A STRUCTURAL MACROECONOMETRIC MODEL OF TURKISH ECONOMY

Submitted by

MUSTAFA KEMAL GÜNDOĞDU

This dissertation is submitted

for the degree of Doctor of Philosophy

İstanbul Bilgi University

Department of Economics

May 2016

Structural Macroeconometric Model for Turkish Economy

Türkiye Ekonomisinin Yapısal Makroekonometrik Modeli

Mustafa Kemal Gündoğdu
109806012

Tez Danışmanı	: Prof. Dr. Durmuş Özdemir
Jüri Üyesi	: Prof. Dr. Ahmet Tonak
Jüri Üyesi	: Doç. Dr. Koray Akay
Juri Üyesi	: Doç. Dr. Mehmet Fuat Beyazıt
Juri Üyesi	: Prof. Dr. Çiğdem Çelik

Tezin Onaylandığı Tarih : 25 Haziran 2016
Toplam Sayfa Sayısı: 115

Anahtar Kelimeler
1) Structural Macroeconometric Model
2) Policy Analysis
3) Macroeconomic Model
4) Forecasting
5) Dynamic Simulation

Anahtar Kelimeler
1) Yapısal Makroekonometrik Model
2) Politika Analizi
3) Makroekonomik Model
4) Tahmin
5) Dinamik Simülasyon

ABSTRACT

This thesis aims to build a small structural macroeconometric model of the Turkish economy by using quarterly data in the period between 1998 and 2014. The model consists of five blocks which are based national income identity, external trade, monetary market, labor force market and national income in terms of production approach. Within-sample forecasting performance of the model is measured by conventional tools while the out-of-sample forecasting performance is tested using confidence intervals generated by stochastic simulations. The trace performance of the model shows that the model is coherent and compatible with the economic theory. Validity of the model is checked both within-sample and out of the sample cases. Results from validity tests indicate that the model is reasonably useful for forecasting and policy analysis. The policy simulations of the model are based on three sets of assumptions: fx rate shock, fiscal policy shock and monetary policy shock. Simulation results suggested that the Turkish economy is highly vulnerable to external shocks through external trade and money market channels. At this point budget discipline appears to be crucial in improving the resilience of the economy against both international shocks and domestic political uncertainties.

ÖZET

Bu tezde 1998-2014 dönemine ait çeyreklik veriler kullanılarak Türkiye ekonomisinin küçük ölçekli makroekonometrik yapısal modelinin oluşturulması amaçlanmıştır. Model, milli gelir özdeşliğinin yanı sıra dış ticaret, para piyasaları, işgücü piyasası göstergeleri ve üretim yöntemine göre hesaplanan ulusal gelirin yer aldığı beş adet bloktan oluşmaktadır. Örneklem içi tahmin sonuçları geleneksel araçlar kullanılarak ölçülürken, örneklem dışı tahmin sonuçları rassal simülasyonlar ile oluşturulan güven aralıkları ile test edilmiştir. Tahmin performansı modelin tutarlı ve ekonomi teorisi ile uyumlu olduğunu göstermiştir. Modelin geçerliliği gerek örneklem içi gerekse örneklem dışı simülasyonlar ile kontrol edilmiştir. Elde edilen sonuçlar modelin tahmin çalışmaları ile politika analizlerinde kullanılabilir olduğunu teyit etmiştir. Tez kapsamında oluşturulan politika simülasyonları kur, maliye politikası ve para politikası şoku olmak üzere üç farklı varsayım kümesine dayandırılmıştır. Simülasyon sonuçları, ekonomiye para piyasaları ve dış ticaret kanalıyla etki eden dış şoklara karşı Türkiye ekonomisinin kırılganlığının yüksek olduğunu göstermiştir. Bu noktada dış şokların yanı sıra yurt içindeki siyasi belirsizliklere karşı dayanıklılığın tesis edilmesi açısından bütçe disiplininin büyük önem taşıdığı değerlendirilmesi yapılmıştır.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Macro-econometric models have been used over the past three decades as important tools of analysis for macroeconomic forecasting and policy assessment (Herve et al. (2011)). Macro-econometric models provide an useful insight into the structural relationship between different key macroeconomic variables. It also helps policymakers with identifying cause-and-effect relationship between the policy and target variables, and helps with making forecasts for the variables. Among the different type of models, macro-econometric models are useful because they illustrate the whole structure of the economy, as well as temporal behavior of the macro-economy. Macro-econometric models also provide an opportunity of tracking the implications of a variety of shocks, (both exogenous and endogenous) and effects of economic policies driven within and between economies and regions (Herve, et al. (2011)).

The concept of macro-econometric modeling was born with the work of Jan Tinbergen in the 1930s. After that many economic institutions and academic researchers have constructed macro-econometric models to illuminate the pattern of domestic output growth and inflation trends, reaction of monetary and fiscal policies in the face of unexpected shocks and the prospects of macroeconomic stability. These models provide frameworks to analyze and observe many aspects of macroeconomic behavior simultaneously and allowing the model builders to study the implications of the economic theories. Attempts to construct macro-econometric model of the Turkish economy have been limited and policy evaluation with the help of macro-econometric models are rarely undertaken. Although one can find small-scale partial econometric models or CGE models based on sector specific relations in Turkish economy, there are

limited numbers works about the general structural macro-econometric models that cover main economic blocks such as consumption, money market, labor market, trade market and so forth…

A structural model is based on mainly 2 sources; economic theory and statistical tools. By analyzing the relationship between the economic variables via statistical tools, the causality of related variables that the economic theory proposed can be tested through an economic data set. Thus, by defining the relationship between the macroeconomic variables it can be determined how and to what extent a change in a variable will reflect to the general economy in medium- and long-term.

Although the estimates obtained from an econometric equation are not always accurate, setting an econometric equation is important since it reflects the set of assumptions of the practitioner and it also provides a basis for projections. Since there are numerous measurable and immeasurable connections between an economic structure, it is difficult to successfully model it by using theoretical equations based on data obtained from questionnaires. But, according to Reiss and Wolak (2007), there are 3 reasons for using the structural modelling.

"First, a structural model can be used in order to estimate the unobserved economic or behavioral parameters that could not otherwise be inferred from nonexperimental data. Second, structural models can be used in order to perform counterfactuals or policy simulations. In counterfactuals, the researcher uses the estimated structural model to predict what would happen if elements of the economic environment change. Finally, structural models can be used to compare the predictive performance of two competing theories. For instance; we could compare the performance of quantity-setting versus price-setting models of competition. It is important to emphasize that these comparisons do not provide unambiguous tests of the underlying economic theories (Reiss and Wolak, (2007))."

The main macro-economic variables mostly used in structural models are inflation, foreign trade figures, public finance, exchange rates, growth, interest rates, and capital flows. In economy literature, the relations between these variables have been analyzed for many times based on different set of assumptions. In these examinations, generally the partial models have been established, and the inferences have been made regarding the entire economy by using the findings from these examinations. In this thesis also, 3

supplementary studies were involved, and the findings from these researches were used to establish a structural model of Turkish economy.

Since, advanced economies have long-term historical economic data and steady economic institutions; it becomes easier to define the partial economic models for these countries. In developing countries, besides, the continuous transformation in the economic structure makes the linkages between economic data are time-variant. In addition, lack of reliable long-term data in developing countries restricts the economists to establish robust and well-defined economic model. For this reason, the modelers have to be aware of all critical economic and social development in the country to be able to address the structural breaks. So, in an economic modelling process, it is crucial to have detailed knowledge of the historical developments of the economy to define general structure of economy. Since the economic policies that were implemented after the year 1980 and the political events that took place during this period were determinants of the general structure of the economy, Turkish economy was analyzed starting from 1980 in this study

1.1 Short Brief on Turkish Economy

In an economic modelling process, it is crucial to determine the general structure of economy and its historical development. Since the economic policies that were implemented after the year 1980 and the political events that took place during this period were determinants of the general structure of the economy, Turkish economy was analyzed starting from 1980 in this study.

Before 1980, the increase in the oil prices considerably increased the need of FX in Turkey. During this period, since Turkey experienced difficulties to find external funding to import crucial input items for production. To overcome this obstruct in the economy, there was a search for external sources. Thus, World Bank and IMF provided funding resources in return for starting structural reforms. After this, a series of measures called “24th January Decisions” in 1980 was put into practice. With these measures, a transition from “import-oriented” to “export-oriented” economic policy took place. With these regulations, the aim was to increase the openness of the economy, to develop market mechanisms, to ensure fiscal discipline, to get inflation under control and to encourage foreign investors. As a result of these implementations, export rate increased two times more in terms of both nominal value in terms of USD

and the volume. By providing funding resources through the banking sector, private real sector began to get stronger. The ratio of public expenditures to GDP fell, while the ratio of public revenue to GDP arose. On the other hand, the contribution of agriculture to economy continued to decrease during these years, while the weight of service sector in economy became more noticeable.

There was an expansion period in Turkish economy between the years 1984 and 1989. The revival throughout the world economies during this period was in line with Turkey's export-oriented growth strategy, and this led to an increase in export. However, in 1990, two important external global events that took place that directly affected Turkish economy negatively. These events were the end of Iran-Iraq war and Gulf crisis. These two external phenomena caused the loss of two important markets for Turkey. In addition to these two important events that closely concern and affect Turkey, the global economic activity experienced a contraction in this period. During this period, the increase in the risk perception had a negative impact on the exchange rates, the demand for credit and public debt. The increase in central government budget deficit and ineffective exchange rate policy prepared the atmosphere for 1994 crisis then taking harsh economic measures was inevitable. Although the new program was based on a tight fiscal and monetary policy, it wasn't implemented effectively due to the early election. Increasing the budget expenditures deteriorated the budged discipline. Then, Turkish economy struggled with the tough and long coalition negotiation after the elections. Finally, the Anayol government was formed. But the problems, however, could not be solved. Political uncertainty caused the delays for measures that had to be taken quickly. IMF officials left Turkey due to this political uncertainty by stating that Turkish economy was worsening. Due to the crisis, banking sector shrank on a real basis and the size of the assets in the sector fell from 44% level of GDP in 1990 to 30% level.

Between 1996 and 1998, due to the fact that the period of short-term governments increased the uncertainty, it was not possible to implement mid- and long-term stabilization programs. On the other hand, due to the base effects of contraction in 1994, Turkey's economy recorded a rapid grow starting as of 1995. However, the increase in the political uncertainties in Turkey and the outbreak of Asia crisis made the economic outlook gloomier. Treasury's annual compound interest rate reached 106%, and budget deficits reached a point, which was difficult to handle, and hyper-inflation concerns

prevailed. General election and the devastating earthquake in August 17th worsened the economic condition in year 1999. The new coalition government that was formed in 1999 agreed to negotiate with IMF in order to prevent that negative course and to find external funding. However, the agreement was not considered to be a way of starting a new process but as the continuum of the early stand-by meetings. In the general elections in April, three-party coalition government signed a mid-term stand-by arrangement which encompasses 2000-2002. As a result, in January 2000, "Inflation Reduction Program", which included tight monetary and exchange rate policies and structural transformations in banking sector, was launched. However, Turkish economy experienced a domestic financial crisis in November 2000 due to the short currency position of banking sector, high amount of capital outflow and rising concerns in stock market. Rapid increase in the interest rates distorted the economic structures of the state and private banks, and market's confidence about the IMF program worsened. Due to the shortage in liquidity, banking sector Turkish economy faced a currency crisis in February, 2001.

In April, 2001, "The Transition to a Strong Economy Program" prioritizing the economic stability was adopted. This program involved a series of immediate measures about public finance, income policies, privatization, banking, and monetary policy. The three-staged program was constructed by taking the impacts of the November 2000 and February 2001 crisis on financial market and particularly on banking sector into account. These stages were quickly getting out of crisis environment through the measures regarding banking sector, preparing a mid-term perspective for economic units to provide stability in exchange rate and ensuring the sustainable growth by establishing a macro-economic stability. During 2002-2007 period, after 2001 crisis, Turkish economy grew averagely by 6.9% on annual basis in parallel with the stability program. Considering the 6.6% growth rate in the first quarter of 2008 as well, it seen that the economy grew for 25 quarters without interruption. This performance indicates the longest uninterrupted growth period in Turkey's history.

Global economic condition was influential on the growth performance of Turkish economy during the global financial crisis started in 2008. So, Turkish economy contracted for 4 consecutive quarters starting from the last quarter of 2008 due to the global financial crisis. However, the economy achieved a strong growth performance in parallel with the other developing countries, and it grew averagely by 9% annually

between 2010 and 2011 thanks to the acceleration in capital flow in global market. After the outperformance in economic growth, the average growth fell to 3% in 2012 and 2013 due to the measures taken by BRSA and CBRT to cool the overheating economy and the developments regarding the global liquidity conditions.

Even if significant achievements have been gained in inflation, public finance, and financial sector regulation in last decade, the current deficit becoming larger because of the enlargement in foreign trade deficit remained in the agenda of economy. While, Turkey's economy grew by 4.8% during 2003-2014 periods on average, net exports generally limited the economic growth. The exception to this situation was observed in the years 2008, 2009, 2012 and 2014.

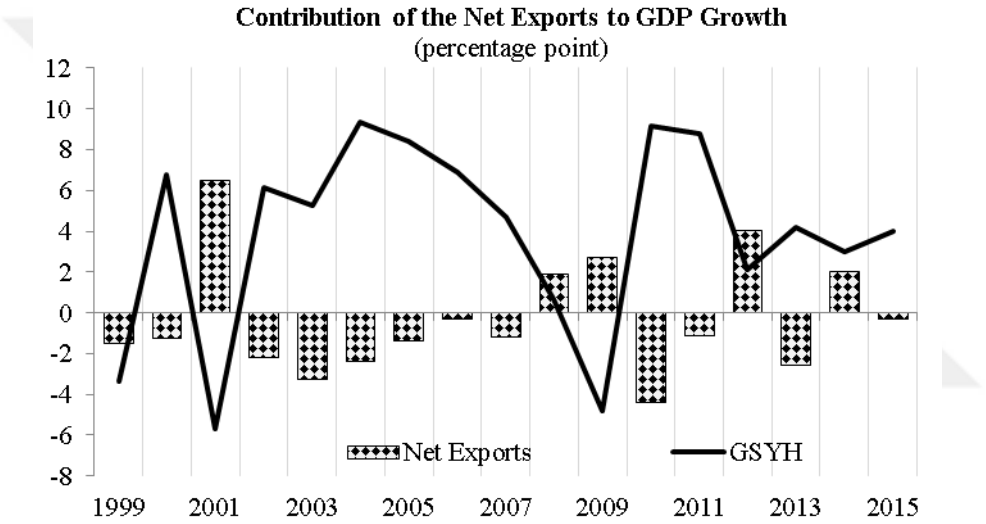


Figure 1.1 Contribution of Net Exports to Economic Growth

While analyzing the foreign trade, figures after 2003 revealed that the annual pace of import growth was generally higher than export's (Figure 1.2). Particularly it is noticeable that the years 2010 and 2011 were the years, when a high rate of growth was achieved and the expansion of foreign trade deficit accelerated. In this period, CPI-based real exchange rate index followed an upwards course and pointed out an appreciation in Turkish Lira. This situation corroborates the ideas that relative appreciation in TRY played a significant role in the expansion of import volume. On the other hand, the fact that export rate increased by over 10% in 2010-2011 was also remarkable. During this period, importance of export market diversification has grown due to the fact that economic activity in Euro-Zone and other major export markets lost momentum. With the impact of the increase in export volume to alternative markets

such as Middle East and North Africa, export performance maintained a positive outlook during this period.

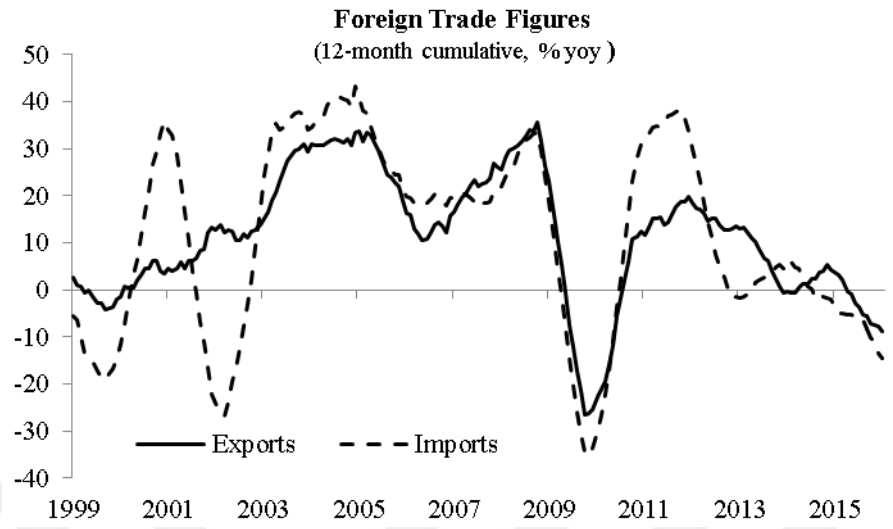


Figure 1.2 Import and Exports, %year over year (yoy) change

Although, a relative revival in domestic demand in European economies, which constitute the biggest export market of Turkey, was expected since 2012, the recovery in European economies couldn't be stabilized yet as of the year 2015. Thus, relatively weak performance of European economies limited the external trade performance. Besides that, the on-going problems in Iraq and increasing geopolitical risks were considered to be important elements of risks in terms of the external trade.

As a result, Turkish economy went through a significant transformation process after the crisis in year 2001. During this period, public finance showed a stronger performance in terms of both rates of the budget balance and the debt stock to GDP. Exchange rates also fell to lower levels, when compared to 2001, in parallel with the decline in the inflation and ensuring the fiscal discipline. Banking sector achieved a resilient outlook in terms of both its asset/liability structure and risk management with the help of economic and political stability as well as restructuring program. During this period Turkey has also experienced "the demographic opportunity which played an important part in the recent achievements of the Turkish economy. A demographic opportunity window is the period, in which the working-age population is growing and the young cohort decreasing, while the old cohort is still small. This is the period, when the rate of the dependent population that are between 1 and 14 year-old and over 65 year-old, to the total population reduce its lowest level. So, demographic opportunity

window offers a unique opportunity for a country. If proper employment policies are applied, the country is able to record high growth rate during this period and makes significant progress in the level of development. For instance; it is observed that the rapid growth period that Japan experienced during 1960s and many Far East countries experienced in 1970s happened at the same time as the demographic opportunity window (Tansel and Kan (2012)). Turkey's demographic structure and population projections indicate the fact that Turkish economy had this demographic opportunity window in the last decade.

1.2 Current Conditions in Global Economy

After the global financial crisis in 2008, major central banks' efforts to stimulate the economy through lower interest rates were accompanied by implying an abandonment of the central bank's traditional monetary policy practices. The global financial crisis was eight years ago, but major central banks such as Fed, BoJ, ECB, BoE still continue expansionary monetary policies. However, these policies have been subjected to debates in economic literature. Many economists believe that global economy still needs further monetary expansions, and it fails in stimulating the employment in developed countries.

When the performance of global economy is analyzed, it can be seen that a modest and uneven recovery continues in developed countries, with a gradual narrowing of output gaps (WE0, 2015). Thus, in December 2015, the Federal Open Market Committee (FOMC) decided that the economic conditions and the economic outlook warranted the commencement of the policy normalization process. This situation demonstrates that the abundance of global liquidity that developing countries benefited from during the period after the crisis will not exist as much in the following period. Due to the gradual tightening of global liquidity conditions, short-term capital movements to developing countries are expected to fluctuate and lose momentum in the forthcoming period. Indeed developing economies currently are suffering from capital flight already as of first quarter of 2016. Therefore, it is anticipated that the developing economies, including Turkey, will be compelled to grow through trade channel instead of finance channel in the forthcoming period.

On the other hand, ECB, BoJ, BoE and PBOE are still far away from monetary policy normalization. Since the economy in Euro Zone, which came to a standstill after the global crisis, continue to struggle with low inflation and recession problems, ECB

launched an asset purchase program and reduced the deposit rate to negative territory in order to support the economy and to cope with deflation. BoE also keeps policy rate at 0.5% since March 2009 and continues Asset Purchase Programme that helps in sustaining the growth and employment. BoE states that the global growth has fallen back further since the year 2013, as emerging economies generally continued slowly. Similarly, BoJ maintained its extraordinary expansionary monetary policy to fight against the deflation concerns. These accommodative monetary policies limited the contractionary effect of Fed's normalization process on the global financial market.

All these information have significant contributions for building a reliable set of assumption for the model structure. Rest of this study is structured as follows: Section 2 introduces two supplementary studies are enclosed to elucidate the relationship between key macroeconomic variables such as, exchange rate, inflation, foreign trade figures. Basic concepts of modelling, literature review, detailed explanation of model structure and behavioral equations are given in Section 3. Simulation results are presented in Section 4 and Section 5 concludes.

2 SUPPLEMENTARY STUDIES

Two supplementary studies performed during the doctoral studies to form a on relations between key macroeconomic variables. In the first study, effects of a change in FX rates on foreign trade balance are studied through a new formulation of Marshall Lerner condition. In second one, effects of a change in FX rates on inflation are investigated by using exchange rate pass-through coefficients.

2.1 Marshall-Lerner Condition

Current Account Deficit of Turkey increased in a largest scale of the country history in the last decade. It was argued that one of the remedies of the deficit problem is to decrease the overvalued domestic currency. The effects of currency depreciation on a countries' trade balance are traditionally analyzed by examining Marshall-Lerner condition (MLC). The MLC suggests that the depreciation of a currency will improve a countries trade balance if the import and export demand price elasticities are greater than one in the long-term.

The economic literature includes number of theoretical and empirical studies of the impact of exchange rate variations on the balance of trade. Some of them are Miles (1979), Bahmani-Oskooee (1998), Wilson (2001), Kale (2001), Mahmud et al (2004), Gomes and Paz (2005), Matesanz and Fugarolas (2009), Çelik and Kaya (2010), Hsing (2010), Yazici and Klasra (2010), Welfens (2012), Sastre (2012) and Soleymani and Chua (2014). Despite their number, they fail in agreeing on the effect of currency devaluation on trade balance.

Kale (2001) employed a long- and short-term methods using quarterly Turkish data between 1984 and 1996. Co-integration test was carried out in order to estimate the long-term elasticities. The study concluded that the real depreciation improves Turkish balance of trade in those years well before the large structural change occurred in Turkey. Çelik and Kaya (2010) analyzed Turkey's bilateral trade dynamics with respect to a panel data of seven countries for the period 1985Q1 to 2006Q4. They questioned the existence of a J-curve[i] by analyzing the relationship between real exchange rates, real income and trade balance for Turkey. They concluded that the effect of devaluation in Turkish currency on trade balance is a country specific phenomenon. Yazici and Klasra (2010) used the quarterly data covering the period 1986 and 1998. Their study examined the J-curve effect in two industries (manufacturing and mining) of Turkish economy.[1] They highlighted a special structural issue on Turkish economy; the import content of export. They concluded that in both sectors the J-curve exist and the violation of the J-curve effect is more severe in the sector with higher import content. Sastre (2012) focused on the issue of simultaneity between export and import flows for the Spanish economy. The issue is also important for Turkish economy. Sastre (2012) reformulated the ML condition in open economies and argued that, in the long-term, the impact of exchange rate fluctuations on the balance of trade of countries with open economies not only depends on export and import price elasticities but also on the cross elasticity values between export and import.

2.1.1 Reformulation of the Marshall-Lerner Condition

In a standard Marshall-Lerner argument;

$$\ln TB = LnX - LnM \tag{2.1}$$

where, TB is the trade balance. $\frac{\partial TB}{\partial e} > 0$, when $\left(\varepsilon_{x,e} + \varepsilon_{m,e}\right) > 0$ where $\varepsilon_{x,e}$ and $\varepsilon_{m,e}$ are the export and import demand elasticities, respectively. Sastre (2012)'s reformulation of the Marshall–Lerner condition, according to the classification of

[1] The theory of the J curve: as a result of devaluation, the trade balance will first worsen and then after the passage of sometime it will start to improve.

countries in relation to cross elasticities between export and import consists of four propositions.

Firstly, if $\varepsilon_{m,x}$= 0 and $\varepsilon_{x,m}$ = 0, where $\varepsilon_{m,x}$ and $\varepsilon_{x,m}$ are cross elasticities of import and export, respectively, Marshall Lerner condition is satisfied when $(\varepsilon_{x,e} + \varepsilon_{m,e}) > 0$. In other words, it characterizes an economy that depends slightly on other countries.

Second proposition states that, If $\varepsilon_{m,x} \neq 0$ and $\varepsilon_{x,m} = 0$, $\frac{\partial TB}{\partial e} > 0$ when $(\varepsilon_{x,e}(1 + \varepsilon_{m,x}) + \varepsilon_{m,e}) > 1$, this is an economy that the demand for imports depends on exports but demand for exports does not depend on imports. This is the condition applies to those economies, in which many industries import raw materials or intermediate goods more than exporting final goods.

Sastre (2012)'s third proposition considers the case, where export depends on import, but import would not depend on exports. The proposition outlines that $\frac{\partial TB}{\partial e} > 0$ when $\left(\varepsilon_{x,e} + \varepsilon_{m,e}(1 + \varepsilon_{x,m})\right) > 1$.

The last case states that exports demand depends on import demand, and vice versa. So, the Marshall Lerner condition is valid when $\left(\varepsilon_{x,e}(1 + \varepsilon_{m,x}) + \varepsilon_{m,e}(1 + \varepsilon_{x,m})\right) > 1$.

2.1.2 Simultaneity Between Imports and Exports

This study utilizes quarterly data between the years 1998 and 2014, and uses Sastre's analytically developed reformulation of the Marshall-Lerner condition for Turkey. Foreign trade data are taken from TURKSTAT, while the source of real exchange rate data is OECD. National investment expenditure, which gave the best result in the analysis as an indicator for domestic demand, is gathered from national income identity. Total GDP of EA-18 countries, which is assumed as a proxy variable for world demand, was taken from EUROSTAT. Before applying the empirical models, the series are transformed into log form and adjusted for seasonality. Deseasonalization is done by using TRAMO/SEATS (Time Series Regression with ARIMA Noise, Missing Observations, and Outliers) method.

Turkish import and export demand equations and their determinants are represented in the following equation:

$$\ln X = f(\ln re, \ln EAD, \ln M) \quad (2.2)$$

$$\ln M = f(\ln re, \ln I(tr), \ln X) \quad (2.3)$$

where, *M* is the volume of imports of goods and services, *I(tr)* is the national investment expenditure, *EAD* is the total GDP of Euro Area-18 as a proxy of world (external) demand, and finally *lne* is the reel exchange rate. The ln stands for logarithm.

Maximum likelihood co-integration procedure proposed by Johansen is used to check if there is a long-term equilibrium relationship between the variables in Eqs. (1) and (2) for Turkey. After obtaining a cointegrated relation between the variables, the residual of the long-term equation is used in the short-term specification as error correction process.

It is required to determine the degree of integration of variables to perform the co-integration analysis. Before conducting the co-integration analysis, Augmented Dickey Fuller (ADF, Dickey and Fuller (1979)) and Phillips-Perron (PP, Phillips and Perron (1988)) unit root tests are performed to determine if all variables have same integration order. Test results confirmed that all variables are stationary at their first differences. In addition to that, the trend, intercept and lag options for each co-integration equation are determined by testing all available options. Results indicated that the level export data have no deterministic trends while import data have quadratic deterministic trends

2.1.3 Turkish Case: Facts and Results

Energy dependence of Turkish economy, which is evaluated as a major structural drawback, may lead to obtain vague results from foreign trade models. According to data, share of oil imports in total imports was about 20% between years 1998 and 2014. Considering the necessity of oil demand in developing countries as Turkey, it is expected that price elasticity of oil import is relatively low. So in this study, oil-excluded total imports are also used as an import indicator to specify price elasticity of imports.

Table 2.1 Johansen Co-integration Test Results

Johansen Co-integration Test	#ofCoint.	Trace	Probability
1.lnX=f(lnM,lner,lnEAD)	at most 1	30.91	0.03
2.lnM=f(lnX,lner,lnI(tr))	none	37.24	0.03
3.lnX=f(lnOEM,lner,lnEAD)	at most 2	16.77	0.03
4.lnOEM=f(lnX,lner,lnI(tr))	none	72.06	0.00

(*) Null Hypothesis states that there is no cointegration relations between variables.

(**) Critical values for Oswald-Lenum (95%) were 29.68 for "At most 1", 15.41 for "At most 2" and 47.21 for "None".

The results of Johansen both for 2 and 6 lag orders corroborated the hypothesis that there are two co-integrating relationships between imports and exports. Moreover, at least two valid co-integration equations were obtained valid when all variable in equations. (1) and (2), and then included into analysis. Estimated coefficients in co-integration vectors were normalized in order to interpret the results. So, it enables us to read the elasticities directly from co-integrating vectors.

Results indicated that all models have at least 1 co-integration equation. The co-integration vectors obtained were;

$$lnX = 0.99\, ln\, M - 0.66 lnre + 0.59 lnEAD \quad (2.4)$$

$$lnM = 0.49\, ln\, X + 0.60 lnre + 0.44 lnI(tr) \quad (2.5)$$

$$lnX = 0.99\, ln\, OEM - 0.90 lnre + 0.96 lnEAD \quad (2.6)$$

$$lnOEM = 0.48\, ln\, X + 0.59 lnre + 0.49 lnEAD \quad (2.7)$$

The results obtained from the analysis indicate that the coefficients in both of imports model were not statistically different. This result was against the presumptions about distorted effects of oil imports on the import elasticity, and it brings another aspect to the forefront; oil imports exhibited a similar course with the other chapters in imports.

Coefficients of reel exchange rates are statistically significant and economically coherent with the theory in all model. Furthermore, the sum of both import and export

elasticities are greater than 1, indicating that standard Marshall-Lerner condition was valid for Turkish economy in the long-term.

This result contradicts with similar studies previously carried out for Turkish economy. Previous works generally covered the period before the year 2000, when Turkish economy struggled with the high inflation, strict trade tariffs of the neighbors and inadequate financial market regulations. Thanks to the financial sector adjustment and restructuring banking sector implemented in the aftermath of the financial crises during 1999-2001, many economic achievements were attained elaborately in both reel and public sectors. So, it is considered that the distorted effects of the external factors on the relation between foreign trade figures and exchange rate were relatively limited in 2000's compared to the previous decades.

Results also indicated that the condition expressed in 4th proposition was verified for Turkey. In other words, import and export in Turkey simultaneously are dependent each other and the condition;

$$\left(\varepsilon_{x,e}\left(1+\varepsilon_{m,x}\right)+\varepsilon_{m,e}\left(1+\varepsilon_{x,m}\right)\right)>1$$

$$\left(0.66_{x,e}\left(1+0.49_{m,x}\right)+0.60_{m,e}\left(1+0.99_{x,m}\right)\right)=2.18.$$

In the case of Turkey, the long-term estimations of the price elasticities of exports and imports, and the respective cross elasticities, lead us to conclude that currency devaluation would, in the long-term, will improve the balance of trade.

2.2 Exchange Rate Pass-Through

The fluctuations in the exchange rates determine the domestic prices in different ways:

- These fluctuations in the exchange rate impact the domestic prices through import goods. The scale of this impact is based on the factors such as the level of the competitiveness of countries and the price elasticity of the import goods.
- The scale of the shock on exchange rate might impact the pass-through effect. Sometimes, small changes in exchange rate are not reflected on the prices due to the pricing strategies adopted by foreign trade companies.
- Exchange rate regime is considered to be another factor determining the pass-through. During floating exchange rate, the relation between exchange rate and

domestic prices weakens in an economy carrying out inflation-targeting regime. However, in his study, Damar (2010) stated that the exchange rate fluctuation was more effective on inflation before floating exchange rate regime was adopted.

In economics, pass through is generally defined in two ways as direct and indirect. Direct way is associated with the concepts of "Law of One Price" and "Purchasing Power Parity". According to them, for a particular import price, the changes in exchange rate are reflected on domestic prices. The increase in exchange rate causes domestic goods to be cheaper for foreign customers and thus leads to an increase in the amount of the export and the total demand (Damar (2010)) (Figure 2.1).

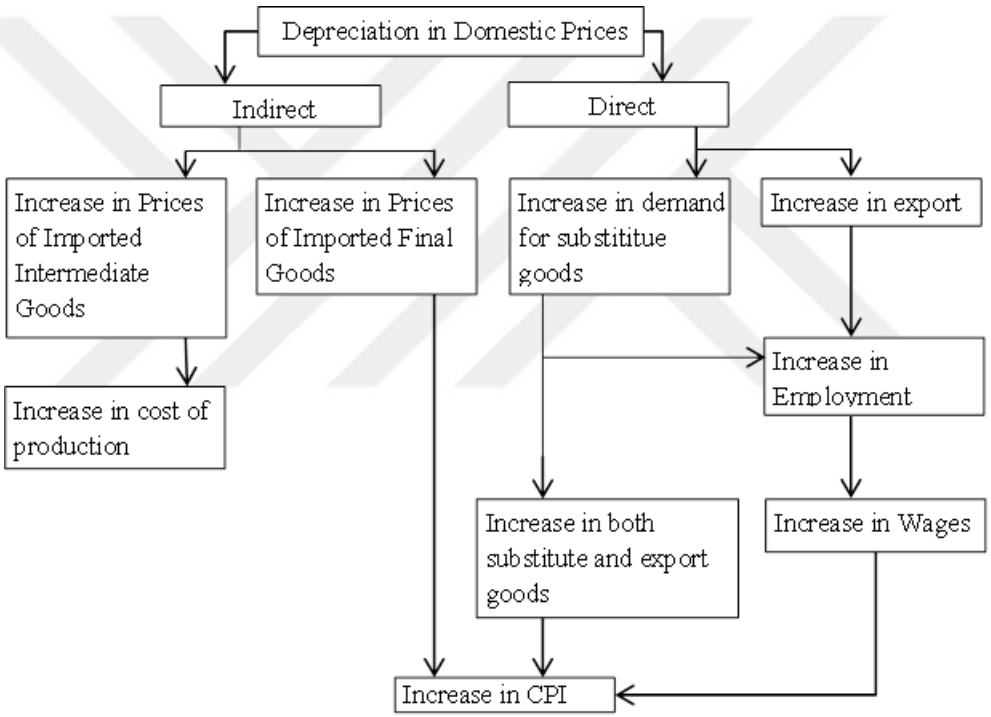


Figure 2.1 Exchange Rate Pass-Through Diagram

It is assumed that the exchange rate pass through occurs through indirect way in Turkey. So, the exchange rate pass-through effect also indicates the sensitivity of the producer prices to exchange rate fluctuations in countries highly dependent on import like Turkey. Determining to what extent the fluctuations in producer prices reflect to the consumer prices is important for predicting the course of inflation and the optimal (the most appropriate) monetary policy that will be applied based on the target inflation.

Openness of the economy to global market is another factor, which determines the exchange rate pass through. In economies, which are highly open to global market,

exchange rate shocks result in fluctuations in prices of intermediate goods as well as the final goods. For instance; in countries like Czech Republic, Hungary and Thailand, where the level of openness is high (in these countries, the ratio of foreign trade volume to GDP is over 80%), it is observed that the pass through effect is also high.

Taylor (2000) stated that the commitment to price stability of the inflation targeting (IT) strategy will decrease the pass-through, and this will help with keeping inflation at lower levels. Gagnon and Ihrig (2004) affirmed that the level of pass-through is especially correlated with the implementation of inflation targeting and with the changes in the monetary policy process. Ball and Reyes (2004) stated that the ERPT would decrease as the monetary policy regime becomes credible, inflation becomes more sustainable and the economy approaches to its long term potential growing trend.

Many studies on the impact of exchange rate fluctuations on inflation have been conducted in Turkey. Leigh and Rossi (2002) examined the impacts of exchange rate fluctuations on price index using VAR analysis for Turkey. Findings gathered through the study, which analyzed the period between 1994 and 2000, demonstrated that the impact of exchange rate on prices lasts after a year, yet a great part of this impact is observed in the first four-month period. In addition to this, the findings also indicate that the pass through rate of producer prices is higher than the pass through rate of consumer prices. In the study, it is also stated that the scale of pass through is larger than the one in other developing countries.

In their study, Kara and Öğünç (2005) analyzed the exchange rate pass through in two periods, which are floating and stable exchange rate regimes' periods. The findings of stable exchange rate period are compatible with those Leigh and Rossi (2002) obtained, and also it was concluded that the impact of this pass through weakened after shifting to floating exchange rate.

Damar (2010) analyzed the pass through by dividing 1995-2000 periods into two categories as floating and stable exchange rate regimes. In his study, the exchange rate pass through into prices was examined separately in terms of both consumer price index inflation and core consumer price index inflation. As a result, the findings indicated that the exchange rate pass through effect into consumer price index inflation were lower than the effect on the core inflation indicator. Damar (2010) stated that in the exchange rate pass through had slackened in years due to the fact that the frequency of external

shocks lowered and the inflation level declined after the transition into inflation targeting period.

2.2.1 Data and Analysis

In this study, there is an attempt to determine how exchange rate shocks affected inflation in January 2003 – December 2014 period. For that period, pass through effect is examined in two periods, which are pre-crisis (before January 2009) and post-crisis (January 2009 and later) periods. There are 5 variables in their model (Producer Price Index, Manufacturing Industry Producer Price Index, Consumer Price Index, Core Consumer Price Index, and Exchange Rate). By using these variables, 4 different pass through equations were analyzed (Table 1). In this study, to determine the direction and scale of the pass through, the VECM (Vector Error Correction Model) model was used and the distribution of this pass through was analyzed through the cause-effect function.

Table 2.2 Pass-Through VECM's

PT 1.	Exchange Rate	→	D-PPI	→	CPI
PT 2.	Exchange Rate	→	Manufacturing D-PPI	→	CPI
PT 3.	Exchange Rate	→	D-PPI	→	Core CPI
PT 4.	Exchange Rate	→	Manufacturing D-PPI	→	Core CPI
PT 5.	Exchange Rate	→	CPI		
PT 6.	Exchange Rate	→	D-PPI		

In data set, currency basket (0.5*EUR+0.5*USD) as an exchange rate, Consumer Price Index, which was announced by TURKSTAT based on 2003=100 as price index, Producer Price Index, core consumer price index denominated by H, and industrial producer price index, broad definition of money supply including currency in circulation, demand and time deposits in billion Turkish Lira, manufacturing industry production index, import Price Index, spot prices of Brent crude oil prices in dollars per barrel also were included in this analysis. By using H defined core consumer price index having specified coverage which excludes unprocessed food products, energy, alcoholic beverages, tobacco products and gold, it is aimed that the pass through will be estimated by excluding the temporal external factors.

Standard time series approaches are utilized to test stationarity, autocorrelation, multicollinearity and heteroscedasticity. The problem related to heteroscedasticity in the

data was solved through White heteroscedasticity estimation. ADF (Augmented Dickey Fuller) test results used in stationarity test indicate that the data in levels were not stationary while first differences were. (See Appendix)

The lag period in the VECM model was determined based on Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC). These two criteria suggested different length of lag regarding the period to be analyzed. Each model was used separately for the proposed length of lag and the one, which has the highest explanatory value, was taken into consideration. In the analysis carried out in the post-crisis period, both criteria showed the same length of lag.

The variables were included into VECM model according to the order in the Table 1. Therefore, exchange rate was taken as an external variable in all models and the impacts of the exchange rate shocks were determined through the order. That's why; in first four models, the interaction chain from exchange rate to producer prices then from producer prices to consumer prices was taken into consideration in the analysis.

2.2.2 Findings

Similar findings were obtained from the four models. The results of the PT Equation 1, which demonstrates the exchange rate pass through to consumer price along producer prices, are consistent with those in PT Equation 2. The results of PT Equation 4, which determine the exchange rate pass through to core consumer price index along producer price index, are also in line with those in PT Equation 3. Taking the similarities among the results into consideration, it is decided to focus on only the results of PT Equation 1 and 4 for the sake of brevity.

Import prices respond relatively quickly to an exchange rate change. After three months, 48% of a change in the exchange rate is passed into import prices, and after 12 months, the pass-through is as much as 80%. Producer prices respond much more sluggishly, with only around 8% pass-through effect after three months. However, after a year, the exchange rate pass-through effect to producer prices reached at 28%. The response of consumer prices to exchange rate changes is relatively limited with 12%.

Table 2.3 Pass-Through Results

∆FX=%10	**After 3 months**	**After 6 months**	**After12 month**
Import Price Index	4.76%	6.31%	7.92%
D-PPI	0.84%	1.97%	2.81%
CPI	0.43%	0.94%	1.23%
C-PPI	0.59%	1.14%	1.44%

2.2.3 Final Remarks

Findings gathered from the study are compatible with the other studies for Turkish economy. The results point out that the fluctuations in exchange rate have influences on the course of both producer and consumer price indices, while these influences have diminished through the analysis period.

After the 2008 crisis, inflation exhibited a flat course in many developed and developing countries, despite the expansionary fiscal policy owing to the shrinking global demand and high volatility in commodity prices. The inflation rate in Turkey also reduced to 5% level depending on the weakness in global and domestic economic performance throughout this period. Thus, it was considered that the relation between exchange rate and inflation may alter after the global financial crisis. To test this hypothesis, pass through effect between years 2010 and 2014 is also examined in this study. However, the findings are empirically irrelevant due to the lower inflationary environment during this period

The results of the analysis indicate that there is a higher impact of the pass through on core inflation compared to consumer price index. This result may refer that the pass through impact on energy and gold prices is higher while it is much lower in alcoholic drinks, tobacco and unprocessed food products. That’s why; the total contribution of these items to the pass through is very limited. Thus, the exchange rate pass-through into headline consumer price index is lower in proportion to the core inflation figures. Besides that, comparing the impact of the exchange rate shocks on producer prices to those on consumer price index revealed that producer prices are more sensitive to change in exchange rate.

According to some economists, since exchange rate pass through effect declined, CBRT had more opportunities than before to take precautions in order to maintain the financial

stability and to support the economic activity by subordinating inflation target. On the other hand, classical methodology of the exchange rate pass-through analysis excludes some other important structural determinants of the inflation rate such as the monetary policies on global scale, commodity prices, inflationary/deflationary pressures depending on global demand, and etc. So, CBRT has to consider the developments in factors outside of its control such as climate condition, commodity prices, monetary policies in developing countries, and analyze the possible repercussion of such shocks on inflation dynamics to implement an efficient monetary policy.

3 THE STRUCTURAL MACROECONOMETRIC MODEL OF TURKISH ECONOMY

Macroeconomic models help the policymakers to evaluate the policies in a scientific and systematic level. Since, forecasting has a crucial role in macroeconomic policy decision; large-scale structural macroeconomic models have an important place in a tool-box of policy makers (Pescatori and Zaman (2011)). According to Reiss and Wolak (2011) structural econometric models have the advantage of detailing the economic and statistical assumptions required to estimate economic quantities. And structural models must have flexible statistical descriptions of data, respectful of the economic institutions under consideration and sensitive to the non-experimental nature of economic data. So if the practitioner has decent knowledge on the economic theory, estimating a structural econometric model provided significant benefits to test both linkages of the key macroeconomic variables and economic theories which are designed to identify these relations by constructing valid and coherent economic model (Reiss and Wolak (2011)). Structural models are built using the fundamental principles of economic theory, often at the expense of the model's ability to predict key macroeconomic variables like GDP, prices, or employment. In other words, economists who build structural models believe that they learn more about economic processes in a cause and effect relation through a scientific approach (Pescatori and Zaman (2011)).

Structural econometric modelling was popular in the last decades. However, it lost its popularity to Computable General Equilibrium and Dynamic Stochastic General Equilibrium Models. The main reason is the Lucas Critique (Lucas (1976)), which argues that it is naive to predict the effects of a change in economic policy on the basis of relationships observed in historical data. In other words, parameters in econometric models are not policy-invariant, but they would change whenever policy is changed. Since any change in policy will systematically alter the structure of econometric models, the outcomes of policies based on these models would potentially be misleading. Thus, the Lucas critique suggests that the economists should model the "deep parameters" (by relating them to preferences, technology, and resource constraints) that are assumed as individual behavior; so-called "micro-foundations." So this critique brings us into DSGE, which dominates the currently popular modelling field.

Despite of its popularity, main limitations of the DSGE models are connected with its essential neoclassical microeconomic assumptions of (1) “rational behavior” of a representative agent that maximizes consumption under a budget constraint and maximizes profits in production with a resource constraint, within (2) a very well behaved market clearing process and guided by (3) rational expectations (Garcia (2011)).

First critique is based on the study of North (1993) who is the 1993 Nobel Prize winner. North (1993) demonstrated that under uncertainty, which rises with shocks affecting macroeconomic performance and these shocks are very frequent in today’s globalized world, it is not possible to assume the idea of (1) a “rational behavior” defended by conventional neoclassical economics and it is more close to real life to accept that people learn and behaves by trial and error (Garcia (2011)). On the other hand, seven recent Nobel Laureates emphasized that the assumption of an automatic adjustment that clears the markets is far from been true due to quite a number of reasons. Hence, there is plenty scientific evidence that a permanent trend towards (2) market automatic adjustment in the sense of market clear with full employment does not exist (Garcia (2011)).

Last critique is correlated with the rational expectations theory which is influential on Lucas Critique, indicates that every agent in an economy has best guess of future events using all the information available today. It refers that current expectations about the

future is totally accurate thus current market equilibrium values are equivalent to the value that it will obtain in the market equilibrium tomorrow. However, according to Bandura (1986) human behavior is a result of the dynamic interaction between personal factors, behavioral patterns and environment. Behavior, for this approach, is regulated by a previous cognitive process (Garcia (2011)). Clearly in this case the rational expectation theory is correct only if the future is a repetition and identical copy of the past market equilibrium. But when the future is an identical copy of the past it is the same to use rational or adaptive expectations since the first ones obtain information from the future, the second ones from the past but in both cases is the same information (Garcia (2011)).

Furthermore according to Pescatori and Zaman, the contribution that DSGE models have provided is mainly methodological, making them a useful complement to, but not a substitute for, large-scale macroeconomic models. Princeton economist Christopher Sims also characterizes DSGE models as useful story-telling devices that cannot yet replace large-scale models for forecasting purposes (Pescatori and Zaman (2011)).

There are also many criticisms about DSGE. For instance; Robert Solow and Narayana Kocherlakota, (the former President of Minneapolis FED), claimed that the DSGE models have failed in foreseeing the financial crisis before 2008. Furthermore, given the difficulty of constructing accurate and valid DSGE models, most of the central banks still rely on the traditional macro-econometric models for short- and long- term forecasting. It is considered that the DSGE need to incorporate relevant transmission mechanisms or sectors of the economy. In addition some issues still remain on how to empirically validate the model and on how to effectively communicate their features and implications to policy makers and to the public. In overall, DSGE models have significant limitations on using in Central Bank's policy simulations (Tovar 2008). So, policy makers are still relying on structural models. Policy makers are better equipped in order to evaluate the direction and magnitude of the reaction of economy to internal and external shocks with a help of structural models. Main criteria for the selection between DSGEs and traditional structural models lie in the tradeoff between statistical validation with reliable forecasts and adaptability of behaviors. So, in this thesis structural modelling is chosen as the approach that is based on practical concerns.

The aim of this study is to develop an open-economy framework, and to attempt to take the unique features of the Turkish economy into account. The model has equations and

identities that represent the behaviors of macroeconomic variables. For convenience, the model consists of 5 blocks; (i) production, (ii) national income identity, (iii) external trade, (iv) monetary market and (v) labor force market. The model captures the nexus between output, government deficit, foreign trade, money market, and price level, and can be used in order to examine the effects of both of domestic and external shocks to the economy. Furthermore, with additional identifications, one can construct monetary transmission mechanism in order to illustrate CBRT's policies used recently. So, the model is also applicable for examining the general effects of monetary, fiscal and exchange rate policies on the overall economy.

3.1 Literature Review

As losing popularity in economic modelling after 2000's, there is not enough number of structural macroeconometric models revealing the changes in Turkish economy after the financial crisis in 2001. The main studies in which macroeconometric models are developed for Turkish economy can be listed as; (1967), Korum (1969), Blitzer et al. (1970), Uğurel (1971) Celasun (1971), Lewis and Urata (1983), Özmucur (1980) and (1984), Yörükoğlu (1980), Yağcı (1983), Fair (1984), Celasun (1986), Gupta-Togan (1984), Uygur (1987), Yeldan (1989), Neck and Karbuz (1993), Özmucur (1993), Özatay (2000), Aysoy et al. (2005), and Özatay (2007).

Uygur (1967) uses appropriate equations on consumption, investment, production (econometric equations on national income, agricultural and industrial production), foreign trade, and taxes. Uygur (1967) divides the taxes into two categories; the direct and indirect taxes. According to Uygur (1967) the results reached in the book are generally the usual ones. The results obtained from investment block show that the previous year's capital stock had a positive effect on current investment rather than a negative effect. It contradicts with the expectation of economic theory, which follows the acceleration principle. This effect is expected to be negative. In other words, according to the economic theory, public or private capital stock of the previous periods should cause a crowding-out effect because of the use of scarce resources (Uygur and Bulutay (2004)). The second result is on the effectiveness of prices in foreign trade. The results of foreign trade block have shown that prices have no significant effects on the imports and exports of Turkey. In the following study (Uygur (1986) p. 96-97), the same result has also been also obtained.

Aysoy et al. (2005) constructs a small-scale quarterly model for the Turkish economy, in which the explicit treatment of the expectations in the inflationary process and the effects of public borrowing on inflation via interest rates were used. He finds that the expectations had the greatest importance in determining the inflation along with the exchange rate in Turkey. In addition to the use of overnight interest rates as an effective policy tool, it seems to be essential to accomplish the structural reforms so as to eliminate risk premium due to the concerns about the debt sustainability.

The studies carried out by Korum (1969), Uğurel (1971) and Özmucur (1980) are defined as the first generation models by Uygur and Bulutay (2004). The studies of Korum (1969) and Uğurel (1971) emphasize the role of econometric models in the process of economic planning, which was started in year 1961 in Turkey. In this parallel, they primarily concern with the structural analysis of the economy, even though they involve one period ahead forecasts and Özmucur (1980) utilizes policy simulations (multiplier analysis) as well. The behavioral equations are entirely linear in variables and parameters, and are estimated through the annual data. They are analyzed in order to obtain the estimations of reduced form of parameters from structural parameter estimations and the solution values (Uygur and Bulutay (2004)).

On the other hand, the studies of Yörükoğlu et al. (1984), and Şenesen (2008) are described as the second generation models by Uygur and Bulutay (2004). These models concern with forecasting the immediate future and, except the last one, they also include policy simulations (Uygur and Bulutay (2004)). In all of the models, the behavioral equations involve non-linearity in variables estimated by annual data like their predecessors. Iterative dynamic solution methods are used in order to solve the equations. Korum (1969)'s model has two versions. In the first version, Korum (1969) uses current prices in order to determine the variables, while real prices are used in the second version. The estimation method used is Ordinary Least Squares (OLS). Problems in estimation, including simultaneity, are mentioned, but no measures are taken against them. Korum also admits that the import equations are not successful, and this can be partly attributed to the import controls, which could not be taken into account. Specification and estimation problems also exist in domestic demand equations, especially in those explaining the agricultural and non-agricultural stock changes. An interesting feature of Korum's model is that non-agricultural wage and

profit (non-agricultural non-wage) incomes are explained, which can be used in order to analyze the functional distribution of income (Uygur and Bulutay (2004)).

Uğurel (1971)'s model is smaller than the Korum (1969)'s model. Most of the behavioral equations are constructed in order to explain import and domestic demand variables. Although the investment expenditure is used as an explanatory variable in the equation for imports of investment goods, the parameter of the variable is found to be statistically non-significant. Furthermore, this result is utilized in order to indicate the characteristics of the Turkish economy. Uğurel (1971) takes simultaneity into account in estimation, and then applies Two Stage Least Squares (2SLS) to the data set of period between years 1949 and 1967. On the other hand, the half of Uğurel (1971)'s estimated equations suffer from severe negative autocorrelation, a problem that is not treated or even considered (Uygur and Bulutay (2004)).

Özmucur (1980) developed an extensive version of Korum (1969)'s model in terms of specification, estimation and other procedures employed. In addition to the wage and profit incomes, also the employment and unemployment are determined in this model. In his study, all of the sectoral exports, i.e. agricultural, mining and industrial exports, are deflated by using the same deflator data, which could of course lead to systematic and huge measurement errors. Measurement errors of this nature are also likely to be present in the real values of import variables (Uygur and Bulutay (2004)). Özmucur (1980) also uses the OLS method in order to estimate the behavioral equations. His data set covers either 1950-74 or 1962-74 periods. One can notice that the positive autocorrelation exists in his data set, however this problem is not considered. On the other hand, 2SLS estimation method is used in order to eliminate the simultaneity problem in estimation.

Uygur (1986) develops another econometric model for Turkey by using single equation method with OLS and GLS. The model has output, price, foreign trade, domestic demand, monetary and fiscal variables. It has also some policy simulations in order to investigate the effects of assumed alternative government policies on the endogenous variables. The simultaneous blocks in the model are estimated by Non-Linear Three Stage Least Squares (NL3SLS) and the recursive blocks by Seemingly Unrelated Regression (SUR) methods. The OLS and GLS estimations are compared with the estimations obtained from NL3SLS and SUR. The data used in estimations belong to the period between years 1961 and 1984 (Uygur and Bulutay (2004)).

Although there are limited number of studies about structural macroeconometric model for Turkey, one can find many well-organized partial economic models, which should be taken into account in constructing comprehensive country models. For instance; Öğünç and Ece (2004) attempt to estimate the potential output of Turkish economy by using basic univariate and bivariate unobserved components models from 1987:q1 to 2002:q4. They also designed confidence bands for potential output and output gap. These bands show that 1993 and 1997-1998 were the expansion periods but 1989, 1994 and 2001-2002 were the recession periods of the economy. Moreover, they claimed that the relationship between inflation and output gap is limited, because the inflation is closely tied to exchange rate and past inflation at the period of study (Özatay (2007)). Özatay (2000) developed, estimated and simulated a quarterly macro-econometric model for Turkey. The model analyzes the substantial inertia in the inflation rate and the high public sector borrowing requirement.

Another work on estimating the potential output of Turkey is carried out by Özatay (2007). In this paper, Vector Error Correction Model and univariate Kalman Filter techniques are used. The estimation findings are in harmony with the existing literature. Moreover, it is verified that Turkish economy has entered a new era of economic stability after many years of fluctuating output (Özatay (2007)).

Sarıkaya et al. (2005) employs the extended Kalman Filter from a multivariate perspective, and the output gap is defined as a function of real interest rate, real effective exchange rate, demand index and its own history. All of the parameters in this study are time-varying. Kaya and Yavan (2007) also use recent statistical and economical approaches in order to measure the gap for Turkish economy and compared all the results. They analyze the correlation between capacity utilization, which exhibits the cyclical movements of the economy (Özatay, (2007)).

Gupta and Togan (1984) construct a specific multi-sectoral general equilibrium model as another example of model built for Turkey. They illustrate the effects of liberal and interventionist policies of government on the GDP and the income of different classes in the economy.

Özdemir and Turner (2005) develop a monetary disequilibrium model for the Turkish economy, and run several simulation experiments through their model. The aim of those simulations is to reveal the relation between fiscal policy and money supply. The

simulation results show that the fiscal discipline is very important in achieving objectives such as sustaining the disinflation process and reducing the high budget deficit in Turkey.

Coşkun (2006) designs the TURKPOL (Turkish Economic Policy Model), which consists of 13 behavioral equations. The TURKPOL model integrates the Keynesian and neoclassical elements. Optimal monetary and fiscal policy designs are presented for Turkish economy over the period 2007-2013. Optimization experiment is conducted under the fixed exchange rate regime and the flexible exchange rate regime. The optimization experiment is carried out using the optimum control algorithm OPTCON and a macro-econometric model of the Turkish economy. In both exchange rate regimes, very similar results have been obtained for the growth rate of the GDP, the inflation rate and the unemployment rate. These results can be interpreted to mean that the exchange rate is ineffective in the iteration process of our functional form or the exchange rate regime had very little effect on the saddle path of those variables (Coşkun, (2006)).

Even if the number of structural model examples that are designed for the Turkish economy is limited, there are well-defined macroeconomic model examples for developing and underdeveloped countries. Large scale macroeconomic models which are developed for countries like China, India, Pakistan, Bangladesh, Brazil, Portugal, Malta, Philippines, and Luxembourg, are frequently used by the policymakers.

Garratt et al. (2006) proposes a long-term macroeconomic structural model for the UK economy that is widely used as a detailed guide. Also, their model is applied to other countries by other practitioners as well. Another example for large-scale macroeconomic model that is widely used is proposed by Bardsen et al. (2005). Even though, both studies are referred in this thesis, the model of Brillet (2015) is considered as a primary source for both the structure of the model and the programming language.

Cagas et al. (2005) have constructed a small quarterly macro-econometric model of the Philippine economy. The model consists of sectors of private consumption, investment, government, trade, production, prices, money, and labor. There are 48 behavioral and technical equations, 17 identities, and 81 variables in total. The behavioral and technical equations have been specified and estimated using PcGive and PcGets software. (Doornik and Hendry (2001) and Hendry and Krolzig (2001)). The equilibrium-

correction form is used for all the behavioral equations. The tracking performance of the model, both within- and out-of-sample, is evaluated and found satisfactory. Policy simulations indicate that it is crucial for Philippine government to address its debt problem in order to achieve higher growth in future. Oil price simulations also show that the country is highly vulnerable to external shocks. Bagnai and Ospina (2007) develop a medium-size structural macro-econometric model of the Chinese economy, consisting of 54 equations estimated with annual data from 1978 to 2006. The estimation methodology accounted for structural breaks of unknown date in the long-term parameters. The simulation experiments confirm the crucial role that FDI play in the economic growth and the competitiveness of China.

Felix (2005) presents a macroeconomic model with some micro foundations for a small open economy in his work. The main purpose is the simulation of external environment and fiscal policy shocks in Portuguese. The model includes sufficiently disaggregated public sector and household disposable income accounts and it considers a fiscal policy rule that ensures the fulfillment of some budgetary requirements. Thus, the impact in main macroeconomic aggregates of external shocks could be evaluated under the assumption that the government automatically adjusts the income tax rate in order to fulfill these requirements. To provide a modelling strategy with transparent and theoretically coherent foundation is one of the targets of the paper prepared by Garratt et al. (2006). They develop a core model for a small and open economy based production technology, arbitrage conditions, flow identities and long- term solvency conditions.

Annicchiarico et al. (2011) compare the dynamic properties of the Italian Treasury Econometric Model (ITEM) with those of the endogenous growth model developed by DG ECFIN for economic policy evaluation (QUEST III). They consider an array of shocks often examined in policy simulations and investigate their implications on macro variables. In doing so, they analyze the main transmission channels in the two models and provided a comparative assessment of the magnitude and the persistence of the effects, trying to ascertain whether the responses to shocks are consistent with the predictions of economic theory.

Arby et al. (2010) prepare a macro-econometric model of Pakistan (MMP). They aim to foresee the effects of monetary policy through forecasting and simulations. They present the basic structure of macro-econometric model for Pakistan consisting of 17 equations, out of which 11 are behavioral equations and the rest are either identities or definitional

equations. The OLS method is used in order to estimate the behavioral equations by using annual data from 1973-2006. They provide the estimation results and results of policy simulations in order to quantify the impact of shocks to various exogenous variables.

McQuinn and O'Reilly (2007) build a quarterly model for each Eurozone country, which would allow cross-country comparability and the analysis of shocks or simulations pertaining to the euro area. The model is medium in scale, being composed of 89 equations, approximately 30 of which are estimated. The level of real output is determined by the interaction of aggregate supply and aggregate demand. Deviations of output from potential and of unemployment from a measure of the time-varying natural rate cause wage and price adjustments to take place, which return the model to a long-term neoclassical equilibrium. Aggregate supply curve is vertical and the level of inflation is invariant to the equilibrium level of output. Currently, the model does not incorporate forward-looking "expectational" terms.

Khan and Din (2011)'s attempt has been made of develop a dynamic macro-econometric model of Pakistan's economy to examine the behavior of major macroeconomic variables such as output, consumption, investment, government expenditure, money, interest rates, prices, exports, and imports. The model consists of 21 equations, 13 of which are behavioral and the rest are identities. The Engle-Granger two-step co-integration procedure is used in order to derive the long- term and short-term elasticities for the period of 1972-2009. The test significance of each estimated equation seems to confirm the model. The estimated long- term parameters are used in order to perform simulation experiments to determine the model's ability to track historical data and to assess the behavior of the key macroeconomic variables in response to the changes in selected exogenous variables. Results indicate that the majority of macroeconomic variables follow an increasing trend over the period of simulation, 2009-2013.

The macro-econometric model based on the model developed by Garratt et al. (2006) is Hanclova (2011) that provides a practical approach for the long- term relationships of a small open economy by using vector error correction model (VECM). The basic macroeconomic framework is a core small open economy model consisting of five long- term relationships; the relative purchasing power parity, the real money market equilibrium condition, the output gaps, the interest rate parity and the interest rate

relationship – Fisher inflation parity. They analyze the consequences of imposing the long- term restrictions for the impulse response functions. The responses of the macroeconomic variables have been investigated both for the domestic shocks.

Stavytskyy and Martynovych (2012) apply the structural macroeconomic models that describe the main aspects of the economic policy in Ukraine. The interdependence between the level of inflation, the value of investment, savings, consumption, export and import transactions, taxes on the foreign trade are defined based on the analysis of the macroeconomic parameters of Ukraine. After investigating all the economic indicators, they are transformed into stationary time series. In addition, they use appropriate estimation parameters to overcome heteroscedasticity and autocorrelation restrictions. As a result, the research shows that a large share of black economy leads to a rather high level of inflation in the state, because its value is primarily determined by expectations of the population under such circumstances. The paper indicates that the further export growth leads to a lower consumption growth and also to a lower growth of savings. Such a situation indicates an insufficient development of the domestic market.

Central Bank of Uganda builds a small scale macroeconomic model for Uganda in 2010. The model consists of five building blocks; a price equation, an aggregate demand equation (IS curve), a money demand equation (LM), an exchange rate equation and a policy rule. The equations are estimated using quarterly data for the period 1999-2009. They conduct simulation experiments to analyze the effect of different shocks on inflation, output, exchange rate and interest rates and look at the effect of a temporary public expenditure shock, a temporary increase in foreign inflation, and a temporary money supply shock. The simulation results suggest that government expenditure is quite effective in raising aggregate demand whilst money supply has little impact on inflation and interest rates but no effect on output.

Since the VAR and VECM models enable practitioner to identify both long- and short-term relationship between variables, these methods are mostly used in macroeconometric modelling. In this thesis, on the other hand, short term coefficients are not consistent and not compatible with economic theory, different estimation models are tested for each behavioral equations.

3.2 Structure and Estimation of the Model

The fundamental concepts of the economy such as “demand” and “supply” might have an important impact on the structural macroeconomic models. The demand side of the economy can be easily implemented through “national income identity,” whereas the definition for the supply side of the economy can be quiet complex. Since, the production function of developing countries such as Turkey might alter in course of time; radical changes might be observed in the factors such as productivity and competitiveness having impact effect on aggregate production. Therefore, it is difficult to define an accurate time-invariant production function through econometric methods for these countries. That’s why the issue of production function has always been appealing for economists despite all challenges. Accordingly, many studies have been made in order to define production function and to predict the variables such as potential output, natural unemployment rate and output gap. On the other hand, supply side of the Turkish economy is left in the background in this thesis due to the several reasons which are explained in the following part.

In the model there are 19 behavioral and technical equations, 7 identities, and 43 variables in total. List of all variables and abbreviations are shown on the Table 3.1. The behavioral and technical equations have been specified and estimated using E-views software.

Table 3.1 List of the key variables in the model

Block	Variable	Type	Data	Source	Unit
National Income Identity	GOV	Exog	Government Expenditure	Turkstat	Million TRY on Constant Price
	CONS	Endo	Resident Household Consumption	Turkstat	Million TRY on Constant Price
	GDP	Endo	GDP	Turkstat	Million TRY on Constant Price
	INVM	Endo	Private and Public Investment	Turkstat	Million TRY on Constant Price
	SAV	Endo	Total Savings	Ministry of Development	Million TRY on Constant Price
External Trade	CAD	Endo	Current Account Deficit	CBRT	Million TRY on Constant Price
	OTI	Endo	Other Investment	CBRT	Million TRY on Constant Price
	PINV	Endo	Portfolio Investment	CBRT	Million TRY on Constant Price
	IMCAP	Endo	Imports, Capital Goods	Turkstat	Million TRY on Constant Price
	IMCONS	Endo	Imports, Consumption Goods	Turkstat	Million TRY on Constant Price
	IMINT	Endo	Imports, Intermediate Goods	Turkstat	Million TRY on Constant Price
	IM	Endo	Total Imports	Turkstat	Million TRY on Constant Price
	EX	Endo	Total Exports	Turkstat	Million TRY on Constant Price
	EAD	Exog	Euro Area Private and Public Consumption Expenditures	Eurostat	Billion EUR, Constant Chained Price
	POIL	Exog	Brent Crude Oil Price	London Comodity Exchange	USD per barrel
Monetary Market	CBPR, CT	Exog	CBRT Policy Rate	CBRT	Interest Rate, average for the period
	BIR, RP	Endo	Yield of Benchmark Bond, 2 year	BIST-100	%, average
	US2Y, CT	Exog	US Yield of Benchmark Bond, 2 year	Federal Reserve Bank	%, average
	CRD	Endo	Banking Sector Total Credit Volume	BRSA	Million TRY on Constant Price
	INF	Endo	Annual Inflation in Consumer Price Index	Turkstat	yoy %
	INFe	Endo	Expected Consumer Price Annual Inflation	CBRT	yoy %
	USDTRY	Exog	USD/TRY	CBRT	FX
	BUDB	Endo	Budget Balance	Ministry of Finance	Million TRY on Constant Price
	BUDE	Exog	Budget Expenditures	Ministry of Finance	Million TRY on Constant Price
	BUDR	Endo	Budget Revenues	Ministry of Finance	Million TRY on Constant Price
Labour Force Market	WAGE	Exog	Wage Cost Index	Oxford Economics	Index
	EMP	Endo	Total Hours Worked in Manufacturing	OECD	Index
Production	AGRIC	Endo	Agriculture Sector (GDP Production App.)	Turkstat	Million TRY on Constant Price
	INDUST	Endo	Industrial Sector (GDP Production App.)	Turkstat	Million TRY on Constant Price
	CONSTR	Endo	Contraction Sector (GDP Production App.)	Turkstat	Million TRY on Constant Price
	SERVIC	Endo	Services Sector (GDP Production App.)	Turkstat	Million TRY on Constant Price
	PROD	Endo	Potential GDP	Model	log of seasonally adjusted value
	FCF	Endo	Fixed Capital Formation	Turkstat	Million TRY on Constant Price
	OG	Endo	Output Gap	Model	log
	CUR	Exog	Capacity Utilization Ratio	CBRT	Index
	LPROD	Exog	OECD, Total Industry Production	OECD	Index

3.2.1 Production Block

In this study, four different Cobb-Douglas production functions were defined for Turkey by taking agriculture, industry, service, and construction sectors into account. Fixed capital stock and labor force were utilized as inputs for each these production functions.

$$GDP_t = AGRIC_t + CONSTR_t + SERVIC_t + INDUST_t$$

Thus, we define the total income with production method. AGRIC represents agricultural production, CONSTR represents construction industry, SERVIC indicates services industry, INDUST points the industrial sector. In the model, individual behavioral equations were estimated for each sector. During the period examined in model, considering that each sector have developed at distinct pace and direction, different regimes designed for sectors. These regimes were specified by using Bai-Perron multiple break point test (Bai and Perron (1998)) and markov switching regression regimes.

$$AGRIC_t = \alpha_0 + \beta_1(s_t)FCF_t + \beta_2(s_t)EMP_t + \varepsilon_t$$

In this presentation, FCF represents the data of fixed capital stock, EMP represents the employment data. (s_t) denotes the regime realization at time t, and $\varepsilon_t \sim IID\ N(0, I)$. The process of (s_t) indicates 3 regimes in the equation for agriculture sector, while, equations for construction, services and industry sectors have 2 regimes.

$$CONSTR_t = \alpha_0 + \beta_1(s_t)FCF_t + \beta_2(s_t)EMP_t + \varepsilon_t$$

$$SERVIC_t = \alpha_0 + \beta_1(s_t)FCF_t + \beta_2(s_t)EMP_t + \varepsilon_t$$

$$INDUST_t = \alpha_0 + \beta_1(s_t)FCF_t + \beta_2(s_t)EMP_t + \varepsilon_t$$

Capital stock and employment data are generally criticized in terms of their reliability and measurement methods. The consistency of the employment data, which is defined as the milestone of production function, is debated mostly. For instance, the definition of an unemployed person varies from country to country- even it differs based on the periods in a same country. Thus, it is thought that the employment data can't reflect actual performance of the labor market. That's why unemployment rate in the USA, which fell below 5% level on 2016, is criticized to be an inaccurate indicator of the sector. So, Fed and economy administration announced that they focus on alternative

employment indicators such as jobless claims and non-farm payrolls. Consequently, in this study, various employment data provided for Turkey from different sources such as OECD, TURKSTAT, World Bank and IMF are tested in the estimation of production functions. Then, OECD's total hours worked data (labor compensation & hours worked) which gave the most consistent results were used as employment data.[2]

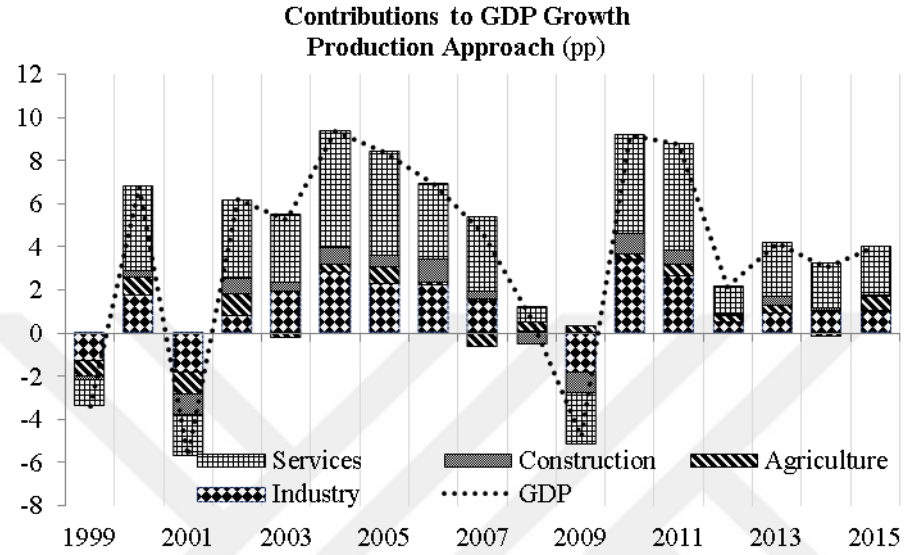


Figure 3.1 Contributions to GDP Growth, Production Approach

In the most general sense, capital stock or fixed capital formation consists of resident producers´ acquisitions, less disposals, of fixed tangible or intangible assets. This covers in particular machinery and equipment, vehicles, dwellings and other buildings. Capital stock level is crucial to determine potential output of an economy. Although agriculture and service sectors are labor intensive sectors, it is not possible to talk about a production activity without the accumulation of capital. Despite the importance of the data, there is no official capital stock data in Turkey. However, in some academic studies, this data was derived through prediction. One of the most detailed studies about this topic was conducted by Saygılı et al. (2005). Saygılı et al. (2005) predicted a series of capital stock for Turkish economy under favor of the method that OECD used. Fixed capital stock for 1998-2014 periods was predicted by using a similar method in this

[2] Average quarterly hours worked is defined as the total number of hours actually worked per quarter divided by the average number of people in employment per quarter (OECD (2016), Hours worked (indicator). doi: 10.1787/47be1c78-en

study as well. OECD's lagged depreciation assumption was also obtained in this study. That means, it was assumed that investments were not exposed to depreciation in the first five years, however linear depreciation method is assumed for the remaining years.

Assumptions about life span of the capital stock are the key elements in estimation of capital stock. In his study, Saygili et al. (2005) use OECD's average lifespan of capital stock for all sectors excluding housing sector. While forming capital stocks at macro level for Turkey, sector-specific capital stocks were estimated and country level data were reached by collecting the sector-specific capital stocks. The series of capital stock that were compiled encompasses 1972-2000 period. In this study, these estimations were extended towards the year 2014 by applying a similar method.

When there is deficiency in fixed capital stock observations for the countries in International Sectorial Database (ISDB) of OECD, those observations are estimated by Perpetual Inventory Model. Perpetual Inventory Model is one of the fundamental methods that are used for capital stock estimations. In capital stock estimation, this model takes the depreciation into account and utilizes the capital investment expenditure observations regarding previous years. Perpetual Inventory Method is simply explained below:

$$FCF_t = \sum INV_t * g(t)$$

In this presentation, FCF stands for the fixed capital stock, and INV stands for the investments at constant prices. $g(t)$ is a function of time which takes a value between 0 and 1, and determines the investments' economic life span. In this study, $g(t)$ function takes the value of 1 for the first 5 years, where it takes the value of 0 at and after the 25th year (Saygılı et al. (2005)).

The definition of a production function is crucial for output gap estimations, but it is quite difficult to define the production function for developing countries like Turkey. Since, the marginal contribution of technology advances to the production possibilities is high in the developing countries; the frequency of the structural transformation in the economy is also high. Therefore, it may be impossible to define production functions that are valid in both the medium and long-run. In this study, the output gap is defined as the difference between total incomes obtained from production functions and the national income identity that is calculated by the expenditure method. But, the output

gap estimations are not correlated with the inflation and the employment indicators. The output gap can only capture the decrease in demand during the crises in 2001 and 2009. Avşar et al. (2007) uses Kalman filter and VECM to estimate the output gap and states that "findings suggest that output gap estimates should be treated with caution. Assessments of the output gap must also be based on professional judgment and supplementary indicators. Additional economic information may provide some useful information for the estimation of the output gap." Hence, the estimation for the output gap is excluded from the focus of this study.

3.2.2 National Income Identity

3.2.2.1 GDP

Although the gross domestic product is the value of goods and services produced by the factors of production in a particular country, GDP can be measured from the expenditure (demand) approach. According National Income Identity;

$$GDP_t = CONS_t + GOV_t + INVM_t + EX_t - IM_t + NSC_t$$

whereas GDP represents total income of the country while CONS, GOV, INVM stands for private consumption, government expenditures and total investments, respectively. EX is export and IM is import. Net stock change, which is shown as NSC in national income identity, is defined as residuals between production and expenditure approaches and also includes statistical discrepancy.

Analyzing the composition of GDP of the Turkish economy revealed that the main driver of the growth was consumption, mainly household consumption. So, Turkish economy is criticized as being dependent on consumption as a booster of economic growth. So, almost all well-known economists and financial institutions such as IMF, WB, S&P etc. underlined necessity of incentives for investment sector and the raising competitiveness of science and technology sectors. On the other hand, as being developing economy, contribution of the investment expenditure was also significant in Turkish economy.

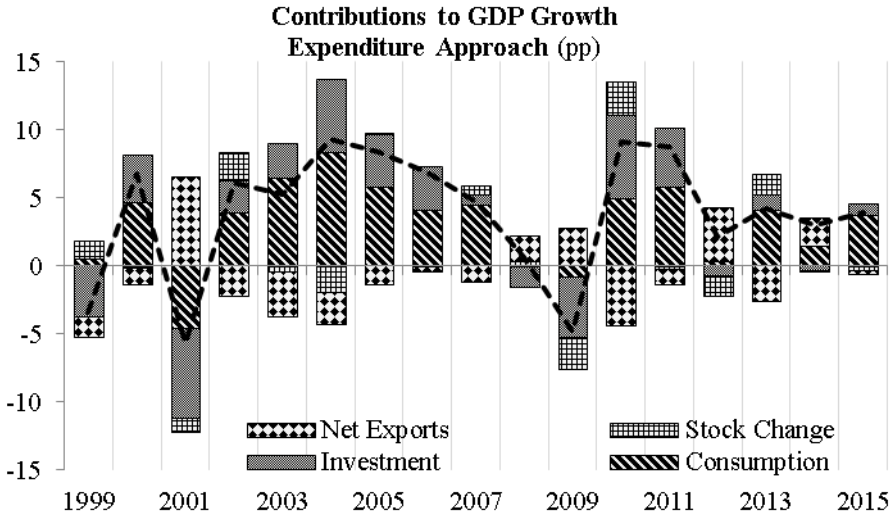


Figure 3.2 Contribution to GDP Expenditure Approach (% point)

Turkish economy has always suffered from a negative trade balance after 2nd World war. However, contraction in the foreign trade deficit in some period especially during crisis periods resulted in positive contribution of net exports on GDP growth. So, positive contribution should not be evaluated as a positive development in foreign trade figures, we can define as a lesser evil condition. Figure 3.3 gives information about investment and net exports. Contribution of net exports is generally negative when contribution of investment was high positive level and vice versa. So, one can claim that investment mostly depended on the imports. Another key info was about stock change. Turkstat announced that Change in Stocks is estimated to be the residual between production and expenditure accounts and also includes the statistical discrepancy. So, it is quite impossible to identify a significant relationship between change in stocks and an economic indicator.

3.2.2.2 Private Consumption

Constant-price private consumption is formulated as a homogenous demand function of income in the long-run, while it is also affected by the expected inflation and the credit growth. Wage data is assumed as a proxy for disposable income.

$$CONS_t = \alpha_0 + \beta_1 CRD_{t-1} + \beta_2 INF_t^e + \beta_3 WAGE_{t-1} + \varepsilon_t$$

where, CRD, INF, and WAGE represent credit volume, annual expected consumer price inflation and wage, respectively, and $\varepsilon_t \sim IID\ N(0, I)$. Credit volume may provide information about the monetary transmission mechanism that also affected the household's consumption function (Chrystal, 2005). Expected change in general price

level and wages as a proxy variable for household's income level are expected to be effective on the course of private consumption based on classical economic theory. According to Johansen's co-integration test results, there are at least 3 co-integration equations with 4 lags.

Depending on the co-integration relationship, Dynamic Ordinary Least Squares methods are used in order to examine the relationships between variables; CONS, CRD, INF and WAGE. All coefficients are statistically significant.

Table 3.2 Estimation Results for the Private Consumption Equation

Equation	Private Consumption (CONS)			
Method	Dynamic Least Square			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
CRD (-1)	0.1487	0.0116	12.8684	0.0000
C	8.1833	0.1578	51.8636	0.0000
INF	-0.1031	0.0183	-5.6479	0.0000
WAGE (-1)	0.0710	0.0196	3.6194	0.0006
R-Squared	0.9816			

According to the results obtained from the equation above, an increase in credit volume of banking sector leads to an increase in the private consumption expenditures in the next period. Also, the expectation for an increase in consumer prices causes a downward pressure on the demand for consumption. Furthermore, there exists a positive correlation between the previous period's wages and the consumption expenditures of this period.

3.2.2.3 Investment

In a closed economy, it is assumed that total savings equal to total investments. But, in open economies, the capital flows and foreign trade deteriorate this balance. In Turkish economy, as the openness index (foreign trade/GDP) rose, the difference between savings and investments is also expanded. Undoubtedly, low level of domestic savings and the globally uncompetitive character of domestic intermediate goods and capital goods production played important roles in this increase. High foreign dependency on capital and intermediate goods leads a significant expansion in the gap between investment and savings. For this reason, in investments equation, the imports data were added as an explanatory variable into the model.

The gap between domestic savings and investments is funded from net capital flows. Because of this, the domestic savings and the net capital flows were used as explanatory variables in equation of investment. Since, the interest rates can be defined as the alternative cost of investments, the interest rate of benchmark bond is also included in investment equation.

Economy theory indicates that real interest rates play important role in investment decisions. According to test results, the explanatory power of nominal interest rate is quite high; coefficient of the CPI based real effective interest rate is not significant in the investment equation. In developing countries such as Turkey in where the financial market is highly volatile, confidence on the economy, the political uncertainties, and the financial conditions also play an important role in investment decisions. Within this framework, under the assumption that the nominal interest rates are more sensitive to the trust environment in economy and the financial conditions, rather than the real interest rates, the nominal interest rates were used in this study.

$$\Delta INV = \alpha_t + \beta_1 s(t)\Delta PINV_{t-1} + \beta_2 s(t)\Delta OTI_t + \beta_3 s(t)\Delta BIR_{t-1} + \beta_3 \Delta IM_t + \beta_3 \Delta SAV_t + \varepsilon_t$$

where, (s_t) denotes the slope dummy variables at time t, and $\varepsilon_t \sim IID\ N(0, I)$. The process of (s_t) has 2 regimes which are determined by Bai-Perron multiple breakpoint test. First one capture before 2003, second one represents after it. INV, PINV, OTI, BIR, IM and SAV represent investment, portfolio investment, other investment, benchmark interest rate, import and savings, respectively.

According to the results obtained from the equation, it can be seen that, both of the savings and imports play determinant role in course of investments in Turkey, At the same time, the portfolio flows and other capital investments also significantly affect the level of investment. As the economy theory projected, the relationship between interest rates and investments is significant and these parameters are inversely related. In second regime representing the period after year 2003, the sensitivity of investments to interest rates was found to be higher.

Table 3.3 Estimation Results for the Investment Equation

Equation	Investment (ΔINVM)			
Method	Ordinary Least Square			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
ΔPINV (-1) s(1)	0.1661	0.0494	3.3602	0.0014
ΔOTI s(1)	0.0480	0.0266	1.8015	0.0768
ΔBIR (-1) s(1)	-0.0017	0.0005	-3.2353	0.0020
ΔPINV (-1) s(2)	0.1447	0.0603	2.3993	0.0197
ΔOTI s(2)	0.0158	0.0177	0.8971	0.3734
ΔBIR s(2)	-0.0051	0.0012	-4.3336	0.0001
ΔIM	0.2925	0.0772	3.7873	0.0004
ΔSAV (-1)	0.5179	0.1100	4.7074	0.0000
R-Squared	0.7365			

3.2.2.4 Savings

Among the factors determining the countries' propensity to save, level of income, growth, demographical structure, inflation, credits, real interest rates, and fiscal policies come to the forefront. In parallel with the increase in individuals' level of income the savings ratio is expected to increase. The studies performed in literature indicate that the level of income is one of the main determinants of the savings. Moreover, it is also said that the effect of an increase in level of income on savings in developing countries is higher than in developed countries. There are also opinions regarding that the effect of real interest rates on marginal propensity to save is vague (Loayza et al. 2000). The effect of real interest rates is formed according to the substitution and income effects. The decrease in real interest rates lowers the credit costs for households, and it increases the present value of future incomes. On the other hand, the decrease of real interest rates may lead to decrease in return of household assets and consequently the decrease in their borrowing requests. For this reason, the net effect varies depending on in which phase of their lives the households are. Because, the young individuals having high income expectations for future periods increase their consumptions due to the decrease in real interest rates, while elderly individuals may tend to save more due to the decrease in real value of their assets (Ferrucci and Cabrera (2007)).

According to the life-cycle hypothesis, the demographic structure of population and the savings are related. It is assumed that, due to the fact that people have low income during their youth, their propensity to save money is low. In the following periods, due to the increase in the people's income, the saving rates are expected to rise. It is estimated that, if the share of the rate of the working population among the population

as a whole increases, the saving rates will increase as well. So the demographic opportunity window in Turkey may also be considered as a crucial aspect in terms of saving as well.

Saving ratio to national income in Turkey exhibited a downward trend since 1980's. The saving rate, which was approximately %25 in mid-1980s, reduced to 14.9% in year 2014. That's why Turkey is considered to be high-dependent on foreign capital compared to developing countries which has similar economic characteristics. Thus, at times when economy is growing rapidly, such as in 2010 and 2011, lack of domestic savings resulted in widening of the current account deficit. This structural problem increases the sensitivity of Turkish economy to external shocks and halts the sustainable, growth. Hence, economic shrinkages in 1994, 2001, and 2009 confirm this contraction effect of capital movements' outcomes on economic activity. Therefore, it is considered that the increasing the domestic savings is essential to ensure a stable and a high rate of growth.

In Turkey, there is no official savings data which are published periodically. The data announced by Ministry of Development are published in annual basis and with 2 years of lags. So, savings data are generated by using annual rate of savings to GDP. In this model, the savings equation has three explanatory variables such as; public expenditures, income, and interest rates.

$$SAV = \alpha_t s(t) + \beta_1 s(t) GOV_t + \beta_2 s(t) GDP_t + \beta_3 BIR_t + \varepsilon_t$$

Where $s(t)$ denotes 2 regimes and $\varepsilon_t \sim IID\ N(0, I)$. $s(2)$ indicates the periods between 2002Q3-2013Q3. SAV stands for savings while GOV, GDP and BIR represent government expenditure, GDP and benchmark interest rate, respectively.

Results of the equation confirm that the increase in public expenditures negatively affect the savings ratio. Moreover, the hypothesis that the increase in level of income supports the savings can be accepted. The relationship between interest rate of benchmark bond and savings is very low but statistically significant.

Table 3.4 Estimation Results for the Savings Equation

Equation	Savings (SAV)			
Method	Fully Modified Least Squares (FMOLS)			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
GOV (s1)	-0.3855	0.0892	-4.3234	0.0001
GDP (s1)	1.2817	0.1276	10.0434	0.0000
GOV (s2)	-0.6506	0.0586	-11.1012	0.0000
GDP (s2)	1.7693	0.0870	20.3318	0.0000
BIR	0.0015	0.0002	6.6085	0.0000
C s(1)	-1.5807	0.6404	-2.4682	0.0174
C (s2)	-4.4614	0.4646	-9.6037	0.0000
R-Squared	0.9882			

3.2.2.5 Government Expenditures and Budget Balance

In this thesis, government expenditures (GOV) in national income identity are treated as an exogenous variable. It is also assumed that the data (GOV) is also related with budget expenditures which are based on central government budget data. So, government expenditures are used in calibration of budget expenditures data in the model.

Since, the tax regulations, and the non-recurring incomes such as privatization are the main determinants of the budget revenues. The budget revenues are also calibrated as an identity equation in this model. So, the model has 2 calibrated identity equations for budget figures which cannot be estimated accurately with behavioral equations.

3.2.3 External Trade Block

3.2.3.1 Imports

The imports were examined through 2 different data sets in this study. The TL-denominated quarterly imports data at constant prices was used in national income equation. Moreover, USD-denominated monthly foreign trade data published by TURKSTAT were analyzed by resolving according to the broad economic classification. Thus, the imports data, which is involved in national income, could be analyzed as intermediate goods, consumer goods, and capital goods. The monthly imports data, by multiplying with the exchange rates in relevant period, were translated into TL currency, and then translated into fixed costs using the deflator. By using the ratio of total transformed imports data to actual TL based imports data, the identity equation of total imports is formed as follows.

$$IM_t = \alpha(IMCONS + IMINT + IMCAP)$$

Whereas IM, IMCONS, IMINT and IMCAP represent the total imports, imports of consumption, intermediate and capital goods, respectively. α is the adjustment coefficient, which is long-term ratio of two import data based on the different sources explained above.

When the import data is analyzed based on the classification of broad economic groups, it can be seen that, among the total import volume, the share of the import of immediate goods was 71%, capital goods were 17%, and consumer goods were 12%. The reason for why the intermediate goods have the biggest share is the energy import that exceeds 20% of the total imports. On the other hand, the share of the intermediate goods among the total export rate was 46%, and the consumer and capital goods were at 44% and 10%, respectively. Within this scope, while it is seen that intermediate goods have a considerably important place in our external trade, it is also understood that consumer goods have a bigger share in our export figures than in import figures.

3.2.3.1.1 Intermediate Goods Imports

The figure 1.3 illustrates that the imports exhibited a more volatile course than exports. The course of imports also corroborated the idea that economic activity and imports are highly correlated. In addition to that, the imports exhibited sharp decreases in 1999, 2002 and 2009 crisis. It makes sense when the imports are analyzed in terms of the broad economic classification, since two thirds of imports are constituted by intermediate goods. Huge proportion of oil imports is also classified as an intermediate good. A proportion of oil import can be defined as autonomous imports. So, it is a reasonable assumption that the demand elasticity of intermediate goods imports was lower than the other types of imports.

Turkey's annual crude oil import is about 20 million tones (147 million barrels). While this number decreases during the crisis, it followed an upward course when the economic activity gained a momentum. Turkish Statistical Institute publishes only the volume of the crude oil import on a monthly basis since March, 2011. Analyzing this data revealed that the developments on spot oil prices in the international market are reflected on the monthly average prices of the imported oil prices with a 1 or 2 lags.

The import of intermediate goods is believed to be related with the expectations regarding the economic activities. An increasing tendency of domestic demand or an improvement in export markets may be projected to reinforce the import of intermediate

goods in further periods. Within this scope, in the equation of intermediate good import, government expenditure and exports are used as explanatory variables. Moreover, the oil prices, USD/TL and domestic manufacturing industry's capacity utilization rate are involved into the equation.

$$\Delta IMINT = \alpha_t + \beta_1 \Delta POIL_{t-2} + \beta_2 \Delta EX_{t-1} + \beta_4 \Delta GOV_{t-3} + \beta_5 \Delta CUR_{t-2} + \varepsilon_t$$

IMINT, POIL, EX, GOV and CUR denote intermediate goods import, Brent crude oil price level, total exports, government expenditure and manufacturing sector's capacity utilization ratio respectively, and $\varepsilon_t \sim IID\ N(0, I)$. The relation of government expenditures and capacity usage ratio with intermediate goods imports was found to be positive and statistically significant. At the same time, the change to be observed in propensity to import is determinant in course of intermediate goods import.

Table 3.5 Estimation Results for the IMINT Equation

Equation	Intermediate Goods Import (ΔIMINT)			
Method	Ordinary Least Square			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
ΔPOIL (-2)	0.1501	0.0464	3.2360	0.0020
ΔCUR (-2)	0.7238	0.2293	3.1567	0.0025
ΔGOV (-3)	0.1898	0.1028	1.8457	0.0700
ΔEX (-1)	0.3181	0.1027	3.0968	0.0030
C	0.0084	0.0059	1.4169	0.1618
R-Squared	0.4661			

Since oil imports constitute a significant amount of intermediate goods imports, change in oil prices lead an expansion in intermediate goods imports. In addition, capacity utilization rate in manufacturing industry is also positively correlated with intermediate goods import as expected. Test results indicate that both coefficients of government expenditures and export performance are positive and significant. So it is considered that the test results are compatible with the pre-assumptions of the model.

3.2.3.1.2 Consumer goods Import

Ensuring financial stability in domestic financial market results in recovery in consumer confidence on general economic conditions which is considered as a factor reinforcing the domestic demand. In addition, accommodative financial conditions support consumption appetite of the households. For this reason, in the behavioral equation of consumer goods import we need a variable representing the domestic financial conditions. In this context, since the foreign investors are sensitive against political

uncertainties or downturns in financial conditions, it can be assumed that portfolio investments are able to reflect the financial conditions and short- and mid-term expectations.

In addition, adding USD/TL exchange rate into the equation enables us to test the sensitivity of consumer goods import to exchange rates. Moreover, in equation, the employment data (as a proxy for aggregate income level), the government expenditures, and the 1-period lagged data of imports of consumer goods were also used. It is thought that, as the household income increases, the import of consumer goods would increase depending on the income elasticity. It was also assumed that the income effect created by government expenditures might support the economic activities in further periods and increase the consumer goods import.

$$\Delta IMCONS = \alpha_t(s_t) + \beta_1(s_t)\Delta PINV_{t-2} + \beta_2(s_t)\Delta EMP_{t-2} + \beta_3(s_t)\Delta USDTRY_{t-1} + \beta_4\Delta GOV_{t-1} + \beta_5 s(t)\Delta IMPCONS_{t-1} + \varepsilon_t$$

where, (s_t) denotes the regime realization at time t, and $\varepsilon_t \sim IID\ N(0, I)$. The process of (s_t) implies 2 regimes. Second regime covers the period between the years 2002-2007. IMCONS, PINV, EMP, USDTRY and GOV represent consumption goods import, portfolio investment in balance of payments, employment, USD/TL and government expenditures, respectively.

According to the findings obtained from the equation, the import of consumer goods is sensitive to the course of exchange rates. In second regime, the effect of USDTRY was statistically non-significant. When both of the coefficients were analyzed using Wald test, it was understood that the coefficient of the USD/TL is positive and statistically significant. But, in periods, when the economic activity relatively loses acceleration, it draws attention that the sensitivity to the changes in exchange rates becomes higher. Similarly, the coefficient of employment indicator in second regime is in higher than in the first regime. Hence, in periods, when the economic activity weakens, the decline in employment parameters significantly decreases the demand to consumer goods. The portfolio investments, which is expected to represent the financial conditions and the trust to economy, is positively related with the consumption goods import and its coefficients are statistically significant in both of the regimes.

Table 3.6 Estimation Results for the Consumption Goods Import

Equation	Consumption Goods Import (ΔIMCONS)			
Method	Ordinary Least Square Method			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
ΔPINV (-2) (s1)	0.1797	0.0620	2.8975	0.0054
ΔIMCONS (-1) (s1)	0.1035	0.1499	0.6906	0.4928
ΔUSDTRY(-1)	-0.2185	0.1196	-1.8272	0.0732
ΔEMP (-2) s(1)	1.0106	0.4014	2.5175	0.0148
ΔPINV (-2) (s2)	0.1804	0.0534	3.3790	0.0014
ΔIMCONS (-1) (s2)	0.1142	0.0747	1.5291	0.1321
ΔUSDTRY(-2)	-0.1272	0.1394	-0.9125	0.3655
ΔEMP (-2) s(2)	1.3195	0.3947	3.3430	0.0015
ΔGOV(-1)	0.1835	0.0876	2.0955	0.0408
C s(1)	-0.0584	0.0075	-7.7741	0.0000
C s(2)	0.0491	0.0082	5.9605	0.0000
R-Squared	0.8074			

3.2.3.1.3 Capital Goods Import

The capital goods imports constituted 16.8% of total imports of Turkey in 2015. The import of capital goods is related with investments. The need of investments increases when domestic demand conditions draw an optimistic picture about the future. In this context, the capital goods import is thought to be related with the propensity to invest and expectations about the domestic demand. At the same time, it can be projected that the course of long-term capital investments would affect the imports of investment product. Because, the acceleration in long-term capital flows in a developing country may corroborate the perception that the appropriate conditions for new investments will emerge in the following periods. Under the light of these assumptions, in the equation of capital goods imports, the 1st-lagged values of investment in national income, other investments in balance of payments, and government expenditures were involved. USD/TL exchange rate is also added into the equation to measure the effects of changes in USD rates on imports.

$$IMCAP = \alpha_t + \beta_1 INVM_{t-1} + \beta_2 OTI_{t-1} + \beta_3 USDTRY_{t-1} + \beta_4 GOV_{t-2} + \varepsilon_t$$

Where $\varepsilon_t \sim IID\ N(0, I)$. IMCAP, INVM, OTI, USDTRY, GOV represent capital goods import, total investment, other investment in balance of payments, USD/TL and government expenditures, respectively.

Table 3.7 Estimation Results for the IMCAP Equation

Equation	Capital Goods Import (IMCAP)			
Method	Fully Modified Least Squares (FMOLS)			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
INVM (-1)	0.6817	0.1096	6.2206	0.0000
GOV (-2)	0.2801	0.0936	2.9933	0.0041
OTI (-1)	0.1239	0.0466	2.6595	0.0101
C	-0.8227	0.4589	-1.7927	0.0782
USDTRY (-3)	-0.0378	0.1771	-0.2135	0.8317
R-Squared	0.9243			

According to the equation results, all of the coefficients were found to be statistically significant when USD/TL is excluded. Significant proportion of capital goods imports is explained by the 1-quarter lagged data of investment expenditures. Similarly, the lagged values of government expenditures and other investments are positively related with capital goods imports. The coefficient of USD/TL exchange rates is negative but not significant. Thus, it can be said that the sensitivity of capital goods imports to changes in exchange rates is relatively low.

3.2.3.2 Exports

Domestic variables in an export equation represent only the supply side of the export. Thus we need an external demand indicator to obtain a valid export equation. Considering the variety of export markets and shares in total export volume, the total consumption demands in EU countries, which are the largest export market of Turkey, is used in the export equation.

According to broad economic classification, consumer goods exports constituted 41% of total exports in year 2015. In this period, the intermediate goods exports became close to 50%. But, only 10% of total exports were the exports of capital goods. Under favor of its geopolitical position, Turkey acts as an intermediate country in external trade (re-export). Under the light of this information, the first lagged data of intermediate goods imports is involved in supply side of the exports equation. Moreover, when the main export commodities are considered, it is seen that the export-based sectors require high level of investment.

Table 3.8 Exports by chapter, 2015 (GTIP)

Chapters	USD billion	% share in total
Vehicles	17.5	12.1
Boilers, Machineries	12.3	8.6
Precious Stones	11.3	7.8
Knitted and Crocheted Goods	8.9	6.2
Electrical Machinery	8.3	5.8
Iron and Steel	6.6	4.6
Non-knitted Goods	5.9	4.1
Articles of Iron and Steel	5.5	3.8
Plastics	5.4	3.7
Mineral Fuels	4.5	3.7
Total	143.9	100

Within this context, it was assumed that exports depend on investments. The exchange rate is also included in exports equation. In a conjuncture, where the investments increase, it is also thought that the increase in quality of export commodities might bring improvement in competitiveness in global markets.

$$EX = \alpha_t + \beta_1 s(t) INVM_{t-2} + \beta_2 s(t) EAD_t + \beta_3 s(t) USDTRY_{t-2} + \beta_4 IMINT_{t-2} + \varepsilon_t$$

where, (s_t) denotes the regime realization at time t, and $\varepsilon_t \sim IID\ N(0, I)$. The process of (s_t) has 2 regimes. (See Appendix) EAD represent total household and public consumption expenditures in Euro Zone. EX, INVM, USDTRY and IMINT denote total exports, total investment, USD/TL and intermediate goods import, respectively.

The results obtained from the equation indicate that the exports are very sensitive to developments in exchange rates. The coefficient of variable indicating the demand of Euro Zone was found to be statistically non-significant. But, the result of Wald test rejected the hypothesis that the sum of coefficients in first and second regimes equals to zero. Within this frame, it can be projected that any recovery to be seen in Euro Zone countries would contribute positively to exports performance. Moreover, the coefficients of investments and intermediate goods imports were found to be in harmony with assumptions and statistically significant.

Table 3.9 Estimation Results for the Exports Equation

Equation	Exports (EX)			
Method	Fully Modified OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
USDTRY (-1) s(1)	0.1739	0.1147	1.5161	0.1387
INVM (-2) s(1)	0.6789	0.1528	4.4443	0.0001
EAD s(1)	0.2051	0.0523	3.9224	0.0004
USDTRY (-1) s(2)	0.0342	0.0824	0.4148	0.6809
INVM (-2) s(2)	0.7188	0.1538	4.6741	0.0000
EAD s(2)	-0.0387	0.0272	-1.4226	0.1640
IMINT (-2)	0.3570	0.1262	2.8294	0.0078
C	-0.8932	0.6497	-1.3748	0.1782

3.2.3.3 Current Account Deficit

Despite the partial improvement in macroeconomic indicators, the current account deficit (CAD) has been the main concern for Turkish economy during the last decades. The deficit expanded consistently between two financial crises owing to widening of the foreign trade deficit. During the same period, Turkish economy kept high growth rate. After global crisis, Turkish economy had double-digit growth rate at the cost of overheating. So, the ratio of current account deficit to GDP peaked in 2011 with 9.9%. Since, if a country is running a structural current account deficit (as in Turkey), accelerating credit growth and appreciation of the domestic currency further exacerbate the problem, increasing the risk of a sudden-stop (Kara (2012)). Policy makers realized that the growth trends were not sustainable and several measures should be taken in order to reduce the current account deficit. The Figure 3.3 illustrated the relationship between credit volume and current account deficit.

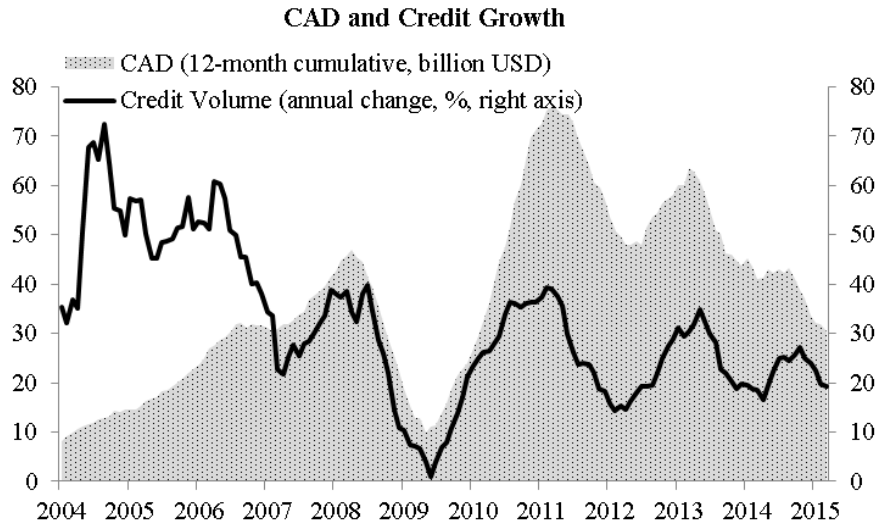


Figure 3.3 Current Account Deficit and Credit Growth

By the way, higher level annual increase in credit growth observed before 2006 was mainly due to both of higher inflation and interest rate. The banking authority of Turkey took several measures in order to curb the growth in consumer loans and credit cards expenditures after 2011. These precautions cannot be easily measured as an economic data. These policies will help to decelerate the increase in imports and to limit the growth in household debt. However, all these measures limited the economic growth after 2012.

Various factors such as economic growth rates, budget deficits, foreign trade balance, terms of trade, exchange rates, interest rates, changes in credit and deposit volumes, money supply or total money stock, inflation rates, internal-external debts may have direct or indirect effects on the current account deficits. However, in general, the current account deficit can be defined as the broadest definition of the foreign trade deficit. According to Aristovnik (2008) on Eastern European and CIS countries, deterioration in the terms of trade causes current account deficit to enlarge. In the same vein, in their studies on 9 developing countries, Bayraktutan and Demirtaş (2011) utilized panel data analysis and identified that an improvement of the terms of trade reduces current deficit. Tagliabue (2005) concluded in his study on Italy that current account deficit and terms of trade are associated in both short- and long-terms.

In Turkey, the current account deficit has been equal almost 80% of foreign trade deficit after 2005. Trajectories of both deficits were similar (Figure 3.4).

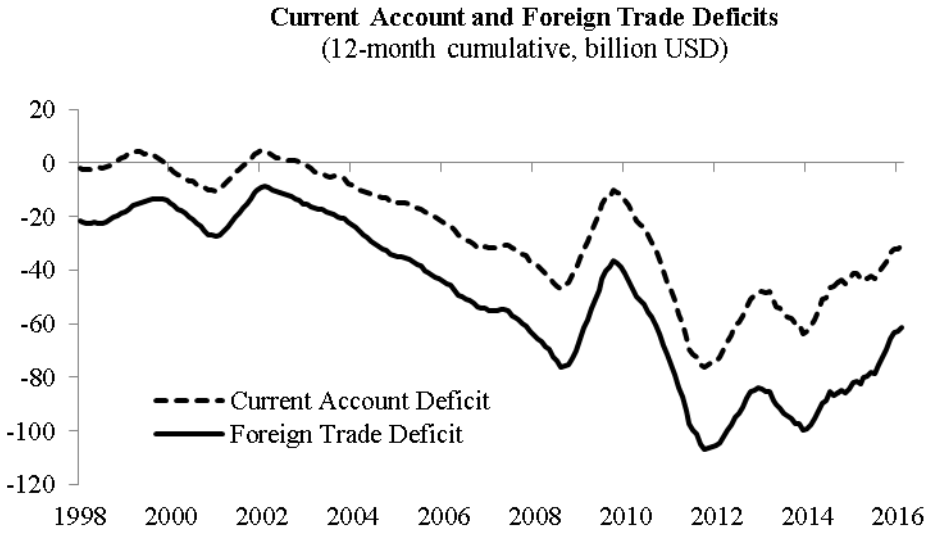


Figure 3.4 Current Account and Foreign Trade Deficits

That's why; in this study, the current account is associated with foreign trade deficit. Other possible factors such as interest rate, credit volume and exchange rates are used in the explanation of imports and exports. Another factor that determines the current account deficit is the tourism incomes, and it is excluded from the scope of this study. Rather than the structural economic variables, the factors affecting the tourism incomes can be determined by using sector dynamics. So, the equation of the current account deficit is formulated as;

$$CAD_t = \beta_1 IM_t + \beta_2 EX_t + \varepsilon_t$$

where CAD, IM and EX represent current account deficit, import and export volume, respectively, and $\varepsilon_t \sim IID\ N(0, I)$. Since all variables are first difference stationary in the model, Johansen co-integration analysis can be conducted. Johansen test results indicate at least one co-integrating equation at the 0.05 level. Depending on the co-integration relationship Dynamic Ordinary Least Squares methods are used in order to examine the long term relationships between current account balance with foreign trade figures and short run ECM

Cointegration equation of current account deficit is;

$$CAD_t = 4.9461 + 2.9739 * \mathrm{EX}_t - 3.3437 * IM_t - 0.005 * QTREND + \varepsilon_t$$

Table 3.10 Estimation Results for the CAD

Equation	Current Account Deficit (CAD)			
Method	Cointegration, VECM			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob.
Coint Eq	-0.7290	0.1185	-6.1383	0.0000
ΔEX (-1)	1.2035	0.3273	3.6771	0.0000
ΔEX (-2)	0.4535	0.2888	1.4320	0.1575
ΔIM (-1)	-1.3447	0.3787	-3.5506	0.0008
ΔIM (-2)	-0.3103	0.3440	-0.9019	0.3708
ΔCAD (-1)	0.3195	0.0973	3.2827	0.0017
ΔCAD (-2)	0.0190	0.1034	0.1841	0.8546
R-Squared	0.7295			

Cointegration coefficients are statistically significant at 5% significance level. Since the deficit is represented as the additive inverse of actual CAD, the signs of coefficients should be considered as inverted. Coefficient of the import, on the other hand, is higher than export's in terms of absolute values. It indicates that the current account deficit widens while terms of trade expand even if the foreign trade deficit remain unchanged.

3.2.4 Monetary Market Block

3.2.4.1 Inflation

In this model, the expected and actual inflation rates are estimated based on the adaptive expectations assumption.

Oil prices in transportation indices, seasonal factors in food prices, change in FX rates, course of economic activity, price changes in foreign market, and monetary policy are the main factors of CPI inflation in an economy. However, it is quite challenging to identify the precise inflation model for Turkish economy. For instance; the transportation indices were more volatile than oil prices mainly due to the adjustment-administered prices and tax regulations in Turkey. Course of domestic food price indices also diverged from global food price indices due to the seasonal factors and unpredictable climate conditions. In addition to them, the unobservable quality changes in CPI basket made it difficult to estimate CPI inflation precisely.

Demand pull inflation can be significantly observed during the times when the economy is in a boom/recession period, and the unemployment rate decreases/increases. In other words, the prices increase when the quantity supply cannot catch up with the growth rate of aggregate demand. However, initial estimation trials states that there is no statistically significant relation between employment rate and inflation rate in the Turkish economy between 1998-2014. This suggests that the inflation rate is not mainly based on demand pull inflation in Turkey. Therefore, the Philips Curve, which represents demand full inflation in the literature, cannot be defined in this model.

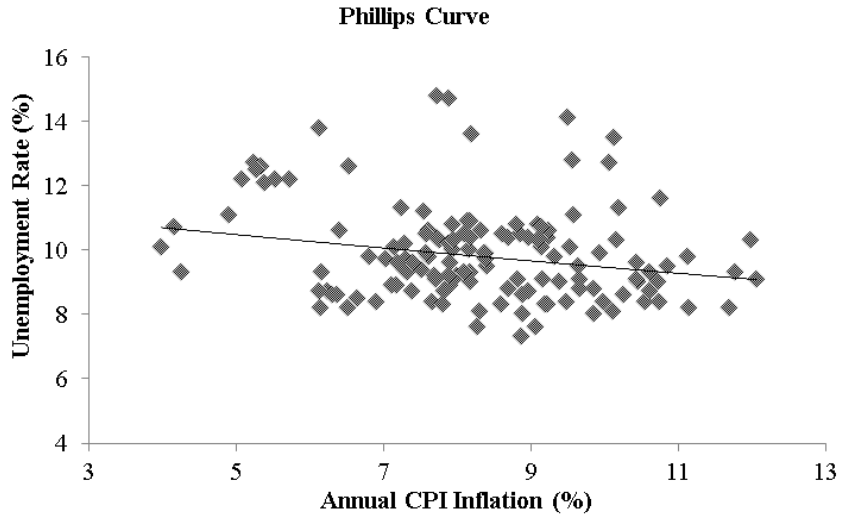


Figure 3.5 Phillips Curve for Turkish Economy, 2005-2015 periods

The other source of inflation is cost pull inflation. It arises when there is a decrease in aggregate supply due to an increase in commodity prices, e.g., oil and food, or due to natural disasters. In addition to that, government regulations and tax levels might also lead to cost pull inflation. In Turkey, the changes in production cost are thought to determine the inflation rate. In this situation, the import dependent consumption and production structure of the Turkish economy plays an important role for explaining the movements of inflation rate. Furthermore, the deterioration in public finance also increased the inflation rate in 1990s. Another factor, which influences the inflation rate, is the monetary policies. Under the light of all these information, the efficiency of monetary policies, the public finance, the exchange rate, and the inflation rate trend are used to explain the inflation rate in this model.

$$INF_t = \alpha_t + \beta_1(s_t)RP_{t-1} + \beta_2\Delta s(t)BUDB_{t-2} + \beta_3\Delta USDTRY_{t-2} + \beta_{4,5}QTREND_t + \varepsilon_t$$

where, (s_t) denotes the slope dummy variables at time t, and $\varepsilon_t \sim IID\ N(0, I)$. The process of (s_t) has 3 regimes. INF, BUDB and USDTRY represent annual inflation in consumer price, central government budget deficit and USD/TL, respectively.

RP is the difference between interest rate and policy interest rate of the Central Bank. The monetary policy is assumed as expansionary if the policy interest rate is lower than the market interest rate. In other words, if the Central Bank is willing to switch a tight monetary policy stance in order to suppress the inflation rate, it should determine the policy interest rate greater than or equal to the market interest rate. Besides controlling for the monetary policy attitudes of the Central Bank, we aim to integrate the inflation rate expectations of the market into the model through the definition of RP

The results below refer that the inflation rate is not only sensitive to the changes in the exchange rate (USD/TL), but also the improvements/deteriorations in public finance. During the 2nd and 3rd regimes, the period after 2003, the RP variable which represents the monetary policy and inflation rate expectations of the market, is influential on the inflation rate.

.

Table 3.11 Estimation Results for Inflation Equation

Equation	Inflation (INF)			
Method	Fully Modified OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
RP (-1) s(1)	0.0796	0.0412	1.9311	0.0589
ΔBUDB (-2) (s1)	-35.5115	15.4705	-2.2954	0.0258
RP (-1) s(2)	-0.0823	0.0259	-3.1778	0.0025
ΔBUDB (-2) (s2)	-60.8431	16.2750	-3.7384	0.0005
RP (-1) s(3)	0.2104	0.2455	0.8572	0.3952
ΔBUDB (-2) (s3)	-10.5763	13.9431	-0.7585	0.4516
ΔUSDTRY (-2)	11.1994	5.6719	1.9746	0.0536
C s(3)	28.5222	4.5012	6.3366	0.0000
TREND	-0.8325	0.2048	-4.0645	0.0002
$TREND^2$	0.0080	0.0022	3.5747	0.0008
C (s1)	36.9988	3.1795	11.6369	0.0000
C s(2)	21.1367	1.9738	10.7087	0.0000

3.2.4.2 Expected Inflation Rate

In this study, the data for the expected inflation rate is obtained from the CBRT's Survey of Expectation, and the Inflation Reports that are published by CBRT periodically. The exchange rate (USD/TL) is used to explain the expected inflation rate as it is also used to explain the actual inflation rate. Furthermore, the current period's actual inflation rate is assumed to influence the projections of the inflation rate for the next period. Therefore, the lagged actual inflation rate is included in the model for the expected inflation rate as an explanatory variable.

$$INF_t^e = \alpha_t(s_t) + \beta_1(s_t)INF_{t-1} + \beta_2 s(t)\Delta USDTRY_{t-2} + \beta_{3,4}QTREND_t + \varepsilon_t$$

where, (s_t) denotes the 2 regime realization at time t, and $\varepsilon_t \sim IID\ N(0, I)$.

Table 3.12 Estimation Results for Expected Inflation Equation

Equation	Expected Inflation (INF^e)			
Method	Fully Modified OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
INF (-1) s(1)	0.0362	0.0027	13.3295	0.0000
ΔUSDTRY s(1)	1.2023	0.2652	4.5341	0.0000
INF (-1) s(2)	0.0274	0.0022	12.6362	0.0000
ΔUSDTRY s(2)	0.0380	0.3920	0.0970	0.9230
C s(1)	1.8646	0.2131	8.7492	0.0000
TREND	-0.0030	0.0087	-0.3407	0.7346
$TREND^2$	0.0000	0.0001	0.4884	0.6271
C s(2)	0.2139	0.0772	2.7724	0.0075

3.2.4.3 Capital Flow

Since the capital flow finances the current account deficit in Turkish economy, capital flow is chosen to be one of the variables that is explained through behavioral equation within the macroeconomic model. Portfolio investment and other investments are used as proxy variables for overall capital flow. The reason is that between 1998 and 2014, portfolio investment and other investment constitute major part of the capital flow in Turkey. Two explanatory variables are included into capital flow equation; risk perception and GDP growth rate. The following equations represent the model for capital flow.

$$PINV = \alpha_t + \beta_1 s(t) \nabla GDP_{t-1} + \beta_2 s(t)(BIR - US2Y)_{t-1} + \beta_{3,4} QTREND + \varepsilon_t$$

$$OTI = \alpha_t + \beta_1 s(t) \nabla GDP_{t-1} + \beta_2 s(t)(BIR - US2Y)_{t-1} + \varepsilon_t$$

where (s_t) denotes the regime realization at time t, and $\varepsilon_t \sim IID\ N(0, I)$. The process of (s_t) has 2 regimes. PINV, OTI, GDP, BIR, US2Y represent portfolio investment in balance of payments figures, other investment in balance of payments figures, GDP, 2-year domestic benchmark bond yield and US' 2-year bond yield, respectively.

Table 3.13 Estimation Results for the Other Investment Equation

Equation	Other Investment (OTI)			
Method	Fully Modified OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
BIR-US2Y (s1)	0.0126	0.0041	3.0657	0.0033
ΔGDP (s1)	0.8063	2.2060	0.3655	0.7160
BIR-US2Y (s2)	-0.0073	0.0009	-8.0642	0.0000
ΔGDP (s2)	0.2863	1.4819	0.1932	0.8475
C s(2)	1.0694	0.1340	7.9815	0.0000
C s(1)	7.7781	0.1200	64.8357	0.0000

Test results indicate that the risk perception influences foreign investors' incentives. The difference between domestic (BIR) and foreign interest rate (US2Y) is used to measure foreign investors' risk perception. Similarly, GDP growth rate affects foreign investors' investment decision. Higher growth rate increases investors' appetite to invest in a country due to higher return expectations while lower growth rate discourages foreign investor.

Table 3.14 Estimation Results for the Portfolio Investment

Equation	Portfolio Investment (PINV)			
Method	Fully Modified OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
ΔGDP (s1)	-0.2296	1.1969	-0.1918	0.8486
BIR-US2Y (s1)	-0.0059	0.0013	-4.7034	0.0000
ΔGDP (s2)	0.7610	1.1435	0.6655	0.5084
BIR-US2Y (s2)	-0.0050	0.0017	-3.0352	0.0036
C s(1)	9.3046	0.1452	64.0681	0.0000
C s(2)	-0.3752	0.0670	-5.5997	0.0000
TREND	-0.0106	0.0061	-1.7382	0.0876
$TREND^2$	0.0002	0.0001	2.3933	0.0200

3.2.4.4 Benchmark Interest Rate

2-year benchmark bond's yield was used as the indicator for domestic interest rate in this study. The policy interest rate of CBRT, the expected inflation, and 2-year bond yields of USA were used in the equation. To identify the accurate regimes for the interest rate, a dual-state time-varying transition probability Markov regime switching process is implemented. The model is constructed as;

$$BIR_t = \alpha_0 + \beta_1(s_t)CT + \beta_2(s_t)INF_t^e + \varepsilon_t$$

where $\varepsilon_t \sim IID\ N(0, I)$. In this study, quarterly average of 2-year benchmark bond yields is taken into consideration as an indicator for the market interest rate. INF^e denotes expected inflation rate, which were announced by CBRT. CT is the difference between CBRT's policy rate and US government 2-year bond yield.

In 2-regime equation formed, it was seen that all of the coefficients are statistically significant and in harmony with the model assumptions. The difference between the CBRT's policy rate and the bond yield of USA is seen to be determinant for the benchmark bond yield rates. In first regime, it draws attention that the coefficient of CT variable is lower. 2nd regime covers the period, in which the political uncertainties in Turkey declined and the recovery in public finance was obtained. This situation conforms that the efficiency of TCMB's monetary policy strengthened in this period. The relation between the inflation expectations and interest rates was found to be statistically significant, and in parallel with the economic theory.

Table 3.15 Estimation Results for the BIR

Equation	Benchmark Interest Rate (BIR)			
Method	Fully Modified OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
CT s(1)	0.6331	0.1265	5.0034	0.0000
INF^e s(1)	11.6545	4.4715	2.6064	0.0125
CT s(2)	1.2178	0.1455	8.3685	0.0000
INF^e s(2)	9.9711	4.6092	2.1633	0.0361
C	-20.8214	8.5441	-2.4369	0.0190
R-Squared	0.9859			

3.2.4.5 Credit Volume

The trend of total credit volume of banking sector is considered as a leading indicator for economic activity. During the period after the global recession, the policymakers take serious steps to revive the credit mechanism in major developed countries especially in Eurozone.

In the Turkish economy, on the other hand, the credit volume was not affected by the fluctuations in economic activity due to high interest rates before 2004. However, after this period, course of the credits has shown similarity with the trajectory of the domestic economic activity. The level of interest rates is the main factors for estimating the credit demand. Since, the interest rates primarily affect the credit volume nominally, the correlation between the credit volume and economic activity was weak before 2004 whereas interest rate was quite high..

In this study, the calculation of credit volume through the constant prices limits the nominal effects of the increase in interest rates on credit volume. Thus, the benchmark interest rate is included in the equation as one of the factors determining the credit demand. In addition, the exchange rate movements are closely monitored by a large part of the population in Turkey. Changes in the exchange rate are the main factor that determines the risk perception in the society towards the financial markets. Therefore, it is assumed that the evolution of TL against USD affects the financial decisions of both the consumers and producers. Since the credit volume data has an upward trend, lagged values of it may be added into equation to increase explanatory power of the equation. Alternatively, the ratio of credit volume to GDP is used as an explanatory variable in order to capture upward trend of the credit volume in this model while the explanatory variable is also evaluated as a constraint for the credit growth. In Turkey, this ratio was 13% in 2002, where it reached to a level around 77% in 2015. Strictly speaking, this

level is lower than both the OECD average (146%) and the global average (125%). Therefore, there might be room for the credit volume to support by the domestic savings. Within this context, the equation for the credit volume is;

$$\Delta CRD_t = \alpha_0 + \beta_1 TREND + \beta_2(s_t)\Delta BIR_t + \beta_3(s_t)\Delta INVM_t + \beta_4(s_t)\Delta USDTRY_t + \beta_5\Delta(CRD/GDP)_{t-1} + \varepsilon_t$$

where, (s_t) denotes slope dummy variables (2 regimes) at time t, and $\varepsilon_t \sim IID\ N(0, I)$. CRD, BIR, INVM, USDTRY denote total credit volume, 2-year domestic benchmark bond yield, total investment and USD/TL, respectively.

Table 3.16 Estimation Results for the Credit Equation

Equation	Change in Credit Volume (ΔCRD)			
Method	OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
ΔBIR s(1)	-0.0010	0.0005	-1.8677	0.0670
ΔINVM s(1)	0.1360	0.1364	0.9966	0.3233
ΔUSDTRY s(1)	-0.1554	0.0843	-1.8431	0.0706
ΔBIR s(2)	-0.0039	0.0017	-2.3208	0.0240
ΔINVM s(2)	0.2808	0.1216	2.3082	0.0247
ΔUSDTRY s(2)	-0.1987	0.0880	-2.2584	0.0278
ΔCRD/GDP	3.8814	1.0931	3.5507	0.0008
C	0.0035	0.0141	0.2487	0.8045
TREND	0.0005	0.0003	1.5417	0.1288
R-Squared	0.5499			

The first regime in the equation covers the period before 2003, where the second regime covers the period after 2003. Under the first regime, the p-values of the coefficients seem to be high which implies the significance of the regressors. High inflation and high interest rate conjuncture in this period is believed to weaken the relationship between almost all explanatory variables. Also, the sensitivity of the credit demand for the interest rate is lower under the first regime. Moreover, the investment demand seems to determine the change in credit volume under the second regime. Statistically significant lagged value of CRD/GDP ratio indicates that the rate of increase in credit volume depends on the increase in the previous period, as well.

3.2.5 Labor Force Block, Employment

The employment surveys, definition of unemployment, and labor force are heavily criticized indicators of the labor market. Main criticism for the labor market data is that the data does not reflect the actual condition of the labor market. In addition, seasonality

in the labor force data sets, the changes in the definition of unemployment and changes in the structure of the employment surveys have increased the concerns about the reliability of the employment data.

It has always been challenging to build a model for explaining the variations in the labor data. In this study, the total hours worked, published by OECD, is used as the labor force indicator. The factors that influence the labor force are government expenditures, investments, wages, and manufacturing sector indicator of OECD.

$$EMP_t = \beta_1(s_t)GOV_t + \beta_2(s_t)INVM_t + \beta_3(s_t)WAGE_t + \beta_4(s_t)LPROD_t + \varepsilon_t$$

where, (s_t) denotes the regime realization at time t, and $\varepsilon_t \sim IID\ N(0, I)$. EMP stands for employment indicator while GOV, INVM, WAGE and LPROD represent government expenditure, total investment, wages and OECD's production indicator for Turkish economy, respectively.

Table 3.17 Estimation Results for the Employment Equation

Equation	Employment (EMP)			
Method	Fully Modified OLS			
Explanatory Variables	Coefficient	Std. Error	t-stat	Prob
GOV s(1)	0.2816	0.0671	4.1950	0.0000
INVM s(1)	0.1923	0.0677	2.8417	0.0045
LPROD s(1)	0.1399	0.0307	4.5620	0.0000
WAGE s(1)	0.0515	0.0253	2.0408	0.0413
GOV s(2)	0.1931	0.2394	0.8067	0.4198
INVM s(2)	0.4063	0.1887	2.1533	0.0313
LPROD s(2)	-0.0612	0.0509	-1.2030	0.2290
WAGE s(2)	-0.0422	0.0500	-0.8442	0.3986

The first regime covers the period from 2001 and 2009. Under the first regime, investment, economic activity, and wages are used to explain the total hours worked. The results show that these variables are statistically significant. On the other hand, wages and total output are not statistically significant for explaining the total hours worked under the second regime. It is possible that the fluctuations in economic activity (after the global crisis) disrupt the relationship between these two variables and total hours worked.

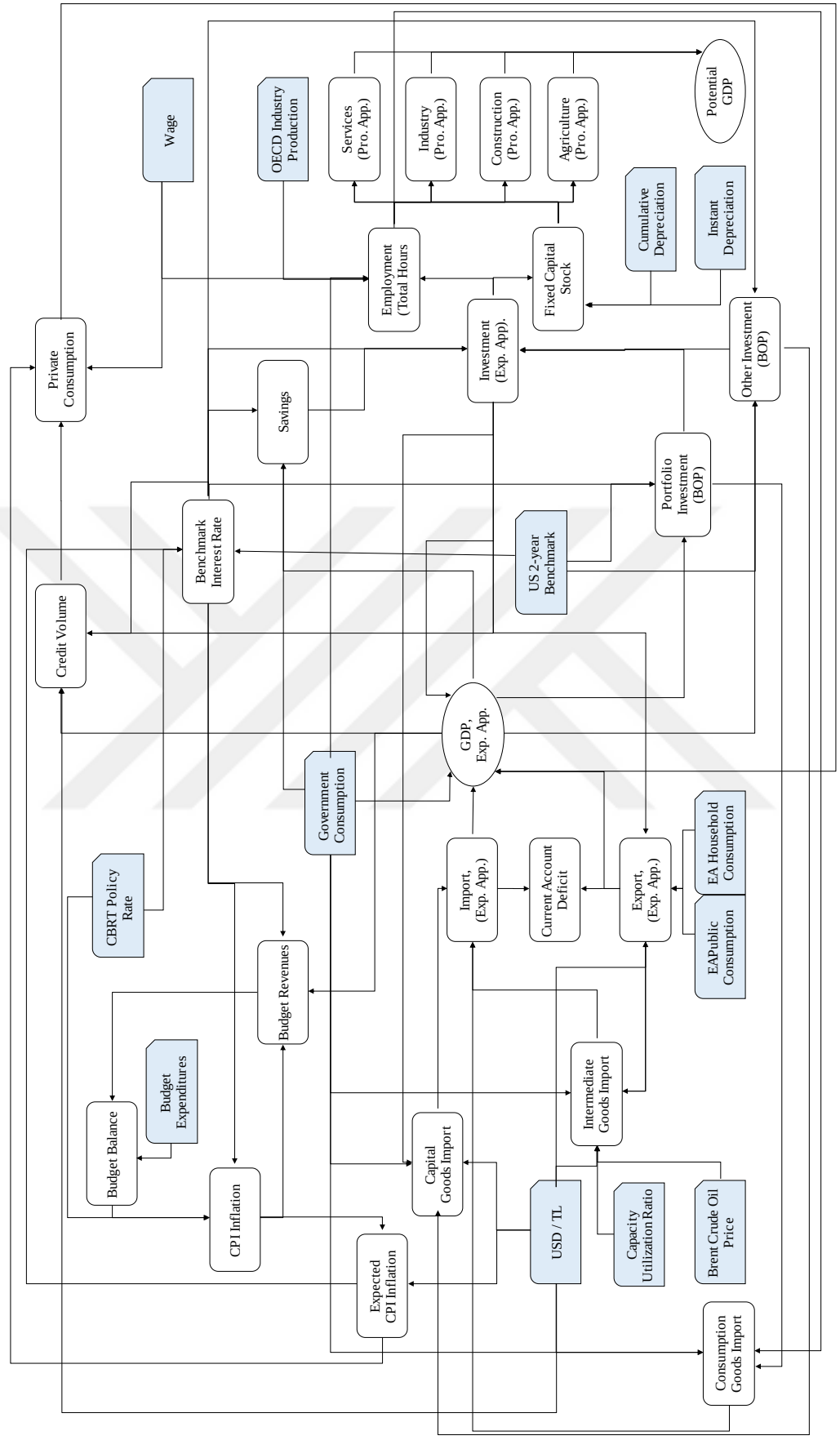


Figure 3.6 Network of the model

4 SIMULATION RESULTS

Since a structural model has many equations, it may not be easily solved even if the model is arranged sequentially. A recursive algorithm such as Broyden, Newton or Gauss-Seidel is necessary to solve the linear system of equations. All these methods are used to solve the model. Although, all of these algorithms give similar results, only the results of the simulations obtained from Gauss-Seidel[3] algorithm are reported in this thesis for the sake of brevity.

In a dynamic simulation, the values of all lagged endogenous variables are set equal to the values predicted by the model in the previous period. On the other hand, in a static model, actual values are used in the set of lagged endogenous variables. In this thesis, dynamic simulation results are evaluated even if the power of static model is always higher than dynamic ones.

The dynamic simulation can be either deterministic or stochastic. In the deterministic simulation all error terms are set to theoretical mean value while stochastic simulations consist of uncertainties by adding random shocks in each estimated equation. The bootstrap method which implies drawing random shocks from the set of residuals

[3] Gauss-Seidel algorithm solve the system of equation by using an initial guess and iterating these equations until a satisfactory convergence (5000 iterations convergence level is 10^{-8}) is reached. Convergence is only secured if the matrix is either diagonally dominant, or symmetric and positive definite. (See Appendix for details)

generated by individual equations is used as a picking process for these random shocks in dynamic stochastic simulations for the out-of-sample forecast.

Structural models with behavioral equations are generally criticized for using dummy variables frequently which raises doubt about the robustness of the estimation. However in this thesis all variables are deseasonalized by Tramo-Seats, thus there is no need to use dummy variables to eliminate seasonal factors. Another criticism about the structural models is that they are not robust to structural breaks. This issue is addressed by ensuring that behavioral equations are estimated with appropriate regime-switching regression methods. So, estimated parameters in behavioral equations are robust to seasonality, and model can capture possible structural breaks in individual equations. Another criticism on structural modeling is about relaxing fundamental statistical assumptions and focusing on practical concerns by neglecting theoretical limitations. For instance, many models in the literature are built by ignoring non-stationarity of variables, heteroscedasticity of error terms, high multicollinearity among regressors, and autocorrelation in the error terms. However, in this thesis, all equations are controlled for heteroscedasticity, non-stationarity, multicollinearity, and autocorrelation by arranging appropriate tests and by using correction methods, e.g., White heteroscedasticity consistent standard errors, Newey-West estimator. In summary, the behavioral equations are arranged by taking into account all necessary adjustments that are suggested by the statistical theory. The detail explanation for these tests and methods can be found in Appendix.

4.1 Scenarios

Six simulations experiment are carried out in this thesis. The first set is designed to measure the accuracy of the model. The next three sets are built to evaluate different scenarios based on FX market shock, increase in government expenditures and rate hike in CBRT's policy rate. The last two simulations are conducted to anticipate the trajectories of key macroeconomic variables until the end of 2019 based on a different set of assumptions about exogenous variables.

4.1.1 1st Scenario (testing accuracy of the model):

The Root Mean Normalized Square Error[4] (RMNSE) and Theil Coefficient[5] (Bliemel (1973)) for the both static and dynamic solutions are obtained to measure accuracy of the model. RMNSE and TC values for both solutions are reported in the Table 4.1. As shown in the table, the model has the ability to track the historical development of the Turkish economy reasonably well. Figures 4.1 and 4.2 illustrate the results of the simulation over period 1998-2014 along with the actual values of key macroeconomic variables. The figures suggest that the predicted values obtained from the simulation follow similar paths with the actual values of the variables. The model also generates consistent results based on annual difference of the data set.. As a result, within-sample simulation results suggest the usefulness of the model on forecasting and policy simulations.

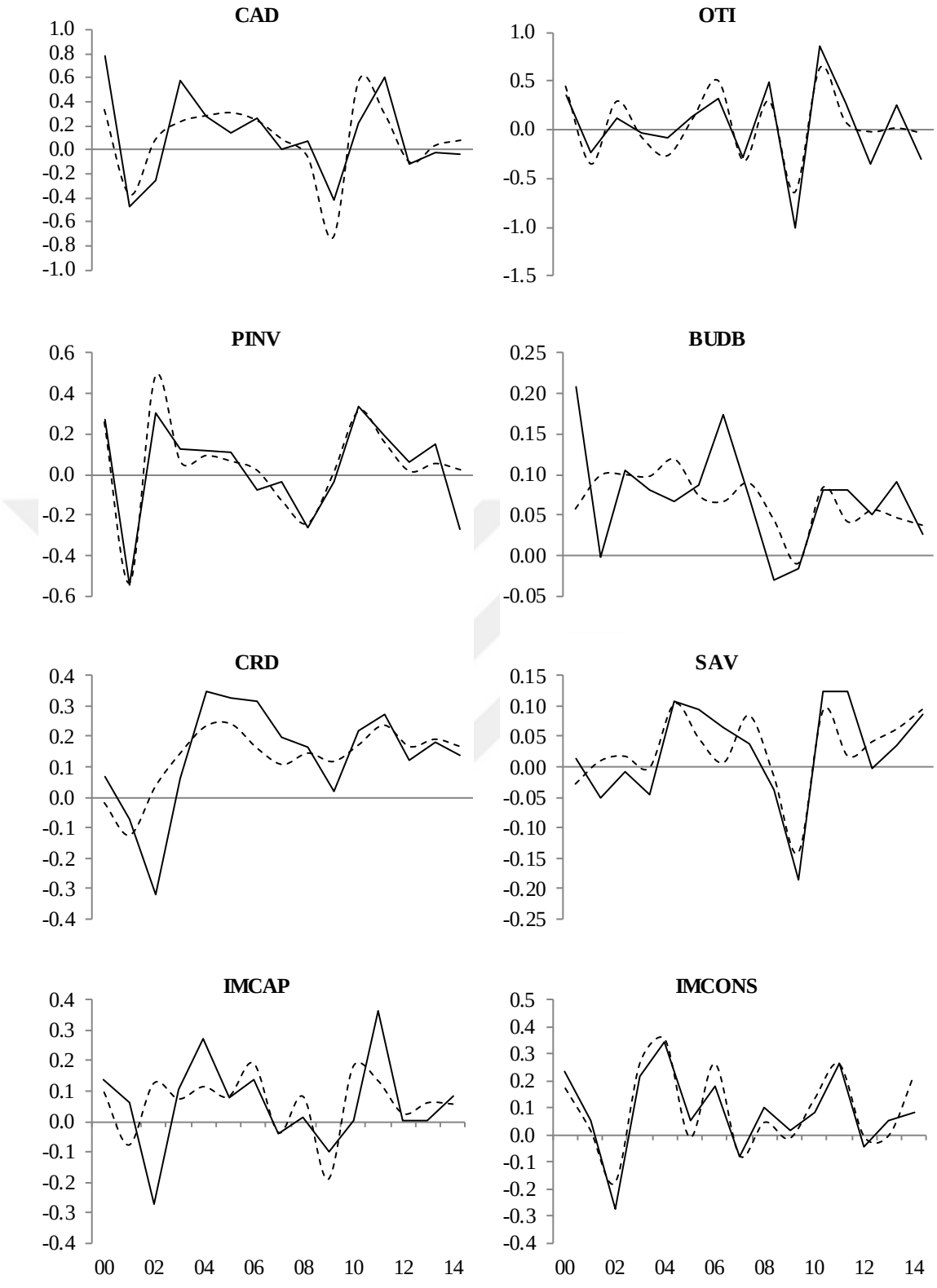
In the model, potential GDP is calculated through 4 estimated sectoral production functions which are defined in the model. Thus, output gap is calculated by taking the difference between the potential GDP and aggregated GDP that is based on the estimated national income identity. According to the economic theory, output gap should reflect economic performance by indicating recession and economic booms. Within-sample simulation results for output gap seem to be accurate, since estimated output gap clearly shows both recession periods in 2001-2002 and in 2008-2009. It also captures the overheating of the economy in 2010 and 2011.

[4] The RMNSE is computed as follows: where y^s and y^a are the simulated and actual values of an endogenous variable, respectively, and T is the number of simulation periods.

$$\frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}((y^s - y^a)^2)}}{y^{mean}}$$

The budget balance and benchmark interest rate take values very close to zero which account for their large theil coefficient and RMNSE. See table 4.1. and 4.2 Figures for estimation are presented at the end of chapter.

[5] When the theil coefficient is equal to zero, it represents the case of equality. This is clearly the case of perfect forecast. When it equals to 1 (the "maximum inequality") if there is either a negative proportionality or if one of the variables is identically zero.



(the figure continues on next page)

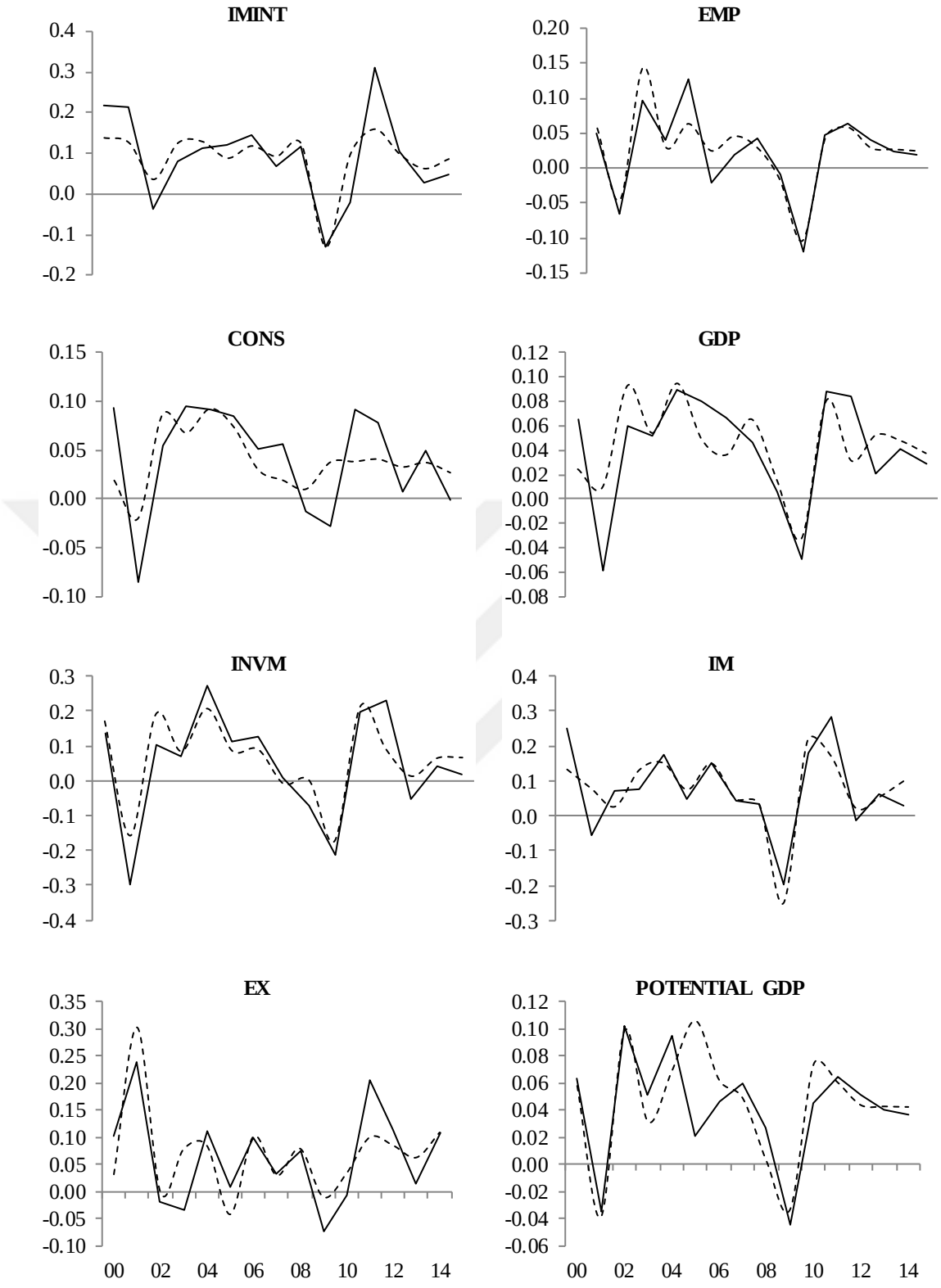
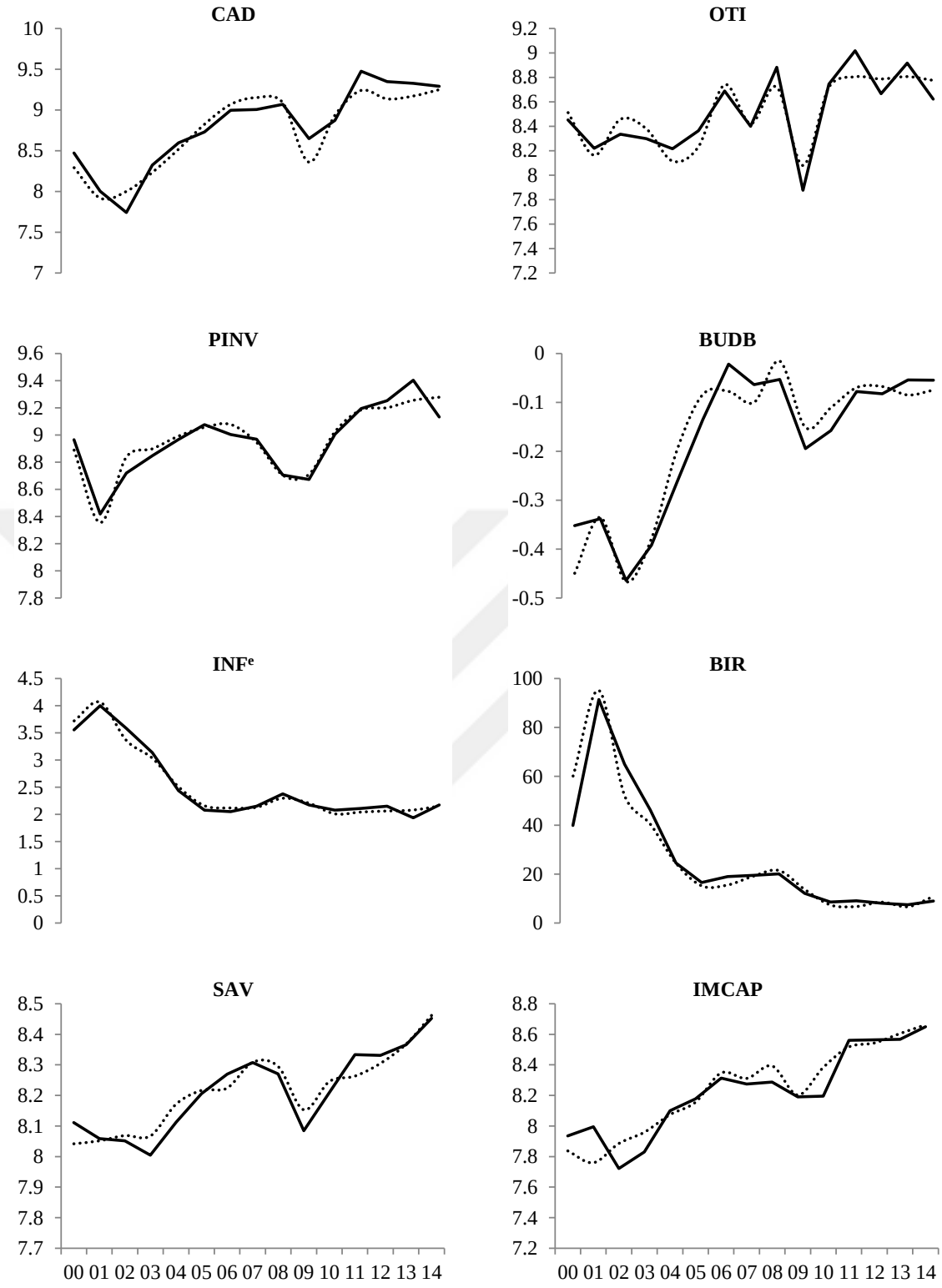


Figure 4.1 Dynamic Results: yoy change, estimates vs. actual values

(year over year difference of the annual average values, dash lines represent actuals)



(the figure continues on next page)

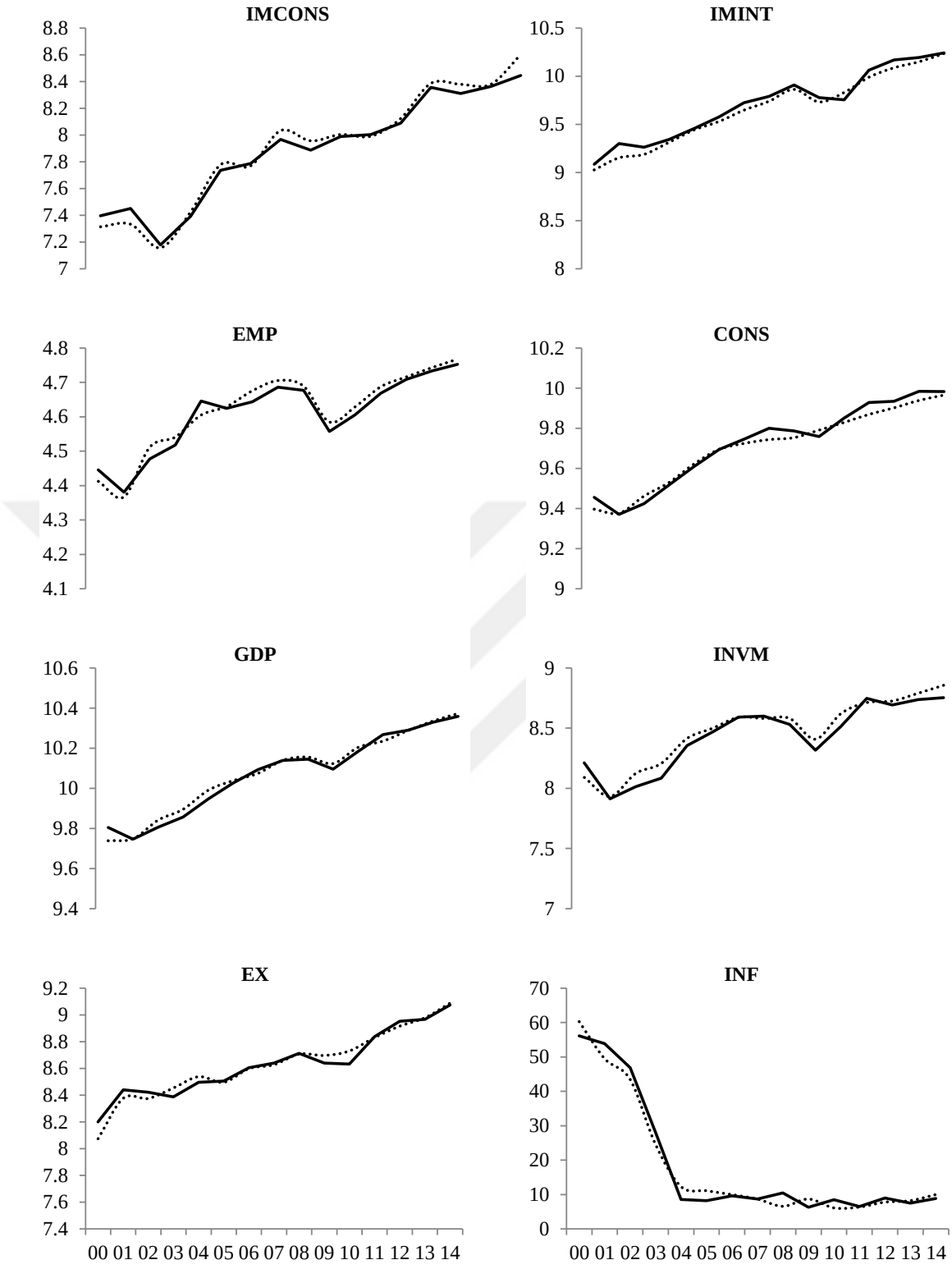


Figure 4.2 Dynamic Results, log level, estimates vs actuals

(log level of annual average values, dotted lines represent actuals)

Table 4.1 Validation of the Model

		Static Model		Dynamic Model	
Variable		Theil	RMNSE	Theil	RMNSE
CONS	Resident Household Consumption	0.001648	0.003297	0.002041	0.004086
FCF	Fixed Capital Formation	0.000085	0.000170	0.000276	0.000553
GDP	GDP	0.001532	0.003064	0.001875	0.003750
INVM	Private and Public Investment	0.003015	0.006030	0.005709	0.011405
SAV	Total Savings	0.003350	0.006703	0.003461	0.006922
CAD	Current Account Deficit	0.015743	0.031447	0.015814	0.031741
OTI	Other Investment	0.011655	0.023320	0.013016	0.026054
PINV	Portfolio Investment	0.005345	0.010696	0.006869	0.013743
IMCAP	Imports, Capital Goods	0.004817	0.009641	0.007281	0.014559
IMCONS	Imports, Consumption Goods	0.003025	0.006057	0.005040	0.010087
IMINT	Imports, Intermediate Goods	0.002439	0.004882	0.003890	0.007804
IM	Total Imports	0.004388	0.008784	0.003832	0.007681
EX	Total Exports	0.003657	0.007321	0.004617	0.009242
BIR	Yield of Benchmark Bond, 2 year	0.032004	0.064271	0.032395	0.064963
CRD	Banking Sector Total Credit Volume	0.001929	0.003869	0.008603	0.017330
INF	Annual Inflation in Consumer Price Index	0.042541	0.086172	0.046800	0.094475
INF^e	Expected Consumer Price Annual Inflation	0.019235	0.039875	0.032114	0.066666
BUDB	Budget Balance	0.115925	0.299545	0.118345	0.306928
BUDR	Budget Revenues	0.002890	0.005782	0.002913	0.005827
EMP	Total Hours Worked in Manufacturing	0.002814	0.005631	0.003162	0.006321
AGRIC	Agriculture Sector (GDP Production App.)	0.001716	0.003433	0.001855	0.003711
INDUST	Industrial Sector (GDP Production App.)	0.001410	0.002820	0.001529	0.003058
CONSTR	Constraction Sector (GDP Production App.)	0.002485	0.004973	0.003001	0.006005
SERVIC	Services Sector (GDP Production App.)	0.000866	0.001732	0.001074	0.002149
PROD	Potential GDP	0.001559	0.003119	0.001634	0.003268

4.1.2 2nd Scenario (FX shock):

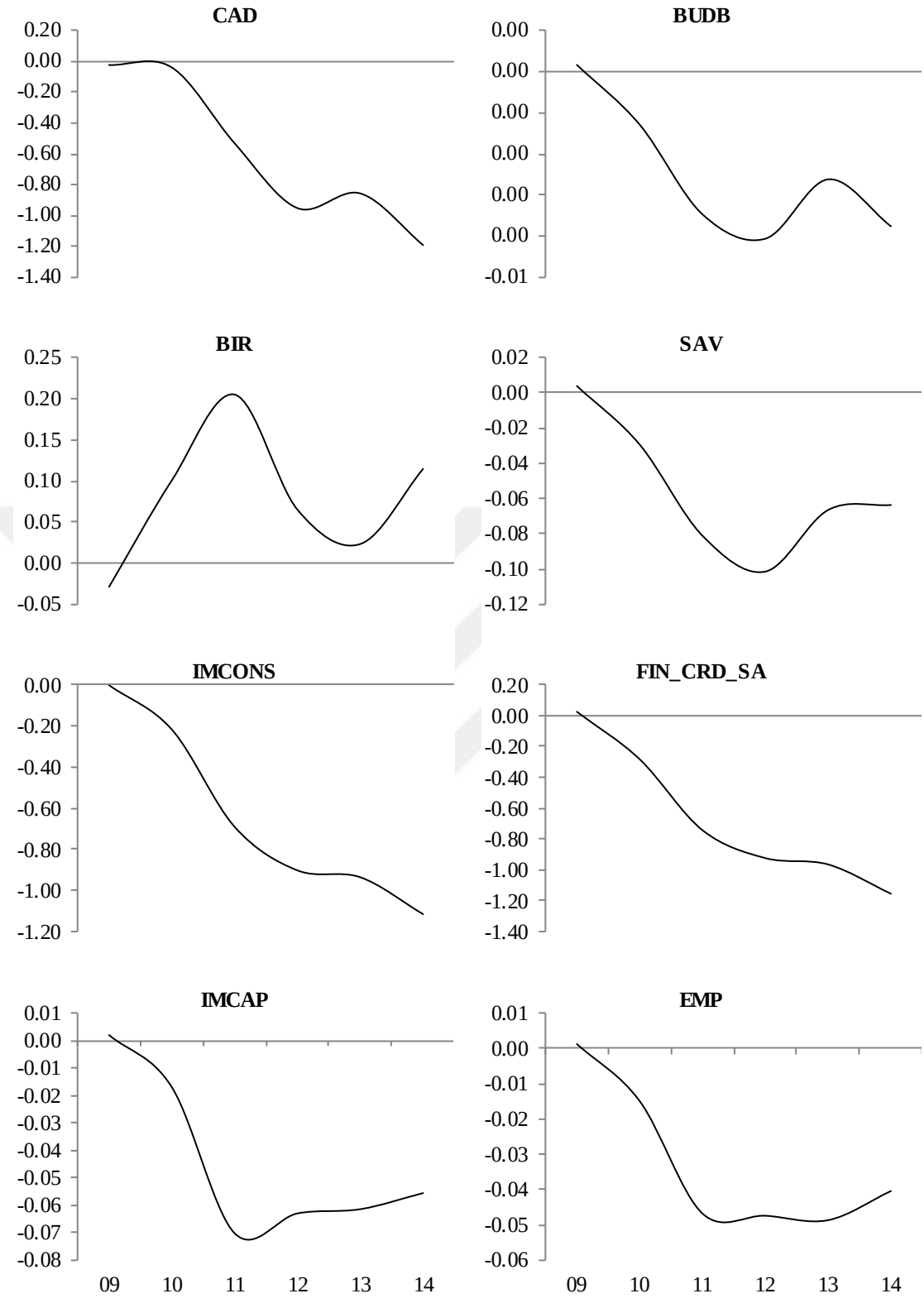
Economists frequently mention the strong dependence of the Turkish economy on external economic phenomenon such as capital flow, international price level, commodity prices, global financial conditions, and external trade, etc. According to this criticism, the vulnerability of the Turkish economy can be arose from two channels; financial and real sectors.

Import-dependent production structure mainly forms the real sector channel of the vulnerability while high dependence of financial sector on international capital flow

basically constitutes the financial channel. Foreign public debt, short FX position of non-financial companies, high dependence on foreign sources of energy and input imports are the main sources of both types of vulnerability. In addition, exchange-rate pass-through is also crucial aspect that has direct effects on financial sector. Thus, in FX scenario simulation, the effects of FX shocks (USD/TL) on the economy are investigated to measure the vulnerability of the Turkish economy during global financial downturns.

The FX scenario assumes that USD/TL is increased by %20 annually in 2010. After 2011, quarterly changes in USD/TL are derived from actual values. Thus, the model is able to illustrate both short-run and long-run effects of the depreciation in Turkish Lira.

Findings obtained from the FX shock scenario are in line with the economic theory that explains the relation between FX rate and other key macroeconomic variables. Figure 4.3 illustrates the effects of the FX shocks on the expected inflation, actual inflation, private consumption, savings, external trade, benchmark interest rate, current account deficit, budget balance, and GDP. The shock reduces GDP growth by 50 bp both in 2010 and 2011. After that, GDP growth recovers due to the favorable base effect. Results suggest that the depreciation of Turkish Lira puts an upward pressure on the price level for 8 consecutive quarters. In the same period, the benchmark interest rate goes up due to an increase in expected inflation. The depreciation of Turkish Lira also has distorted effects on consumption and savings. Despite contraction in private consumption, total savings also plunge due to the reduction in GDP growth. External shock has distorted effects on budget balance due to the expansion of interest expenditures of the central government. On the other hand, the depreciation in Turkish Lira causes both external trade and current account deficit to recover as stated in the first complementary study of this thesis in which a new approach of Marshall-Lerner condition is tested for the Turkish economy.



(the figure continues on next page)

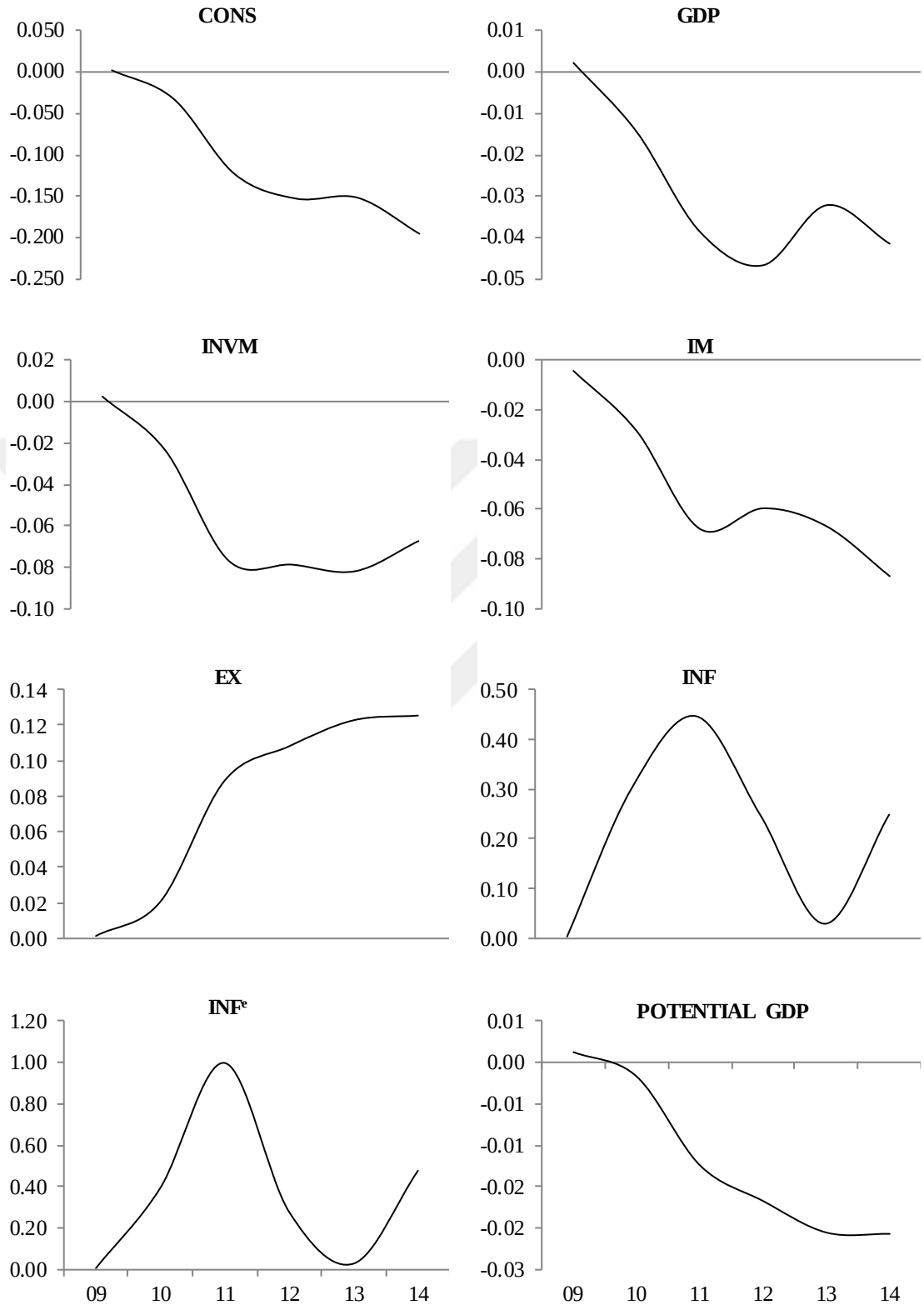


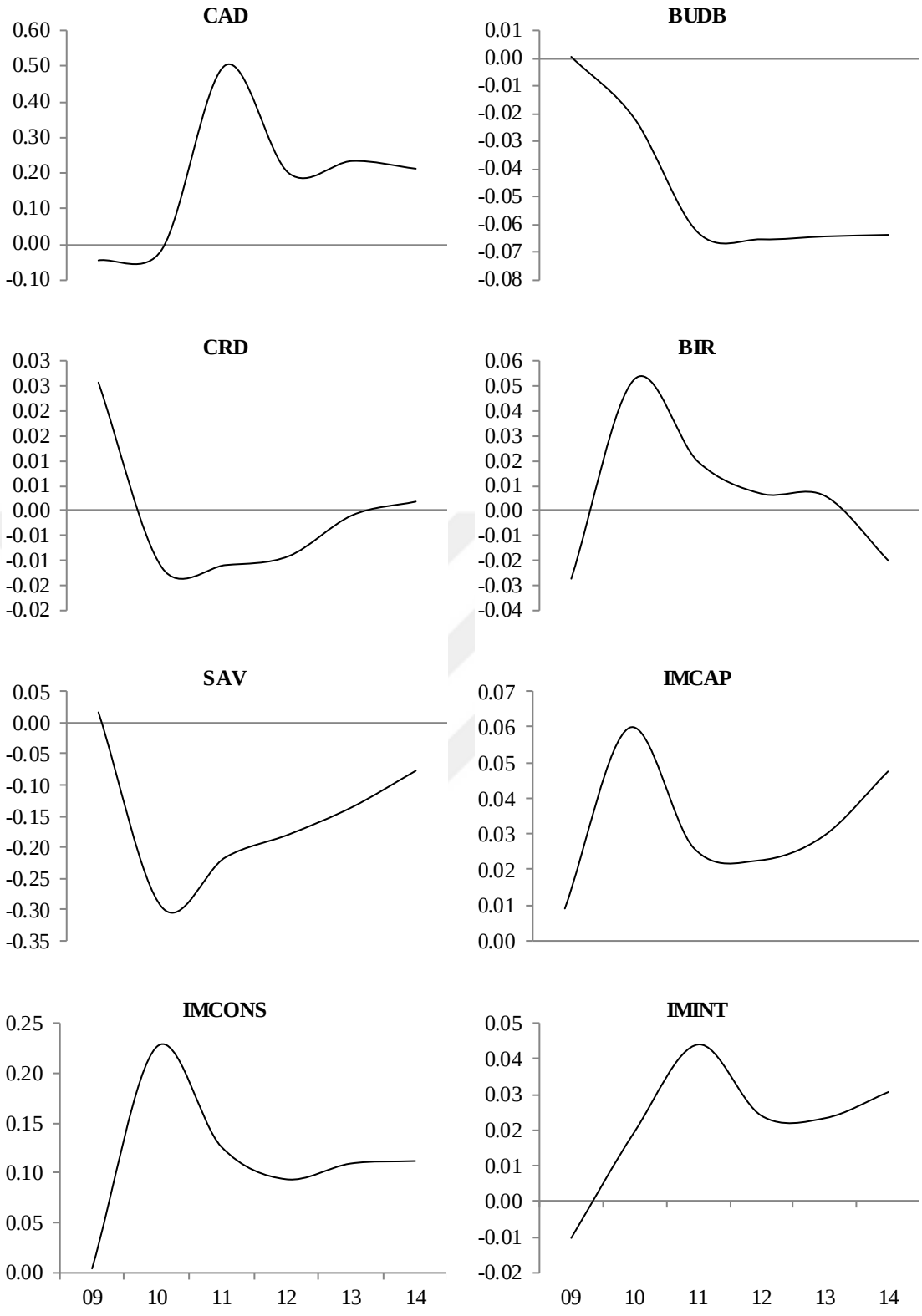
Figure 4.3 Response of the key variables to FX shock.

(annual differences between estimated values of the 2nd scenario and 1st scenario)

4.1.3 3rd Scenario (expansionary fiscal policy):

Until 2003, high inflation rate was a major source of vulnerability for the Turkish economy. As remarked by authorities and well-recognized international financial institutions, the Turkish economy achieved strict fiscal consolidation and fiscal discipline after the financial crisis in 2001. These achievements lead to success in reducing the inflation rate. Thus, one of the main focuses of this scenario is evaluating the effects of fiscal discipline on financial indicators. In addition, government expenditures play an important role in economic growth and development. Between 1998 and 2014, government expenditures made a significant contribution on economic growth by around 45 basis points on average. On the other hand, after 2011, the average contribution of government expenditures on economic growth exceeded 60 basis points. By the light of all these information, the third scenario which focuses on fiscal policy, considers the response of key macroeconomic variables to a change in the government expenditures through two channels; central government budget deficit, and public expenditures in the national income identity.

Main assumption of the third scenario implies that the public spending has been increased by 5% gradually in 2010. Since, the structure of the model is created under the assumption that almost all real variables affect public spending, it is anticipated that the shock would be influential on the course of key macroeconomic variables. The results meet the expectations such as the expansion of the public spending results in a significant decrease in total savings so in investments. Furthermore, since the expansion in public spending increased the employment level, it has positive effect on the economic growth in the short run. On the other hand, the deterioration in both current account and budget deficit are permanent and significant. In addition, inflation and interest rate increase as initial response to expansionary fiscal policy. It leads a significant contraction in both investment and consumption. As a result, in medium and long-run, the magnitude of the positive effect on GDP diminished, and net aggregated effect of public spending on economic growth was positive, but almost negligible. (See figure 4.4 for the results of the third scenario)



(the figure continues on next page)

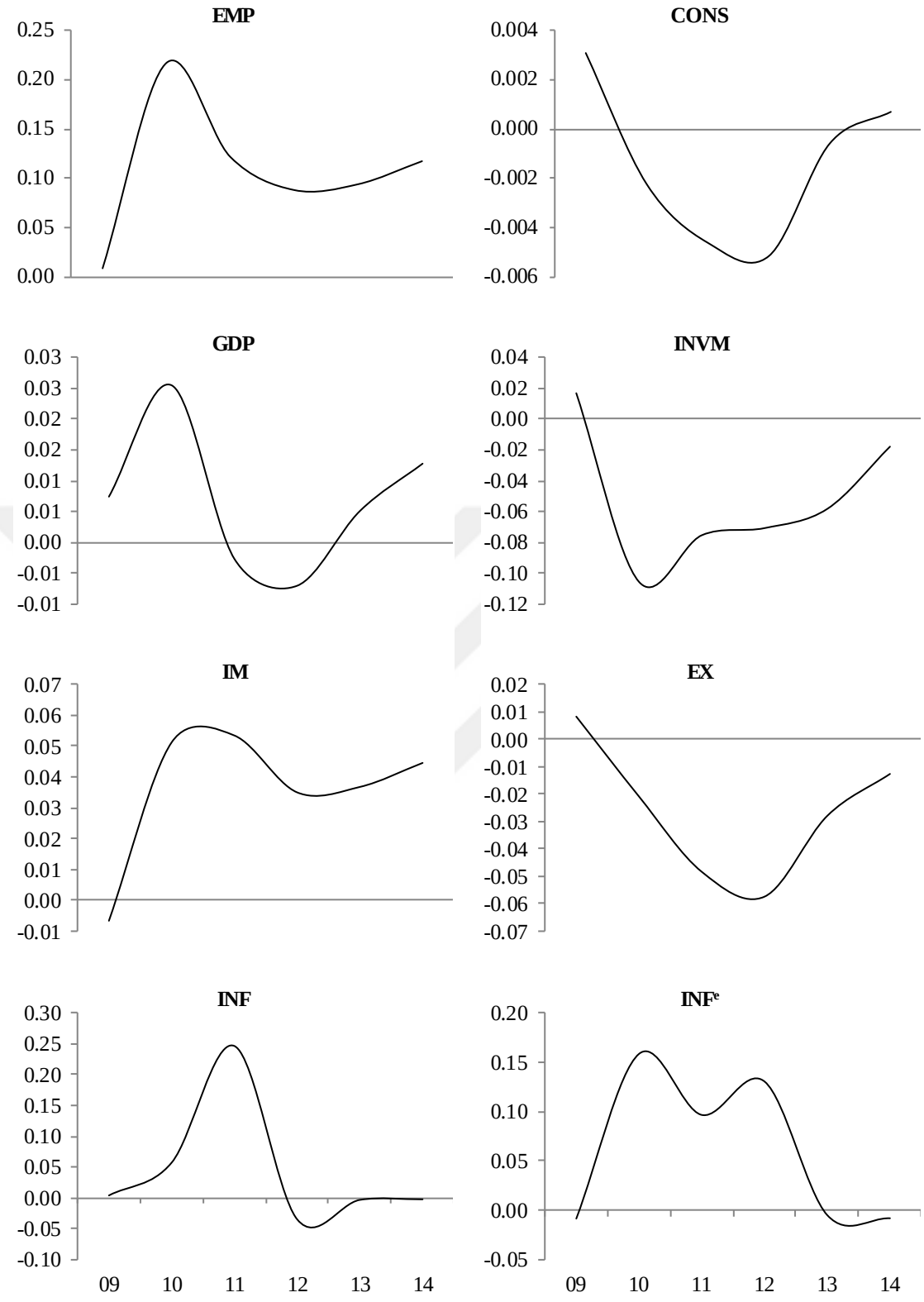


Figure 4.4 Response of key variables to expansionary fiscal policy

(annual differences between estimated values of the 3rd scenario and 1st scenario)

4.1.4 4th Scenario (tight monetary policy)

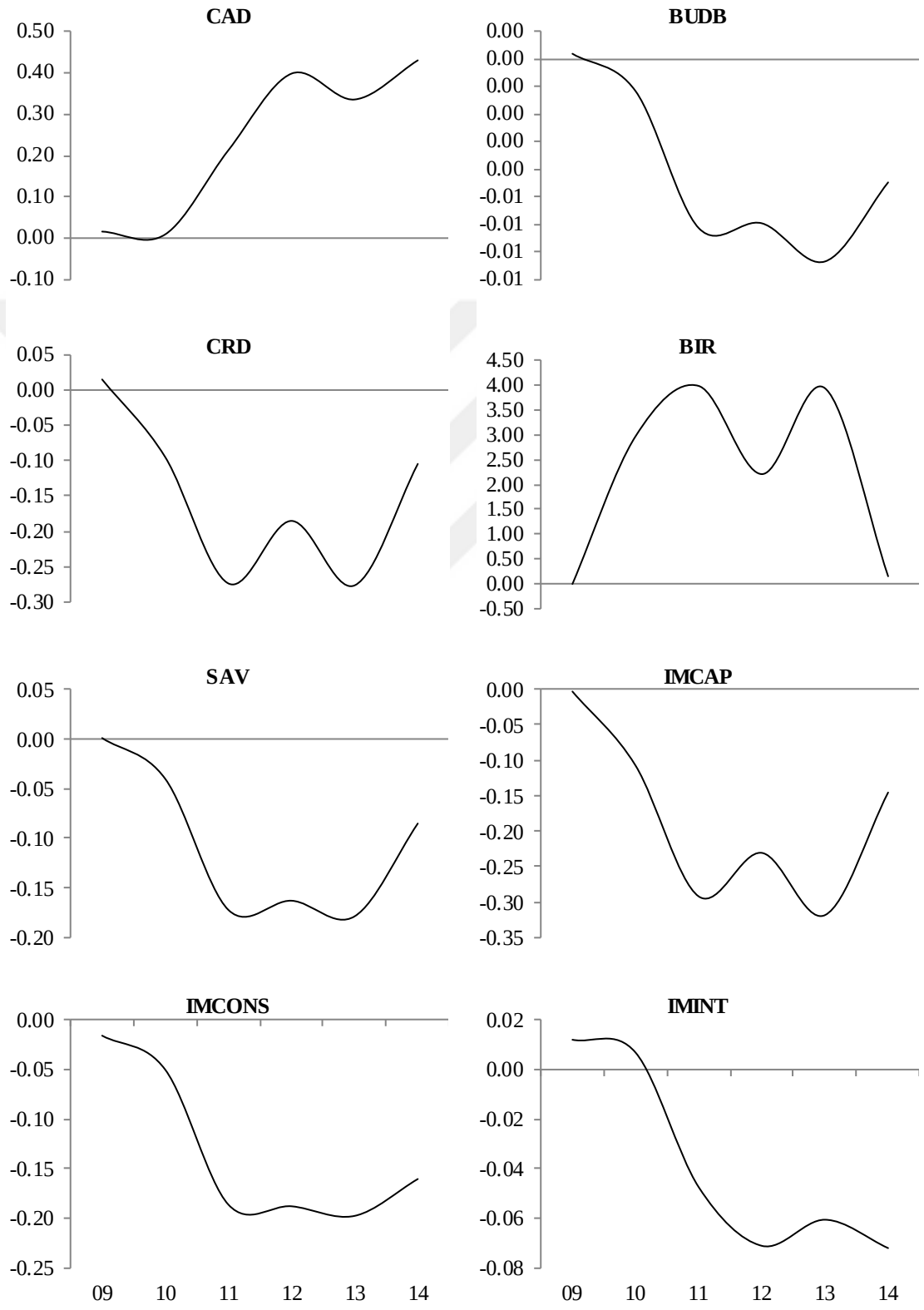
In the fourth scenario, the effects of a change in the policy rate of the CBRT are investigated. This simulation focuses on the impact of a hike in CBRT's policy rate by 300 bp (to 12%) in the first quarter of 2010. Scenario also implies a gradual reduction (25 bp per half of a year) in policy rate starting from first quarter 2012.

The model is designed to measure the effect of an increase in CBRT's policy rate on inflation through the equations of benchmark interest rate and expected inflation. If the CBRT implements a strong and front-loaded monetary tightening by hiking policy rate above the benchmark interest rate, it is anticipated that this cautious stance would put downward pressure on inflation. However, CBRT's decision is also evaluated as an official approval for an increase in the expected inflation. Concurrently, one can assure that the CBRT's act may restrain these expectations. So, it is assumed that there is no need for an additional exogenous shock on expected inflation which should be the main reason of the CBRT's policy movement.

Simulation results are illustrated on Figure 4.5. Firstly, the change in policy rate should affect the bond market. The simulation results are compatible with this anticipation. Benchmark bond rate increases instantly and follows a similar path to the CBRT's policy rate. Higher bond rates cause a dramatic increase in the cost of borrowing for all economic agents. So, the model captures these effects. Higher interest rate limits investors' appetite and consumption. Although, total imports also contracted, current account deficit expands as exports decline due to the sharp drop in investment. GDP and labor market also suffer from the high interest rate. Furthermore, the simulation results suggest that the CBRT manage to reduce the inflation rate by tightening monetary policy. However, the increase in budget expenditures, due to the rise in interest expenditures, distorts budget discipline which limits the downward trend on inflation. So, the aggregated results of an increase in CBRT's policy rate indicate a decline in inflation at the cost of a contraction in total output as stated by William Philips.

Although, the results are seemed to be compatible with the economic theory and general perception about economic phenomenon, one should recall that the model has a huge set of assumptions which might reflect practitioner's point of view. For instance, inflation rate is influenced by both the change in aggregate demand and production cost, but the effect of aggregate demand on inflation does not provide valid results; thus, the effect is measured indirectly through interest rate. Since the inflation rate follows a downward

trend during the sample period due to the favorable base effect, the trajectories of inflation cannot capture the fluctuations in total output directly. That is why in this thesis it is assumed that the supply-side and cost-push factors on inflation are more effective for the course of the inflation.



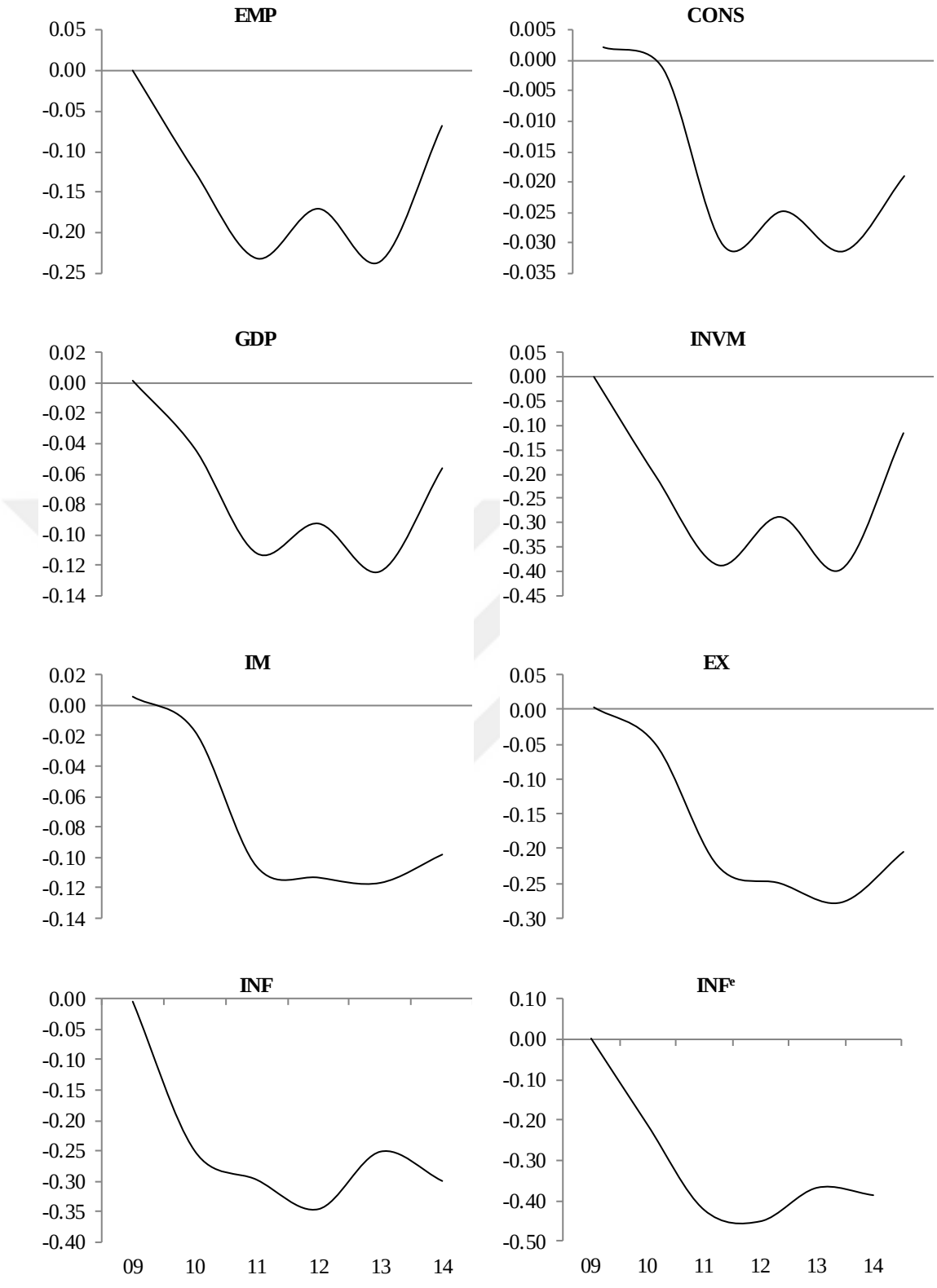


Figure 4.5 Response of key variables to contractionary monetary policy

(annual differences between estimated values of the 4th scenario and 1st scenario)

4.1.5 5th Scenario (forecast simulation, business-as-usual)

Out-of-sample performance of the model is evaluated by forecasting future values of the variables until the end of 2019. It is assumed that the all exogenous variables trace the same trend of their past values in business-as-usual scenario. Main assumption of this scenario refers that there is no any uncertainty or shocks on exogenous variables and these variables follows a steady course with a normally distributed innovations.

The model results are checked by using stochastic simulation exercises. Stochastic simulation, applying the bootstrap method, exerts random shocks from individual equation residuals into each estimated equation for a specified period, and thereby introduces uncertainty into the model forecasts. As shown in Figure 4.7 which is represented out-of-sample performance of the model appears to be reasonably satisfactory. Figure 4.7 also represents boundaries of the out-of-sample simulations for selected key endogenous variables with 5% and 95% quantiles generated from 100 simulations.

Although, possible technological developments or structural changes in production sector are ignored in the forecast scenarios, out-of-sample forecast of output gap can be used as a performance indicator for the consistency of the model and scenarios. According to results, in both forecast scenarios output gap follows a relatively flat course. If there is an identification problem or irrational assumption in forecast scenarios, output gap may increase or decrease dramatically in defiance of pre-assumptions about trajectories of exogenous variables (See Figure 4.6).

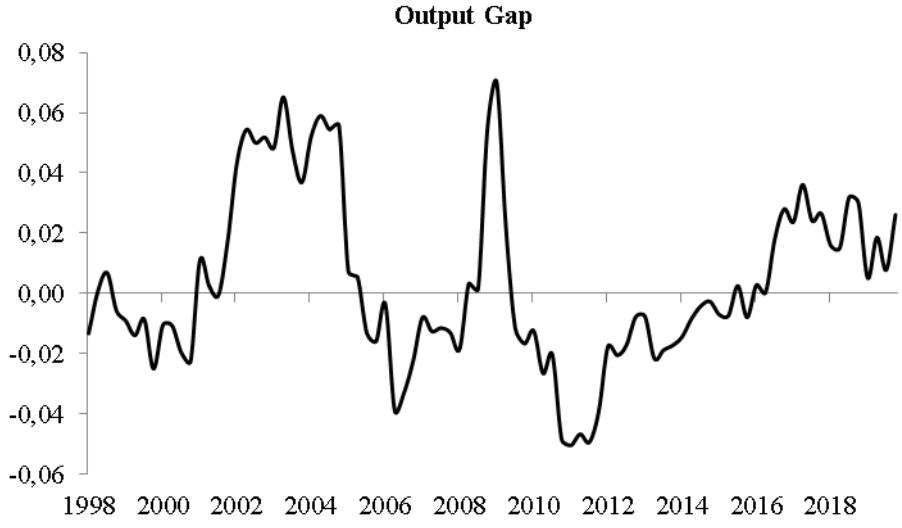


Figure 4.6 Estimated Outputgap

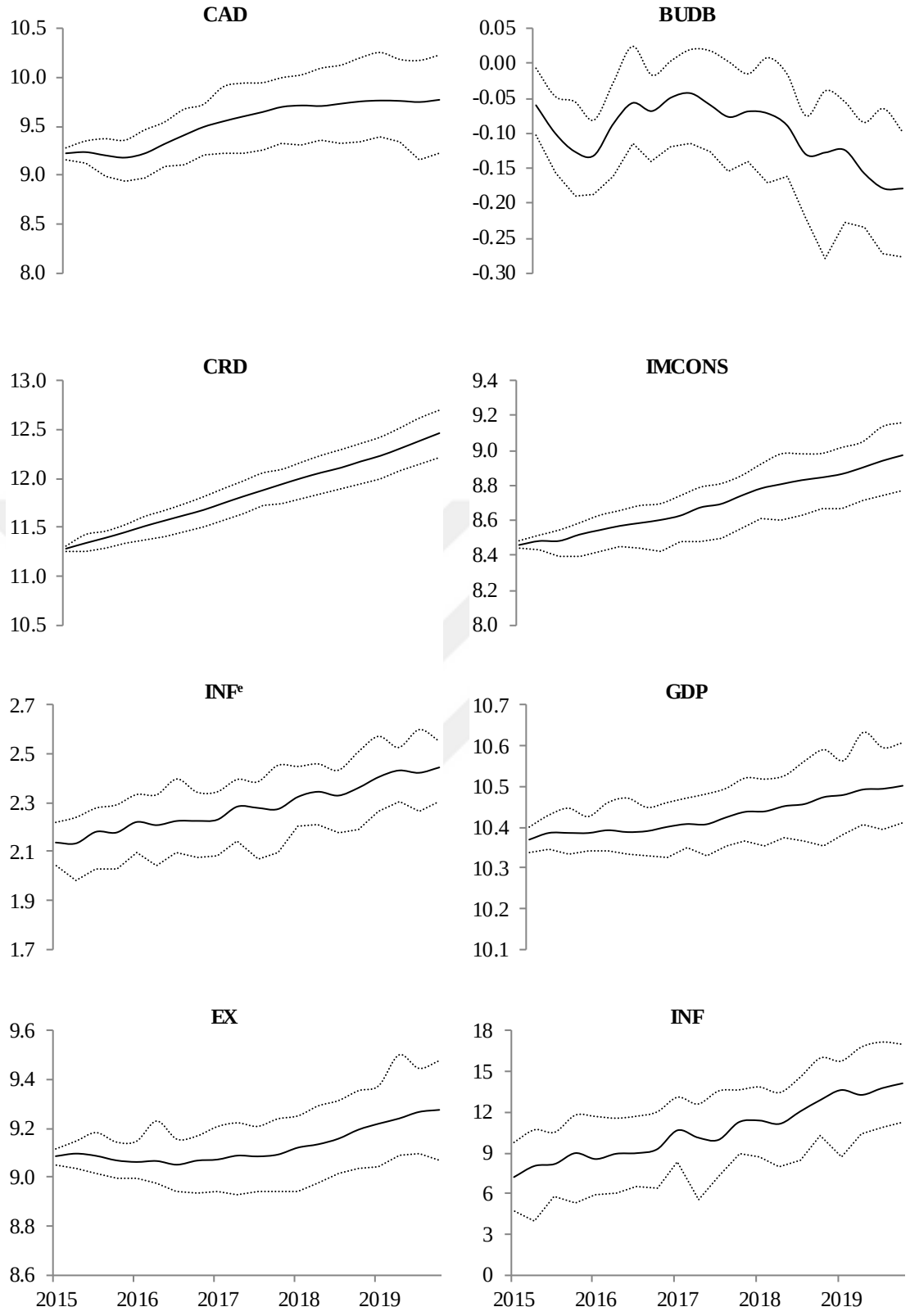


Figure 4.7 Out of sample dynamic stochastic forecast results

4.1.6 6th Scenario (forecast simulation):

In this section, results of three separate out-of-sample simulations are presented. The following assumptions about selected exogenous variable are included one-by-one to the business-as-usual scenario whereas values of all other exogenous variables equal the values in scenario 5.

- USD/TL is increased by 5% in each quarter of 2015 while it is rose by 2% annualy in each year after 2015.
- Government expenditures is increased by 5% in 2015.
- CBRT decreases the weighted average cost of funding (WACF) gradually down to 5% in 2015. Then, the WACF exhibits a steady course around 5% until the end of the period.

Figure 4.8, 4.9 and 4.10 present the results of the scenarios for selected variables. The findings of out-of-sample scenario analysis are compatible with the within-sample scenario results.

Although results of the both within sample and out-of-sample simulations verify the model consistency, there are various factors which should be determined heuristically by the practitioners in forecasting process. Selecting appropriate regimes for each equation in out-of-sample simulations is the major assumption. In addition, determining the course of key exogenous variables is also influential on forecasting process. So, forecast results are subject to high level of uncertainties that is based on idiosyncratic views and opinions. That's why assumptions on the out-of-sample simulations (regimes, exogenous variables, shocks) should be confirmed by multiple parties if the structural macroeconomic model is used on policy simulations.

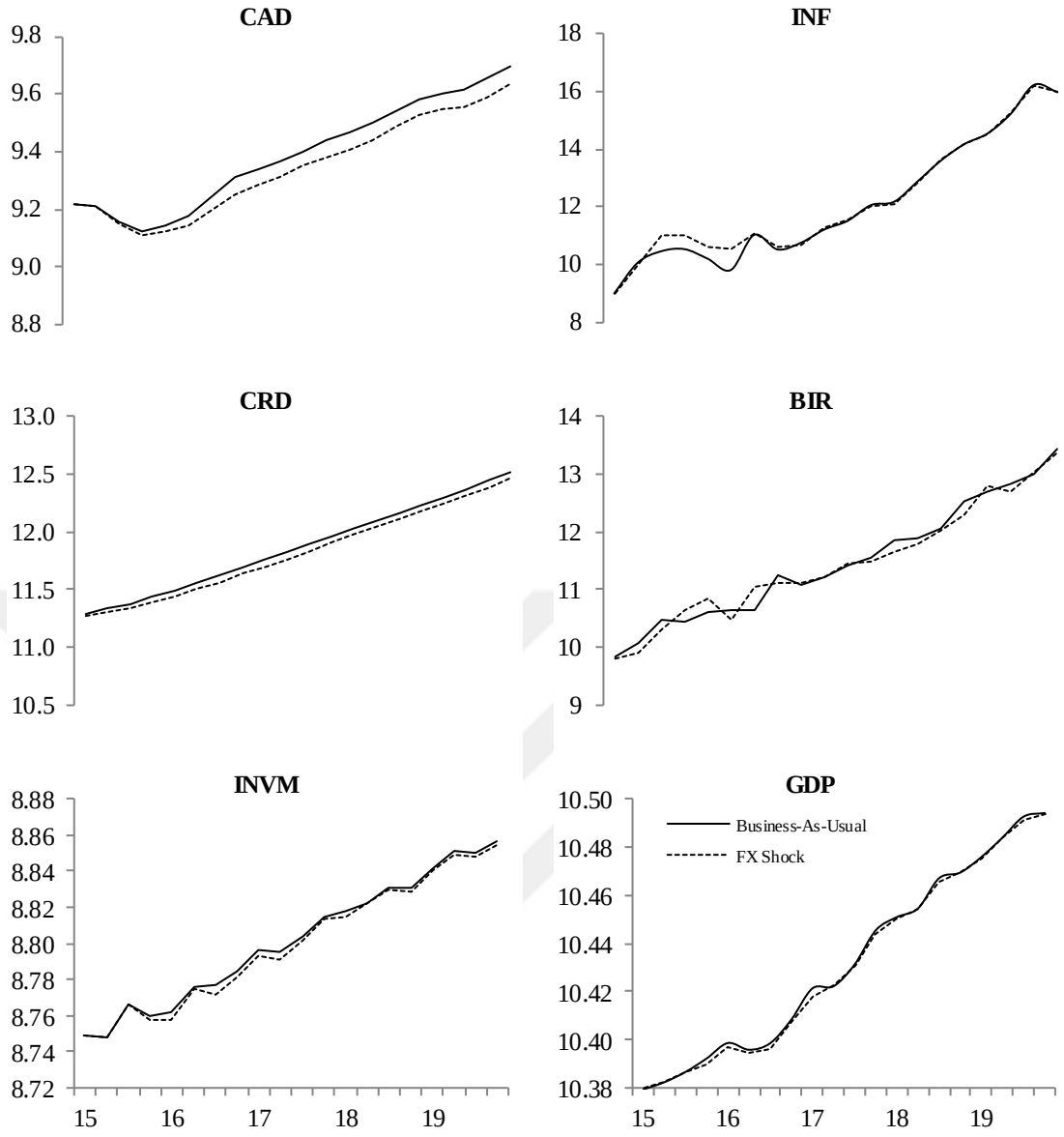


Figure 4.8 Out-of-sample FX-shock results

Increase in USD/TL reduces current account deficit while expected inflation and actual headline inflation figures are deteriorated. In addition, depreciation in TL results contraction in consumption, investment and employment. However, recovery in foreign trade figures limits the contractionary effect of the depreciation on economic growth. Aggregate effect of the depreciation in TL on GDP, on the other hand, is contractionary during 2015-2017 periods.

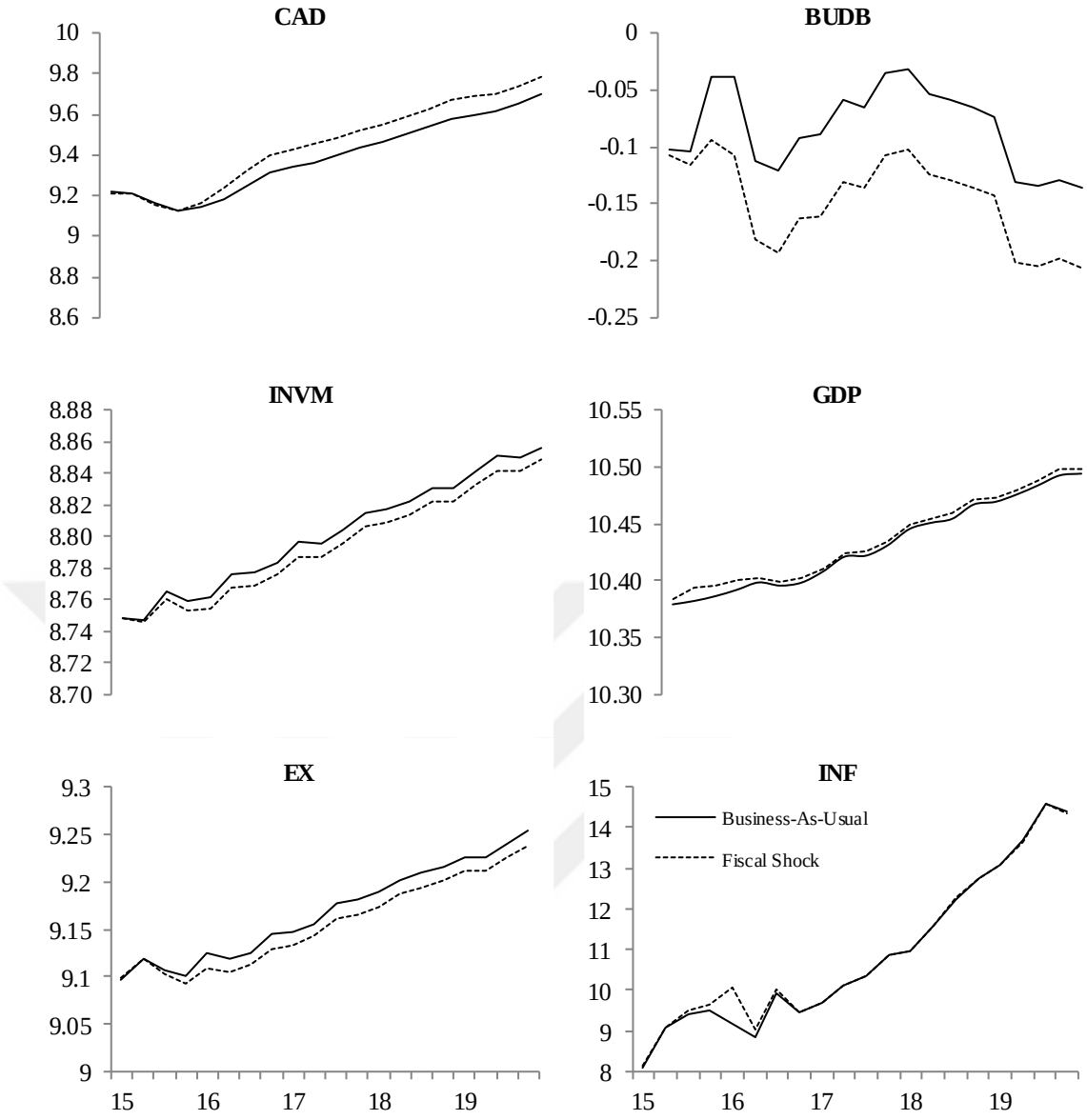


Figure 4.9 Out-of-sample fiscal policy simulation results

Results of the simulation based on the expansionary fiscal policy assumption are also remarkable. Increase in government expenditures deteriorates budget balance and leads to an upward pressure on inflation figures. In addition, it reduces total investment. Contraction in investment influences adversely export performance and current account deficit. On the other hand, expansionary fiscal policy has both direct and indirect positive effects on GDP. Recovery in employment owing to expansionary policy supports private consumption through income effect. As a result, increase in government expenditure has positive effect on GDP while it deteriorates current account deficit and inflation figures.

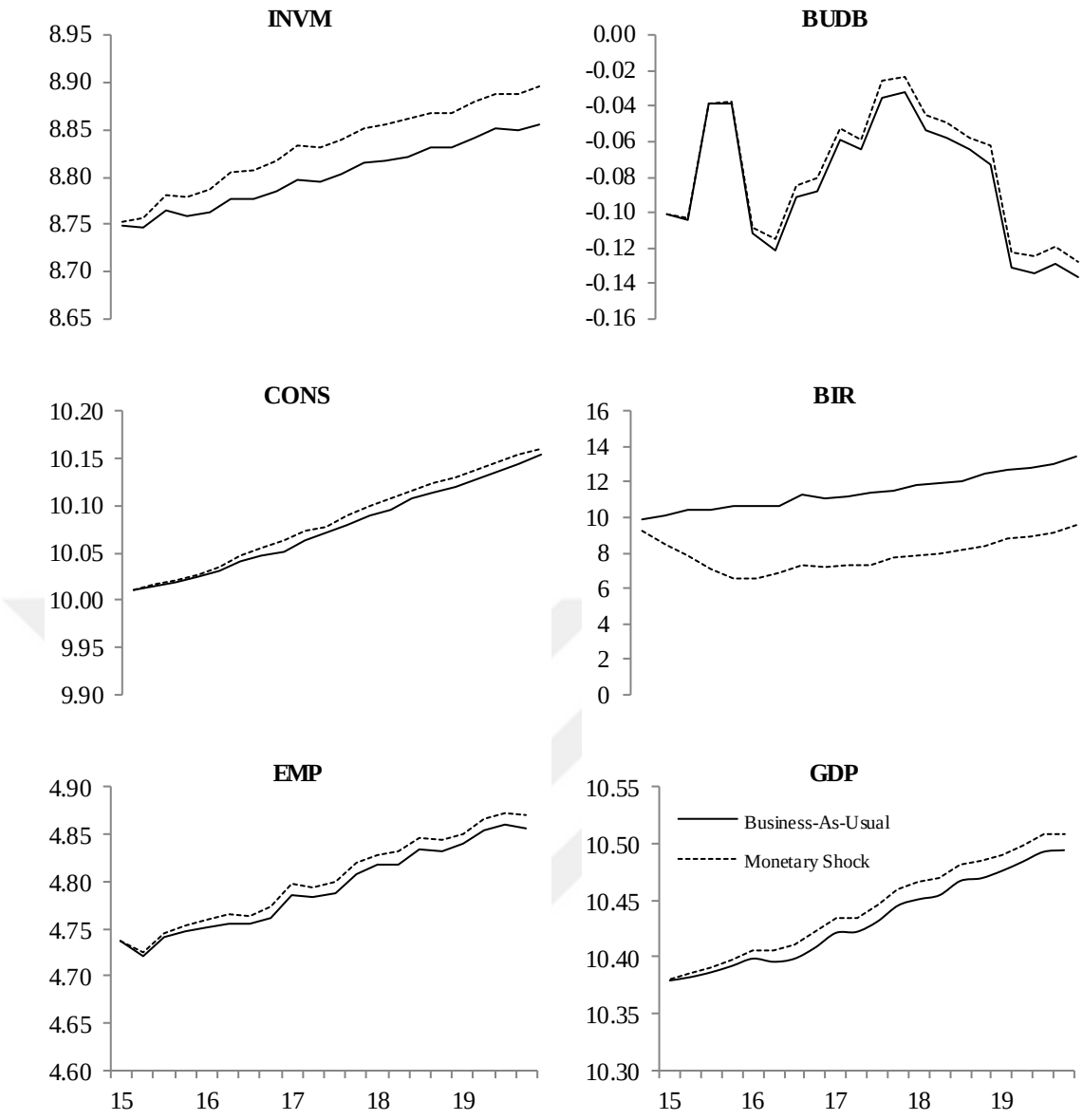


Figure 4.10 Out-of-sample loose monetary policy simulation results

The last simulation assumes that CBRT implements a loose monetary policy to support economic growth. It is obvious that inflation targeting is primary objective of CBRT. In this context, it is reasonable to assume that the CBRT's policy decision also reflects expected inflation. So, the loose monetary policy should be implemented in a deflationary conjuncture. Since the model is designed based on this assumption, CBRT's decision has downward effects on both the benchmark interest rate and expected inflation. However, decrease in interest rate reduces budget expenditures while employment recovers significantly. In addition, loose monetary policy leads to an expansion in GDP through investment and private consumption, as expected. Results of the out-of-sample simulations also verify model's consistency.

5 CONCLUSION

This thesis aims to build a small structural macroeconometric model of the Turkish economy by using quarterly data in the period between 1998 and 2014. The model consists of five blocks which are based national income identity, external trade, monetary market, labor force market and national income in terms of production approach. In the model, there are 19 behavioral and technical equations, 7 identities, and 43 variables in total. The behavioral and technical equations have been specified and estimated by using E-views software.

Within-sample forecasting performance of the model is measured by conventional tools such as root mean normalize square error and Theil coefficients, which were computed for endogenous variables in both static and dynamic simulations of the model. Test results indicate that the model is valid and verified in sample period. The policy simulations of the model are based on three sets of assumptions: FX rate shock, fiscal policy shock and monetary policy shock. The first simulation indicates the vulnerability of the economy against external shocks. The second and thirds scenarios address the importance of budget discipline and effectiveness of the monetary policy. The out-of-sample forecasting performance of the model is tested using narrow confidence intervals generated by stochastic simulations. In addition, results of the out-of-sample policy simulations are compatible with the results of the within sample policy simulations.

As a result, validity of the model is checked both within the sample and out of sample cases. Results indicate that the model is reasonably useful for forecasting and policy analysis. Scenario simulations refer that the Turkish economy is highly vulnerable to

external shocks through external trade and money market channels. Hence, a higher degree of saving should be promoted by all agents in the economy as a social responsibility via education to overcome main structural vulnerability of Turkish economy. Furthermore maintaining budget discipline is also crucial to improve its resilience against both international shocks and domestic political uncertainties.

6 REFERENCES

Akal, M. (2008). Üretim Malları İthalatı Fiyat ve Gelir Esneklikleri Tahmini: Türkiye Örneği. Kocaeli Üniversitesi Sosyal Bilimler Enstitüsü Dergisi (15) 2008/1:1-16.

Annicchiarico, B., Di Dio, F., Felici, F., & Nucci, F. (2011). Macroeconomic Modelling and the Effects of Policy Reforms: an Assessment for Italy using ITEM and QUEST. Government of the Italian Republic (Italy), Ministry of Economy and Finance, Department of the Treasury Working Paper, (1).

Arby, M. F., Malik, M. J., & Hanif, M. N. (2010). The size of informal economy in Pakistan.

Aristovnik, A. (2008). Short-term determinants of current account deficits: evidence from Eastern Europe and the former Soviet Union. Eastern European Economics, 46(1), 24-42.

Arize, A.C. (1994). Cointegration Test of a Long- Run Relation Between The Real Exchange Rate And The Trade Balance. International Economic Journal.

Avşar, H., Girici, Y. & Özatay Z. (2007).Measuring the Output Gap for Turkish Economy- A Preliminary Work (1987-2003)

Aysoy, Cem and KIPICI, Ahmet N. (2005), "A Quarterly Macroeconometric Model of the

Bagnai, A. and Ospina, C. (2007). Structural changes and the transition process: a

Bahmani-Oskooee, M. & Niroomand, F. (1998). Long-Run Price Elasticities and The Marshall-Lerner Condition.

Bai, J., & Perron, P. (1998). Estimating and testing linear models with multiple structural changes. Econometrica, 47-78.

Bandura, A. (1986). Social Foundation of Thought and Action: A Social Cognitive Theory.Prentice Hall, New Jersey, USA.

Ball, C. P., & Reyes, J. (2004). Inflation targeting or fear of floating in disguise: The case of Mexico. International Journal of Finance & Economics, 9(1), 49-69

Bardsen, G., Eitrheim Ø., E. S. Jansen & Nymoen, R. (2005). The Econometrics of Macroeconomic Modelling. Oxford: Oxford University Press.

Bayraktutan, Y., & Demirtaş, I. (2011). Gelişmekte Olan Ülkelerde Cari Açığın Belirleyicileri: Panel Veri Analizi.

Bliemel, F. (1973). Theil's forecast accuracy coefficient: A clarification. Journal of Marketing Research, 10(4), 444-446.

Blitzer, C. R., Çetin, H., & Manne, A. S. (1970). A Dynamic Five-Sector Model for Turkey, 1967-82. The American Economic Review, 60(2), 70-75.

Brillet, J. L. (2015). Macro Econometric Modelling: A Practical Approach under EViews, with a Focus on Africa.

Bulutay, T. (1967). Ekonometrik Bir Deneme: Teori ve Türk Ekonomisine Uygulama. Ankara: Siyasal Bilgiler Fakültesi.

Cagas, M. A., Ducanes, G., Magtibay-Ramos, N., Qin, D., & Quising, P. (2006). A small macroeconometric model of the Philippine economy. Economic Modelling, 23(1), 45-55.

Celasun, M. (1971). Possible economic growth in Turkey (1972–1977) Experiments with three aggregative models. Middle East Technical University, Ankara.

Celasun, M. (1986). A General Equilibrium Model of the Turkish Economy, SIMLOG-1. METU Studies in Development, 13(1-2), 29-94.

Chrystal, K. Alec & Mizen, P. (2005b). A Dynamic Model of Money, Credit, and Consumption: A Joint Model for the UK Household Sector. Journal of Money, Credit and Banking, Vol. 37, No. 1,pp. 119-143.

Coşkun Özkaramete, N. (2013). Optimal Monetary and Fiscal Policy: OPTCON Algorithm for Turkish Economy. School of Applied Management and Technology.

Current Account: The Italian Evidence", Operations Research and Decisions, 3-4, 99-111.

Çelik, S., & Kaya, H. (2010). Real exchange rates and bilateral trade dynamics of Turkey: panel cointegration approach. Applied Economics Letters, 17(8), 791-795.

Damar, A. O. (2010). Türkiye'de Döviz Kurundan Fiyatlara Geçiş Etkisinin İncelenmesi. TCMB Uzmanlık Yeterlilik Tezi.

Derviş, K. & Robinson, S. (1978). The Foreign Exchange Gap, Growth and Industrial Strategy in Turkey: 1973-1983. Washington D.C.: World Bank Staff Working Paper, No.306.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American statistical association, 74(366a), 427-431.Document no:47

Doornik, J. A., & Hendry, D. F. (2001). Modelling dynamic systems using PcGive 10. Timberlake Consutants.

Elmas, B. & Göçer, İ. (2013). Genişletilmiş Marshall-Lerner Koşulu Çerçevesinde Reel Döviz Kuru Değişimlerinin Türkiye'nin Dış Ticaret Performansına Etkileri: Çoklu Yapısal Kırılmalı Zaman Serisi Analizi. BDDK, Cilt:7, Sayı:1.

Fair, R. C. (1984). Specification, estimation, and analysis of macroeconometric models. Harvard University Press.

Felix, R. (2005). A Macroeconomic structural model for the Portuguese economy. Banco de Portugal.

Ferrucci, G., & Miralles-Cabrera, C. (2007). Saving behaviour and global imbalances: the role of emerging market economies.

Gagnon, J. E., & Ihrig, J. (2004). Monetary policy and exchange rate pass-through. International Journal of Finance & Economics, 9(4), 315-338.

Garcia, N. (2011). DSGE Macroeconomic Models: A Critique. Economie Appliquée, N01, January-March 2011, Paris. Special number on Macroeconomics. See: www.ismea.org

Garratt, A., Lee, K., Pesaran, M. H. & Shin, Y. (2006). Global and National Macroeconometric Modelling (A Long-Run Structural Approach). Oxford University Press.

Goodman, N. (1970). The New Riddle of Induction. In Readings in the Philosophy of Science, ed. by B.A. Brody. New Jersey: Prentice-Hall.

Gregory, A.W. & Hansen, B.E. (1996). Tests for Cointegration in Models with Regime and Trend Shifts. Oxford Bulletin of Economics and Statistics.

Gupta, S., & Togan, S. (1984). Who benefits from the adjustment process in developing countries? A test on India, Kenya, and Turkey. Journal of Policy Modeling, 6(1), 95-109.

Hanclova, J. (2011). A prediction of long-run macroeconomic relations and investigation of domestic shock effects in the Czech economy. Mathematical Models and Methods in Modern Science.

Hendry, D. F., & Krolzig, H. M. (2001). Automatic econometric model selection using PcGets 1.0. Timberlake Consultants.

Hervé, K., Pain, N., Richardson, P., Sédillot, F., & Beffy, P. O. (2011). The OECD's new global model. Economic Modelling, 28(1), 589-601.

Hood, W.C. & Koopmans, T. J. (1953). Studies in Econometric Method. Cowles Commission for Research in Economics. New York: John Wiley and Sons.

Hsing, Y. (2010). Test of the Marshall–Lerner condition for eight selected Asian countries and policy implications. Global Economic Review, 39(1), 91-98.

Husar, J. (2004). Foreign Trade, Devaluation and Elasticities: A Model Approach.

Imbs, J. & Méjean, I. (2010). Trade Elasticities. The National Centers of Competence in Research (NCCR).

Johansen, S. (2006). Cointegration: An Overview. In Mills, T. C. and K. Patterson (eds.), Palgrave Handbook of Econometrics, vol. 1 of Econometric Theory. Basingstoke: Palgrave-MacMillan.

Johnston, J. (1963). Econometric Methods. New York: McGraw-Hill.

Kale, P. (2001). Turkey's trade balance in the short and the long run: error correction modeling and cointegration. The International Trade Journal, 15(1), 27-56.

Kara, H. (2012). Monetary policy in Turkey after the Global Crisis (No. 1217).

Kara, H. ve Öğünç F. (2005) "Exchange Rate Pass-Through in Turkey: It is Slow, but is it Really Low?". Türkiye Cumhuriyet Merkez Bankası Arastırma Tebliği, No:10.

Kaytaz, M. & Özmucur, S. (1984). Türkiye İçin Makroekonomik Modeller. In Ord. Prof. Şükrü Baban'a Armağan. İstanbul: İstanbul İktisat Fakültesi.

Khairul, B. (2013). Achieving the vision 2030: An Indonesia macroeconomic model using system dynamics approach.. Institute Technologi Bandung. http://www.researchgate.net/publication/ 236859486.

Khan, M. and Din, M. (2011). A Dynamic macroeconometric model of Pakistan's economy.

Klein, L.R. (1956). A Textbook of Econometrics. New York: Row, Peterson and Co.

Kocherlakota, N (2007). Model fit and model selection Federal Reserve Bank of St. Louis Review, July/August.

Koopmans, T.J. (1950). Statistical Inference in Dynamic Economic Models. Cowles Commission for Research in Economics. New York: John Wiley and Sons.

Korum, U. (1969). Ekonometrik Modeller ve Türk Ekonomisi İçin Bir Deneme. Ankara: Siyasal Bilgiler Fakültesi.

Köksal, B. (1970). An Econometric Model for Turkey. Unpublished Ph.D. Thesis: New York University.

Lewis, J.D. & Urata, S. (1983). Turkey: Recent Economic Performance and Medium-Term Prospects, 1978-1990. World Bank Staff Working Paper No.602. Washington D.C. : World Bank.

Loayza, N., Schmidt-Hebbel, K., & Servén, L. (2000). What drives private saving across the world?. Review of Economics and Statistics, 82(2), 165-181.

Lucas, Robert (1976). "Econometric Policy Evaluation: A Critique". In Brunner, K.; Meltzer, A. The Phillips Curve and Labor Markets. Carnegie-Rochester Conference Series on Public Policy 1. New York: American Elsevier. pp. 19–46. ISBN 0-444-11007-0.

macroeconometric model of China. Luiss Lab of European Economics LLEE Working

Mahmud, S. F., Ullah, A., & Yucel, E. M. (2004). Testing Marshall-Lerner condition: a non-parametric approach. Applied Economics Letters, 11(4), 231-236.

Matesanz, D., & Fugarolas, G. (2009). Exchange rate policy and trade balance: a cointegration analysis of the Argentine experience since 1962. Applied Economics, 41(20), 2571-2582.

McQuinn, K., & O'Reilly, G. (2007). A model of cross-country house prices. Research Technical Paper, 5.

Miles, M.A. (1979). The Effect of Devaulation and The Trade Balance of Payment: Some Result. Journal of Political Economy.

Neck, R., & Karbuz, S. (1993). Optimal budgetary policies under uncertainty: a stochastic control approach. Fakultät für Wirtschaftswissenschaften der Universität Bielefeld.

Öğünç, F. & Ece, D. (2004). Estimating the output gap for Turkey: an unobserved components approach. Applied Economic Letters, Vol. 11, pp.177-182.

Özatay, F. (1999). Populist policies and the role of economic institutions in the performance of the Turkish economy. Yapi Kredi Economic Review, 10(1), 13-26.

Özatay, F. (2000). A Quarterly Macroeconometric Model for a Highly Inflationary and Indebted Country:Turkey. Economic Modelling, 17, 1-11.

Özatay, F. (2000). A quarterly macroeconometric model for a highly inflationary and indebted country: Turkey. Economic Modelling, 17(1), 1-11.

Özatay, F. (2007, December). Expansionary fiscal contactions: new evidence from Turkey. In Economic Research Forum 14th Annual Conference, Cairo, Egypt.

Özdemir, K.A. & Turner, P. (2005). A Monetary Disequilibrium Model for Turkey: Investigation of a Disinflationary Fiscal Rule and its Implications on Monetary Policy. CBRT Working Papers, No: 05/07.

Özmucur, S. (1980). Türkiye'nin Ekonometrik Modeli:1950-1974. İstanbul: Boğaziçi Üniversitesi.

Özmucur, S. (1984). Türk Ekonomisi Tahmin Modeli. İstanbul Türk Sanayicileri ve İşadamları Derneği.

Özmucur, S. (1986). An Econometric Model For Turkey: 1965-1984. İstanbul: Turkish Industrialists and Businessmen's Association.

ÖZMUCUR, S. (1993). Girdi/Çıktı Tablolarından Elde Edilen Faktör Gelirlerinin Dağılımı. Maliye Araştırma Merkezi Konferansları, (35).

Pakistan Institute of Development Economics Working Papers 2011:69

Pescatori A. & Zaman S. (2011). Macroeconomic Models, Forecasting, and Policymaking Economic Commentary. Number 2011-19 Oct. 5, 2011

Pesaran, M. H. & Shin, Y. (2002). Long-Run Structural Modelling. Econometric Reviews, Vol.21, pp. 49-87.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. Biometrika, 75(2), 335-346

Reis Gomes*, F. A., & Senne Paz, L. (2005). Can real exchange rate devaluation improve the trade balance? The 1990–1998 Brazilian case. Applied Economics Letters, 12(9), 525-528.

Reiss, P. C., & Wolak, F. A. (2007). Structural econometric modeling: Rationales and examples from industrial organization. Handbook of econometrics, 6, 4277-4415.

Rossi, M. M., & Leigh, M. D. (2002). Exchange rate pass-through in Turkey (No. 2-204). International Monetary Fund.

Sarıkaya, Ç., Öğünç F., Ece D., Kara H. & Özlale Ü. (2005). Estimating Output Gap for the Turkish Economy. Central Bank of the Republic of Turkey.

Sastre, L. (2012). Simultaneity between export and import flows and the Marshall–Lerner condition. Economic Modelling, 29(3), 879-883.

Saygılı, Ş., Cihan, C., & Yurtoğlu, H. (2005). Türkiye ekonomisinde sermaye birikimi, verimlilik ve büyüme (1972-2003): uluslararası karşılaştırma ve AB'ye yakınsama süreci (2014) (Vol. 6). TÜSİAD.

Senesen, G. G. (2005). The production structure of Turkey: the main results via Input-Output model. TUSİAD Series of Development Strategies, (3).

Sims, C (1980): "Macroeconomics and reality", Econometrica, Vol. 48, No. 1, pp. 1-48, January.

Sims, C (2008a): "Improving monetary policy models", Journal of Economic Dynamics and Control, forthcoming.

Soleymani, A., & Chua, S. Y. (2014). Effect of exchange rate volatility on industry trade flows between Malaysia and China. The Journal of International Trade & Economic Development, 23(5), 626-655.

Stavytskyy, A., & Martynovych, D. (2012). The econometric modelling of Ukrainian macroeconomic tendencies. Ekonomika, 91(1), 79.

Stock, J. & Watson, M. W. (1993). A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems. Econometrica.

Şenesen, Ü. (1986). Türkiye Ekonomisi İçin Bir Ekonometrik Model Denemesi. İstanbul: İstanbul Ticaret Odası.

Şimşek, M. & Kadılar, C. (2005). Türkiye'nin İhracat Talebi Fonksiyonunun Sınır Testi Yöntemi ile Eş-bütünleşme Analizi. Doğuş Üniversitesi Dergisi, 6 (1):144-152.

Tagliabue, G. (2005), "Co-Integrating Relationship Between Terms of Trade, Money And

Tansel, A., & Kan, E. O. (2012). Labor mobility across the formal/informal divide in Turkey: Evidence from individual level data. Informal Divide in Turkey: Evidence from Individual Level Data (December 21, 2012).

Taylor, J. B. (2000). Reassessing discretionary fiscal policy. The Journal of Economic Perspectives, 14(3), 21-36.

Tinbergen, J. (1951). Econometrics. New York: The Blakiston Co.

Tintner, G. (1952). Econometrics. New York: John Wiley and Sons.

Togan, S. (1983). A Macroeconometric Model of The Turkish Economy-A Comment. METU Studies in Development, 10(3), 323-8.

Tovar, C. E. (2009). DSGE models and central banks. Economics: The Open-Access, Open-Assessment E-Journal, 3.

Turkish Economy",Central Bank Review, vol. 5-2, p.p. 39-71.

Uğurel, İ. (1971). A Macroeconomic Model For Turkey: 1949-1967. Barcelona: Paper Presented at the European Meeting of the Econometric Society.

Uğurel, İ. (1971). A Macroeconomic Model For Turkey: 1949-1967. In European Meeting of the Econometric Society, Barcelona, Semptember.

Uygur, E. & Bulutay, T. (2004). The Experience of Econometric Model Building For The Turkish Economy:1960-1986. Turkish Economic Association Discussion Paper, 2001/12. http://www.tek.org.tr

Uygur, E. (1983). Makroekonometrik Modeller İktisat Politikası Uygulamasına Yardımcı Olabilir mi? Siyasal Bilgiler Fakültesi Dergisi, 37(1-4), 1-18.

Uygur, E. (1987). Econometric Model of the Turkish Economy. Ankara: SESRTCIC (Social Research and Training Centre for Islamic Countries).

Valavanis, S. (1959). Econometrics. New York: McGraw-Hill.

Welfens, P. J. (2012). Marshall-Lerner condition and economic globalization. International Economics and Economic Policy, 9(2), 191-207.

Wilson, P. (2001). Exchange rates and the trade balance for dynamic Asian economies—does the J-curve exist for Singapore, Malaysia, and Korea?. Open economies review, 12(4), 389-413.

Yağcı, F. (1982). Türk Ekonomisi İçin Ekonometrik Bir Model Çalışması: TEM1. İstanbul: Türkiye Sınai Kalkınma Bankası.

Yağcı, F. (1983). A Macroeconometric Model of The Turkish Economy. METU Studies in Development, 10(1), 1-44.

Yazici, M., & Ahmad Klasra, M. (2010). Import-content of exports and J-curve effect. Applied Economics, 42(6), 769-776.

Yeldan, A. E. (1989). Structural adjustment and Trade in Turkey: Investigating the alternatives "beyond export-led growth". Journal of Policy Modeling, 11(2), 273-296.

Yörükoğlu, T.K. (1980). Türkiye Ekonomisinin Kısa Dönemli Yönetimi: Maliye ve Para Politikaları Üzerine Bir Deneme. Unpublished Thesis: Istanbul University.

References in Appendices

Andrews, D. W., & Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. Econometrica: Journal of the Econometric Society, 1383-1414.

Andrews, D. W. (1993). Tests for parameter instability and structural change with unknown change point. Econometrica: Journal of the Econometric Society, 821-856.

Diebold, F. X., Lee, J. H., & Weinbach, G. C. (1994). Regime switching with time-varying transition probabilities. Business Cycles: Durations, Dynamics, and Forecasting, 144-165.

Dolado, J. J., Gonzalo, J., & Marmol, F. (2001). Cointegration. A Companion to Theoretical Econometrics, 634-654.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, 251-276.

Filardo, A. J. (1994). Business-cycle phases and their transitional dynamics.Journal of Business & Economic Statistics, 12(3), 299-308.

Gómez, V., & Maravall, A. (1995). Programs Tramo and seats.

Granger, C. W., & Newbold, P. (1974). Spurious regressions in econometrics.Journal of econometrics, 2(2), 111-120.

Granger, C. W. J., & Lee, T. H. (1989). Investigation of production, sales and inventory relationships using multicointegration and non-symmetric error correction models. Journal of applied econometrics, 4(S1), S145-S159.

Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. Econometrica: Journal of the Econometric Society, 357-384.

Hamilton, J. D. (1994). Time series analysis (Vol. 2). Princeton: Princeton university press.

Hansen, B. E. (1992). Heteroskedastic cointegration. Journal of Econometrics,54(1), 139-158.

Hylleberg, S. (1992). Modelling seasonality. Oxford University Press.

Inder, B. (1993). Estimating long-run relationships in economics: a comparison of different approaches. Journal of econometrics, 57(1), 53-68.

Nelson, C. R., & Plosser, C. R. (1982). Trends and random walks in macroeconmic time series: some evidence and implications. Journal of monetary economics, 10(2), 139-162.

Phillips, P. C., & Loretan, M. (1991). Estimating long-run economic equilibria.The Review of Economic Studies, 58(3), 407-436.

Quandt, R. E. (1960). Tests of the hypothesis that a linear regression system obeys two separate regimes. Journal of the American statistical Association,55(290), 324-330.

Saikkonen, P. (1991). Asymptotically efficient estimation of cointegration regressions. Econometric theory, 7(01), 1-21.

Stock, J. H., & Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. Econometrica: Journal of the Econometric Society, 783-820.

Wooldridge, Jeffrey M. (2000). Introductory Econometrics: A Modern Approach. Cincinnati, OH: South-Western College Publishing.

7 APPENDICES

7.1 Technical Details

All econometric tests and model are constructed in E-views version 7.0 and 8.0. So, technical details for tests and estimation techniques are retrieved from the references which are presented on the E-views' official documents.

7.1.1 Variance Inflation Factor (VIF)

VIF and Tolerance are two measures that can guide a researcher in identifying multicollinearity. Before developing the concepts, it should be noted that the variance of the OLS estimator for a typical regression coefficient (say β_i) can be shown to be the following[6].

$$Var(\hat{\beta}_i) = \frac{\sigma^2}{S_{ii}(1 - R_i^2)}$$

where $S_{ii} = \sum_{j=1}^{n}(X_{ij} - \bar{X}_i)^2$ and R_i^2 is the unadjusted R^2 when you regress X_i against all the other explanatory variables in the model, that is, against a constant, X_2, X_3, ..., X_{i-1}, X_{i+1}, ..., X_k. Suppose there is no linear relation between X_i and the other explanatory variables in the model. Then, R_i^2 will be zero and the variance of $\hat{\beta}_i$ will be σ^2/S_{ii}. Dividing this into the above expression for $Var(\hat{\beta}_i)$, we obtain the variance inflation factor and tolerance as

[6] See Wooldridge (2000), Chapter 3 appendix for proof.

$$VIF(\hat{\beta}_i) = \frac{1}{(1 - R_i^2)}$$

$$\text{Tolerance}(\hat{\beta}_i) = 1/VIF = 1 - R_i^2$$

It is readily seen that the higher VIF or the lower the tolerance index, the higher the variance of $\hat{\beta}_i$ and the greater the chance of finding β_i insignificant, which means that severe MC effects are present. Thus, these measures can be useful in identifying MC. The procedure is to choose each right hand side variable (that is, explanatory variable) as the dependent variable and regress it against a constant and the remaining explanatory variables. We would thus get $k - 1$ values for VIF. If any of them is high, then MC is indicated. Unfortunately, however, there is no theoretical way to say what the threshold value should be to judge that VIF is "high." Also, there is no theory that tells you what to do if MC is found.

7.1.2 The Lagrange Multiplier Test

The LM statistic is useful in identifying serial correlation not only of the first order but of higher orders as well. Here we confine ourselves to the first-order case. The general case of AR(p) is discussed later.

$$y_t = \beta_0 + \beta_1 x_{t1} + \beta_2 x_{t2} + \cdots + \beta_k x_{tk} + \rho \varepsilon_{t-1} + u_t$$

The test for ρ = 0 can be treated as the LM test for the addition of the variable ε_{t-1} (which is unknown, and hence one would use e_{t-1} instead).

1. Estimate the regression model by OLS and compute its estimated residuals, e_t.
2. Regress e_t against a constant, x_{t1}, ..., x_{tk} and e_{t-1}, using the $T - 1$ observations 2 through T. Then the LM statistic can be calculated by $(T - 1)R_e^2$, where R_e^2 is the R-squared from the auxiliary regression. $T - 1$ is used because the efficient number of observations is $T - 1$.
3. Reject the null hypothesis of zero autocorrelation in favor of the alternative that $\rho \neq 0$ if $(T - 1)R_e^2 > \chi^2_{1,(1-a)}$, the value of χ_1^2 in the chi-square distribution with 1 d.f. such that the area to the right of it is 1 − α, and α is the significance level.

7.1.3 Switching Regression

Suppose that the random variable of interest, y_t follows a process that depends on the value of an unobserved discrete state variable s_t. We assume there are M possible regimes, and we are said to be in state or regime m in period t when $s_t = m$, for $m = 1, \dots, M$.

The switching model assumes that there is a different regression model associated with each regime. Given regressors X_t and Z_t, the conditional mean of y_t in regime m is assumed to be the linear specification:

$$\mu_t(m) = X_t'\beta_m + Z_t'\gamma \tag{1}$$

Where β_m and γ are k_X and k_Z vectors of coefficients. Note that the β_m coefficients for X_t are indexed by regime and that the γ coefficients associated with Z_t are regime invariant.

Lastly, we assume that the regression errors are normally distributed with variance that may depend on the regime. Then we have the model:

$$y_t = \mu_t(m) + \sigma(m)\epsilon_t \tag{2}$$

When $s_t = m$, where ϵ_t is iid standard normally distributed. Note that the standard deviation σ may be regime dependent, $\sigma(m) = \sigma_m$.

The likelihood contribution for a given observation may be formed by weighting the density function in each of the regimes by the one-step ahead probability of being in that regime:

$$L_t(\beta, \gamma, \sigma, \delta) = \sum_{m=1}^{M} \frac{1}{\sigma_m} \phi\left(\frac{y_t - \mu_t(m)}{\sigma(m)}\right) . P(s_t = m | \Im_{t-1}, \delta) \tag{3}$$

$\beta = (\beta_1, \dots, \beta_M)$, $\sigma = (\sigma_1, \dots, \sigma_M)$, δ are parameters that determine the regime probabilities, $\phi(.)$ is the standard normal density function, and $\Im_{t-1}$ is the information set in period $t-1$. In the simplest case, the δ represent the regime probabilities themselves.

The full log-likelihood is a normal mixture

$$l(\beta, \gamma, \sigma, \delta) = \sum_{t=1}^{T} \log\left\{\sum_{m=1}^{M} \frac{1}{\sigma_m} \phi\left(\frac{y_t - \mu_t(m)}{\sigma(m)}\right) . P(s_t = m | \Im_{t-1}, \delta)\right\} \tag{4}$$

which may be maximized with respect to $(\beta, \gamma, \sigma, \delta)$.

7.1.3.1 Simple Switching

To this point, we have treated the regime probabilities $P(s_t = m|\Im_{t-1}, \delta)$ in an abstract fashion. This section considers a simple switching model featuring independent regime probabilities. We begin by focusing on the specification of the regime probabilities, then describe likelihood evaluation and estimation of those probabilities.

It should be emphasized that the following discussion is valid only for specifications with uncorrelated errors.

In the case where the probabilities are constant values, we could simply treat them as additional parameters in the likelihood in Equation (4). More generally, we may allow for varying probabilities by assuming that p_m is a function of vectors of exogenous observables G_{t-1} and coefficients δ parameterized using a multinomial logit specification:

$$P(s_t = m|\Im_{t-1}, \delta) \equiv p_m(G_{t-1}, \delta) = \frac{\exp(G'_{t-1}\delta_m)}{\sum_{j=1}^{M} \exp(G'_{t-1}\delta_j)} \quad (5)$$

For $\delta = (\delta_1, \delta_2, \dots, \delta_M)$ with the identifying normalization $\delta_M = 0$. The special case of constant probabilities is handled by choosing G_{t-1} to be identically equal to 1.

7.1.3.2 Markov Switching

The Markov switching regression model extends the simple exogenous probability framework by specifying a first-order Markov process for the regime probabilities. We begin by describing the regime probability specification, then discuss likelihood computation, filtering, and smoothing.

The first-order Markov assumption requires that the probability of being in a regime depends on the previous state, so that

$$P(s_t = j|s_{t-1} = i) = p_{ij}(t) \quad (9)$$

Typically, these probabilities are assumed to be time-invariant so that $p_{ij}(t) = p_{ij}$ for all t, but this restriction is not required.

We may write these probabilities in a transition matrix

$$p(t) = \begin{bmatrix} p_{11}(t) & \cdots & p_{1M}(t) \\ \vdots & \ddots & \vdots \\ p_{M1}(t) & \cdots & p_{MM}(t) \end{bmatrix} \tag{10}$$

where the ij -th element represents the probability of transitioning from regime i in period $t-1$ to regime j in period t. (Note that some authors use the transpose of $p(t)$ so that all of their indices are reversed from those used here.)

As in the simple switching model, we may parameterize the probabilities in terms of a multinomial logit. Note that since each row of the transition matrix specifies a full set of conditional probabilities, we define a separate multinomial specification for each row i of the matrix

$$p_{ij}(G_{t-1}, \delta_i) = \frac{\exp(G'_{t-1}\delta_{ij})}{\sum_{s=1}^{M} \exp(G'_{t-1}\delta_{is})} \tag{11}$$

for $j = 1, \ldots, M$ and $i = 1, \ldots, M$ with the normalizations $\delta_{iM} = 0$.

As noted earlier, Markov switching models are generally specified with constant probabilities so that G_{t-1} contains only a constant. Hamilton's (1989) model of GDP is a notable example of a constant transition probability specification. Alternately, Diebold, Lee, and Weinbach (1994), and Filardo (1994) adopt two-state models that employ time-varying logistic parameterized probabilities.

7.1.4 Unit root tests, Cointegration and Cointegration Regression Methods

A series is said to be stationary if the mean and autocovariances of the series do not depend on time. A well-known example of a nonstationary series is the random walk;

$$\gamma_t = \gamma_{t-1} + \varepsilon_t$$

where ε is a random disturbance term. So variance of the series is rising over time. So the random walk is a difference stationary series because the first difference γ of is stationary:

$$\gamma_t - \gamma_{t-1} = (1 - L)\,\gamma_{t-1} = \varepsilon_t$$

A difference stationary series is said to be integrated and is denoted as I(d) where d is the order of integration. The order of integration can be defined as the number of differencing operations to make the series stationary.

Stationarity problems were ignored in applied works until famous papers by Granger and Newbold (1974) and Nelson and Plosser (1982) alerted many to the econometric implications of non-stationarity and the dangers of running nonsense or spurious regressions (Granger, 1999). Granger (1981), tried to solve the problem by indicating that a vector of variables, (all are stationary after differencing), could have linear combinations which are stationary in levels. Later, Engle and Granger (1987) were the first to formalize the idea of integrated variables sharing an equilibrium relation which turned out to be either stationary or have a lower degree of integration than the original series. "They denoted this property by cointegration, signifying co-movements among trending variables which could be exploited to test for the existence of equilibrium relationships within a fully dynamic specification framework" (Dolado, Gonzalo and Marmol. 1999).

The variables which are used in an econometrics analysis needed to be stationary since the majority of econometric theory is based on the assumption of stationarity. So it is crucial to determine whether the series are stationary or not before using them in an econometric analysis. There are numerous method to check a series' stationarity in literature. Since, Augmented Dickey Fuller (ADF) test is mostly used in thesis, only theoretical framework of the test is described below.

Considering a simple AR(1) process:

$$(1) \qquad \gamma_t = \rho\gamma_{t-1} + \theta x_t + \varepsilon_t$$

Where x_t is a regressor which is optional and it may consist of constant or trend or both, ε_t is assumed a white noise. So if $|\rho| \geq 1, \gamma$ is a non-stationary series which means variance approaches infinity with time. On the other hand, if $|\rho| \leq 1, \gamma$ is a stationary series. Thus, the hypothesis of stationarity can be evaluated by testing whether the absolute value of $|\rho|$ is strictly less than one. So null hypothesis in a standard Dickey-Fuller (DF) test is $H_0: \rho = 1$ against the one-sided alternative $H_1: \rho \leq 1$

The standard DF test is fulfilled by estimating equation (1) after subtracting γ_{t-1} from both sides of the equation:

$$(2) \qquad \Delta\gamma_t = \beta\gamma_{t-1} + \theta x_t + \varepsilon_t$$

Where $\beta = \rho - 1$. So null and alternative hypotheses may be defined as $H_0: \beta = 0$ and $H_1: \beta \leq 0$. Value of the test statistics for β:

$$(3) \qquad \phi_\beta = \hat{\beta}/(\psi_\beta)$$

Where $\hat{\beta}$ is the estimate of β, ψ_β is the coefficient standard error. The simple Dickey-Fuller unit root test is valid only if the series is an AR(1) process. If the series is correlated at higher order lags, the assumption of white noise disturbances ε_t is violated. However, the Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the γ series follows an AR(ρ) process and adding ρ lagged difference terms of the dependent variable to the right-hand side of the test regression:

$$(4) \qquad \Delta\gamma_t = \beta\gamma_{t-1} + \theta x_t + \beta_1\Delta\gamma_{t-1} + \beta_2\Delta\gamma_{t-2} + \ldots + \beta_\rho\Delta\gamma_{t-\rho} + \upsilon_t$$

Where $\beta = \rho - 1$. So null and alternative hypotheses may be defined as $H_0: \beta = 0$ and $H_1: \beta \leq 0$. Value of the test statistics for β:

$$(5) \qquad \phi_\beta = \hat{\beta}/(\psi_\beta)$$

Engle and Granger (1987) pointed out that if a linear combination of two or more non-stationary series is stationary, the non-stationary time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and usually is interpreted as a long-run equilibrium relationship among the variables.

Consider now two time series y_{1t} and y_{2t} which are both *I*(*d*) (i.e., they have compatible long-run properties). In general, any linear combination of y_{1t} and y_{2t} will be also *I*(*d*). However, if there exists a vector (1, β)' , such that the linear combination;

$$(6) \qquad z_t = y_{1t} - \alpha - \beta y_{2t}$$

is *I*(*d* -*b*), *d* ≥*b* >0, then, following Engle and Granger (1987), y_{1t} and y_{2t} are defined as cointegrated of order (*d* , *b*), denoted $y_t = (y_{1t}, y_{2t})' \sim CI(d, b)$, with (1, -β)'

called the cointegrating vector (Dolado, Gonzalo and Marmol. 1999).

It is important to note that the cointegrating vector is not unique, since for any nonzero value of γ, $(\gamma, -\gamma\beta)$' is also a cointegrating vector. γ=1 has been chosen in (3) as a

normalization rule. Another important issue of cointegration is that all variables must be integrated of the same order to be candidates to form a cointegrating relationship. However there are extensions of the concept of cointegration, called *multicointegration*, when the number of variables considered is larger than two and where the possibility of having variables with different order of integration can be addressed (see, e.g., Granger and Lee, 1989). Most of the cointegration works examine the case where variables have a single unit root, since few economic variables prove in practice to be integrated of higher order. If variables have a strong seasonal component, however, there may be unit roots at the seasonal frequencies.

CI(1,1) variables, so that z_t in (3) is *I*(0) and the concept of cointegration mimics the existence of a long-run equilibrium to which the system converges over time. If, e.g., economic theory suggests the following long-run relationship between y_{1t} and y_{2t}:

$$(7) \quad y_{1t} = \alpha + \beta y_{2t}$$

then z_t can be interpreted as the equilibrium error (i.e., the distance that the system is away from the equilibrium at any point in time). Note that a constant term has been included in (1) in order to allow for the possibility that z_t may have non-zero mean. At this stage, it is important to point out that *C1(1 1)* variables must share a set of stochastic trends. Using the example in (1), since y_{1t} and y_{2t}: are *I(1)* variables, they can be decomposed into an *I(1)* component (say, a random walk) plus an irregular I(0) component (not necessarily white noise). Denoting the first components by μ_{it} and the second components by u_{it} ,$i = 1,2$ we can write:

$$(8) \quad y_{1t} = \mu_{1t} \text{-} u_{1t}$$

$$(9) \quad y_{2t} = \mu_{2t} \text{-} u_{2t}$$

In other words, if y_{1t} and y_{2t} *CI(1, 1)* variables, they must share (up to a scalar) the same stochastic trend, say μ_t , denoted as *common trend*, so that $\mu_t = \mu_{1t}$ and $\beta\mu_t = \mu_{2t} 2t$ (Dolado, Gonzalo and Marmol. 1999).

In this thesis VAR-based Johansen Cointegration Test which is developed in Johansen (1991,1995) is performed to evaluate cointegration relation between macroeconomic variables. Condiser a VAR of order ρ to perform a Johansen Cointegration Test;

$$(10) \quad \gamma_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} \dots \beta_\rho y_{t-\rho} + \theta x_t + \varepsilon_t$$

Suppose γ_t is a *k*-vector of non stationary *I(1)* variables, x_t is a *s*-vector of deterministic variables, ε_t is the error term. Thus *(7)* may be rewritten as;

$$(11) \quad \Delta\gamma_t = \pi\gamma_{t-1} + \sum_{i=1}^{\rho-1} \tau_i \Delta\gamma_{t-i} + \theta x_t + \varepsilon_t$$

Where:

$$(12) \quad \pi = \sum_{i=1}^{\rho} \beta_i - I \qquad\qquad \tau_{\text{i}} = -\sum_{J=1}^{\rho} \beta_i$$

According to Granger's representation theorem, if the coefficient matrix(π) has reduced rank *s<k*, then one can assert that *k x s* matrices α and φ each with rank *s* such that $\pi = \alpha\varphi'$ and $\varphi'\gamma_t$ is *I(0)*. *s* is the number of cointegrating relations and each column of the *s* may defined as the cointegrating vector. α is known as the adjustment parameters in the VEC model. Johansen's method is to estimate the π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of π.

So far it is shown that a linear combination of two or more series which have same integration orders are cointegrated. So suppose that the n+1 dimensional time series vector process (γ_t, x_t') , with cointegrating equation

$$(13) \quad \gamma_t = x_t'\beta + D_{1t}'\varphi_1 + u_{1t}$$

Where $D_t = (D_{1t}', D_{2t}')'$ are deterministic trend regressors and:

$$(14) \quad x_t = \tau_{21}' D_{1t} + \tau_{22}' D_{2t} + \varepsilon_{2t}$$

$$(15) \quad \Delta\varepsilon_{2t} = u_{2t}$$

Thus, D_{1t}', regressors enter into both the cointegrating equation and the regressors equations, while the D_{2t}' are deterministic trend regressors which are included in the regressors equations but excluded from the cointegrating equation.

Following Hansen (1992), one can assume that the innovations $u_t = (u_{1t}, u_{2t}')'$ are strictly stationary and ergodic with zero mean, contemporaneous covariance matrix Σ, one-sided long-run covariance matrix Λ, and covariance matrix Ω.

$$(16) \quad \Sigma = \mathrm{E}(u_t, u_t') = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \Sigma_{22} \end{bmatrix}$$

$$(17) \quad \Lambda = \sum_{j=0}^{\infty} \mathrm{E}\left(u_t, u'_{t-j}\right) = \begin{bmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \Lambda_{22} \end{bmatrix}$$

$$(18) \quad \Omega = \sum_{j=-\infty}^{\infty} \mathrm{E}\left(u_t, u'_{t-j}\right) = \begin{bmatrix} \omega_{11} & \omega_{12} \\ \omega_{21} & \Omega_{22} \end{bmatrix} = \Lambda + \Lambda' - \Sigma$$

the assumptions imply that the elements of γ_t and x_t are *I(1)* and cointegrated but exclude both cointegration amongst the elements of x_t and multicointegration.

If the series are cointegrated, ordinary least squares estimation of the cointegrating vector β in Equation *(13)* is consistent (Hamilton 1994). However, the OLS estimates have an asymptotic distribution which is usually non-Gaussian, has asymptotic bias and asymmetry. Hence ordinary procedures are not valid without a substantial modification. In this content OLS is generally not recommended to analyze cointegrated vectors.

The shortcoming of OLS stems the presence of long-run correlation between the cointegrating equation errors and regressor innovations, and cross-correlation between the cointegrating equation errors and the regressors. Although rarely seen, if x'_t are strictly exogenous regressors the bias, asymmetry, and dependence on non-scalar nuisance parameters vanish.

Phillips and Hansen (1990) recommend a semi-parametric correction for the estimator to cope with the problems caused by the long run correlation between the cointegrating equation and stochastic regressors innovations. The resulting Fully Modified OLS (FMOLS) estimator is asymptotically unbiased and has fully efficient.

The FMOLS estimator provides preliminary estimates of the symmetric and one-sided longrun covariance matrices of the residuals. Let $\hat{u}_{1t}$ be the residuals obtained after estimating Equation *(13)* and $\hat{u}_{2t}$ can be derived indirectly as $\hat{u}_{2t} = \Delta\hat{\varepsilon}_{2t}$ from Equation *(14)*. Let $\widehat{\Omega}$ and $\widehat{\Lambda}$ be long run covariance matrices computed by using the residuals $\hat{u}_t = (\hat{u}'_{1t}, u'_{2t})'$. Hence one can define the modified the equation as;

$$(19) \quad \gamma_t^+ = \gamma_t - \widehat{\omega}_{12}\widehat{\Omega}_{22}^{-1}\hat{u}_2$$

and estimated bias correction term

$$(20) \quad \lambda_{12}^+ = \hat{\lambda}_{12} - \widehat{\omega}_{12}\widehat{\Omega}_{22}^{-1}\widehat{\Lambda}_{22}$$

The FM-OLS estimator;

$$(21) \qquad \hat{\phi} = \begin{bmatrix} \hat{\beta}_1 \\ \hat{\varphi}_1 \end{bmatrix} = (\sum_{t=1}^{T} Z_t \, Z_t')^{-1})(\sum_{t=1}^{T} Z_t \, \gamma_t^{+} - T \begin{bmatrix} \hat{\lambda}_{12}{}^{+} \\ 0 \end{bmatrix})$$

where $Z_t = (x_t', D_t')'$.

Another attempt to estimate alternative cointegrating regressions was adding dynamic components (in the form of lags, leads or differences) to avoid the bias (for details, see Inder (1993), Phillips and Loretan (1991), Saikkonen (1991), Stock and Watson (1993). The method, Dynamic OLS (DOLS), propose that augmenting the cointegrating regression with lags and leads of Δx_t, result in orthogonal error term of cointegrating equation:

$$(22) \qquad \gamma_t = x_t'\beta + D_{1t}'\varphi_1 + \sum_{j=-q}^{r} \Delta x_{t+j}'\delta + \upsilon_{1t}$$

Adding q lags and r leads of the differenced regressors is expected to eliminate all of the long-run correlation between u_{1t} and u_{2t}, least-squares estimates of using Equation *(22)* have the same asymptotic distribution as those obtained from FM-OLS.

7.1.5 Seasonal Adjustment

Seasonality is defined as movements observed in time series, that repeat throughout the year, at given time points each year, with similar intensity in the same season. It can be observed in time series whose occurrence frequency is higher than once in a year.

According to Hylleberg (1992), seasonality is the systematic, although not necessarily regular, intra - year movement caused by the changes of the weather, the calendar, and timing of decisions, directly or indirectly through the production and consumption decisions made by the agent of the economy.

It means that seasonal movements are expected to be predictable. Under normal circumstances they can be expected to recur, although, they can gradually change over time as factors that induce seasonality are not stable in time.

Macroeconomic data are sometimes subject to “noise” that can be seriously misleading when interpreting the macroeconomic variables. Seasonal effects which is the one of the well-known types of noise, plays a dominant role on the course of the variables across time.

Tramo ("Time Series Regression with ARIMA Noise, Missing Observations, and Outliers") performs estimation, forecasting, and interpolation of regression models with missing observations and ARIMA errors, in the presence of possibly several types of outliers. Seats ("Signal Extraction in ARIMA Time Series") performs an ARIMA-based decomposition of an observed time series into unobserved components. The two programs were developed by Victor Gomez and Agustin Maravall (1995). Typically, individuals will first "linearize" a series using Tramo and will then decompose the linearized series using Seats.

In the TRAMO, the program estimates and forecasts regression models on which error terms follow ARIMA processes If a regression is subject to

• missing observations in the series,

• contamination by outliers,

• contamination by deterministic effects.

Another important case is the trading day (TD) effect which may vary by country, religion or social life. The stochastic components estimated by SEATS provide the decomposition of the linearized series that has been preadjusted by TRAMO. The deterministic effects estimated by TRAMO that form the preadjustment component can be combined with the SEATS estimators in order to obtain the final estimators of the components. By default,

- Level Shift outliers will be assigned to the final trend.

- Additive and Transitory Change outliers will be assigned to the final irregular component.

- Calendar effects (Trading Day, Easter, Leap Year, moving holidays) will go to the final seasonal component after proper centering. The mean resulting from the centering will go the trend. (They also may form a separate component.)

- Regressions and intervention variable effects can form a separate component or be assigned to the one thought appropriate. (If assigned to the seasonal component, the effects will always be centered and the resulting means added for the trend.)

The basic methodology followed is described in Gomez and Maravall (1994).

7.1.6 Structural Break Test

To determine whether the economy has experienced with a structural break(s) between 1998 and 2014 is a crucial task for identifying valid relation between economic phenomenons. Tests for parameter instability and structural change in regression models have been an important part of applied econometric work dating back to Chow (1960), who tested for regime change at a priori known dates using an F-statistic. To relax the requirement that the candidate breakdate be known, Quandt (1960) modified the Chow framework to consider the F-statistic with the largest value over all possible breakdates. Andrews (1993) and Andrews and Ploberger (1994) derived the limiting distribution of the Quandt and related test statistics. More recently, Bai (1997) and Bai and Perron (1998, 2003) provide theoretical and computational results that further extend the Quandt-Andrews framework by allowing for multiple unknown breakpoints.

7.1.7 Iteration Methods

7.1.7.1 Gauss Seidel Method

This method algebraically solve each linear equation for x_i. Starting from initial values (historical values on the past, on the future the last computed period or a base simulation), one computes in a given order the whole set of equations, using the most recently obtained values. This gives a new set of initial values. The process is repeated, always using the last value for the endogenous explanatory variables, until the distance between the last two solutions is small enough to be considered negligible. (The convergence level can be determined by user in Eviews and this level is chosen as $e*10^{-8}$ for this study.) When the solution has been reached, the absolute relative approximate error is used after each iteration to check whether the error is small enough for the tolerance level. The Gauss-Seidel Method allows the user to control round-off error.

Let formalize the method:

1. Set of n equations with n unknown

$$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + \ldots + a_{1n}x_n = c_1$$

$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \ldots + a_{2n}x_n = c_2$$

$$a_{n1}x_1 + a_{n2}x_2 + a_{n3}x_3 + \ldots + a_{nn}x_n = c_n$$

2. Rewrite each equation solving for the corresponding unknown, First equation, solve for x_1, Second equation, solve for x_2

3.
$$x_1 = \frac{c_1 - a_{12}x_2 - a_{13}x_3 \ldots\ldots - a_{1n}x_n}{a_{11}}$$

$$x_2 = \frac{c_2 - a_{21}x_1 - a_{23}x_3 \ldots\ldots - a_{2n}x_n}{a_{22}}$$

$$\vdots \qquad \vdots \qquad \vdots$$

$$x_{n-1} = \frac{c_{n-1} - a_{n-1,1}x_1 - a_{n-1,2}x_2 \ldots\ldots - a_{n-1,n-2}x_{n-2} - a_{n-1,n}x_n}{a_{n-1,n-1}}$$

$$x_n = \frac{c_n - a_{n1}x_1 - a_{n2}x_2 - \ldots\ldots - a_{n,n-1}x_{n-1}}{a_{nn}}$$

4. Assume an initial guess for [X]

$$\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_{n-1} \\ x_n \end{bmatrix}$$

5. General form of each equation.

$$x_n = \frac{c_n - \sum_{\substack{j=1 \\ j \neq n}}^{n} a_{nj}x_j}{a_{nn}}$$

6. Calculate the Absolute Relative Approximate Error

$$\left|\in_a\right|_i = \left|\frac{x_i^{new} - x_i^{old}}{x_i^{new}}\right| \times 100$$

The iterations are stopped when the absolute relative approximate error is less than a prespecified tolerance for all unknowns. One class of system of equations always converges: One with a *diagonally dominant* coefficient matrix.

Diagonally dominant: [A] in [A] [X] = [C] is diagonally dominant if:

$$\left|a_{\mathrm{ii}}\right| \geq \sum_{\substack{j=1 \\ j\neq \mathrm{i}}}^{n} \left|a_{ij}\right| \qquad \left|a_{ii}\right| > \sum_{\substack{j=1 \\ j\neq i}}^{n} \left|a_{ij}\right|$$

For all i and for at least one “i”

7.2 Statistical Tables

Table 7.1 Variance Inflation Factors, VIF>10 implies multicollinearity

Endogenous Variable	Coefficients	VIF
CAD	exp var 1	7.4282
	exp var 2	2.0591
	exp var 3	2.3235
	exp var 4	4.6823
	exp var 5	3.6490
	exp var 6	5.0367
	exp var 7	4.2917
BIR	exp var 1	3.2481
	exp var 2	3.2481
CONS	exp var 1	2.1645
	exp var 2	3.9611
	exp var 3	3.6592
CRD	exp var 1	1.1563
	exp var 2	1.2237
	exp var 3	1.8492
	exp var 4	1.2683
	exp var 5	1.1391
	exp var 6	1.1719
	exp var 7	1.3234
	exp var 8	1.4596
EMP	exp var 1	5.4379
	exp var 2	5.8586
	exp var 3	7.1997
	exp var 4	76.4757
INF^{e}	exp var 1	1.4015
	exp var 2	1.4015
EXP	exp var 1	4.1721
	exp var 2	5.2547
	exp var 3	1.8212
	exp var 4	11.5845
IMCAP	exp var 1	5.3340
	exp var 2	4.1951
	exp var 3	1.7480
	exp var 4	1.3419
IMCONS	exp var 1	1.4621
	exp var 2	2.5823
	exp var 3	2.1803
	exp var 4	1.8742
		1.3037
IMINT	exp var 1	1.6726
	exp var 2	1.6950
	exp var 3	1.1956
	exp var 4	1.1909
INF	exp var 1	1.0791
	exp var 2	1.1021
	exp var 3	1.1045
INVM	exp var 1	1.1455
	exp var 2	1.4767
	exp var 3	1.2433
	exp var 4	1.2069
	exp var 5	1.3965
OTI	exp var 1	1.1085
	exp var 2	1.1085
PINV	exp var 1	1.0017
	exp var 2	1.0017
SAV	exp var 1	6584.144
	exp var 2	6770.019
	exp var 3	4.595983

Table 7.2 Heteroskedasticity and Serial Correlation Tests

Equations	Breusch-Pagan-Godfrey Heteroskedasticity Test*		Breusch-Godfrey Serial Correlation Test**	
	F-statistic	F-Probability	F-statistic	F-Probability
BIR	34.9048	0.0000	32.7904	0.0000
CAD	3.5259	0.0033	2.0628	0.1366
CONS	16.4398	0.0000	16.4398	0.0000
CRD	2.9982	0.0177	0.3818	0.6844
EMP	128.9879	0.0000	128.9879	0.0000
INF^{e}	12.0669	0.0000	360.6860	0.0000
EXP	3.3488	0.0152	17.6446	0.0000
IMCAP	19.6886	0.0000	19.6886	0.0000
IMCONS	0.4206	0.6586	0.4206	0.6586
IMINT	0.6554	0.5231	0.6554	0.5231
INF	34.9649	0.0000	34.9649	0.0000
INVM	1.9192	0.1558	1.9192	0.1558
OTI	0.5355	0.5880	25.6681	0.0000
PINV	121.2505	0.0000	121.2505	0.0000
SAV	69.0566	0.0000	69.0566	0.0000

(*) Breusch Pagan Godfrey test is used to test the null hypothesis states that there is a hetersokedasticity. The standard errors are calculated by using White covariance matrix consistent estimator.

(**) Breush Pagan test is used to test the null hypothesis states that there is no serial correlation. Newey-West standard errors to correct for the serial correlation.

Table 7.3 Augmented Dickey-Fuller test results

ADF Unit Root Test, p-value

Variable	Level	1st Log Difference	Variable	Level	1st Log Difference
BP_CAD	0.2034	0.0007	FTS_X_CAP_SA	0.3704	0.0000
BP_FDI_SA	0.2528	0.0002	FTS_X_CNS_SA	0.9021	0.0000
BP_GT_M_SA	0.3830	0.0000	FTS_X_INT_SA	0.7979	0.0000
BP_GT_NET	0.0000	0.0000	FX_USDTRY	0.0006	0.0000
BP_M_SA	0.7972	0.0001	LF_EARN_SA	0.7697	0.0340
BP_NEO	0.0146	0.0000	LF_EMP_SA	0.9770	0.0000
BP_OI_SA	0.0197	0.0000	LF_LFPR_SA	0.5491	0.0000
BP_PI	0.1445	0.0000	LF_THW_SA	0.7182	0.0000
BP_RA	0.0007	0.0000	LF_UR_SA	0.0534	0.0000
BP_TOUR_SA	0.7163	0.0000	LF_WAGECOST	0.8992	0.0000
BP_X_SA	0.8804	0.0000	LF_WAGECOST_MAN	0.2775	0.2111
BUD_BB	0.1073	0.0000	LI_CUR	0.0205	0.0000
BUD_BE	0.1227	0.0000	LI_MINING	0.7811	0.0000
BUD_IE	0.6852	0.0000	LI_PROD	0.0218	0.0182
BUD_PB	0.0137	0.0000	NI_AGR_SA	0.7448	0.0000
BUD_TR	0.6539	0.0000	NI_CNS_GVT_SA	0.8989	0.0000
COM_BRENT_SA	0.2623	0.0000	NI_CNS_HH_SA	0.9043	0.0000
COM_BRENT_EQ	0.3033	0.0000	NI_CONST_SA	0.7350	0.0001
COM_BRENT_YC	0.0001	0.0000	NI_FCF_SA	0.9766	0.0124
EA_HHCONS	0.0002	0.0000	NI_GDP_SA	0.9627	0.0000
EA_HHCONS_CH	0.4137	0.0000	NI_INVM_SA	0.7400	0.0128
EA_PBCONS_SA	0.0130	0.1883	NI_INVM_PBL_SA	0.6782	0.0000
EA_PCONS_CH	0.4999	0.0000	NI_INVM_PRV_SA	0.4898	0.0005
FCF_DEPR	0.4372	0.0000	NI_M_SA	0.9188	0.0000
FIN_BIST	0.3734	0.0000	NI_MAN_SA	0.9606	0.0000
FIN_BIST_EQ	0.3926	0.0000	NI_SERV_SA	0.9544	0.0000
FIN_BIST_EQYC	0.0193	0.0000	NI_STCK_SA	0.0003	0.0000
FIN_BIST_YC	0.1930	0.0000	NI_X_SA	0.8566	0.0000
FIN_CB_BR	0.6143	0.0000	P_CPI_SA	0.0004	0.1712
FIN_CB_LR	0.6371	0.0000	P_CPI_INF_SA	0.3592	0.0000
FIN_CB_PR	0.7085	0.0000	P_EU_CCPI_SA	0.2214	0.1573
FIN_CRD_SA	0.9823	0.0041	P_EU_CCPI_INF	0.0467	0.0075
FIN_CRD_CH	0.3188	0.0000	P_EU_CPI_SA	0.6274	0.0002
FIN_DEFLATOR_SA	0.0000	0.0003	P_EU_CPI_INF	0.0498	0.0000
FIN_DEP_SA	0.8413	0.0002	P_GLB_NFOOD_SA	0.7857	0.0000
FIN_DEP_CH	0.0407	0.0023	P_GLB_RFOOD	0.5623	0.0000
FIN_IR	0.6034	0.0000	P_PPI_SA	0.0015	0.0133
FIN_SAVING_SA	0.4521	0.0003	P_PPI_INF	0.0770	0.0000
FIN_US_2Y	0.6848	0.0418	P_US_CPI	0.0008	0.0000
FIN_VIX	0.0913	0.0000	P_US_CPI_CORE	0.0832	0.0132
FIN_VIX_EQ	0.0071	0.0000	W_AE_GDP	0.0001	0.0000
FTS_M_SA	0.7926	0.0000	W_AE_M_SA	0.4599	0.0000
FTS_M_CAP_SA	0.7901	0.0000	W_EM_GDP	0.0302	0.0000
FTS_M_CNS_SA	0.7349	0.0002	W_EM_M_SA	0.7594	0.0000
FTS_M_INT_SA	0.7807	0.0000	BUD_BR	0.6231	0.0000
FTS_X	0.7840	0.0000	P_EXP	0.2497	0.0000

(Null hypothesis in ADF test, states that there is a unit root)

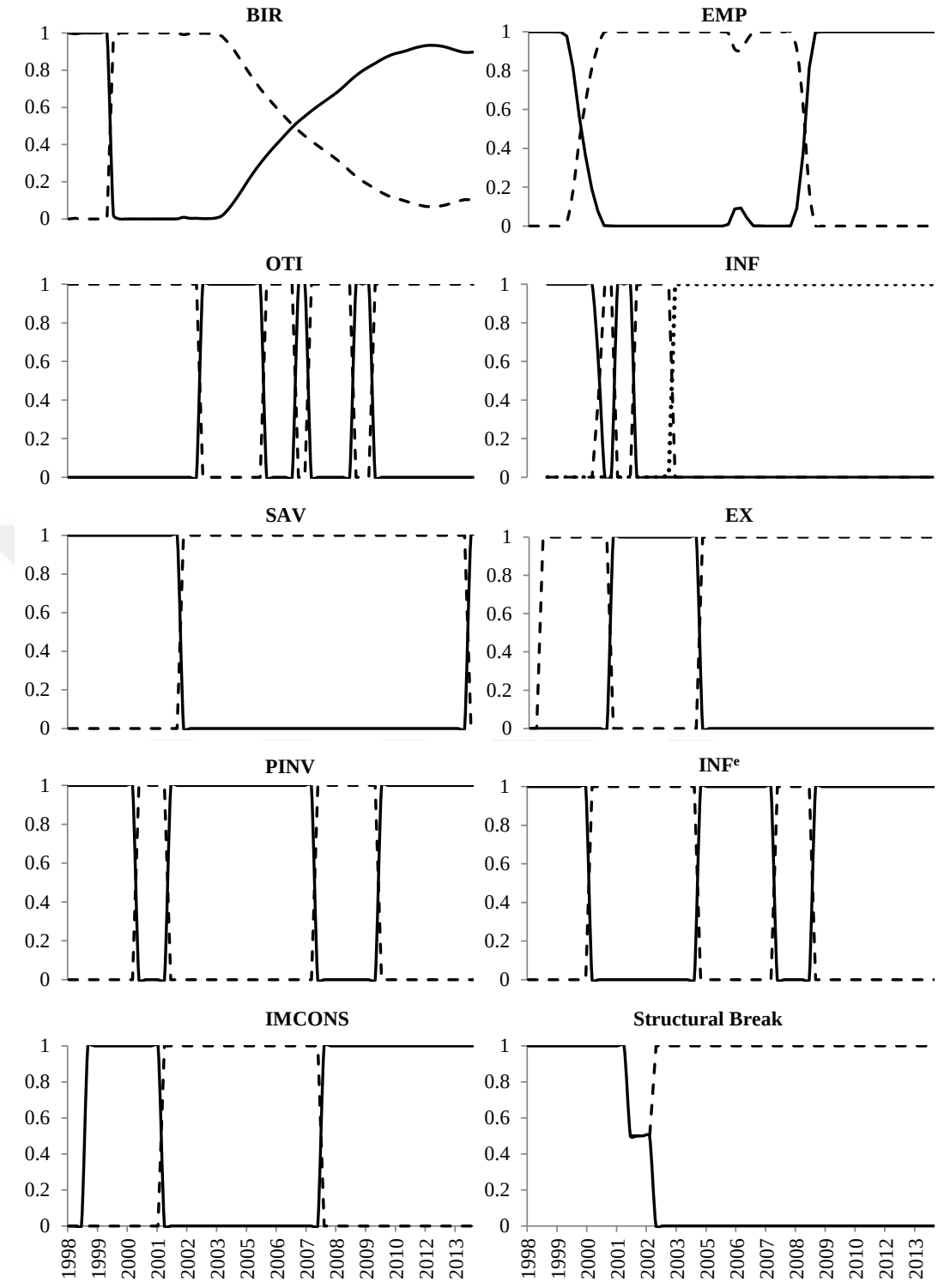


Figure 7.1 Regime-Switching and Structural Break, dummy variables