	FT			
T, 2002Q2,	√	√			
T, 2002Q2,FT	X	√	1ST	ПТ	3RD
T, 2000Q4, 2002Q2	√	√	X	√	√
T, 2001Q1, 2002Q2,	√	FT			
T, 2001Q4,	√	FT ПТ			

2002Q2					
T, 2001Q4, 2002Q2	√				
T, 2000Q1, 2002Q2	√	RT			
T, 2000Q1, 2000Q4, , 2002Q2	√	RT	√		
T, 2000Q1, 2000Q4, , 2002Q2, RT	√	√		GT,FT, ПТ	
T, 2000Q1, 2000Q4, 2001Q2, 2002Q2	√	RT, ПТ	√		
T, 2000Q1, 2000Q4, 2001Q4, 2002Q2	√				
T, 2001Q1, 2001Q2, 2001Q4	√	FT , PT			
T, 2000Q1, 2001Q1, 2001Q2, 2002Q4		FT , PT			
T, 2000Q1, 2001Q1, 2001Q2, 2002Q4, 2002Q2		PT, ПТ			
T, 2000Q1, 2001Q1, 2001Q2, 2002Q4, 1997Q4		X			
2 LAGS					
-	√	√	2^{ND} ,4^{TH} ,8^{TH}	√	
T	√	√	1^{ST} , 2^{ND} ,4^{TH} ,8^{TH}	ПТ	4^{TH}
T, 1994Q3	√	RT			
T, 1994Q3,RT	√	FT			
T, 2001Q1	√	√	1^{ST}	ПТ	
T, 2000Q4,	√	√	1^{ST} , 4^{TH} ,8^{TH}	ПТ	4^{TH}

T, 2001Q1	√	√	1^{ST}, 12^{TH}	ПТ	4^{TH}
T, 2001Q2	√	RT, PT			
T, 2001Q4	√	√	1^{ST}, 2^{ND} ,4^{TH} 8^{TH}	ПТ	4^{TH}
T, 2002Q4	√	√	1^{ST}, ,4^{TH} ,8^{TH}	ПТ	4^{TH}
T, 2002Q2	√	√	1^{ST}, ,3^{RD} ,8^{TH}	ПТ	4^{TH}
T, , 2000Q1, 2000Q4	√	√	1^{ST}	ПТ	4^{TH}
T, , 2000Q1, 1997Q4	√	√	1^{ST}	ПТ	4^{TH}
T, 2001Q1, 2001Q1	√	FT			
T, 2001Q1, 2001Q1, FT	√	√	1^{ST}	ПТ	3^{RD}
T, 2000Q4, 2001Q1	√	√	1^{ST}, 12^{TH}	ПТ	4^{TH}
T, 2000Q1, 2000Q4, 2001Q1	√	√	1^{ST}, 12^{TH}	RT, ПТ	1^{ST}, 8^{TH}
T, 1997Q4, 2000Q4, 2001Q1	√	√	1^{ST}, 12^{TH}	PT, ПТ	4^{TH}
T, 2001Q1, 2001Q2, 2001Q4	√	FT, PT			
T, 2000Q1, 2001Q1, 2001Q2, 2001Q4, 2002Q4	√	FT, PT			
T, 2000Q1, 2001Q1, 2001Q2, 2001Q4, 2002Q2, 2002Q4	√	PT			
T, 2000Q1, 2001Q1, 2001Q2, 2001Q4, 2002Q2, 2002Q4, PT	√	FT			
T, 1997Q4, 2000Q1, 2001Q1,	√	PT			

2001Q2, 2001Q4, 2002Q2, 2002Q4					
T, 1997Q4, 2000Q1, 2001Q1, 2001Q2, 2001Q4, 2002Q2, 2002Q4, PT	√	FT, ПТ			
1 LAG					
-	√	√	1^{ST} , 2^{ND} , 4^{TH}	GT, RT, PT, ПТ	
T	√	RT			
T, RT	√	GT			
2001Q2	√	RT, GT			
T, 2001Q2	√	RT, GT, PT			
T, 2001Q1	√	√	1^{ST} ,	RT, GT	X
T, 2000Q4	√	RT			
T, 2000Q1	√	RT			
2001Q1	√	√	1^{ST} ,	RT, GT	X
T, 2001Q4	√	RT			
T, 1994Q2, 2001Q1	√	RT			
T, 2001Q1, 2001Q2, 2001Q4	√	GT, PT			
T, 2000Q1, 2001Q1, 2001Q2, 2001Q4, 2002Q4	√	GT, PT			
T, 2000Q1, 2001Q1, 2001Q2, 2001Q4, 2002Q2, 2002Q4	√	GT, PT			

4 VARIABLES (GT, RT,FT, PT)_WITH SEASONAL DUMMIES					
V	**S**	**E**	**A**	**N**	**H**
ALTERNATIVES BELOW ARE TRIED IN ALL LAGS FROM 1 TO 4, BUT LAG 2 IS SUPPORTED.					
T	√	√	2ND , 4TH , 8TH	√	3^{RD}
2001Q1	X				
2001Q2	X				
T, 2001Q1, 2001Q2	X	F_T			
2001Q1, 2001Q2	X				
T, 2002Q2	√	√	8^{TH}	√	3^{RD}
T, 2002Q1	√	√	2^{ND}, 4^{TH}	√	3^{RD}
T, 2001Q2, 2002Q2	√	√	X	X	X
T, 2001Q2, 2002Q1	√	√	√	FT	√
T, 2000Q1	√	√	√	√	√

APPENDIX B: IMPULSE RESPONSE OF VARIABLES

Response of g_t:				
Period	g_t	r_t	f_t	p_t
1	0.007162	0.000000	0.000000	0.000000
	(0.00066)	(0.00000)	(0.00000)	(0.00000)
2	0.006590	-0.001305	0.001140	-0.003084
	(0.00113)	(0.00094)	(0.00101)	(0.00099)
3	0.005446	8.06E-05	-0.001852	-0.004851
	(0.00143)	(0.00135)	(0.00139)	(0.00140)
4	0.003236	-0.000406	-0.001078	-0.004103
	(0.00160)	(0.00146)	(0.00149)	(0.00167)
5	0.001282	-9.43E-05	-0.001735	-0.003059
	(0.00167)	(0.00131)	(0.00138)	(0.00167)
6	-0.000343	-0.000228	-0.000983	-0.001313
	(0.00162)	(0.00106)	(0.00110)	(0.00156)
7	-0.001267	-0.000150	-0.000690	-2.20E-05
	(0.00146)	(0.00083)	(0.00081)	(0.00137)
8	-0.001580	-0.000152	-0.000129	0.000945
	(0.00121)	(0.00067)	(0.00058)	(0.00119)
9	-0.001406	-0.000102	0.000164	0.001319
	(0.00098)	(0.00058)	(0.00051)	(0.00105)
10	-0.000966	-6.43E-05	0.000364	0.001291
	(0.00085)	(0.00049)	(0.00049)	(0.00093)
Response of r_t:				
Period	g_t	r_t	f_t	p_t

1	-0.012290	0.024124	0.000000	0.000000
	(0.00337)	(0.00224)	(0.00000)	(0.00000)
2	-0.004628	0.000123	0.004050	-0.007865
	(0.00338)	(0.00333)	(0.00366)	(0.00365)
3	0.001782	0.004791	-0.002649	-0.003393
	(0.00294)	(0.00335)	(0.00356)	(0.00325)
4	0.000266	0.000232	0.003327	-0.002015
	(0.00258)	(0.00269)	(0.00245)	(0.00261)
5	0.000757	0.002203	-0.002148	-0.003146
	(0.00238)	(0.00186)	(0.00188)	(0.00210)
6	0.000175	0.000299	0.000669	-0.001523
	(0.00198)	(0.00134)	(0.00145)	(0.00189)
7	1.85E-05	0.000606	-0.000959	-0.001453
	(0.00152)	(0.00107)	(0.00121)	(0.00158)
8	-0.000375	0.000119	2.90E-05	-0.000426
	(0.00108)	(0.00071)	(0.00088)	(0.00125)
9	-0.000512	0.000161	-0.000285	-0.000151
	(0.00081)	(0.00054)	(0.00065)	(0.00093)
10	-0.000540	4.22E-05	5.45E-05	0.000258
	(0.00063)	(0.00037)	(0.00045)	(0.00072)
Response of f_t:				
Period	g_t	r_t	f_t	p_t
1	1.14E-05	-0.001625	0.004638	0.000000
	(0.00065)	(0.00063)	(0.00043)	(0.00000)
2	0.000241	0.000861	0.000102	-0.000743
	(0.00059)	(0.00058)	(0.00064)	(0.00065)
3	-0.000370	0.001051	0.000956	-0.000240
	(0.00051)	(0.00060)	(0.00063)	(0.00055)
4	-5.46E-05	0.000804	-0.000187	-0.000953

	(0.00045)	(0.00049)	(0.00044)	(0.00044)
5	0.000206	0.000364	7.92E-05	-0.000661
	(0.00043)	(0.00037)	(0.00038)	(0.00039)
6	0.000205	0.000208	-0.000101	-0.000609
	(0.00037)	(0.00027)	(0.00029)	(0.00037)
7	9.60E-05	0.000135	-9.53E-05	-0.000418
	(0.00031)	(0.00022)	(0.00024)	(0.00032)
8	-2.04E-05	7.40E-05	-9.80E-05	-0.000265
	(0.00027)	(0.00015)	(0.00018)	(0.00028)
9	-9.82E-05	4.20E-05	-6.89E-05	-0.000109
	(0.00023)	(0.00012)	(0.00013)	(0.00023)
10	-0.000137	1.82E-05	-2.83E-05	6.02E-06
	(0.00019)	(8.9E-05)	(0.00010)	(0.00019)
Response of p_t:				
Period	g_t	r_t	f_t	p_t
1	-0.002538	-0.005142	-0.006128	0.020286
	(0.00287)	(0.00282)	(0.00272)	(0.00188)
2	-0.006961	0.010115	-0.007303	0.012727
	(0.00352)	(0.00331)	(0.00336)	(0.00313)
3	0.001100	-0.007642	0.002992	0.003931
	(0.00336)	(0.00343)	(0.00353)	(0.00362)
4	0.006294	-0.002611	-0.001863	0.002487
	(0.00322)	(0.00301)	(0.00308)	(0.00330)
5	0.004218	-0.003091	0.002499	0.001155
	(0.00285)	(0.00225)	(0.00212)	(0.00262)
6	0.003341	-0.000326	-0.001739	-0.001669
	(0.00253)	(0.00192)	(0.00171)	(0.00235)
7	0.002050	-0.000829	-4.16E-05	-0.001373
	(0.00206)	(0.00141)	(0.00142)	(0.00210)

8	0.001120	-0.000271	-0.001109	-0.001488
	(0.00162)	(0.00103)	(0.00115)	(0.00176)
9	0.000184	-0.000329	-0.000407	-0.000622
	(0.00142)	(0.00078)	(0.00087)	(0.00147)
10	-0.000387	-0.000163	-0.000464	-0.000142
	(0.00126)	(0.00052)	(0.00065)	(0.00122)
Cholesky Ordering: g_t r_t f_t p_t				
Standard Errors: Analytic				

APPENDIX C: ACTUAL VALUES (1994Q1-2008Q4) AND THE FORECASTED VALUES (2009Q1-2009Q4) FOR THE MACROVARIABLES

observation	p_t	f_t	g_t	r_t
1994Q1	-0.000755828	0.002235374	0.010333501	0.059658501
1994Q2	0.002512044	-0.013958295	-0.024362996	0.021611311
1994Q3	-0.009416086	-0.012156988	-0.023759223	0.128951302
1994Q4	0.020865504	-0.006532655	-0.015440503	0.026392274
1995Q1	0.004103606	-0.010816239	-0.003308721	0.047510871
1995Q2	0.001549011	-0.006652619	0.029489301	0.051235118
1995Q3	-0.012291634	-0.010330788	0.02555128	0.06735942
1995Q4	-0.005246762	-0.001693289	0.016973945	0.069796514
1996Q1	0.023973089	-0.004480365	0.01764037	0.09290203
1996Q2	0.004475284	-0.010544522	0.01828523	0.057427803
1996Q3	-0.00912502	-0.002622657	0.01519056	0.117137845
1996Q4	-0.01113872	0.00044968	0.017976709	0.053289941
1997Q1	0.011584901	-0.004707987	0.014271506	0.038547734
1997Q2	-0.008375179	-0.005032236	0.019416039	0.047098007
1997Q3	-0.004212811	-0.002656078	0.019902084	0.061874192
1997Q4	-0.003317452	0.00743469	0.019832559	0.013229664
1998Q1	0.008354605	-0.009985657	0.018965316	0.050387558
1998Q2	0.007709846	-0.015392212	0.007481179	0.067343864
1998Q3	0.009855658	-0.011703473	0.007558567	0.096929783
1998Q4	-0.000605336	-0.003063082	-0.003218412	0.085212976
1999Q1	0.00246194	0.001425643	-0.011816407	0.093831626
1999Q2	0.007503079	-0.006571948	-0.003847415	0.072951023
1999Q3	0.0034042	-0.006007088	-0.014251008	0.060536164

1999Q4	0.006551457	-0.005401291	-0.004129072	0.011782606
2000Q1	0.043874525	-0.022753335	0.011523768	-0.059029506
2000Q2	0.021265706	-0.016415393	0.015319149	0.005503429
2000Q3	-0.000505755	-0.017524156	0.023792561	0.013607546
2000Q4	0.014591746	0.002265532	0.015492512	-0.010636075
2001Q1	0.06154968	-0.026555332	0.00278875	0.15203473
2001Q2	0.194678569	-0.015005477	-0.01508812	-0.019848952
2001Q3	-0.004509993	-0.015848305	-0.019132381	0.072713591
2001Q4	0.01222078	-0.003933078	-0.026566951	0.001106712
2002Q1	-0.057460214	-0.014718727	0.000732872	0.034486185
2002Q2	-0.024739642	-0.02312283	0.015232635	0.088054102
2002Q3	-0.019168896	-0.012976455	0.017665281	0.090176887
2002Q4	-0.018597251	0.008453027	0.02680488	0.025523095
2003Q1	0.001666788	-0.012922714	0.017192111	0.046398
2003Q2	-0.00176136	-0.012803648	0.00927337	0.050427992
2003Q3	-0.034368922	-0.01537374	0.012062095	0.084272833
2003Q4	0.013465975	-0.003660164	0.013132225	0.023392602
2004Q1	0.012763738	-0.016548325	0.021791202	0.031369035
2004Q2	-0.003653053	-0.014273953	0.027394982	0.044105314
2004Q3	-0.001115098	-0.017063003	0.021879321	0.048695563
2004Q4	-0.000866759	-0.00374416	0.0194606	0.010201211
2005Q1	0.012788395	-0.015409264	0.018770137	0.022463972
2005Q2	0.00688182	-0.01754872	0.018132197	0.016600257
2005Q3	0.010633335	-0.01196686	0.020734208	0.020533567
2005Q4	0.018044751	-0.016212903	0.023865041	-0.007989046
2006Q1	0.005757203	-0.015319685	0.0131051	0.016293275
2006Q2	0.016032715	-0.021590633	0.022911142	0.005733527
2006Q3	-0.002917917	-0.015001274	0.016983492	0.030551535
2006Q4	-0.007593517	-0.006695548	0.014249818	0.020051687

2007Q1	0.017554148	-0.016068719	0.017685952	0.024749757
2007Q2	-0.014379274	-0.010391337	0.009170619	0.021652776
2007Q3	-0.001793598	-0.0116262	0.008613578	0.04578697
2007Q4	-0.001594534	-0.005273315	0.010446078	-0.000566914
2008Q1	0.015422568	-0.010765189	0.016527986	0.011462873
2008Q2	-0.003910641	-0.014641045	0.006579185	0.0078312
2008Q3	0.00117482	-0.014785896	0.003200992	0.037696576
2008Q4	-0.006708495	0.003083491	-0.015479438	0.015528302
2009Q1	0.0023405	-0.0175675	-0.0100327	0.0370441
2009Q2	0.0130078	-0.0161712	-0.00972837	-0.00413141
2009Q3	-0.0323548	-0.0173301	-0.00226915	0.0355433
2009Q4	-0.0144045	-0.00777877	0.00124426	-0.0159771