

Sources of Macroeconomic Fluctuations in Turkey: Evidence from a Structural Vector Autoregressive Approach

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Abstract

The analysis of business cycle is one of the most important steps for both healthy evaluation of economic developments and construction of accurate economic policies. There still have been debates among different schools of thought about the sources of business cycles and notably, the impulse propagation mechanisms, not providing a consensus about the subject. Nowadays, those debates go on between the economists from Keynesian and Classical tradition, namely New Keynesian and Real Business Cycle theories. The focal point of the argument is to distinguish the shocks as a source of business cycle fluctuations. Keynesian theory sees the aggregate demand as the dominant source of changes in output. Real Business Cycle Theory assumes that the fluctuations in the economy are produced mainly due to changes in real factors, particularly shifts in technology, preference or taste, affecting the aggregate supply. By employing structural vector autoregression (SVAR) technique, in this study we try to identify those shocks that impact Turkish economy and to construct the dynamic responses caused by these shocks. The results of the study suggest that the fluctuations in real output is mainly due to supply shocks both in the short and long-runs. Also, domestic supply shocks, defined as productivity shocks, are the most important disturbances in explaining output fluctuations. Consequently, for a true understanding of the developments in Turkish economy and design of economic policies that enable stable and sustained long-run economic growth, the results of the study have to be evaluated carefully.

Keywords: Business Cycle, Structural VAR, Real Business Cycle Theory, Shocks, impulse response, variance decomposition

JEL Classification: E32, F41, C51

1. Introduction

The analysis of business cycle fluctuations is important for both the evaluation of economic developments and the application of effective economic policies. The debate about the causes of fluctuations in economic activity is almost as old as the economic theory itself. A large number of potential driving forces have been identified. Private and public demand shocks, monetary policy and productivity shocks are among the most prominent. Also the business cycle is one of the most interested and controversial subject of macroeconomics. There still have been debates among different schools of thought about the sources of business cycles and notably the impulse propagation mechanisms, not providing a consensus about the subject.

Today two sides of the debate about the sources of business cycle fluctuations are the economists from the Keynesian and from the classical tradition. Generally, the classical economists (New Classical and real business cycle theories), think that the imbalances between aggregate demand and aggregate supply will be eliminated by the rapid adjustment of prices and the output level will not be away from its full employment level except for short periods. On the other hand the economists from the Keynesian tradition warn about the possibility of output fluctuations as a result of legal regulations and nominal rigidities in prices and wages. In the Keynesian theory, output level in the short run is determined by the effective demand of economic agents. So the main source of short term fluctuations in the national income is the demand shocks. If the market conditions and the change in prices cannot be successful in closing the gap between demand and supply, there can be movements out of the equilibrium level. Perception of disequilibrium by the individuals is slow and the economy moves to its long run equilibrium after they adjust their behavior to the current condition. Monetarists, another group from the classical tradition, emphasize the importance of nominal money stock in the fluctuations of national income level.

Usually, fluctuations in macroeconomic variables cannot be forecasted. Sometimes the changes in demand and supply conditions inside the country are effective and sometimes a shock from the other parts of the world results in fluctuations. Over the past decade, tighter integration of international financial markets and positive expectations of future growth and profitability in emerging market countries have triggered a sharp increase in capital flows to those economies. (Carstens A. G., 1998) Turkey is one of the countries who can attract huge amount of capital after 2001 with the advantage of serving higher interest rates when compared with other developing countries. But the problem is that those capital inflows have not always been stable and permanent. Particular conditions in the recipient countries or some other global effects have triggered the massive capital outflows.

International business cycles can sometimes create negative shocks such as wars, crises, high energy prices. On the other hand during some periods low interest rates, low inflation rates, increased liquidity with capital inflows, rapid growth rates and trade opportunities can create expansion path of the business cycle.

The expansion phase of the business cycle has benefited the developing countries by creating cheap finance possibilities. But at the same time it strengthens the speculative effects, fastens the formation of booms, deteriorates economic balances and increases the fragility of those countries. Another danger is the increasing inflation pressure which arises

as a result of overheated economies. In such a position, the interest rates starts to rise, the artificially expanded balloons begin to burst and the capital returns to its mother country from the temporary unsecured harbors. Business cycle is not dead but is likely here to stay. So policymakers, who are continually subject to business cycles, should adopt certain goals to improve their ability to deal with fluctuations. First of all they must learn how to recognize and address the economy's vulnerability to disruptions and unanticipated events. Perhaps every recession cannot be prevented but something can be done to avert the consequences of the big ones.

2. Business Cycle Fluctuations in Turkey

The first step of forming appropriate stabilization policies is determining the sources of macroeconomic fluctuations. Time series of GDP for emerging economies exhibit greater volatility, as measured by the standard deviation of such series. In addition, there is a crucial difference between the depths of recessions in emerging economies and in industrial ones. This forces us to investigate the cycle and trend components of time series of developing countries more carefully.

In 1980's it was believed that the main causes of the crises was the interventionist financial policies and that liberalization would help to restore growth and stability by raising savings and improving overall economic efficiency. However these expectations have not been realized. In many countries financial liberalization has increased financial instability instead of lifting the level of domestic savings and investment and Turkey was not an exception.

In Turkey, since 1980 important steps have been taken towards liberalization. The aim of these policies was transition to a market economy. A more liberal, export oriented program was launched in the beginning of 1980. In the first half of 1980's domestic financial movements have been liberalized. A more important step was integrating domestic financial sector with the world. This has taken place in the second half of 1980's after legal and institutional arrangements have been completed. The next step was the liberalization of international capital movements which began in August 1989. Therefore the reason of fluctuations in GNP, exchange rates and the price level is not only the domestic policies but also developments in the international capital markets.

The plan of this study which aims to analyze business cycle fluctuations in Turkey will be as follows: First a literature review about the business cycle fluctuations in different countries will be given. Next a model is introduced and the sources of business cycle fluctuations in Turkey will be investigated by the use of a structural Vector Autoregressive (SVAR) model. Moreover with the help of impulse response and variance decomposition techniques, dynamic effects of different shocks on basic macroeconomic variables will be identified.

3. Studies about Business Cycle Fluctuations in Different Countries

One of the most influential empirical papers ever published to date is a paper by Kydland and Prescott (1990). In this well known article they displayed the stylized facts of business cycle fluctuations in USA. In this study following the Lucas's definition, business cycle is defined as the deviations of aggregate real output from its trend. Plosser (1989) investigates real business cycle fluctuations in USA between 1954-1985. For analyzing the properties of the business cycle, he used the moments of the

sample and found out that the growth rate of investments is the most volatile process. Output, wages and consumption follow this. Blanchard and Quah (1989), who use AD-AS model and long term restrictions, argue that the demand shocks are the primary sources of US fluctuations. Shapiro and Watson (1988) investigated the effect of aggregate supply and demand shocks on output in the United States. They modeled aggregate supply shocks as three independent shocks: labor supply shocks, total factor productivity shocks and oil price shocks. They found that aggregate demand shocks accounted for only 25 percent of the variance of the unpredictable change in output, leaving the remainder to be explained by aggregate supply shocks. Backus and Kehoe (1992) conducted a study for a group of developed countries, concerning the properties of business cycles. This was the first paper to examine business cycles in different countries from a real business cycle perspective. They found a regularity in the cyclical behavior of real quantities among the countries. Blanchard and Watson (1986) introduce a structural VAR approach to answer two questions: i) how many sources of shocks to the economy are relevant and ii) are fluctuations caused by an accumulation of small shocks or by infrequent large shocks. They conclude that fluctuations are due to fiscal money, private demand and supply shocks. Blanchard (1989) asks whether the dynamic joint behavior of output, unemployment, prices wages and money would explain the macroeconomic fluctuations. He uses a Keynesian macroeconomic model with short term restrictions. The results support the theory that demand shocks account for most of the output fluctuations and are associated with increases in prices and wages.

However, there are other studies which support real supply shocks as the source of business cycle fluctuations. King et al. (1991) find that nominal shocks explain over 50 percent of economic fluctuations in output, investment and consumption. Gali (1992) examines a structural VAR IS-LM model for US economy using short term and long term restrictions. He uses four different shocks for his analysis: Supply, money demand, money supply and fiscal shocks. He finds that supply shocks account for 70 percent of GDP variability. Fiorito and Kollintzas (1994) employ the HP filter to study the stylized facts of business cycles in the G7 countries for the period 1960 to 1989. Confirming Backus and Kehoe (1992), the authors found that all expenditure components such as consumption, investment, exports and imports were procyclical. Kydland and Zarazaga (1997) study business cycle regularities in Argentina and compare them to those prevailing in the US and other developed countries. They find that the business cycle regularities in Argentina are very similar to those of developed countries. Bjornland (2000) has investigated the dynamic effects of shocks in four different countries. She identified three types of shocks. Oil price shocks, demand shocks and supply shocks. The results indicate that in the long run, supply disturbances are the dominant cause of economic fluctuations. Kwark (1999) identifies sources of business fluctuations in a two country open economy model with the structural VAR method. His main finding is that US country specific shocks are the most important in explaining US and foreign output fluctuations except in the short run.

4. The Model and Econometric Method

In this part of the study we describe the theoretical background that the analysis will be based upon. This includes a description of the macroeconomic model used to derive the long run restrictions, and a description of the SVAR technique that will be followed for estimation. The basic macroeconomic model which is used for empirical analysis of business cycle fluctuations in Turkey based on the article by Hoffmaister and Roldos (1997) that analysis the business cycle fluctuations in Asia and Latin America.

In the real business cycle models, total product of a good which can be used for consumption and investment purposes is represented by constant returns to scale production function. When K is Capital and L is Labor the Cobb-Douglas production is:

$$Q = AK^\alpha L^\beta e^u \quad (1)$$

Taking the natural logarithm of both sides of the equation, we obtain the following linear equation:

$$\ln Q = \ln A + \alpha \ln K + \beta \ln L + u \quad (2)$$

If we define $C = \ln A$ and put it in equation (2)

$$\ln Q = C + \alpha \ln K + \beta \ln L + u \quad (3)$$

Let us think about a small open economy that produces both tradable and non tradable goods. The sector which produces tradable goods uses imported intermediate goods (M) as well as Capital (K) and Labor (L). Under these circumstances output is represented by the following equation (4)

$$Q_{x_t} = A_{x_t} [K_t^{1-\alpha} L_t^\alpha]^\mu M_t^{1-\mu} = A_{x_t} V_{x_t}^\mu M_t^{1-\mu} \quad (4)$$

In this equation A_{x_t} represents technology. If we subtract the intermediate goods from the gross product, we reach the real value added (Y_{x_t})

$$Y_{x_t} = Q_{x_t} - P_m M^* \quad (5)$$

P_m is the world price of the imported intermediate good. With the small economy assumption the country does not have a chance to affect this price. M^* is the optimal quantity of the intermediate good.

$$M^* = P_m^{-1/\mu} A_{x_t}^{1/\mu} (1-\mu)^{1/\mu} V_{x_t} \quad (6)$$

Following this equation we can express real value added (Y_x) as:

$$Y_{x_t} = [\mu(1-\mu)^{(1-\mu/\mu)}] A_{x_t}^{1/\mu} P_m^{(\mu-1)/\mu} V_{x_t} \quad (7)$$

In order to complete the supply side of the model we assume that only labor (L_n) is used in the production of non tradable goods.

$$Q_{n_t} = Y_{n_t} = A_{n_t} L_{n_t}^\beta \quad (8)$$

Although this assumption is very strict, it emphasizes the fewer use of imported intermediate goods in the production of non tradable goods and the labor intensive production in this sector. By using equations (4-8) Real GNP can be calculated as the sum of value added in tradable and non tradable sectors.

$$Y_t = Y_x + RY_n \quad (9)$$

In order to see the effects of different shocks on GNP a real exchange rate equation which equalizes the relative price of non tradable goods with respect to tradable goods and marginal product of labor in each sector is required.

$$R\beta A_n (L-l_x K)^{\beta-1} = \alpha B l_x^{\alpha-1} \quad (10)$$

$$R = \frac{\alpha B l_x^{\alpha-1}}{\beta A_n (L-l_x K)^{\beta-1}} \quad (11)$$

$l_x = L_x/K$ is the inverse of Capital/Labor ratio in the tradable sector.

By the use of $B = \mu A_x^{1/\mu} [(1-\mu)P_m^{-1}]^{(1-\mu)/\mu}$ equation we can express the real exchange rate as a function of parameters and exogenous variables.

If we put B in equation (11)

$$R = \frac{\alpha \mu A_x^{1/\mu} (1-\mu)^{\frac{1-\mu}{\mu}} P_m^{-1} l_x^{\alpha-1}}{\beta A_n (L-l_x K)^{\beta-1}} \quad (12)$$

$$(L-l_x K)^{\beta-1} = \left(L - \frac{L_x}{K} K\right)^{\beta-1} = (L-L_x)^{\beta-1} = L_n^{\beta-1}$$

$$R = \frac{\alpha \mu A_x^{1/\mu} (1-\mu)^{\frac{1-\mu}{\mu}} P_m^{-1} l_x^{\alpha-1}}{\beta A_n L_n^{\beta-1}} \quad (13)$$

When we put the derived real exchange rate formula to equation (9) which expresses real GNP as the sum of value added in tradable and non tradable sectors we get the real GNP equation.

$$Y_t = \left[\mu(1-\mu)^{\frac{1-\mu}{\mu}} \right] A_x^{\frac{1}{\mu}} P_m^{-1} K l_x^{\alpha} [1 + (\alpha/\beta)(L_n/L_x)] \quad (14)$$

If we take the logarithm of both sides of the equation

$$\log Y_t = \phi + \left[\frac{1}{\mu} \right] \log A_x - \left[\frac{1-\mu}{\mu} \right] \log P_m + (1-s_n/\lambda_n) \log K_t + (\alpha - s_n/\lambda_n) \log l_x \quad (15)$$

An equation for real GNP is derived.

Here $\phi = \left[\mu(1-\mu)^{\frac{1-\mu}{\mu}} \right]$ is the constant term. $\mu < 1$. s_n is the ratio of non tradable goods in total production. λ_n is the ratio of labor working in non tradable sector in total labor force.

Equation (15) gives us the factors that affect real GNP. First two terms other than the constant term in the equation represent supply shocks. The price increase in the imported intermediate goods will create the same effect with the negative technology shock.

According to the last GNP formula which we derive in equation (15), the factors that affect GNP in the long run can be listed as follows:

- a) As $\frac{1}{\mu}$ is greater than zero, a positive technology shock in tradable sectors will increase the growth rate.
- b) $1-\mu > 0$ So $\frac{1-\mu}{\mu} > 0$. A foreign trade shock which results from the deterioration of terms of trade with higher prices of imported

intermediate goods will affect the growth rate negatively. This can be evaluated as a negative supply shock.

- c) According to the third coefficient in equation (15) increase in the government expenditure will decrease the capital stock but this will not change the growth rate of GNP, because labor capital ratio is determined by world interest rates.
- d) The last term in equation (15) reveals the effects of world interest rate shock. Under the perfect capital mobility assumption, the marginal revenue of capital will be equalized to world interest rates in the long run. An increase in world interest rates will decrease GNP. Because the capital labor ratio (l_x) is multiplied by a negative coefficient.

In many studies which investigate the sources of business cycle fluctuations, neutrality of money and nominal exchange rate is accepted. As stated by Blanchard and Quah (1989) it is not wrong to regard the long run effects of nominal shocks as zero. Because when compared to real shocks, nominal shocks have very little effects in the long run.

4.1. SVAR Method

When the model we introduced and the development of Turkish economy in the last 20 years is considered, the following SVAR model can be estimated.

$$\begin{bmatrix} \Delta r_t^* \\ \Delta P_t^m \\ \Delta Y_t \\ \Delta R_t \\ \Delta P_t \end{bmatrix} = C(L) x \begin{bmatrix} \varepsilon_t^i \\ \varepsilon_t^{tt} \\ \varepsilon_t^s \\ \varepsilon_t^d \\ \varepsilon_t^n \end{bmatrix}$$

From the variables in the left side of the equation r^* is the world interest rate, p^m is the terms of trade, Y is the level of output, R is the real exchange rate, P is the price level.

$C(L)$ is a square matrix which is composed of lag polynomials. In the right hand side of the equation there are parameters that represent structural shocks. They are ε^i world interest rate shock, ε^{tt} terms of trade shock, ε^s supply shock, ε^d demand shock and ε^n nominal shock in turn.

4.2. Long Term Constraints

In the SVAR model 5 long term constraint is used. These are:

1) World interest rates are given. Under the assumption of Turkey as a small open economy none of the shocks in Turkish economy affects world interest rates. World interest rates are determined with their own stochastic process and local variables do not have any effect on them. Under these assumptions we can compose one of the constraints in our structural model. World interest rates have a stochastic structure which is determined by only world interest rate shock. Therefore

$$\Delta r^* = \sum_{k=0}^{\infty} c_{11}(k) \varepsilon_{t-k}^i \quad (16)$$

2) A common definition of terms of trade is the ratio of export prices to import prices. This concept is one of the best concepts that explain a country's foreign trade position.

As a result of the deterioration of terms of trade against a country, imported goods become more expensive and/or exported goods become cheaper.

A continuous deterioration of terms of trade result in deficits in foreign trade and balance of payments. Moreover it creates a pressure on the value of exchange rates. Terms of trade is one of the factors which determines the international competitive power of a country. The most important factor which changes the terms of trade is the changes in the exchange rate. This impact is mostly seen in the short run. But in the long run, structural changes in production and consumption determine the terms of trade. In this respect, an increase or decrease of world interest rates in a business cycle will effect Turkey's terms of trade significantly.

The first shock that determines terms of trade is world interest rate shock which represents the cyclical movements in the world. The second shock is the terms of trade shock which is created by the changes in export and import prices. The determination of terms of trade by these two shocks can be seen in equation (17) below.

$$\Delta P_t^m = \sum_{k=0}^{\infty} c_{21}(k) \varepsilon_{t-k}^i + \sum_{k=0}^{\infty} c_{22}(k) \varepsilon_{t-k}^{ii} \quad (17)$$

3) The first factor that affects the growth of Real GNP is the world interest rate shock. One of the most important indicators of production method in a country is labor/capital ratio. And this is determined by world interest rates. Moreover, in the long run, under the assumption of perfect capital mobility, marginal product of capital will be equalized to world interest rates.

The second factor that has an influence on the growth rate of real GNP is the foreign trade shock which is a result of deterioration of terms of trade against a country. This will affect the growth rate negatively. Although it can rarely happen in a periphery country, the development of terms of trade in favor of a country cease the transfer of resources to abroad and have positive effects on the growth rate.

The last impact on real GNP is coming from technology shocks which can be considered as a supply shock. It is expected that a positive technology shock will increase the growth rates. Although it is not logical to think about negative technology shocks, few technological advancements and difficulties in obtaining the new technologies can be considered as negative technology shocks.

As a result, the shocks that affect growth rate of GNP are the world interest rate shock, terms of trade shock and technology shock. Demand shocks and nominal shocks do not have any long run effects on GNP.

$$\Delta Y_t = \sum_{k=0}^{\infty} c_{31}(k) \varepsilon_{t-k}^i + \sum_{k=0}^{\infty} c_{32}(k) \varepsilon_{t-k}^{ii} + \sum_{k=0}^{\infty} c_{33}(k) \varepsilon_{t-k}^s \quad (18)$$

4) Fluctuations in world interest rates and changes in the price of imports creates fluctuations in the real exchange rate. Positive shocks on import prices result in depreciation of the real exchange rate. As this impact is coming from the changes in terms of trade, we place terms of trade shocks in the real exchange rate equation.

Apart from this, technology shocks generate fluctuations in the real exchange rate. But this impact is different if technology shock comes true in tradable and non-tradable sectors. If technology shock materializes in the tradable sectors, real exchange rate appreciates. But if the technology shock comes true heavily in non-tradable sectors real exchange rate depreciates.

Other than the introduced shocks, ε^d represents demand shocks. As a result of applied fiscal policies, labor force can move between tradable and non-tradable sectors. Depending on the direction of this movement, there are fluctuations in the real exchange rate.

$$\Delta R_t = \sum_{k=0}^{\infty} c_{41}(k) \varepsilon_{t-k}^i + \sum_{k=0}^{\infty} c_{42}(k) \varepsilon_{t-k}^{ii} + \sum_{k=0}^{\infty} c_{43}(k) \varepsilon_{t-k}^s + \sum_{k=0}^{\infty} c_{44}(k) \varepsilon_{t-k}^d \quad (19)$$

5) We can point out the fluctuations in the price level by the help of equation (20) below.

$$\Delta P_t = \sum_{k=0}^{\infty} c_{51}(k)\varepsilon_{t-k}^i + \sum_{k=0}^{\infty} c_{52}(k)\varepsilon_{t-k}^m + \sum_{k=0}^{\infty} c_{53}(k)\varepsilon_{t-k}^s + \sum_{k=0}^{\infty} c_{54}(k)\varepsilon_{t-k}^d + \sum_{k=0}^{\infty} c_{55}(k)\varepsilon_{t-k}^n \quad (20)$$

Here ε^n represents nominal shocks. According to this equation all real and nominal shocks are effective on the price level. By following the general approach of the studies about the sources of business cycle fluctuations in literature, we can assume money and nominal exchange rate neutral in the long run. The assumption that nominal shocks are neutral in the long run may underestimate the importance of nominal shocks in explaining output fluctuations. (Hoffmaister and Roldos p.13) But Blanchard and Quah (1989) stated that the identification process is robust even when the effect of nominal shock is not zero but small compared to the effect of real shocks. According to the long-run restrictions, the SVAR model can be represented compactly as follows:

$$\begin{bmatrix} \Delta r_t^* \\ \Delta P_t^m \\ \Delta Y_t \\ \Delta R_t \\ \Delta P_t \end{bmatrix} = \begin{bmatrix} c_{11}(L) & 0 & 0 & 0 & 0 \\ c_{21}(L) & c_{22}(L) & 0 & 0 & 0 \\ c_{31}(L) & c_{32}(L) & c_{33}(L) & 0 & 0 \\ c_{41}(L) & c_{42}(L) & c_{43}(L) & c_{44}(L) & 0 \\ c_{51}(L) & c_{52}(L) & c_{53}(L) & c_{54}(L) & c_{55}(L) \end{bmatrix} * \begin{bmatrix} \varepsilon_t^i \\ \varepsilon_t^m \\ \varepsilon_t^s \\ \varepsilon_t^d \\ \varepsilon_t^n \end{bmatrix}$$

Or $X_t = C(L).\varepsilon_t$

Where $c_{ij}(L).\varepsilon_t = \sum_{k=0}^{\infty} c_{ij}(k).\varepsilon_{t-k}$ for $i, j = 1, \dots, 5$

5. Empirical Analysis of Business Cycle Fluctuations in Turkey

After the introduction of the data set, with the help of unit root and cointegration tests the appropriate method for the analysis will be chosen.

5.1. Data

The data set in this study covers 1987-2005 period and they are quarterly growth rates of the chosen series. During the calculations of the growth rates, changes in the logarithms of the data is used. The data is derived from the Central Bank of the Republic of Turkey, Turkish Statistical Institution and International Finance Statistics. 5 time series are used in the study. They are: i) GNP with 1987 ii) Real Exchange rate index (It is calculated by the Central Bank of Turkey with 1995 prices. An increase in the real exchange rate represents the appreciation of Turkish Lira and a decrease in the real exchange rate index represents a depreciation of TL.) iii) Consumer price index iv) LIBOR interest rates of American Bonds are used as a proxy for world interest rates v) Terms of trade.

5.2. Time Series Analysis

For investigating the stationarity of the series, unit root tests are used. After the graphical investigation a deterministic trend is determined only in the Real GNP series. So for the unit root tests, the assumption that real GNP has a constant and trend, other series have only constant is considered. In order to test the presence of unit root in a series, the following equation should be estimated.

$$\Delta x_t = c + \alpha x_{t-1} + \sum a_i x_{t-i} + b_1 trend + e_t$$

The null hypothesis states that α is equal to zero and the series has a unit root. In our analysis, all the series are used in their natural logarithms. The variables that will be used in VAR analysis should be stationary. So for testing stationarity Augmented Dickey Fuller (ADF) test is used.

5.3. Augmented Dickey Fuller Test

Table 1 : Augmented Dickey Fuller Test Results

Variable	Level	First Difference
World interest rates	-2.643965	-4.095545*
Terms of trade	-3.845670*	-10.71464*
Real GNP	-2.692846	-7.185346*
Real Exchange Rate	-1.415317	-8.538780*
Consumer Price Index	0.615859	-10.97308*

* represents the rejection of null hypothesis at %1 significance level

According to the ADF Test, World interest rates, Real GNP, Real Exchange Rate and Consumer Price index series are not stationary at their levels. But the ADF test statistics for the level of Terms of trade is greater than the table critical value at %1 significance level. So it is determined that terms of trade series is stationary at its level and is used in this form for later analysis.

When we calculate the first difference of the series, all of them become stationary as we can reject the null hypothesis which states that the series are non stationary. So World interest rates, Real GNP, Real Exchange Rate and Consumer Price index series are difference stationary series. For our future analysis all these series will be used at their first differences.

5.4. Cointegration Test

Before estimating the structural VAR model, the cointegration relations between the variables should be checked. If the series are cointegrated at their levels, then a specification error is made in the estimation of VAR model at the first differences. In order to prevent this mistake, Johansen Cointegration test is applied to the levels of the series.

Table 2. Cointegration Test Results with Trace Statistics

Unrestricted Cointegration Rank Test				
Hypothesized		Trace	5 Percent	1 Percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None	0.316682	63.76337	68.52	76.07
At most 1	0.186658	36.34615	47.21	54.46
At most 2	0.165267	21.47073	29.68	35.65
At most 3	0.080358	8.464381	15.41	20.04
At most 4	0.033226	2.432902	3.76	6.65

As the calculated trace test statistics is smaller than the critical values at %5 and %1 significance levels we conclude that there is no cointegration between series.

Table 3. Cointegration Test Results with Maximum Eigenvalue

Hypothesized		Max-Eigen	5 Percent	1 Percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None	0.316682	27.41722	33.46	38.77
At most 1	0.186658	14.87542	27.07	32.24
At most 2	0.165267	13.00635	20.97	25.52
At most 3	0.080358	6.031478	14.07	18.63
At most 4	0.033226	2.432902	3.76	6.65
*(**) denotes rejection of the hypothesis at the 5%(1%) level				
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels				

According to the maximum eigenvalues there are no cointegration relations in both %1 and %5 significance levels.

5.5. Estimation of the Unrestricted VAR

As the series are stationary now and there are no cointegrating vectors, we can estimate the VAR model. According to Sims, if there is true simultaneity among a set of variables, they should all be treated on an equal footing; there should not be any apriori distinction between endogenous and exogenous variables. It is in this spirit that Sims developed his VAR model. (Gujarati; 2003 p.848)

An important decision before estimating the VAR model is the decision of the maximum lag length. If we include too many lagged terms, this will create a degrees of freedom problem and if we include too few lags this will lead to specification errors. The decision of appropriate lag length can be given by the use of criterion such as Akaike, Schwartz, Hannan-Quinn, Final Prediction Error. Then the model that gives the lowest criteria is chosen. VAR Lag Order Selection Criteria in Eviews 6 shows that the appropriate lag length is 3 for this study.

5.6. Estimation of the Structural VAR

From the results of the estimated VAR, the matrices of the long run effects (C(L)) , and the simultaneous effects (C(0)), of the shocks were as follows:

Long Run Effects:

$$C(L) = \begin{pmatrix} Wint \\ TOT \\ RGNP \\ RExchr \\ CPI \end{pmatrix} \begin{pmatrix} \text{(interest rate shock)} & \text{Terms of Trade Shock} & \text{Supply Shock} & \text{Demand Shock} & \text{Nominal Shock} \end{pmatrix} \begin{bmatrix} 0,444330 & 0 & 0 & 0 & 0 \\ 0,230382 & 0,172429 & 0 & 0 & 0 \\ -0,000647 & -0,010524 & 0,025184 & 0 & 0 \\ 0,008752 & -0,007723 & 0,034591 & 0,039571 & 0 \\ 0,147788 & 0,143449 & -0,049176 & -0,070330 & 0,125357 \end{bmatrix}$$

Simultaneous effects:

$$C(0) = \begin{pmatrix} Wint \\ TOT \\ RGNP \\ RExchr \\ CPI \end{pmatrix} \begin{pmatrix} \text{(interest rate shock} & \text{Terms of Trade Shock} & \text{Supply Shock} & \text{Demand Shock} & \text{Nominal Shock)} \\ \hline 0,074036 & -0,056227 & -0,021089 & -0,003148 & -0,004118 \\ 0,031714 & 0,051546 & -0,008868 & -0,008982 & -0,003831 \\ 0,008459 & 0,000726 & 0,022866 & -0,005574 & -0,001150 \\ 0,013807 & 0,013326 & 0,044239 & 0,058385 & 0,002040 \\ 0,041690 & 0,048124 & -0,020907 & -0,033867 & 0,392817 \end{pmatrix}$$

By analyzing the long run and short run effects, it can be checked if the movements of the variables after the shocks are consistent with the theoretical economic model or not.

5.7. The response of Real GNP to shocks in the short and long run

While a shock in the world interest rates effects Real GNP positively in the short run, it shows its serious effects in the long run and decreases the GNP consistent with the theoretical model. This result can be anticipated for Turkey as it has a huge external debt and increase in the world interest rate will bring important costs to the debt burden. There are also fluctuations in Real GNP with the developments in the terms of trade. Terms of trade shock decreases Real GNP in the long run. A positive technology shock, which can be considered as a supply shock, increases GNP both in the short and long run. As it is assumed that demand shocks and nominal shocks do not have any effect on GNP in the long run, there are zeros in the long run matrix for the related fields.

The SVAR system could be used to obtain the impulse responses and variance decompositions of the fluctuations of the variables after shocks.

5.8. Impulse Response Functions

One of the important tools which have made VAR models so attractive is the impulse response functions (IRF). IRF summarizes the dynamic reaction of a variable to a specific shock. The figure below shows the dynamics of the effects of five types of shocks on the real GNP growth rate.

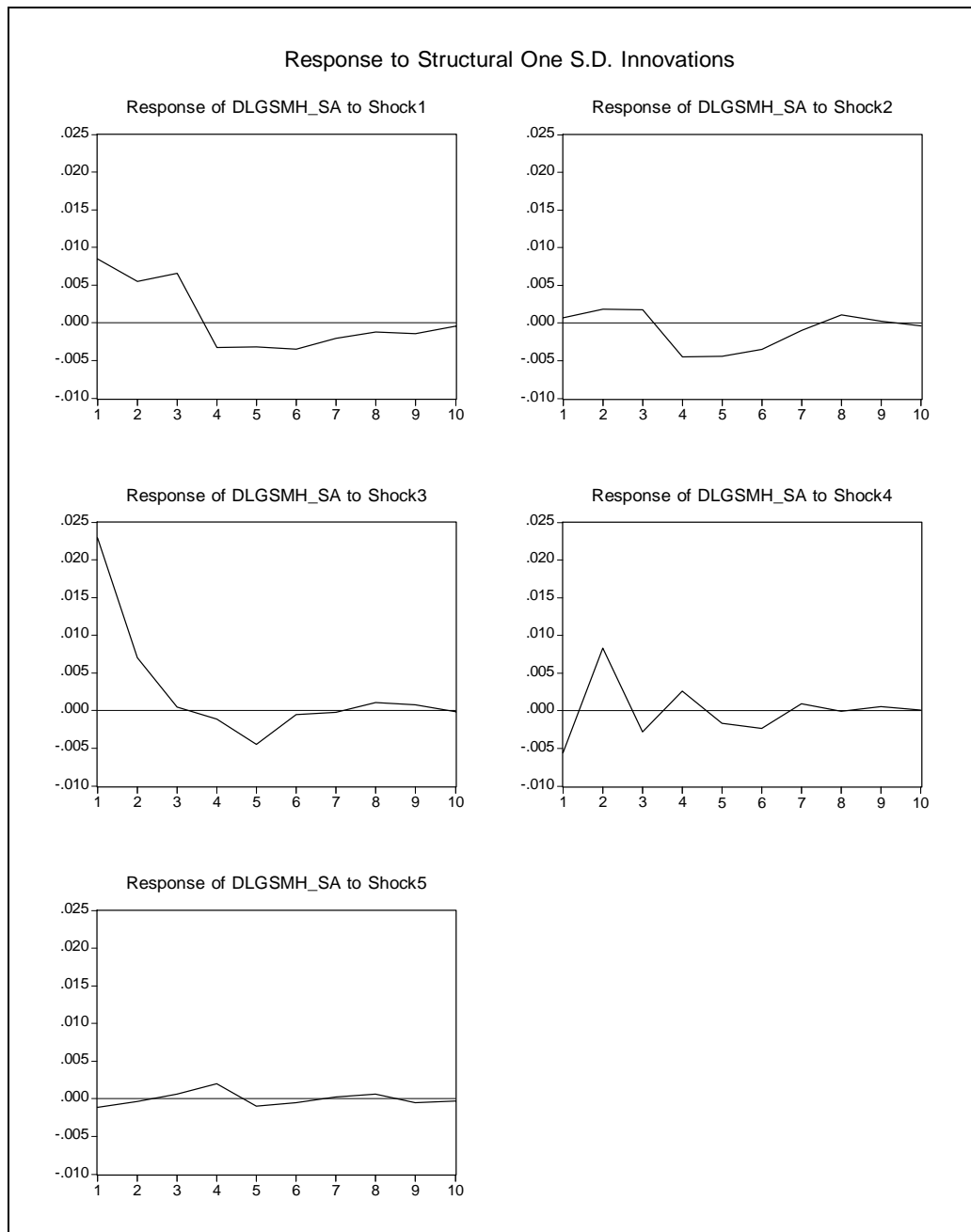


Figure 1: Response of Real GNP to different shocks

As a result of increase in the world interest rates, growth rate of real GNP decreases rapidly. The effect of terms of trade shock on real GNP can be seen after the third period. Initially there is no change in the growth rate of GNP but after the third period, growth rate declines rapidly. It is expected that GNP will increase after positive supply shocks like technology shocks. This increase will come from the increase in productivity of existing factors of production. However, the expected high growth rates after the positive supply shock was not realized in Turkey. On the contrary the growth rate of GNP declined. The reason of this decline can be the deficiency of technological investment in the productivity increases, the mistakes in the choice of sectors for technological advancements or the high cost of resources which are used to renew technology. If the technology investment is made by the use of foreign debt and if the cost of investment is too high, for an increase in growth rates, the initial costs have to be covered first. It should be kept in mind that the adaptation of new technologies to production activity would take some

time. As a result of all these factors, the positive effect of supply shocks on GNP is realized after a period of like two years.

After the demand shock, there are fluctuations in GNP but consistent with the theoretical expectations, demand shocks do not have a significant effect on GNP in the long run.

There are small deviations from the equilibrium rate of GNP after the changes in money supply, but nominal shocks have no significant effects on growth rate of GNP in the long run. As the classical economists denote, money is neutral in the long run.

Moreover, the return of impulse response functions to zero levels shows the stability of the estimated model.

5.9. Variance Decomposition of the effects of the shocks on Real GNP

The variance decomposition of the effects of the five types of shocks on the growth rate of GNP is presented in table 4.

Table 4 Variance Decomposition

Period	S.E.	World interest rate shock	Terms of Trade Shock	Supply Shock	Demand Shock	Nominal Shock
1	0.095469	11.40586	0.083953	83.34738	4.952162	0.210645
2	0.108611	13.07920	0.523650	73.34976	12.86444	0.182948
3	0.120333	17.46153	0.869711	68.52016	12.92949	0.219109
4	0.128442	17.81485	3.073917	65.35558	13.08043	0.675216
5	0.132845	17.90175	4.972110	63.76854	12.62150	0.736097
6	0.137410	18.60980	6.066244	61.78527	12.80197	0.736707
7	0.140358	18.91039	6.129434	61.40481	12.81816	0.737196
8	0.142296	18.96903	6.218693	61.27097	12.76352	0.777789
9	0.143349	19.10890	6.204335	61.13160	12.75109	0.804077
10	0.144240	19.11919	6.212229	61.10849	12.74703	0.813058

Technology shocks which can be regarded as supply shocks, explain %83 of the fluctuations in real GNP in the short run. This effect decreases to %73 in the second period, and continuing to decline in the following periods, decrease to %61 after 10 periods. But consistent with the Real Business Cycle theory, supply shocks are the most important factor which explains the sources of fluctuations in the real GNP both in the short and long runs.

The second important factor that affects real GNP is the changes in the world interest rates. World interest rates explain %11 of fluctuations but this effect increases in the length of time and by the end of 10 th period increases to %19. This figure reveals the dependency of Turkish economies' growth performance to international capital movements which are fed by high real interest rates.

The importance of terms of trade can be seen more apparently in the long run. The effect which is below %1 during the first periods, increases in time and reaches %6 at the end of last period. The reason for this effect is the change in structure of export sector from traditional to industrial goods.

The effect of demand shocks is %5 in the first period and it is stable around %12 in the following periods. The nominal shocks, on the other hand, has little or no effect in explaining fluctuations in real GNP. Their

effect is no more than %1 both in the short and long runs. Nominal shocks are not effective on the level of output in the long run.

We can evaluate world interest rate shocks and terms of trade shocks as external shocks. Turkey as a small open economy does not have power to change the world interest rates which are determined by many factors in the world financial markets. As Turkey has a huge external debt, it is inevitable for Turkey to be effected from the changes in interest rates. Although terms of trade is partially determined by the applied exchange rate policy, export and import prices may change according to the other developments in the world. As a result, world interest rate shocks and terms of trade shocks, which are regarded as external shocks, together explain nearly % 12 of GNP fluctuations in the short run. In the long run the importance of external shocks increase and reach %25. The share of world interest rates is more in this ratio. When simultaneous effects are considered, the internal shocks are more important, but in the long run the effect of external shocks are more apparent. We can say that %75 of the fluctuations in real GNP is explained by factors inside the country.

Conclusion

The analysis of business cycle fluctuations is important for both the evaluation of the developments in economy and the implementation of effective economic policies. The causes of fluctuations in economic activities are one of the controversial topics among the economists. Understanding the impulses and propagation mechanism of the business cycles would be of practical importance for policy makers and economists alike. By using structural vector autoregression (SVAR) technique, in this study we try to identify those shocks that impact Turkish economy and to construct the dynamic responses caused by these shocks. The results of the study suggest that the fluctuations in real output is mainly due to supply shocks both in the short and long-runs. Also, domestic supply shocks, defined as productivity shocks, are the most important disturbances in causing the fluctuations in output.

Although the changes in money supply tend to create small deviations from the long-run trend growth rate of GNP, the nominal shocks, in general, don't have significant effects on growth rate of GNP in the long run. Moreover, the findings of the study indicate that the money is neutral in the long run, supporting the Classical propositions. Therefore for a true understanding of the developments in Turkish economy and designing the economic policies that aims to create an environment that enables stable and sustained long-run economic growth, the results of the study should be taken into account carefully.

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