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Does Foreign Direct Investment Affect Macroeconomic Dynamics? An S-VAR Approach for Turkey

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Abstract

This study analyzes the effects of foreign direct investments (FDI) on the macroeconomic dynamics of the Turkish economy through the Structural Vector Autoregressive (SVAR) model. The results obtained, by the economic theory, reveal the positive effects of FDI on economic growth and domestic investment volume. The results also confirm the assumption of economic theory that domestic and foreign investments are complementary. It is understood that the FDI put some pressure on prices to increase, but it is balanced by the decisions of the monetary authority. While FDI does not play a critical role in reducing unemployment, it significantly contributes to the increase in imports, especially in capital goods.

Keywords: FDI; Macroeconomic variables; Economic policy; SVAR model.

1. Introduction

The development of economic globalization in the last three decades has created a significant increase in capital mobility. This process, which also included FDI, became one of the critical channels that contributed to the increase in trade integration and production volume. Undoubtedly, foreign investments are one of the driving forces of economic growth and development for those who make economic policy decisions today. In macroeconomic terms, it is argued that FDI positively affects fundamental variables such as economic growth, interest rate, inflation rate, trade balance, public investments, private investments, unemployment rate, and real exchange rate. Consequently, the FDI inflows and the economic policies implemented to attract foreign investments to the country have become important factors in terms of the country's macroeconomic performance. In this process, especially technology transfer comes to the fore (Nayak and Sahoo, 2021).

Although the share of FDI in total investments in Turkey remained low, it increased significantly after 2002. This increase is mainly explained by national macroeconomic stability and public sector policies aimed at attracting more foreign investment (Siklar and Kocaman, 2018). In addition, the increases in raw material prices in the world and the imbalances in international markets (long-lasted low-interest rates, low dynamism in developed economies, and economic recessions) have made Turkey an attractive option for international investors.

This study examines the effect of FDI on key macroeconomic variables such as real exchange rate, trade balance, private and public investment volume, output, prices, unemployment, and benchmark interest rate in Turkey. For this purpose, the SVAR model with restrictions reflecting current economic conditions is estimated using quarterly data from 2003:1 to 2021:4. Following this introduction, the study is divided into five parts: The second part mainly discusses the theoretical framework, the third part deals with the stylized facts of FDI and macroeconomic conditions in Turkey, the fourth part examines the SVAR model, the fifth part discusses the estimation results, and finally the last part summarizes the conclusions reached and includes some policy recommendations.

2. Literature Review

In economic theory, the effects of FDI on economic activity in a country is a controversial issue. On one side of this debate is the neoclassical theory of economic growth, based on the Solow (1956) model. Neoclassical growth theory supports that foreign investments will have a positive effect on the economy in the short run. However, this positive effect is not in question in the long run as there is a decreasing return on physical capital. On the other side of the debate is the endogenous growth theory developed by Romer (1986). The endogenous growth theory replaces some of the assumptions of neoclassical theory (for example, replacing fixed factor productivity with the assumption of increasing total factor productivity). According to the endogenous growth model, the production function basically depends on research and development (R&D) activities and human capital accumulation. In this process, as

stated by Yimer (2022), foreign investments are evaluated within the production function and create positive effects on the economy through knowledge or learning (by doing or observing). It should be noted that apart from these two main streams, there are other approaches such as the New Keynesians (also called the new neoclassical synthesis). This approach concentrates on the IS-LM analysis proposed by Hicks in 1937 and elaborated by Hansen in 1949. The basis of the approach is based on the extension of the IS-LM model through the Mundell-Fleming model and, thus, the short-term effects of monetary and fiscal policies can be examined. On the other hand, Kaldor (1966) argued that economic activities are determined by the foreign trade balance, while trade between countries depends on foreign demand and cost reduction. Both of the mentioned approaches relate economic activities to technological diffusion and reach similar results to Romer's endogenous growth theory. Correspondingly, foreign investments support economic growth by contributing to the accumulation of physical and human capital.

There are many empirical studies conducted to explain the relationship between FDI and economic growth. In the majority of these studies, it is concluded that foreign direct investments positively affect economic growth in macroeconomic terms (Yimer, 2022). Since there is a large empirical literature examining the relationship between FDI and economic activities, short summaries in terms of scope, method, and results of prominent studies or studies that analyze recent data are presented in Table 1 below.

The number of studies examining the relationship between FDI and economic activities in the Turkish economy is limited. However, analyzing these relations individually (for example, in the context of economic growth, unemployment, or exchange rate) is quite widespread. Short summaries of some of these studies in terms of scope, method, and results can be examined in Table 2.

Table-1. Short Empirical International Literature

Author(s)	Country (Group) /Region	Methodology	Basic Findings
De Gregorio (1992)	Latin America	Panel regression	Foreign investment is three to six times more efficient than total investment.
Blomstrom *et al.* (1996)	Developing countries	OLS	There is a strong direct impact of FDI on economic growth, as well as an indirect impact through the interaction of FDI with human capital.
De Mello (1997)	Developing countries	Panel causality	Growth – FDI nexus is sensitive to country-specific factors.
Hermes and Lensink (2003)	Developed and developing countries	Panel regression	The development of the financial system plays an important role in enhancing the positive relationship between FDI and economic growth.
Basu *et al.* (2003)	Developing countries	Panel cointegration and causality	Causality between GDP and FDI represents a bidirectional characteristic for open economies while it is unidirectional for less-open economies running from GDP to FDI.
Alfaro *et al.* (2004)	Developed and developing countries	Cross section regressions	FDI's contribution to GDP growth is unclear. Results indicate that the financial deepening positively affects FDI inflows.
Durham (2004)	Developed and developing countries	Cross section regressions	Lagged FDI and equity foreign portfolio investment do not permanently contribute to economic growth. However, in some countries, the results support the view that FDI has a positive effect on financial development.
Hansen and Rand (2006)	Developing countries	Panel cointegration and causality	FDI appears to be growth enhancing much in the same way as domestic investment.
Okuyan and Erbaykal (2008)	Emerging markets	Toda – Yamamoto causality	In Brazil, Mexico, Malaysia, South Korea, Thailand, and Turkey economic growth causes FDI to increase while causality works bidirectionally in Singapore and Indonesia.
Yol and Teng (2009)	Malesia	Error correction methodology	Real Exchange rate, GDP growth and infrastructure investments positively affect FDI, while export volume has a negative effect.
Albuescu *et al.* (2010)	Central and East European countries	Panel GLS and SUR	There is a positive relationship between aggregate demand, trade openness, and labor productivity, while interest rate has a negative effect. Similarly, the existence of a stable financial system is a significant factor to attract FDI.
(Vijaykumar *et al.*, 2010)	BRICS	Panel cointegration	The most important determinants of FDI are GDP, labor cost, infrastructure, real exchange rate, and gross capital formation.
Musa and	MENA	VAR	FDI has a positive (but statistically

Ibrahim (2014)			insignificant) effect on the development of the stock market.
(Jude and Levieuge, 2014)	Developing countries	Panel smooth regression	There is a positive FDI growth effect only beyond a given threshold of institutional quality.
Tripathi *et al.* (2015)	India	VECM	There is a significant correlation between all fundamental macroeconomic variables and FDI except the foreign exchange rate.
Iamsiraroj and Ulusbasoglu (2015)	Developed and developing countries	Meta-regression analysis	FDI positively affects economic growth. This association holds globally as strongly as in the developing world.
Iamsiraroj (2016)	Developed and developing countries	Simultaneous equations system	The causality between FDI and economic growth is bidirectional. Factors (like human capital and trade openness) that stimulate economic growth are also the basic elements affecting FDI inflows.
Asamoah *et al.* (2016)	Sub-Saharan African countries	GARCH	Macroeconomic uncertainty negatively affects FDI flows.
Kanli and Aydogus (2017)	Developed and developing countries	Panel regression	While an increase in CDS premiums negatively affects FDI inflows in middle-income countries, the increase of credit rating to investment grade has a positive effect and causes investments to spread in long term.
Oloyede and Kolapo (2018)	Nigeria	OLS	There is a positive effect of inflation, population and trade openness on FDI while unemployment, exchange rate, and interest rate negatively affect the FDI inflows.
Ozcag *et al.* (2018)	Transition economies	GMM	FDI positively affects economic growth.
Koc and Saidmuradov (2018)	Central Asian countries	Granger causality	There is a unidirectional causality running from FDI to economic growth and energy consumption.
Akadiri *et al.* (2019)	African countries	Panel cointegration and causality	Data support the presence of long-run equilibrium among FDI, GDP, and trade openness. The causality is bidirectional.
Lawson *et al.* (2019)	Ghana	OLS	Inflows of FDI vary within the structural break analyzed and a low percentage of bilateral investment treaties reflect as a contributing factor to FDI.
Sofuoglu *et al.* (2019)	Developed and developing countries	Panel FMOLS and DOLS	Depending on the positive relationship between economic freedom and FDI in the long run, it is concluded that increases in economic freedom raise FDI.
(Agir and Rutbil, 2019)	Developing countries	Granger causality	In the short-run, there isn't any causality relationship between FDI and GDP growth.
Akadiri and Ajmi (2020)	Sub-Saharan African Countries	Panel causality	There is a bidirectional causality relationship between FDI and energy consumption.
Canh *et al.* (2020)	Countries included in World Economic Uncertainty Index	Panel regression	Domestic economic uncertainties have a negative impact on FDI inflows.
Bulut and Balaylar (2021)	Developing countries	Panel regression	There is a negative relationship between FDI and the current account deficit/output ratio while the nonperforming loans ratio and total foreign reserves/total foreign debt ratio display a positive relationship with FDI.
Yimer (2022)	African countries	Dynamic common correlated effects (CCE) estimation procedure	In the long-run FDI positively affects economic growth while short-run effects are not statistically significant. In fragile economies, this relationship entirely disappears.

Table-2. Short Empirical Literature Related to Turkey

Authır(s)	Methodology	Basic Findings
Deichmann *et al.* (2010)	Conditional logit model	Agglomeration, depth of local financial markets, human capital, and coastal access dominate location decisions for the aggregate sample of foreign investors.
Saray (2011)	ARDL	It has been concluded that FDIs coming to Turkey have no effect on employment.
(Gunaydin and Cetin, 2015)	ARDL	In the long run, increases in FDI reduce youth unemployment and there is bidirectional causality between them.
Durmaz (2017)	ARDL	Improvements in democracy have a significant positive impact on FDI flows to Turkey. The results may also put forward that, in the long run, FDI inflows will have spillover effects on Turkey's economy.
Acaravcı and Akyol (2017)	VAR	FDI positively affects GDP growth.
Terzi and Kahveci (2017)	VAR	While FDI and economic growth mutually affect each other, no effect of FDI on employment has been determined.
Benli and Yenisu (2017)	Cointegration	There is a bidirectional causality relationship between FDI and economic growth in both the short and long run.
Yalman and Kosaroglu (2017)	Toda – Yamamoto causality	No relationship was found between foreign direct investments, economic growth, and unemployment.
Umit and Karatas (2018)	Toda – Yamamoto causality	No meaningful relationship was found between FDI and employment.
Dereli (2018)	VECM and Toda – Yamamoto causality	There is no causal relationship between FDI and growth. According to the VECM result, it was concluded that foreign direct investments increase economic growth.
Siklar and Kocaman (2018)	VECM	FDI contributes positively to economic stability. Causality is bidirectional.
Balkanli (2019)	Cointegration and Granger causality	There is a positive relationship between FDI and economic growth in the long run.
Terzi and Bekar (2019)	ARDL	It has been determined that foreign direct investments and openness affect each other positively. In addition, a one-way positive relationship was found from the number of tourists to foreign direct investments. In the long run, it has been concluded that both the number of tourists and the rate of openness affect foreign direct investments positively.
(Canbay and Kirca, 2020)	ARDL	While it was determined that a 1% increase in FDI increased unemployment by 0.96% in the long run, no relationship was found between the variables in the short run.
Ozturk and Pehlivan (2020)	Toda-Yamamoto causality	It was concluded that there is bidirectional causality between FDI and democracy.
Phillip *et al.* (2021)	Time-varying parameter (TVP) approach	The inflow of foreign direct investment, energy use, urbanization, and real income has led to environmental problems in Turkey.
Otluoglu and Sirin (2021)	Panel regression	A positive relationship was found between FDI and ROA and cash flow, which are considered firm performance criteria. On the other hand, the MBV was negatively affected by FDI.
Demir *et al.* (2021)	VAR	There is a bidirectional causality relationship between inflation and foreign direct investments in the long run. On the other hand, there is a unidirectional causality running from economic growth to foreign direct investments.

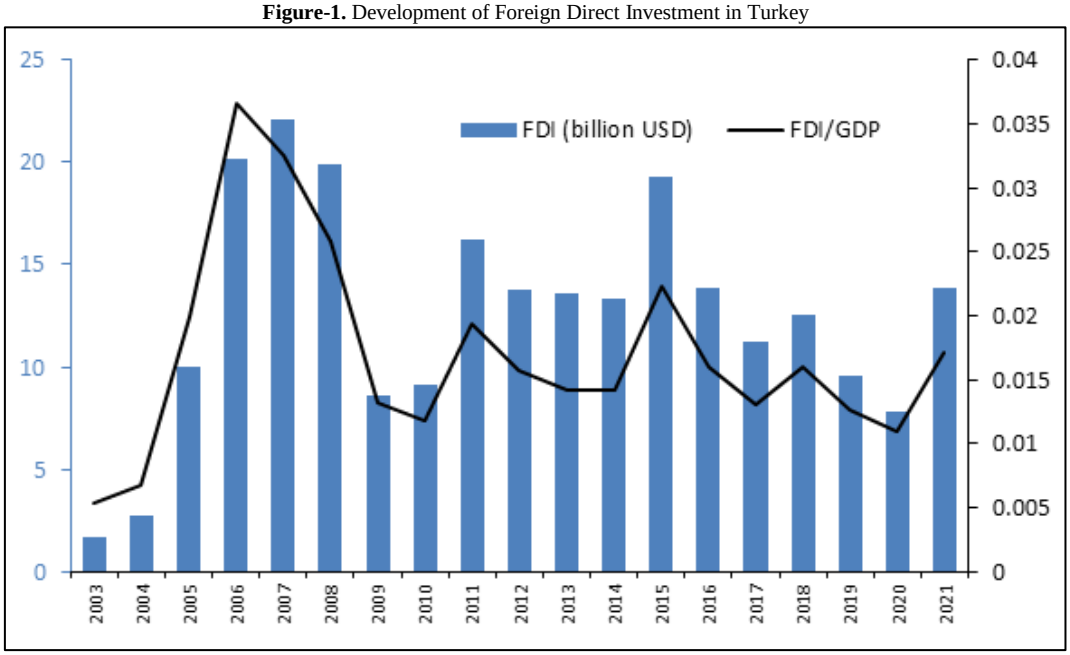
3. Some Stylized Facts

3.1. Foreign Direct Investment

The promotion and regulation of activities related to foreign direct investment in Turkey officially started with the law adopted in 1954. However, Turkey has not been an attractive country for foreign investors due to the import substitution industrialization strategy preferred as a development policy. Transitioning to an export-oriented industrialization strategy in 1980, Turkey established an international direct investment law in 1989 to establish the necessary legal infrastructure. A limited increase was observed in FDI inflows in this period due to the political and economic instability experienced in the country on the one hand and the lack of adequate legal infrastructure on the other. A new direct investment law was enacted in 2003 as a part of the economic reforms implemented following the 2001 banking and real sector crises, the most severe economic crisis in the country. With the changes made over time, this law is still in effect. In order to make a comparison, while the total FDI inflow in Turkey was 15.5 billion dollars between 1989 and 2003 when the first law was in force, this value reached 237.5 billion dollars from 2004 to

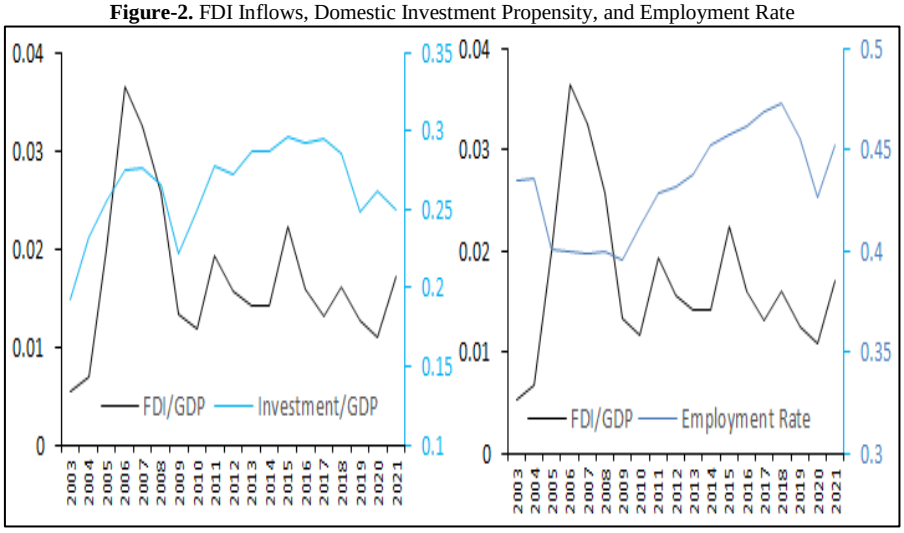
2021. Figure 1 shows the FDI inflows and the foreign direct investments/GDP ratio by years in the 2003-2021 period.

Figure-1. Development of Foreign Direct Investment in Turkey



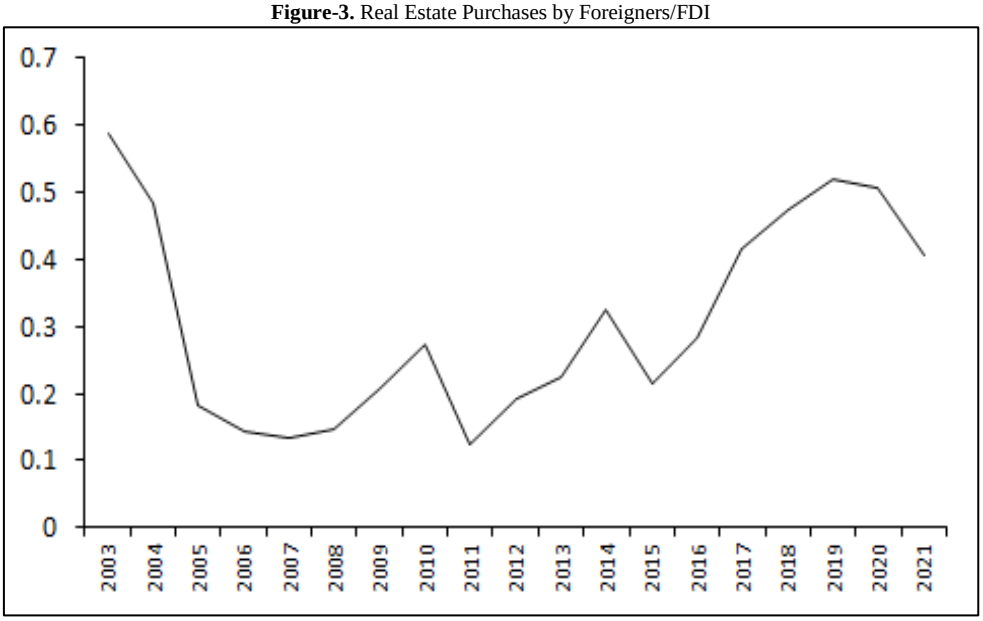
It is observed that the effect of FDI inflows, which intensified especially after 2005, on employment and the total investment volume in the country remained limited (see Figure 2). Considering that FDI inflows are mostly through privatizations and real estate purchases, this result should be considered natural. For instance, in 2007, when the highest inflow was experienced during the analysis period, 17.5 billion dollars of the 22.1 billion dollars investment inflow was realized through privatizations and acquisitions and 3 billion dollars of it was realized through real estate purchases.

Figure-2. FDI Inflows, Domestic Investment Propensity, and Employment Rate



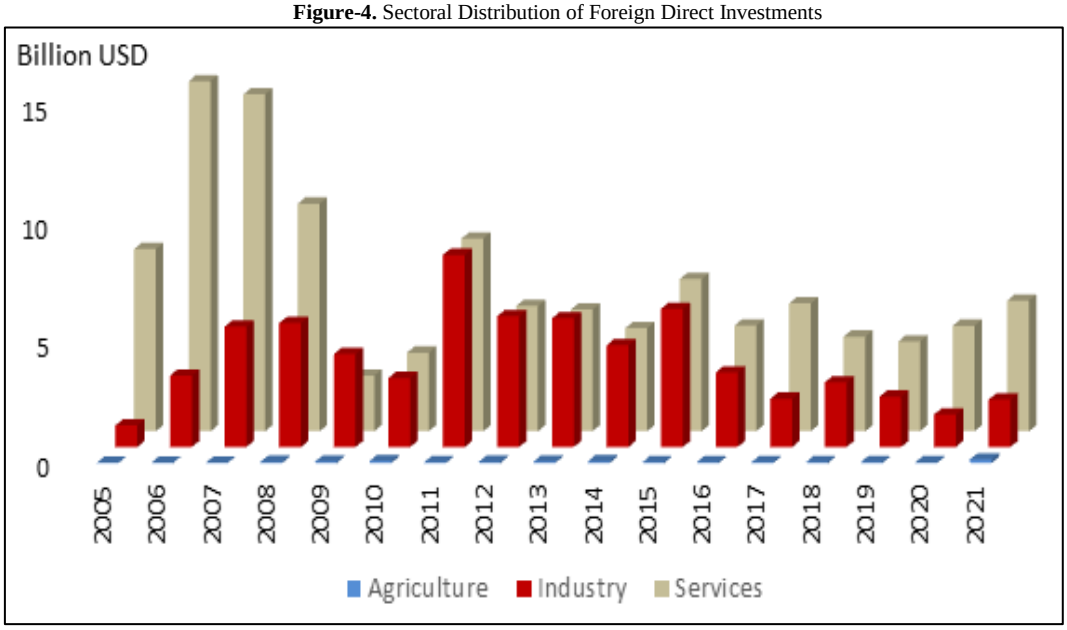
It is observed that FDI inflows decreased by nearly half in 2009 and 2010 with the effect of the 2008 Global Crisis. FDI inflows, which started to recover in 2011 with the change in risk perception, showed an increasing trend until 2015. Presenting a decreasing trend since 2016, inflows show to have increased again in 2021. Most of the foreign investments realized during the review period were in the form of real estate purchases. Most of the foreign investments realized during the study period were in the form of real estate purchases. The share of real estate purchases made by foreigners in the total foreign investment inflows in the 2003-2021 period is shown in Figure 3. Throughout the study period, approximately one-third of foreign direct investment inflows occurred in the form of real estate purchases, while the ratio is around 50% in the last three years.

Figure-3. Real Estate Purchases by Foreigners/FDI



The sectoral distribution of FDI inflows in Turkey can be followed in Figure 4. According to the distribution for the 2003 - 2021 period, the sector with the highest foreign investments is the services with a total of 173.9 billion dollars. This is followed by the industrial sector with 101.5 billion dollars and the agricultural sector with 1 billion dollars. When the sub-sectors are analyzed, the finance and insurance sector received the highest investment with 75.3 billion dollars in the same period, followed by the manufacturing industry sector with 73.4 billion dollars and the telecommunications sector with 38.4 billion dollars.

Figure-4. Sectoral Distribution of Foreign Direct Investments



A sectoral change in foreign direct investment inflows is striking in recent years. Capital inflows started to concentrate in the services sector again, as in the early 2000s. First of all, investments made in the industry are superior to the services in terms of foreign trade availability. Investments concentrated in the services remain weak in terms of contribution to the country's foreign exchange receipts. On the other hand, it is easier for investments made in the services sector to leave the country. This is a factor that increases the probability of experiencing possible balance of payments problems in case of an increase in risk perception.

Figure-5. Distribution of Foreign Direct Investments by Country

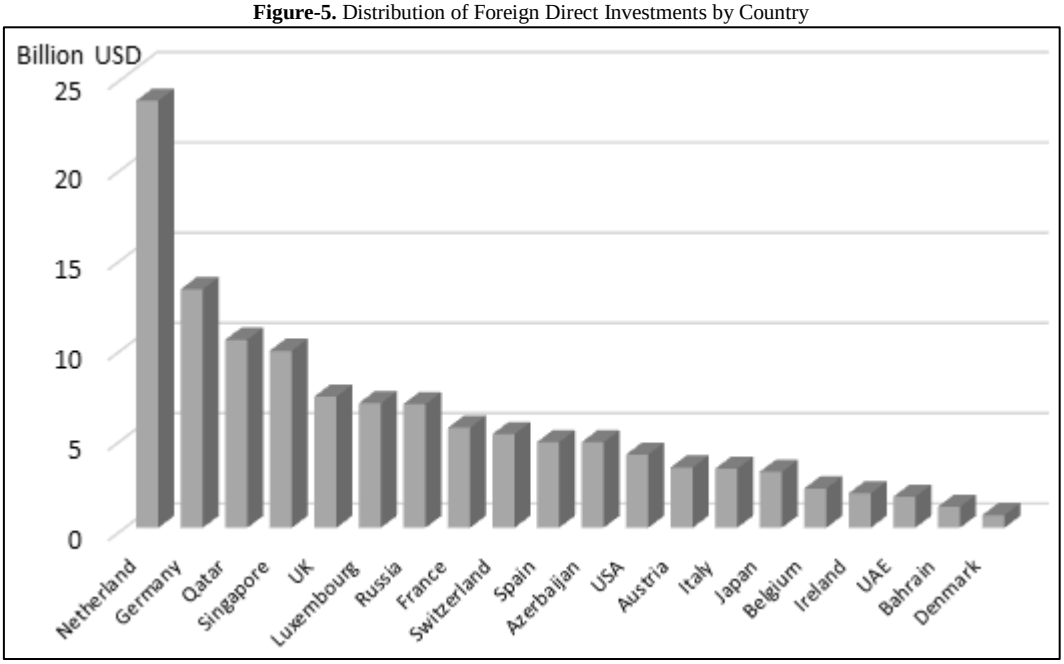
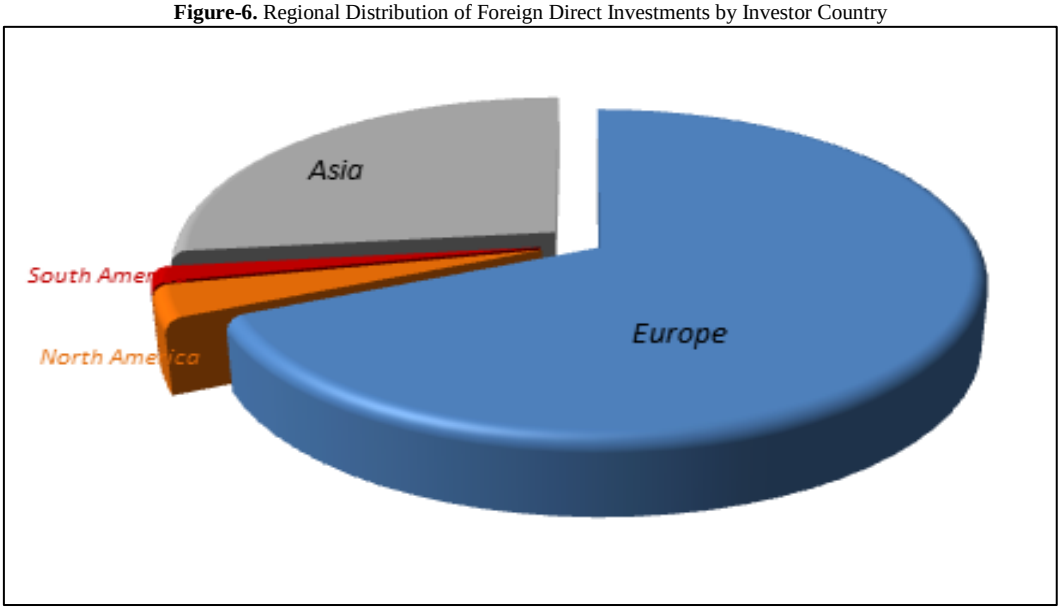


Figure 5 gives the distribution of FDI in the study period by country. The figure covers the 20 countries that made the highest investments in Turkey during 2003-2021. The share of the first 20 countries in total foreign direct investments is approximately 95%. The share of European countries with 68% in total foreign direct investments draws attention. This group is followed by Asia with 27%, North America with 3%, and South America with 1.5% (see Figure 6).

Figure-6. Regional Distribution of Foreign Direct Investments by Investor Country



It is observed that foreign direct investments coming to Turkey during the review period are mostly in the form of company acquisitions (or mergers). Considering this fact together with the rapidly increasing real estate purchases in recent years, as determined in Figure 3, it is thought that the impact of foreign direct investments on economic activities, especially on economic growth, will be limited. This issue will be discussed in the next part of our research.

3.2. Macroeconomic Performance

Throughout the 90s, Turkey suffered the problems of high inflation, undervalued domestic currency, and financing of government budget deficits through Central Bank resources. In this period, economic risks were quite high due to high real interest rates, high inflation, volatile output growth, high government budget deficit, high public debt stock, fragile banking sector, and political instability. With the effect of financial instability in the international economic environment during this period, Turkey faced banking system crises in 1999 and 2001. As a result of the stand-by agreement signed with the IMF in 2001, the exchange rate regime was changed from the crawling peg to the floating one and many structural reforms were implemented. The most important of these are the regulations that bring legal independence to the Central Bank and prevent the financing of budget deficits by creating money. As a result of this structural transformation, the inflation rate dropped to a single digit in 2004 after

30 years. As a result of erasing 6 zeros from the currency unit in 2005 and the atmosphere of trust created, the Central Bank started to implement inflation targeting monetary policy in 2006 (Siklar and Siklar, 2022).

Inflation rates decreased all over the world due to the decrease in total demand and the fall in commodity prices due to the global crisis that started in the American financial markets at the end of 2008 and affected the whole world. In the face of this global development, the Central Bank loosened its monetary policy and turned to monetary expansion and interest rate cuts. However, as a result of the continuation of this monetary expansion, the inflation rate has started to increase again since 2016. As a result of the Covid-19 pandemic, which started to affect Turkey as of March 2020, the volume of economic activity began to contract due to the decreasing domestic and foreign demand. Especially the contraction in the services sector and the decrease in employment reached remarkable dimensions.

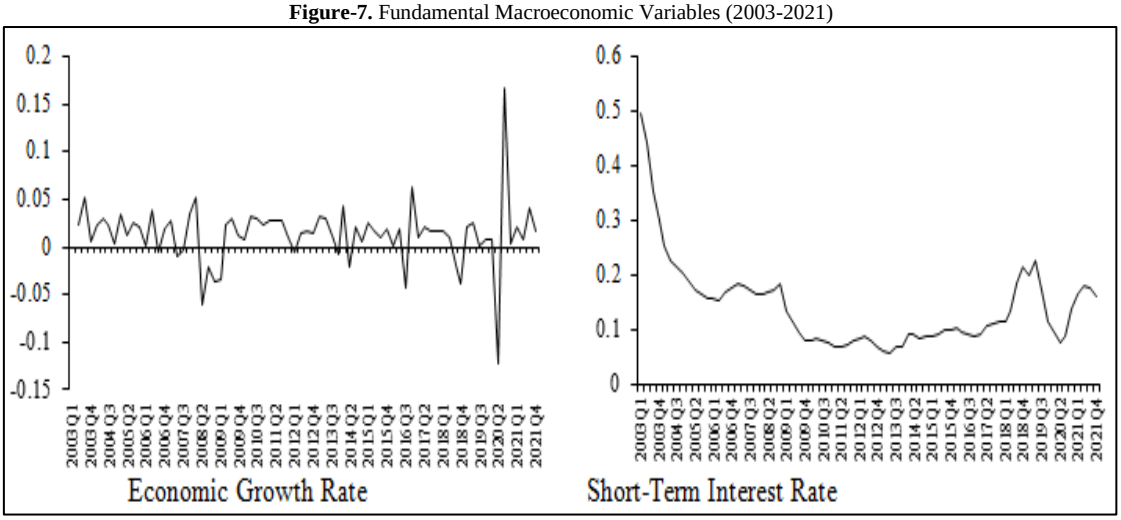
The available data show that the unemployment rate in Turkey has increased gradually over the years. The average unemployment rate was in the 7%-8% range until the 2000s, and fluctuated between 10%-13%, reaching double digits from the 2000s. Youth unemployment has climbed to the level of 25%-30% during the same period. Although some studies support the Okun Law, which states that high growth rates will reduce unemployment rates, they produce results that the Okun coefficient may vary within the framework of cyclical fluctuations (Erdogan *et al.*, 2008). In other words, production falls short of creating employment.

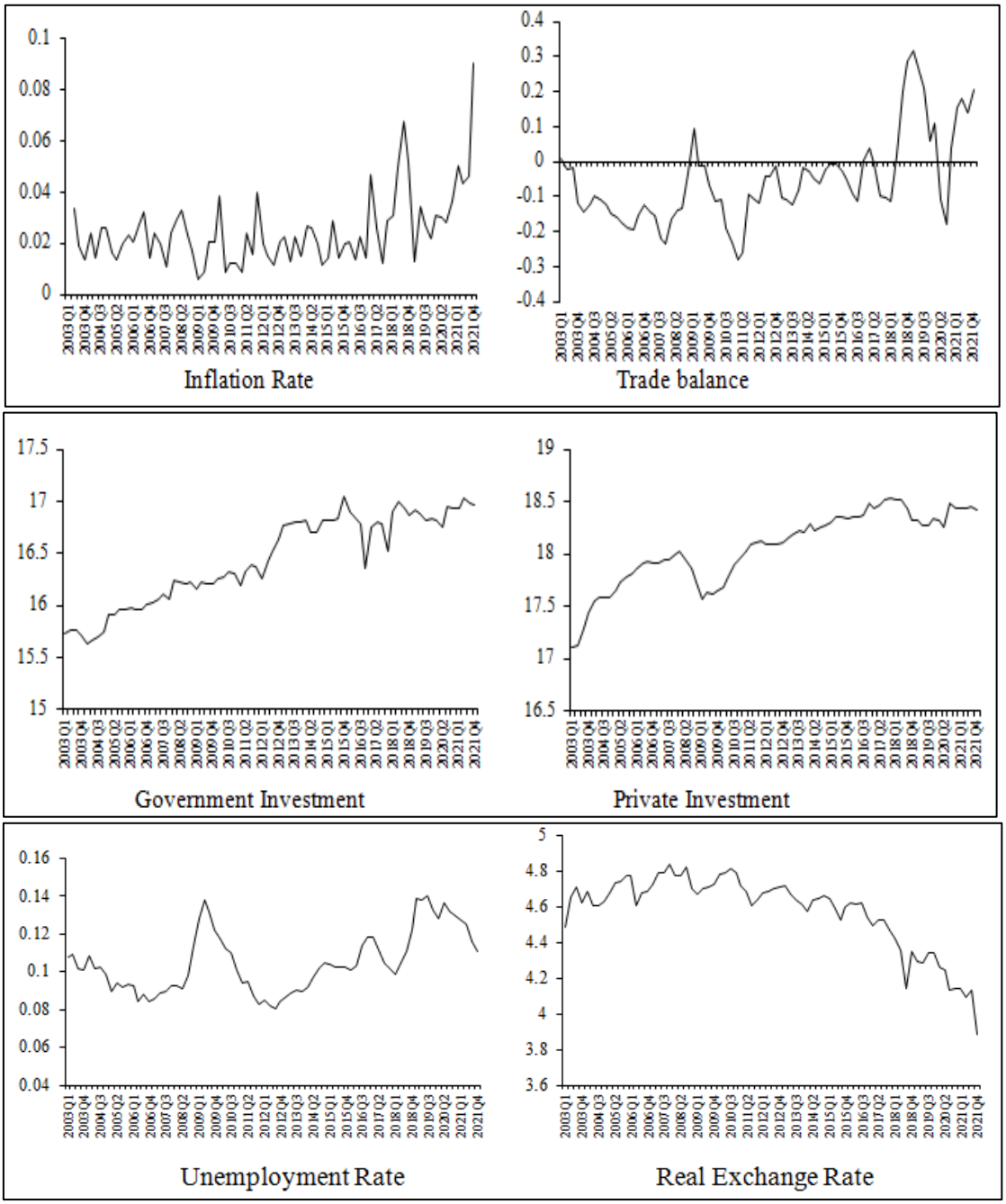
The Turkish economy has adopted an export-oriented industrialization strategy since 1980, and relatively low growth rates have been realized due to long lasted macroeconomic instability. In this context, in an environment where macroeconomic equilibrium could hardly be achieved, there were great fluctuations in output growth rates from year to year. Different growth performances in successive periods created overly optimistic or pessimistic expectations of investment and consumption decisions, further exacerbating the existing economic instability (Tari and Kumcu, 2005). According to TURKSTAT data, the average growth rate in Turkey was 3.54% in the 1990-2002 period and 5.47% in the 2003-2021 period.

When Turkey's current account balance is analyzed, in times of economic crisis, it is observed that the current account deficit has decreased compared to previous years or there has been a current account surplus, in periods when growth rates are high, the current account deficit also increases in parallel with the growth. This situation shows that the Turkish economy has to have a current account deficit in order to grow rapidly, so the production structure is dependent on imported inputs. In addition, Turkey's low level of savings and consumers' interest in imported products are also the determinants of the current account deficit on the consumption side. Studies in the literature associate the current account deficit problem in Turkey with indicators such as the budget deficit, overvalued domestic currency, total loans, oil prices, export/import coverage ratio, and economic growth rate (Turan and Afsal, 2020). According to TURKSTAT data, the current account balance in Turkey ran a deficit of 3.9% of GDP on average in the period 2003-2021 due to the increase in economic growth while the same ratio was, on average, 2.7% in the 1980-2002 period. The current account balance also provides information on whether the equilibrium between investment and savings is achieved. If the current account balance gives a deficit, it is understood that domestic savings are insufficient to finance investments, therefore capital inflows are needed from abroad.

In the context of the basic macroeconomic developments summarized above, the developments observed in the basic macroeconomic variables to be used in this study during the 2003-2021 period can be followed in Figure 7 below.

Figure-7. Fundamental Macroeconomic Variables (2003-2021)





4. Methodology

For our purposes in this study, the structural VAR model stands out as the appropriate method. Since such a multi-equation model allows the determination of dynamic relationships among a large number of variables, it is the main tool used to understand the effects of a shock in one variable on other variables included in the model. From this point of view, we will discuss this section under two headings. We will first examine the specification of the model and then introduce the identification assumptions and structural restrictions.

4.1. Specification of the Model

The relationship between the variables included in the SVAR model including short-term contemporaneous constraints, which we will use in this study, is as follows:

$$\Gamma X_t = \Lambda(L)X_{t-1} + \Omega\xi_t \qquad (1)$$

In this equation, X_t is the vector of endogenous variables we defined in the previous section, $\Lambda(L)$ is an $(n \times n)$ dimension matrix describing the lagged interactions of endogenous variables, and ξ is the normally distributed stochastic error term with zero mean and constant variance [i.e. $\xi \sim N(0,1)$]. Γ and Λ are $(n \times n)$ dimensional matrices showing contemporaneous relationships between variables and linear relationships between reduced stochastic and structural errors, respectively.

Due to the identification problems, it is not possible to directly estimate the equation (1). For this reason, the reduced form VAR model without any restriction is used and restrictions are imposed on the model to identify its structure. The reduced form VAR model can be written as:

$$X_t = \Theta X_{t-1} + \varepsilon_t \qquad (2)$$

where $\Theta = \Gamma^{-1}\Lambda(L)$ and $\varepsilon_t = \Gamma^{-1}\Omega\xi_t$. Accordingly, the stochastic residual terms $(\Gamma^{-1}\Omega\xi_t)$ can be derived from the observable residual terms (ε_t) of the reduced VAR model:

$$\Gamma^{-1}\Omega(\Omega)'^{(\Gamma^{-1})\xi_t(\xi_t)'} = \varepsilon_t(\varepsilon_t)' \quad (3)$$

Using the expectation operator, we can express the above equation as:

$$E[\varepsilon_t(\varepsilon_t)'] = \Gamma^{-1}\Omega(\Omega)'(\Gamma^{-1})'E[\xi_t(\xi_t)'] \quad (4)$$

In this equation, if we define the variance-covariance matrix as $E[\varepsilon_t(\varepsilon_t)'] = \Xi$ and consider that $E[\xi_t(\xi_t)'] = 1$, since the stochastic terms ε_t and ξ_t are $(n \times 1)$ dimensional vectors, the last equation above can be rewritten as :

$$\Gamma\Xi(\Gamma)' = \Omega(\Omega)' \quad (5)$$

According to Lutkepohl (2017) Lütkepohl (2017), the relationship between reduced form stochastic terms and structural terms can be written as follows:

$$\Gamma\varepsilon_t = \Omega\xi_t \quad (6)$$

4.2. Model Identification and Constraints

The data vector X_t consists of endogenous variables:

$$X_t = \{y_t, r_t, \pi_t, f_t, b_t, i_t^g, i_t^p, u_t, x_t\}$$

The definition of the variables in this endogenous variables vector is as follows: y_t: real gross domestic product, r_t: short-term interest rate as a proxy for the monetary policy rate, π_t: headline inflation based on consumer price index, f_t: foreign direct investment, b_t: foreign trade balance, i_t^g: public sector investment, i_t^p: private investment, u_t: unemployment rate and x_t: real exchange rate. While $y_t, r_t, \pi_t, b_t, i_t^g, i_t^p, u_t$ in the model are traditional "fundamental macroeconomic" variables, f_t and x_t are the variables related to the external sector whose effects will be discussed in this study. All variables, except the interest rate and unemployment rate, are used as the first difference in their logarithmic levels.

As stated by Bernanke (1986) and Sims (1986), Γ is considered a non-recursive structure with contemporaneous restrictions. They are largely used to examine the interaction of macroeconomic variables and provide some advantages in this sense: (i) The long-run relationship between some variables, such as fundamental macroeconomic variables and FDI, is not very clear and its determinability is difficult. However, it is possible to determine these relations in the short term based on standard economic knowledge. (ii) In the use of contemporaneous constraints, it is not necessary to impose restrictions on lagged variables. This allows the data used to reveal the interaction between the lagged variables. (iii) Some shocks can be transitory and, therefore, this makes contemporary restrictions more appropriate. Following Lutkepohl (2017), the constraints to be loaded on the Γ and diagonal Ω matrices in equation (6) can be formulated as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & \gamma_{15} & \gamma_{16} & \gamma_{17} & 0 & 0 \\ \gamma_{21} & 1 & \gamma_{23} & 0 & 0 & 0 & 0 & 0 & 0 \\ \gamma_{31} & 0 & 1 & 0 & 0 & \gamma_{36} & \gamma_{37} & \gamma_{38} & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ \gamma_{51} & 0 & \gamma_{53} & 0 & 1 & \gamma_{56} & \gamma_{57} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ \gamma_{71} & 0 & \gamma_{73} & 0 & 0 & \gamma_{76} & 1 & 0 & \gamma_{79} \\ \gamma_{81} & \gamma_{82} & \gamma_{83} & 0 & \gamma_{85} & \gamma_{86} & \gamma_{87} & 1 & 0 \\ \gamma_{91} & \gamma_{92} & \gamma_{93} & \gamma_{94} & \gamma_{95} & \gamma_{96} & \gamma_{97} & \gamma_{98} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon^y \\ \varepsilon^r \\ \varepsilon^\pi \\ \varepsilon^f \\ \varepsilon^b \\ \varepsilon^{ig} \\ \varepsilon^{ip} \\ \varepsilon^u \\ \varepsilon^x \end{bmatrix}_t$$

$$= \begin{bmatrix} \omega_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \omega_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \omega_{33} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \omega_{44} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \omega_{55} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \omega_{66} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \omega_{77} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \omega_{88} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \omega_{99} \end{bmatrix} \begin{bmatrix} \xi^y \\ \xi^r \\ \xi^\pi \\ \xi^f \\ \xi^b \\ \xi^{ig} \\ \xi^{ip} \\ \xi^u \\ \xi^x \end{bmatrix}_t$$

The GDP equation allows determining the dynamics of the production volume against the other variables of the model. y_t can respond to changes in the variables $r_t, \pi_t, f_t, u_t, x_t$ with only one period lag. Therefore, $\gamma_{12} = \gamma_{13} = \gamma_{14} = \gamma_{18} = \gamma_{19} = 0$. On the other hand, since b_t, i_t^g, i_t^p are components of total output, the shocks to be observed in them will simultaneously affect the production volume; i.e. $\gamma_{15} = \gamma_{16} = \gamma_{17} \neq 0$. The short-term interest rate equation (r_t) represents the role of monetary policy in the model. It is accepted that the monetary authority will react by changing the interest rate in case of domestic and international shocks in an economy, and thus the dynamics of the money supply will be reflected in the model. Undoubtedly, there are other tools that the central bank can use, especially open market operations. However, since the purpose of this study is not to discuss the role of monetary policy, such control variables were excluded from the model. The generally accepted approach in economic theory is that the short-term interest rate will be affected by production and inflation. Therefore, we will assume that r_t is simultaneously affected by production (y_t) and inflation (π_t) shocks (Siklar and Siklar, 2021). On the other hand, based on the findings of Kim (2003), we will assume that the short-term interest rate is contemporaneously affected

by the real exchange rate (x_t) because the monetary authority can respond to exchange rate shocks by adjusting the interest rate.

We will assume that the monetary authority will need more than a quarter to assess the effects of f_t, i_t^g and i_t^p since the increases in these variables form a part of the national output and their effects become observable only in later periods. It is therefore unlikely that the output level will react simultaneously to shocks in these variables; that is, it is assumed that $\gamma_{24} = \gamma_{26} = \gamma_{27} = 0$. It can be accepted that monetary authorities cannot contemporaneously react to the deterioration in the foreign trade balance (b_t) for at least two reasons. First of all, the deterioration in the foreign trade balance may be related to a sudden change in the preferences of foreign consumers. The adaptation of the supply to this change and its reflection on the households' income take place gradually. In this case, the monetary authority can only detect these shocks with a lag of a few periods. On the other hand, since foreign trade shocks are temporary, it may be unnecessary for the monetary authority to react. Therefore it is accepted that $\gamma_{25} = 0$. We also assume that the effects of the unemployment rate (u_t) and real exchange rate (x_t) shocks in monetary policy will occur delayed due to data lag $(\gamma_{28} = \gamma_{29} = 0)$.

The variable π_t in the model describes the relative price dynamics in the economy. Considering that prices are sticky in the short run, we will assume that prices are exogenous across all variables except y_t, i_t^g, i_t^p and u_t. In this case, $\gamma_{32} = \gamma_{34} = \gamma_{35} = \gamma_{39} = 0$.

In the context of foreign direct investments, it can be acceptable that foreign investments are exogenous since the inflow of funds that finance them before the relevant projects are implemented. This means that $\gamma_{41} = \gamma_{42} = \gamma_{43} = \gamma_{45} = \gamma_{46} = \gamma_{47} = \gamma_{48} = \gamma_{49} = 0$.

The trade balance can be handled independently of many contemporaneous shocks (except y_t, π_t, i_t^g and i_t^p); that is, it is accepted that $\gamma_{52} = \gamma_{54} = \gamma_{58} = 0$. Since the real exchange rate can affect the foreign trade balance only with a certain lag, a shock will not have a contemporaneous effect on b_t and it can be accepted that $\gamma_{59} = 0$.

Since public investments are programmed by the government with the public budget, they do not react simultaneously to the shocks to be observed in the variables of the model. Therefore, it is accepted that $\gamma_{61} = \gamma_{62} = \gamma_{63} = \gamma_{64} = \gamma_{65} = \gamma_{67} = \gamma_{68} = \gamma_{69} = 0$.

It is accepted that private investments (i_t^p) do not have a contemporaneous relationship with the f_t, b_t and u_t in the model, in other words, $\gamma_{74} = \gamma_{75} = \gamma_{78} = 0$. Unemployment rate (u_t) is considered to have a simultaneous relationship with all variables except FDI (f_t) and real exchange rate (x_t), and it is considered as $\gamma_{84} = \gamma_{89} = 0$. Finally, it is assumed that the real exchange rate (x_t) has a contemporaneous relationship with the shocks in all other variables in the model: $\gamma_{91} = \gamma_{92} = \gamma_{93} = \gamma_{94} = \gamma_{95} = \gamma_{96} = \gamma_{97} = \gamma_{98} \neq 0$.

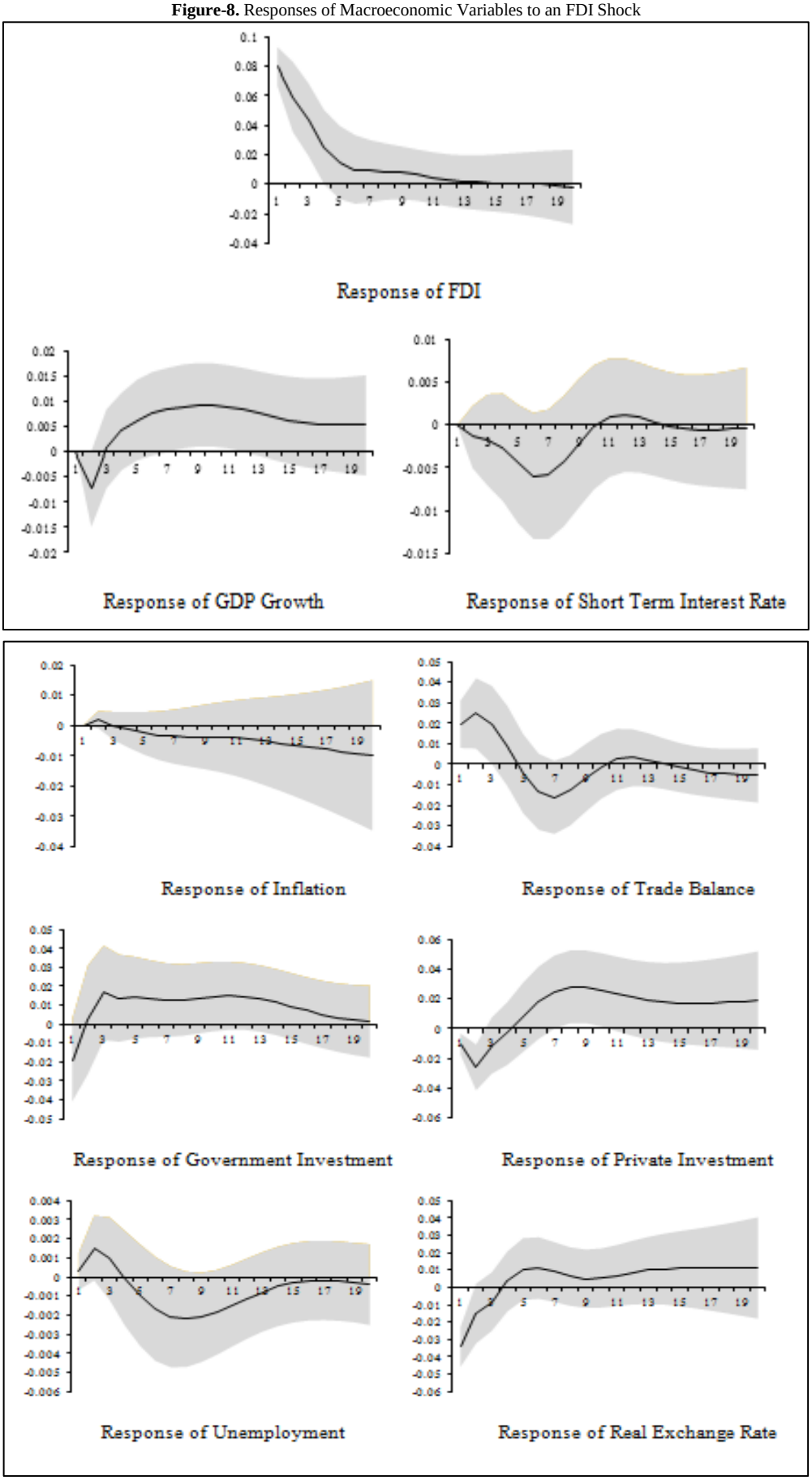
5. Estimation Results

The detailed description and sources of the data for the period 2003:1 – 2021:4 of the variables used in the estimation of the SVAR model, whose details are discussed in the above section, are given in Appendix-1 at the end of the study. The data are seasonally adjusted time series through the X-12 methodology, excluding the policy interest rate. Stationarity tests of the relevant time series show that all series are stationary at the first difference of their logarithmic levels except interest rate and unemployment rate which are difference-stationary at their levels (see Appendix-2). Since most of the criteria used to determine the optimal lag level to be used in the estimation of the model indicate that the appropriate lag length is 2 quarters, this lag was preferred for the estimation of the unrestricted VAR model (see Appendix-3). According to the diagnostic test results of unrestricted estimation, it is seen that parameter stability is provided, there is no problem of autocorrelation and heteroscedasticity, and the residual terms obtained have a normal distribution (see Appendix-4).

Most of the coefficients ($\gamma_{nk}$and ω_{nk}) in the Γ and Ω matrices have expected signs regarding economic theory and are statistically significant (see Appendix-5). Since the evaluation of the coefficients one by one will not contribute to the purposes of this study, the impulse-response functions obtained as a result of the estimation of the SVAR model are presented in this section (Figure 8). Through these functions, it is possible to determine the dynamic responses of the fundamental macroeconomic variables included in the model against FDI shocks.

First, most of the confidence intervals for all impulse-response functions contain zeros during the 20-quarter simulation period. Therefore, the statistical significance of the response sizes should be doubted. Although the obtained reactions are in the expected direction according to the economic theory, their magnitudes should be questioned. For this reason, it is useful to evaluate the comments to be made as a guide.

Figure-8. Responses of Macroeconomic Variables to an FDI Shock



In case of a positive FDI shock, the negative reaction of the production level in the first two quarters turns into a positive one and becomes permanent. When the initial negative reaction is evaluated together with the deterioration in the foreign trade balance in the same period, it is due to the increase in imports due to technology transfer. In terms of a developing economy like Turkey, it can be concluded that foreign investors need high-tech products and demand these capital goods produced abroad. While this increase in import volume affects economic growth

negatively at the beginning, over time (from the 4th quarter) this interaction turns into a positive and becomes permanent.

The response of the short-term interest rate and inflation rate to a positive FDI shock, albeit limited, contributes to economic stability. Particularly, the downward trend observed in the short-term interest rate during the first 6 quarters is remarkable. This situation can be accepted as the reflection of the decrease in the risk premium on the short-term interest rates due to the foreign exchange earning activities of FDI. However, this effect reverses as of the 6th quarter with the introduction of other dynamics in the economy and fades over time. As a natural consequence of its positive effect on production, a positive FDI shock seems to have a modest, albeit limited, reducing effect on inflation. This situation reveals the positive contribution of FDI to economic stability. Considering the existence of the results indicating that the macroeconomic stability accelerates FDI inflows to the country (Siklar and Kocaman, 2018), it is possible to state that the interaction works bidirectional.

It is observed that the positive FDI shock deteriorates the foreign trade balance at the beginning (first two quarters), but then this effect reverses and the foreign trade deficit reducing effect becomes stronger. As stated earlier, the increase in FDI initially creates an increase in imports of capital goods and adversely affects the foreign trade balance. However, as a result of their positive contribution to the export volume in the following periods, this effect is reversed and the foreign trade deficit of the country decreases permanently.

Public and private investments respond positively to an FDI shock. While the response of public investments is limited, private investments give a stronger response. On the other hand, while the positive response of public investments fades over time, the response of private investments is permanent within 20 quarters. This situation indicates that public investments are mostly complementary investments aimed at eliminating infrastructure deficiencies while private investments are especially concentrated in sub-industry investments. The positive effect of FDI on public and private investments reveals that it indirectly strengthens the gross capital accumulation.

The effect of a positive FDI shock on unemployment is quite limited. While the response of unemployment was increasing at the beginning (first 3 quarters), it changes in the direction of decrease in the following periods and fades over time. The reason for this temporary effect on employment is the concentration of FDI in the services sector in Turkey. While it is expected that the effect of FDI on unemployment will be stronger due to the improvements they will create in resource allocation, the fact that this effect is quite weak and temporary is considered an issue that needs to be analyzed separately.

In line with expectations, the response of the real exchange rate to a positive FDI shock is to appreciate, albeit limited. The real exchange rate rises above its initial value as of the 4th quarter and maintains this value throughout the simulation period. This situation can be evaluated as a result of the permanent improvement in the foreign trade balance and the concentration of FDI in foreign exchange earning activities.

6. Conclusion

This study has analyzed the effect of FDI on Turkey's fundamental macroeconomic variables. A structural VAR model with contemporaneous constraints has been developed to detect short-term effects. The results indicate that a positive FDI shock has positive effects on the real side of the economy (such as production, investment, and foreign trade balance). The increase in the amount of domestic public and private complementary investments and the expansion in the export volume determine the contribution of FDI to economic growth and capital accumulation. Although at a limited level, it is seen that FDI has positive effects on variables related to the financial side such as short-term interest rate, inflation rate, and real exchange rate, these are mostly temporary. This indicates that FDI can be considered a factor that can make positive contributions to economic stability. Contrary to expectations, the response of the unemployment rate to a positive FDI shock remains extremely limited. Although limited, the positive effect on unemployment is temporary and disappears within the simulation period.

Although the obtained results show that FDI has positive effects on the fundamental macroeconomic variables, they also indicate that Turkey should take a lead in attracting and directing foreign direct investments to the country. If the foreign direct investment inflows, which have been concentrated in housing purchases in recent years, can be directed to the manufacturing industry, it is clear that the positive effects will grow even more. In this context, the policies to be implemented and the arrangements to be made should be carried out according to new strategic needs within the framework of a medium and long-term plan. Among these, knowledge and technology transfer, which will enable the establishment of new production facilities (or the restructuring of existing ones) that will strengthen the industrialization process, have an important place. With the implementation of this type of strategy, the FDI increase in productive sectors, accompanied by domestic complementary investments, will contribute much more to economic growth and development than ever before.

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Appendices

Appendix-1. Definition and Sources of the Data

Symbol	Explanation
y	Definition: Real Gross Domestic Product Transformation: Seasonal adjustment* - logarithm Period: 2003: I – 2021: IV Source: Turkish Statistical Institution (TURKSTAT)
r	Definition: Monetary Policy Interest Rate (Interbank market overnight interest rate) Transformation: None Period: 2003: I – 2021: IV Source: CBRT – EDDS and EDDS Archive**
π	Definition: Consumer Price Index Transformation: Seasonal adjustment – logarithm Period: 2003: I – 2021: IV Source: TURKSTAT
f	Definition: Net Foreign Direct Investment Transformation: Seasonal adjustment – logarithm Period: 2003: I – 2021: IV Source: CBRT – EDDS
b	Definition: Foreign Trade Balance Transformation: Seasonal adjustment – logarithm Period: 1987: I – 2021: IV Source: TURKSTAT
i^g	Definition: Public Sector Investment Transformation: Seasonal adjustment – logarithm Period: 2003: I – 2021: IV Source: TURKSTAT
i^p	Definition: Private Sector Investment Transformation: Seasonal adjustment – logarithm Period: 2003: I – 2021: IV Source: TURKSTAT
u	Definition: Unemployment Rate Transformation: Seasonal adjustment Period: 2003: I – 2021: IV Source: TURKSTAT
x	Definition: Real Exchange Rate (CPI-based) Transformation: Logarithm Period: 2003: I – 2021: IV Source: CBRT - EDDS

Notes: * All seasonal adjustments have been carried out by using the X12 methodology.
** EDDS refers to the electronic data delivery system of CBRT.

Appendix-2. Unit Root Tests

Variable	Conventional Unit Root Tests					Unit Root with Break Test		
	ADF	Lag**	Prob	PP	Prob	ADF	Lag**	Prob
y_t	2.7413*	1	0.2237	2.3543*	0.2656	2.2766	1	0.9506
Δy_t	11.3052	0	0.0001	11.3052	0.0001	14.0545	0	0.0000
r_t	3.0941	4	0.1157	3.4579	0.2012	3.3112	4	0.1727
Δr_t	5.8691	3	0.0000	4.3709	0.0007	4.3112	4	0.0227
π_t	2.9329*	8	1.0000	3.6542*	1.0000	0.0259	8	1.0000
$\Delta \pi_t$	4.5969	0	0.0022	3.5429	0.0094	5.6019	0	0.0000
f_t	0.4583	0	0.9841	0.5329	0.9868	3.1118	10	0.6199
Δf_t	9.0076	0	0.0000	9.0636	0.0000	9.3445	0	0.0000
b_t	2.8196	1	0.080	2.0654	0.259	7.3993*	1	0.135

			4		1			1
Δb_t	5.2260	7	0.0000	6.6940	0.0000	6.8504	0	0.0000
i_t^g	1.4348	10	0.5599	1.1909	0.6746	3.3758	10	0.4568
Δi_t^g	8.4504	1	0.0000	13.7993	0.0001	10.9617	0	0.0000
i_t^p	1.6609	5	0.4465	3.0330	0.1304	3.8241*	3	0.4851
Δi_t^p	4.2300	4	0.0068	6.8439	0.0000	7.5909	0	0.0000
u_t	2.4777	1	0.1250	2.0723	0.2563	3.6092	1	0.3259
Δu_t	5.4644	0	0.0000	5.5445	0.0000	6.1105	0	0.0000
x_t	0.4973	0	0.9856	0.4973	0.9856	2.7251	0	0.8209
Δx_t	9.7603	0	0.0000	9.7603	0.0000	10.8950	0	0.0000

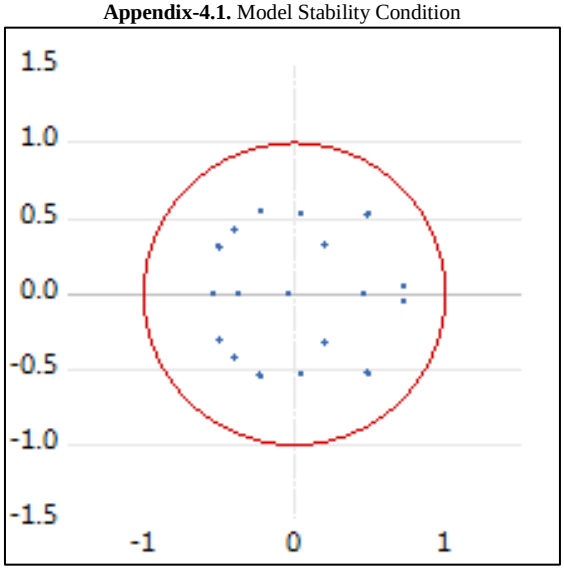
* Refers to trend inclusion.
** Based on Akaike Information Criterion.

Appendix-3. Lag Order Selection

Lag	Log Likelihood	Likelihood Ratio	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan Quin Information Criterion
0	358.5059	---	6.25E-10	-9.8474	-9.7209	-9.7970
1	809.3449	839.0614	3.53E-15	-21.9263	-21.2938*	-21.6745
2	840.1428	53.8963*	2.35E-15*	-22.3373*	-21.1990	-21.8841*
3	852.0250	19.4735	2.67E-15	-22.2229	-20.5787	-21.5683
4	866.5715	22.2239	2.83E-15	-22.1825	-20.0324	-21.3266

* indicates lag order selected by the relevant criterion.

Appendix-4. Diagnostic Tests for VAR Residuals
Appendix-4.1. Model Stability Condition



Appendix-4.2. LM Test for Serial Correlation

Lag	LR Stat.	DF	Prob	Rao F Stat.	DF	Prob
Null Hypothesis: No serial correlation at lag order h						
1	14.8779	81	0.2120	1.0813	81, 248.1	0.2318
2	11.0451	81	0.7067	0.6844	81, 248.1	0.8070
3	10.1793	81	0.8123	1.1216	81, 248.1	0.2081
Null Hypothesis: No serial correlation at lags 1 to h						
1	14.8779	81	0.2120	1.0813	81, 248.1	0.2318
2	39.9189	162	0.4586	1.2751	162, 244.0	0.1607
3	50.3673	243	0.7177	1.0638	243, 183.5	0.3750

Appendix-4.3. White Heteroscedasticity Test

Residuals from the Equation for	R^2	F (36, 36)*	Prob	χ^2 (36)	Prob
y_t	0.4167	0.7145	0.8411	30.4225	0.7307
r_t	0.7138	2.4945	0.0037	52.1103	0.0402
π_t	0.5971	1.4817	0.1214	43.5852	0.1800
f_t	0.5822	1.3934	0.1620	42.5000	0.2113
b_t	0.6224	1.6484	0.0692	45.4359	0.1347
ig_t	0.6792	2.1168	0.0136	49.5787	0.0654
ip_t	0.4016	0.6710	0.8819	29.3145	0.7772
u_t	0.4282	0.7490	0.8050	31.2610	0.6934
x_t	0.6070	1.5442	0.1000	44.3098	0.1611
Joint	--	---	---	1653.5100 (1620)	0.2775

* Numbers in parentheses show degrees of freedom for the relevant distribution.

Appendix-4.4. Normality Test

	Skewness	χ^2	Prob	Kurtosis	χ^2	Prob	Jarque – Bera Stat	Prob
y	0.4304	2.1920 (1)*	0.1387	4.0324	3.1534 (1)	0.0758	5.3453 (2)	0.0691
r	-0.2632	0.8198 (1)	0.3652	2.1092	2.3477 (1)	0.1255	3.1675 (2)	0.2052
π	-0.0674	0.0537 (1)	0.8167	2.8567	0.0607 (1)	0.8053	0.1145 (2)	0.9444
f	0.4624	2.5301 (1)	0.1117	3.3125	0.2888 (1)	0.5910	2.8190 (2)	0.2443
b	-0.4170	2.0577 (1)	0.1514	2.8965	0.0317 (1)	0.8587	2.0894 (2)	0.3518
ig	0.2362	0.6601 (1)	0.4165	2.8971	0.0313 (1)	0.8596	0.6914 (2)	0.7077
ip	-0.3663	1.5881 (1)	0.2076	3.0503	0.0075 (1)	0.9311	1.5956 (2)	0.4503
u	-0.0141	0.0023 (1)	0.9614	3.1999	0.1182 (1)	0.7310	0.1205 (2)	0.9415
x	0.0029	0.0001 (1)	0.9931	2.3743	1.1582 (1)	0.2818	1.1583 (2)	0.5604
Joint	---	9.9041 (9)	0.3538	---	7.1974 (9)	0.6166	17.1015 (18)	0.5161

* Numbers in parentheses show degrees of freedom for χ^2 distribution.

Appendix-5. Estimates of Γ and Ω Matrices

$$\Gamma = \begin{bmatrix} 1 & 0 & 0 & 0 & 1.7253 & -0.1687 & 2.1350 & 0 & 0 \\ -0.1631 & 1 & -0.4219 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1.5052 & 0 & 1 & 0 & 0 & -0.1755 & 0.8403 & -1,3823 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ -4.7142 & 0 & 8.7934 & 0 & 1 & 2.6386 & 3.0109 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ -1.2659 & 0 & -2.7354 & 0 & 0 & 0.0754 & 1 & 0 & -0.5272 \\ 0.4105 & 0.1498 & 0.0655 & 0 & -0.1309 & -0.0287 & -0.0971 & 1 & 0 \\ -0.6697 & -0.7625 & 0.7808 & 0.6262 & 0.0988 & 0.1440 & 0.5954 & -0.7565 & 1 \end{bmatrix}$$

$$\Omega = \begin{bmatrix} 0.1511 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.0137 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.1010 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.0838 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1.1021 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.1181 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.0473 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0076 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0505 \end{bmatrix}$$

Parameter	Coefficient	z-statistic	Probability	Parameter	Coefficient	z-statistic	Probability
γ_{21}	-0.1631	1.8397	0.0658	γ_{76}	0.0754	1.1938	0.2326
γ_{31}	-1.5052	0.4409	0.6593	γ_{86}	-0.0287	1.7723	0.0763
γ_{51}	-4.7142	1.1975	0.2326	γ_{96}	0.1440	2.1094	0.0349
γ_{71}	-1.2659	2.7644	0.0057	γ_{17}	2.1350	0.2203	0.8256
γ_{81}	0.4105	2.0324	0.0421	γ_{37}	0.8403	0.4443	0.6568
γ_{91}	-0.6697	1.1394	0.2545	γ_{57}	3.0109	0.0944	0.9248
γ_{82}	0.1498	1.7597	0.0785	γ_{87}	-0.0971	0.9560	0.3391
γ_{92}	-0.7625	1.5119	0.1305	γ_{97}	0.5954	1.9488	0.0513
γ_{23}	-0.4219	2.1130	0.0346	γ_{38}	-1.3823	0.3417	0.7325
γ_{53}	8.7934	9.1118	0.0000	γ_{98}	-0.7565	0.4578	0.6471
γ_{73}	-2.7345	1.7814	0.0748	γ_{79}	-0.5272	2.8559	0.0043
γ_{83}	0.0655	0.1902	0.8492	ω_{11}	0.1511	0.2506	0.8022
γ_{93}	0.7808	0.9922	0.3211	ω_{22}	0.0137	11.6351	0.0000
γ_{94}	0.6262	6.4482	0.0000	ω_{33}	0.1010	0.3428	0.7318
γ_{15}	1.7253	0.2184	0.8271	ω_{44}	0.0838	12.0830	0.0000
γ_{85}	-0.1309	1.7930	0.0730	ω_{55}	-1.1021	0.0924	0.9264
γ_{95}	0.0988	0.7006	0.4836	ω_{66}	0.1181	12.0830	0.0000
γ_{16}	-0.1687	0.4588	0.6464	ω_{77}	0.0473	3.9185	0.0001
γ_{36}	-0.1755	0.2911	0.7710	ω_{88}	0.0076	2.9594	0.0031
γ_{56}	2.6386	0.1014	0.9192	ω_{99}	0.0505	8.0000	0.0000

Log-likelihood 1414.30.
Likelihood Ratio Test for Over Identification: χ^2 (5) = 8.1814; Probability = 0.4465.