THE RELATIVE SENSITIVITIES ANALYSIS BETWEEN THE ECONOMIC GROWTH RATE AND SELECTED MACROECONOMIC VARIABLES: TURKEY CASE

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ABSTRACT

The aim of this study is the investigation of the relations between the selected macroeconomic variables and the economic growth rate for the period of 1987-2010 in Turkey. Relative Sensitivities Analyasis (RSA) was used to accomplish this aim. This statistical method is used for examining the relationships between variables in the over time. According to the results of study, consumption budget balance has higher relative sensitivity on the economic growth rate than the other variables. On the other hand, changes in the stock of external debt and current account deficit have no effect on the economic growth rate, expect periods of 1991, 1994, 2001 and 2008-2009. In this context, for the stabilization of the economic growth rate, especially consumption expenditure and budget deficit should be considered.

Keywords: Economic Growth, Macro Models, Relative Sensitivities Analysis.

JEL Classification: O40, O11,C680.

EKONOMİK BÜYÜME ORANI VE SEÇİLMİŞ MAKROEKONOMİK DEĞİŞKENLER ARASINDA BAĞIL DUYARLILIK ANALİZİ: TÜRKİYE ÖRNEĞİ

ÖZ

Bu çalışmanın amacı bazı makroekonomik göstergeler ile ekonomik büyüme arasındaki ilişkileri,1987-2010 dönemi Türkiye için incelemektir. Bu amaçla Bağıl Duyarlılık Analizi kullanılmıştır. Bu istatistiksel yöntem değişkenler arasındaki ilişkileri, zaman içindeki değişimleri dikkate alarak, kapsamlı biçimde incelemektedir. Çalışmanın sonuçlarına göre, tüketim harcamaları ve bütçe dengesinin ekonomik büyüme üzerinde diğer değişkenlere göre bağıl duyarlılığı yüksektir. Öte yandan, dış borç stoku ve cari açıktaki değişimler ile ekonomik büyüme arasında, 1991, 1994, 2001 ve 2008-2008 dönemleri dışında, bağıl duyarlılık zayıftır. Bu kapsamda, ekonomik büyüme hızının istikrar kazanmasında özellikle tüketim harcamaları ve bütçe dengesine kontrol edilmelidir.

Anahtar Kelimeler: Ekonomik Büyüme, Makro Modeller, Bağıl Duyarlılık Analizi.

JEL Classification: O40, O11,C680.

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1. Introduction

Fluctuations in economic growth lead to macroeconomic instability. In such a case, domestic and foreign investors see risk in this economy and the total investments decline. Accordingly, decreased gross domestic production and increased unemployment happens. Beside this, the trade deficit emerges if the country's exports less than imports. Implemented policies ensure external balance effect to internal balance or vice versa. For government, to stop economic instability and provide confidence in the market is getting more difficult. In particular, if there is not a high create added value production in an economy, fluctations will occur in economic growth and internal&external imbalance problems are usually resolved interest rate and exchange rate instruments.

Figure 1. Growth Rate of the Turkey's GDP for 1987-2010 Periods

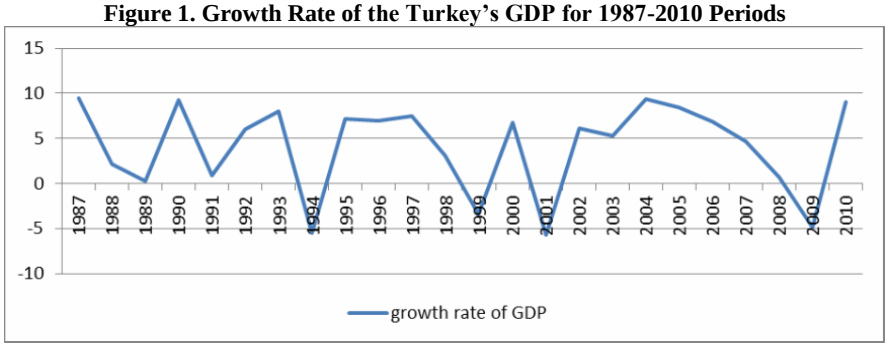


Figure 1 shows that Turkey's economic growth followed by a decreasing trend from 1987 to 1989 and then reaches to 9.4% in 1990. During the 1990s, economic growth rate takes negative values due to economic crises in the years 1994, 1999 and 2001. After 2002, Turkey's economic growth rate has an increasing trend and reaches up to 8.9% in 2004. It has gone into a decreasing trend from 2005 and this trend continues until 2010 under the effects of the global economic crises. In 2010, the growth rate started to take positive values again.

In previous studies, high interest rates & low exchange rate policies or economic growth policies dependent on high foreign saving were generely examined as cause of fluctuations in economic growth in Turkey. This study contributes to the literature by using a different method for investigating the cause of the fluctuations in growth. The second part of the study examines early studies in the literature under the hypothesis of endogenous growth. The third part of the study describes the variables and the applied method. Results are evaluated in the fourth part. The paper is completed with the conclusion and policy recommendations. According to the literature, the relative sensitivity method has been not used in this area.

2. Economic Theory and the Literature Analysis

Economic growth has gained new perspectives and attention due to the developments in endogenous growth theories. These theories bring new possibilities in the analysis and insight using new modelling processes which use intensive mathematics and econometric techniques (Fine, 2000: 245). According to these endogenous growth models open economic policies, foreign trade restrictions, capital savings, foreign investment volume affect to the economic growth rate (Dollar, 1992, Bahmani-Oskoee ve Domac, 1995, Sachs and Warner, 1995, Lee, 1996, Frankel and Romer, 1999, Miller and Upadhyay, 2000, Arnold, Javorcik and Mattoo, 2006).

Beside this, there is usually an inverse relation between economic growth and the current account balance in endogenous growth theories. This situation arises due to the import dependent growth and the increments in economic growth rates causes serious problems in current balances (Debelle-Faruqee,1996, Kandil-Greene, 2002). On the other hand, Post-Keynesian approaches takes the demand into consideration and then investigates the payment limitations for the explanation of the relationship between trade and growth (Jayaraman, 2001: 13-21). Furthermore, public expenditure is an external factor that can be used as a strategic tool for directing the growth rate and improving the short-term alternations. Hence, there is a causality between the public expenditure and the growth rate. Contararily, public expenditure is an internal variable in Wagner Law and the direction of the causality is from the economic growth rate to the public expenditure.

Oskooee and Domac (1995) concluded that there is a bi-directional long term correlation between the economic growth and export volume using co-integration and error correction model for the period of 1923-1990. Freund (2000) has determined that the increase in the economic growth rate increases consumption expenditures and decreases savings volume and hence causes deficit in the current balance using time series and panel data using the information on 25 countries having $10000 or more GDP per person in the period of 1980-1997. Dominguez (2005) investigated the economy of Singapore after the 1997 crisis using least squares approximation (LSA) for the period of 1999-2003. It is concluded that the increments in GDP has a negative effect on current balance.

Calderon et al (1999) determined that there is an inverse and weak relation between the growth rate and the current account deficit using generalized method of moments (GMM). Chin and Prasad (2000) used Least Squares (LSQ) and Finite Effect Method (FRM) and concluded that there is an extremely weak relation between the growth rate and current balance uing the data of 70 countries between 1971-1995. Bussiere et al (2004) investigated the variables of current balance using LSDV and GMM methods for developed and developing countries for the periods of 1980-2002 and 1995-2002. They have found out that there is a statistically weak and inverse relationship between the current account balance and the economic growth

rate. On the other hand, openness has a positive effect in technological efficiency hence providing an increase for the growth rate (Lee, 1996 and Arnold, Javorcik, Mattoo, 2006). Utkulu and Ozdemir (2004) have estimated the effects of trade liberalization on the economic growth rate using endogenous growth theory for the period 1995-2000. They have concluded to a long term positive relation using co-integration methods. Accordingly, the increment of the growth rate of Turkey is due to the openness and the removal of foreign trade restrictions after the year 1980, which is estimated by the endogenous growth theory.

In another study, it is concluded that there is not a causal relation between the export volume and the economic growth by applying Johansen co-integration method to seasonal data (Ozmen and Furtun, 1998). There are various studies on the investigation of the relation between the public expenditure and the economic growth rate such as (Sattar, 1993), (Terzi, 1998), (Halıcıoğlu, 2003), (Yigidim and Kose,1997), (Yamak and Zengin, 1996), (Ulusoy and Zengin, 1998), (Demirbas, 1999), (Simsek, 2004). For example, (Sattar, 1993) has argued that the public expenditure has a positive effect on the economic growth of developing countries while it has a negative effect in the developed countries. This result is in accorance with the Wagner Law for the developed countries and the Keynesian approach for the developing countries. Terzi (1998) tested the Wagner Law using time series technique for the period of 1960-2000. The results of this study does not fully comply with the Model 1 of the Wagner Law however it shows that there is a long term relation between the economic growth and the public expenditure. Yigidim and Köse, (1997) performed Granger causality test for the 1980-1996 period and concluded that the public expenditure does not have an effect on the economic growth but the most influential factor on the economic factor of Turkey is the import volume. In another study, Sarı (2003) investigated the total expenditure, current expenditure, total foreign debt, total investment and foreign debt expenditure using the Wagner hypothesis and obtained results that are in accordance with this hypothesis.

3. Variables Used in This Study, Statıonarity Tests and the Application Method

In this study, the relations among the economic growth rate, current deficit, foreign borrowing, budget balance, investment and consumption expenditure, openness, export and import volumes in Turkey between the period of 1987:Q1-2010:Q4 are investigated using Relative Sensitivities Analysis. Relative sensitivities between the growth rate and other variables as a function of the period are also obtained in order to visualize the effects of the independent variables on the growth rate and to provide insight for the economic policy makers.

3.1 Variables

Variables used in this study are normalized using the general level of price the year 1987 and the ratio of GDP. These are economic growth rate (GTR), current

account balance (CADTR), total foreign debt stock (EDTR), budget balance (BTR), investment expenditure (ITR), consumption expenditure (CONTR), import volume (IM), export volume (EXTR), The ratio of the sum of import and export volumes to the GDP (OPEN). Variables are taken from the Central Bank, Statistics Institute and Ministry of Development of Turkey.

3.2. Stationarity Tests

Time series need to be stationary for using analysis (Gujarati, 1995, p.750). Various tests are used to check if the time series is stationary or not. Among these tests, ADF (Augmented Dickey-Fuller), PP (Phillips-Perron) ve KPSS (Kwiatkowski, Phillips, Schmidt, Shin) unit root tests are widely utilized. PP and KPSS tests are performed on the time series in this study. PP unit root test is applied a non-parametric improvement to remove the autocorrelation. On the other hand, parallel hypotheses are checked with ADF test. In both of the unit root tests, a delay length to convert the error term to white noise is determined. Various information criteria are used to determine the lag length. Some of theese criteria are Akaike (ACI), Schwartz (SC) and Final Prediction Error (FPE) criteria (Johansen, 1995; Enders, 1995). The simplest form of PP test can be given as in Equations (4) and (5) (Phillips-Perron, 1988).

$$Y_t = \mu_1 + \varphi_1 Y_{t-1} + e_t \quad (4)$$

$$(1-\varphi_1 L)Y_t = \mu + e_t \quad (5)$$

The unit root is found as $1/\varphi$ when t=1, 2, ..., T. The series is said to have unit root if $\varphi = 1$. The formula used for PP test is shown in Equation (6). CF is the correction factor.

$$Z_0 = T(\varphi_1 - 1) - CF \quad (6)$$

The lag length for converting the error term into white noise can be determined by Akaike and Scwartz criteria. Zero hypothesis in PP test implies that the time series which are not differentiated have unit roots which also means that these series are not stationary. In zero hypothesis, φ coefficient is tested against being zero statistically. It means that this hypothesis is rejected if φ coefficient is statistically important. In this case, the time series is stationary. The tests used for Dickey-Fuller are defined as Z in PP test.

Some studies in the literature support KPSS test since ADF and PP tests are sensitive to the lag length. KPSS test is developed by Kwiatkowski (Kwiatkowski et al, 1992). The zero hypotheses of ADP-PP tests and KPSS tests are the inverse of each other. In ADF and PP tests, the existence of unit tests implies the zero hypothesis while in KPSS test, being stationary is taken as zero hypothesis. KPSS test statistics can be given as in Equation (7) (Kwiatkowski et al., 1992, p. 54).

$$\eta_\mu = T^2 - \sum_{t=1}^{T} S_T{}^2 / s^2 \quad (7)$$

The limited delay parameter has to be determined for l → ∞ for the consistency of t=1,2,...T, *s* 2 (l) . S_T shows the partial process sum of the residuals. The calculated value is compared to the critical value for testing the hypotheses.In KPSS test, the verification of the hypothesis shows that the series is stationary. The aim of the KPSS test is the removal of problem caused by the existence of the unity test from the deterministic trend via changing this trend. KPSS test is different than the similar unit root tests from this viewpoint. Another important property of the KPSS test is that the variance of the random walk test is zero since it implies the stationary trend of H_0 hypothesis (Kwiatkowski et al., 1992: 159-178).

Table 1. The Results of Stationary Tests

Variables	PP, Level		KPSS, Level	
	Constant	Constant&trend	Constant	Constant&trend
GTR	-5.102* (-3.500)	-5.086* (-4.057)	0.0366* (0.739)	0.0365* (0.216)
CONTR	-12.991* (-3.500)	-13.348* (-4.057)	0.204* (0.739)	0.260* (0.216)
CADTR	-4,619* (-3,500)	-5,754* (-4,057)	0,859* (0,739)	0,084* (0,216)
EXTR	-3.018* (-3.500)	-3.907 (-3.457, 5%)	0.903* (0.739)	0.150 (0.156, 5%)
EDTR	-2.724 (-2.583, 10%)	-3.256 (3.154, 10%)	0.770 (0.830, 10%)	0.122 (0.146, 5%)
	PP, 1. Difference		KPSS, 1. Difference	
BTR	-9.592* (-3.50)	-9.574* (-4.056)	0.117* (0.739)	0.079* (0.216)
ITR	-5.578* (-3.500)	-6.131* (-4.057)	0.345* (0.739)	0.113* (0.216)
IMTR	-10.869* (-3.501)	-11.486* (-4.058)	0.273* (0.739)	0.076* (0.216)
OPEN	-11.973* (-3.501)	-12.445* (-4.058)	0.463* (0.347)	0.211* (0.216)

*, statistically meaningful according to 1% meaning level. The lag length is 5 in PP analysis (New-West Bandwith). Exponential Correction Method (Holt-Winters-No Seasonal) is used for the removal of seasonal effects.

The lag length is selected according to LM statistics in KPSS test. GTR, CONTR, CADTR, EXTR, EDTR are level stationary variables according to PP and KPSS test results. Other variables are first difference stationary.

3.3. Aplied Method

Relative Sensitivity Analysis (RSA) is used in this study. The relationships between variables can be seen in a more comprehensive way with this method. In comparative statistical analysis, changes in endogenous variables are investigated in connection with the change in exogenous variables. In other words, changes in an

economic outcome is investigated and then the influences on the other economic parameters are determined. The research on the changes of economic inputs and outputs can be viewed as a branch of a more general statistics area called sensitivity analysis. Elasticity is also a subset of sensitivity analysis, which is given as the sensitivity measurement of an economic variable such as the demanded quantity to one of its determinants such as income.

Several local and global sensitivity analyses applied to microeconomic and macroeconomic problems exist in the literature. In (Borgonovo and Peccati, 2004), absolute sensitivity analysis is applied to the equations regarding the investment decisions and then the elasticity of survival risk validation is investigated. Similarly, a global sensitivity analysis is performed on investment decisions in energy sector (Borgonovo and Peccati, 2006).

In statistics, basically three types of sensitivities can be calculated in order to provide insight to the analysts, namely absolute sensitivity, semi-normalized sensitivity and the normalized (relative) sensitivity. Let the outcome of a model be y, which is a function of input variables such *x1, x2,...., xn* as shown in Equation (8).

$$y = f(x_1, x_2, \ldots, x_n) \tag{8}$$

Absolute sensitivity is defined as the absolute change in the output *y* with respect to the change in one of the input variables, *x*.

$$S_{abs} = \frac{\Delta y}{\Delta x_n} \tag{9}$$

Semi-normalized sensitivity includes the change in the output variable with the ratio of the changes of output and input variables as given in Equation (10).

$$S_{semi-norm} = y\frac{\Delta y}{\Delta x_n} \tag{10}$$

Absolute values and the rate of changes of both output and input variables exist in the definition of the relative sensitivity as formulated in Equation (11).

$$S_{abs} = \frac{y}{x}\frac{\Delta y}{\Delta x_n} \tag{11}$$

Relative sensitivity is utilized in various fields in theoretical and applied science such as medical science (Isenring et al, 2009).

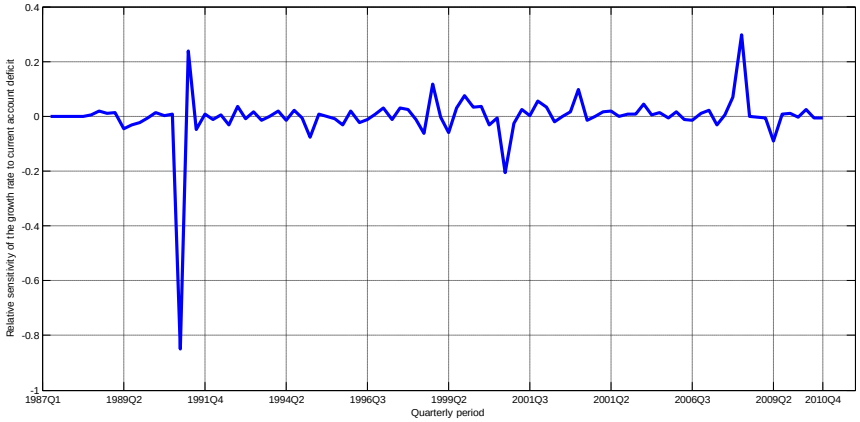
Relative sensitivity differs from absolute senstivity in two ways. The first difference is that relative sensitivity considers the values of the input and output variables such that the effects caused from the amounts are taken into account. While absolute sensitivity is merely a ratio of the change of input and output

variables, relative sensitivity gives a better understanding of the effects of input variables on the output variables. Secondly, it is easier to obtain the time dependent sensitivity with the relative sensitivity concept. Hence, because of these reasons, it is logical to use relative sensitivity as well as absolute sensitivity for econometric applications.

4. Results and Discussion

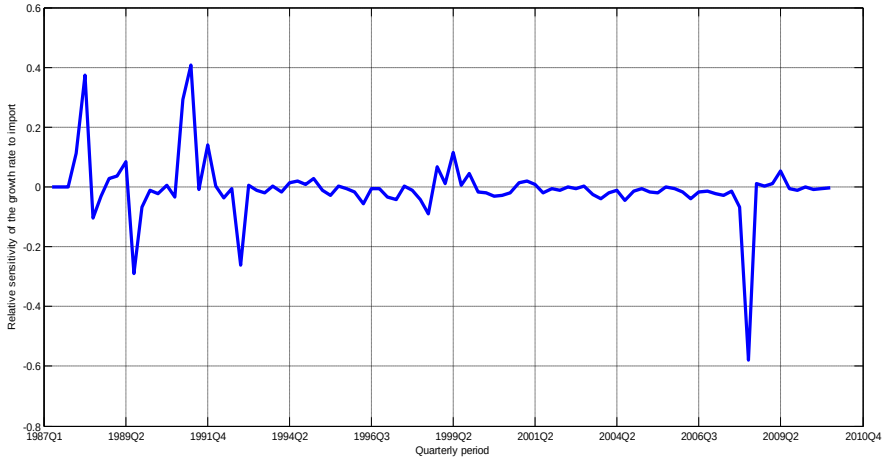
Sensitivity analyses of the variables affecting the economic growth rate has been obtained with Equation (11) using MATLAB programs. It can be seen that the relative sensitivity of the these macroeconomic variables have a greater effect on the economic growth rate during economic crisis periods, namely 1991, 1994, 2001 and 2008.

Figure 2. The Relative Sensitivity Of The Growth Rate To Current Account Deficit



According to Figure 2, the sensitivity the economic growth rate to current account is not high except for the periods of economic crisis. For example, the highest sensitivity rate was experienced in 1991 (between -0.9 and 0.3). For 1999-2001 periods, sensitivity rate is between 1.1 and -0.2; for 2008-2009, between 0 and 0.3. Except these periods, the relationship between growth and the current account deficit can be said that weak.

Figure 3. The Relative Sensitivity of the Growth Rate to İmport Volume



Looking to Figure 3, the sensitivity the economic growth rate to import is higher for the periods of 1991-1994 than the following years. In the following years, it is not high, again except 1999-2001 and 2009 periods.

Figure 4. The Relative Sensitivity Of The Growth Rate To Openness Rate

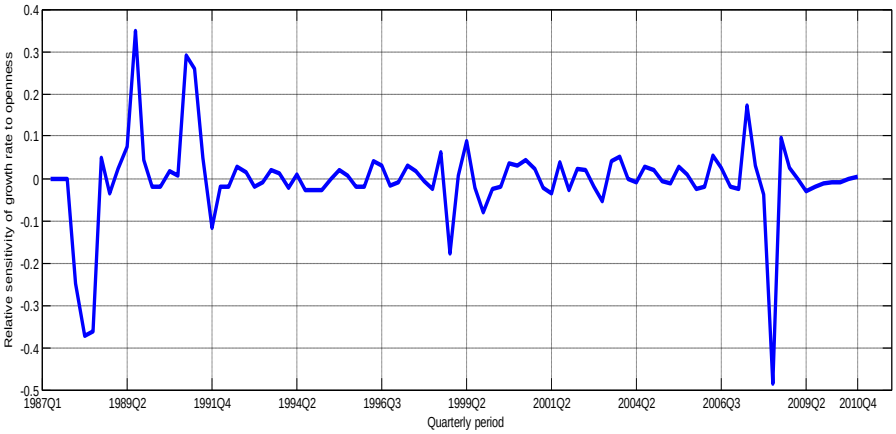
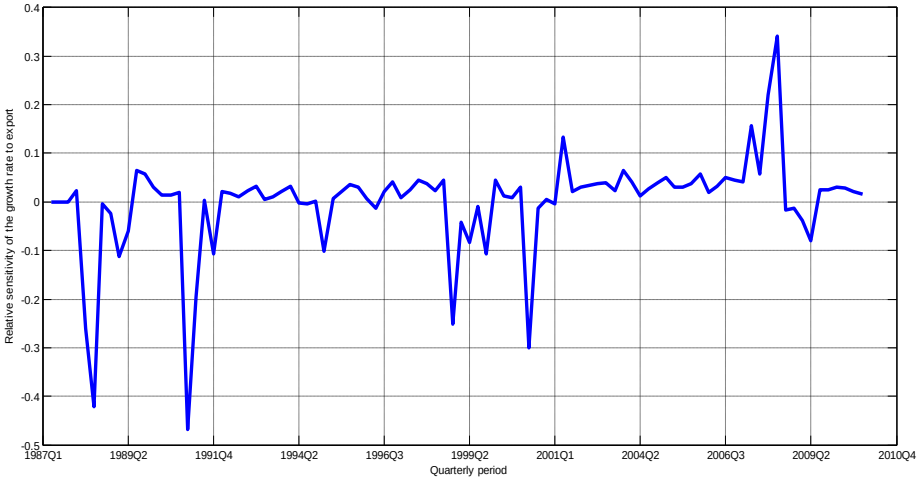


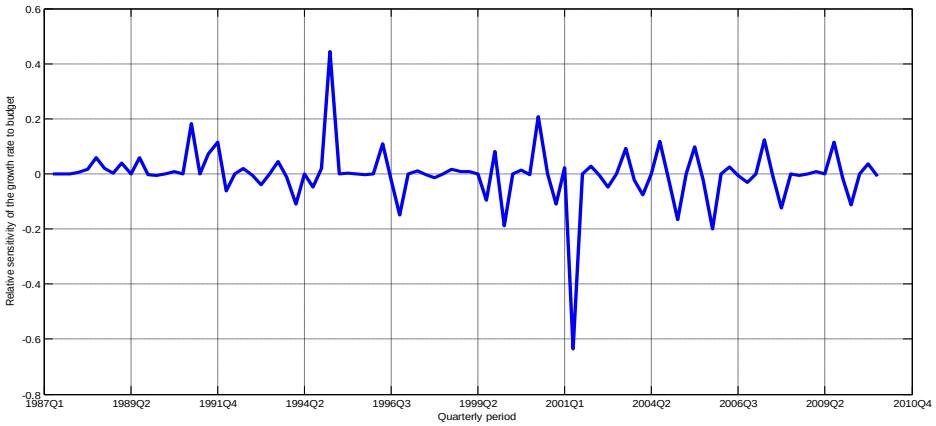
Figure 4 show that, the relative sensitivity of the growth rate to openness rate is higher than the current account deficit. For all the examined period, the economic growth rate has been sensitive to openness. Hovewer, relative sensitivity of the growth rate to openness rate increased in 1999, 2001 and 2008-2009 periods.

Figure 5. The Relative Sensitivity Of The Growth Rate To Export Volume



According to Figure 5, relative sensitivity of the growth rate to export volume is high. Exports are seen have a significant impact on the growth rate. During periods of reduced volume of exports, the growth rate is also reduced. In 2008-2009, due to a decrease in domestic and foreign demand, the total demand declined. Accordingly, the impact of net exports was positively on the economic growth rate.

Figure 6. The Relative Sensitivity Of The Growth Rate To The Budget Balance



According to Figure 6, relative sensitivity of the growth rate to budget deficit is high. Like export volume, budget deficit seems to have a significant impact on the growth rate. There is a positive relationship between economic growth and public spending.

Figure 7. The Relative Sensitivity Of The Growth Rate To Foreign Debt Stock

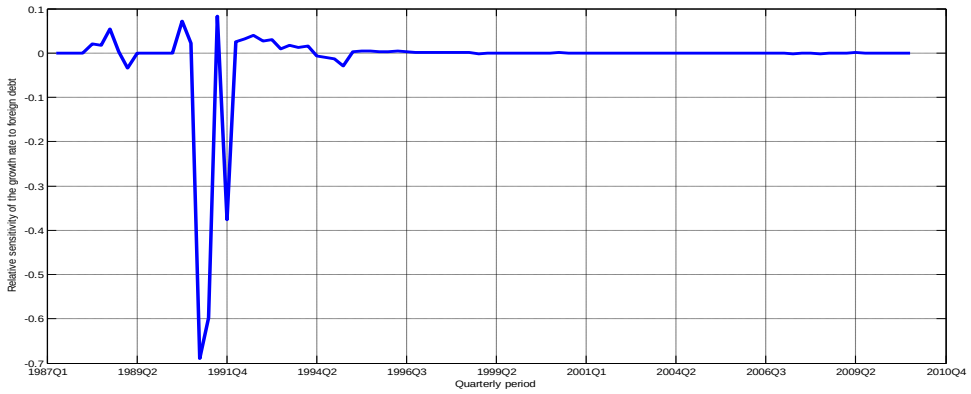
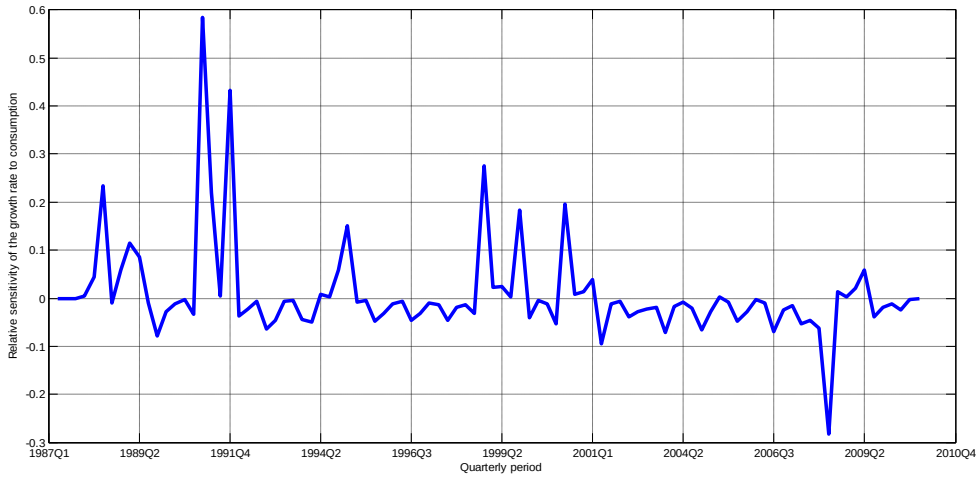


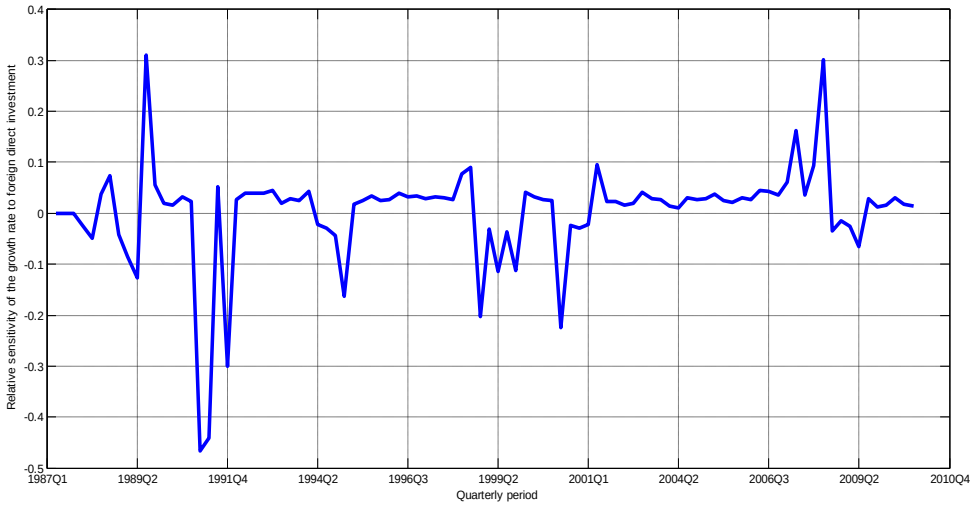
Figure 7 shows that, the relative sensitivity of the economic growth rate on foreign debt is not high except for the periods of 1990-1991 (between 0.08 and -0.7). But following years, particularly after 1995, this effect disappeared.

Figure 8. The Relative Sensitivity Of The Growth Rate To Consumption Expenditure



We can see that on the Figure 8, the relative sensitivity of the growth rate to consumption expenditure is high. The relative sensitivity ratio of the growth rate to consumption expenditure is 5% in 1990. Volatility continued for the all this years.

Figure 9. The Relative Sensitivity of The Growth Rate to İnvestment Expenditure



According to Figure 9, the relative sensitivity of the growth rate to investment expenditure is high. Especialy in 1987-1991 periods, this ratio's volatility is between 0.33 and -0.45. Volatility continued for the all this years.

5.Conclusion

In this study the detailed investigation of the relations between the main macroeconomic variables and the economic growth rate is performed and verification using the endogenous growth theory for the period of 1987-2010 in Turkey is done. Relative Sensitivity Analysis is used in this study because it shows relationships between variables can be seen in a more comprehensive way. According to the results of study, relative sensitivity of the growth to consumption expenditure and budget balance have highest. Beside, investment, export volume and openness are high effect to economic growth rate. In addition this, relative sensitivities of the selected variables on the economic growth rate are high during the economic crisis periods, namely 1991, 1994, 2001 and 2008. Turkey's economic growth rate is largely depent on the consumption expenditure and budget balance. Other hand, the stock of external debt and current account deficit have no effect on the economic growth rate, except periods of 1991, 1994, 2001 and 2008-2009. In

this context, for the stability of the economic growth, consumer expenditure and budget deficit should be more considend more carefully.

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