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Inflation and Growth: Positive or Negative Relationship?

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Abstract: This study has been motivated by two developments. Firstly, by the vast literature on the relationship between inflation and growth which is abundantly endowed with diverse theoretical explanations and contradictory evidence and by the unique experience of the Turkish economy with inflation and growth. A preliminary examination of the Turkish data pointed to a negative relation between inflation and growth. Moreover, there is a unanimous agreement among the students of the Turkish economy that many factors have contributed to inflation in this country. In view of these facts this paper employs a VAR model which will enable us to identify the sources of the shocks and control for external factors. In addition VAR models have a high predictive power and enable the researcher to observe the impulse response functions. The study employs Generalised Impulse Response analysis. In the empirical experiments oil prices, money supply, government spending and taxes have been taken as the most likely determinants of inflation. The study shows that there is a negative relationship between inflation and output growth in Turkey and that the underlying explanatory factor is the real exchange rate. This result is robust.

Key words: Phillips curve, inflation, growth, real exchange rate

INTRODUCTION

Following Friedman's (1977) Nobel Lecture the theoretical and empirical research on the relationship between inflation and output growth has progresses along two distinct lines. The first line of research starting with Friedman's hypothesis that higher nominal inflation raises inflation uncertainty, has tended to investigate the relationships among inflation, inflation uncertainty, growth and growth uncertainty. The second line of research has tended to remain within the confines of traditional macroeconomics and investigate the relation between inflation and growth without reference to inflation uncertainty and growth uncertainty.

This study follows the second line and examines the nature of the relation between inflation and growth in the Turkish economy whose experience with these phenomena has been unique and can only be compared to that of Brazil.

Within the second line of research two distinct camps, with opposite predictions on the relation between inflation and growth, have distinguished themselves. Researchers of the first camp base their arguments on the Phillips curve and output gap, defined as the difference between actual and potential output and assert a positive relation between inflation and growth. The underlying reasoning is that if actual output rises above potential output, this will create an upward pressure on wages in the labor market. Higher wages, in turn, will lead to higher production costs and hence higher prices. This conclusion has been supported by empirical findings. Gerloch and Smets (1999), for instance, show that 1% increase over potential output raises inflation by 0.2% in the subsequent quarter in the EMU-5 countries. Moreover, since inflation is serially correlated, future inflation rate will also rise. Another interesting study has been undertaken by Paul *et al.* (1997) who work with data pertaining to 70 countries and the 1960-1989 period. They report that the relation between inflation and growth is positive only in some countries. Mallik and Chowdhury (2001) analyse inflation-growth dynamics in four South Asian countries (Bangladesh, India, Pakistan and Sri Lanka) and find statistically significant evidence of a positive relation between these two variables.

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Researchers belonging to the second camp base their arguments on the Real Business Cycle theories and assert that inflation negatively affects growth. One of the main studies investigating this negative relationship between inflation and growth has been carried out by Kydland and Prescott (1990). These authors argue that supply shocks, not demand shocks, are responsible for the inverse relationship. Supply shocks render the prices countercyclical, while demand shocks cause procyclical moves in prices towards output. However, there is a condition to be taken into account: Price flexibility. In an environment with sticky prices, a demand shock will increase the output while prices move very little. As output is on the way towards its trend, prices may be rising. Hence, a negative correlation between these variables can also be observed even when a demand shock is responsible for these movements. Ball and Mankiw (1994) and Judd and Trehan (1995) study these effects. In addition, Den Haan and Wouter (2000), by using long forecast horizons within a VAR framework, argues that a negative correlation between output and growth exists.

Yet another study showing the divergence of output growth from inflation in developing countries is that of Agenor and Hoffmaister (1997), who employ generalized VAR analysis to examine the short run dynamics among inflation, output, nominal wages and exchange rate. They find that a fall in the depreciation of the exchange rate reduces inflation and stimulates output. But the expansion in output is short lived. Kirmanoglu (2001), by employing VAR models shows that high inflation rates in Turkey cause lower economic growth. Mendoza (2003) finds evidence of inflation-output trade off in the Turkish economy using VAR and GARCH models. Beside VAR models, panel data studies also support this negative relationship, especially for countries that suffer from high inflation. Barro (1996), for instance, shows that a negative relation exists for a set of countries who had inflation rates above 15%. Judson and Orphanides (1996) use a 10% threshold. Bruno and Easterly (1998) argue in favor of a 40% inflation as the relevant threshold inflation rate. Ghosh and Philips (1998) find a positive effect for low inflation rates, but for those above 5% they find a non-linear negative effect.

In this study we hypothesis that there is a third variable affecting output-inflation relation: the real exchange rate. By certain channels and mechanisms, fluctuations in output and inflation can be explained by real exchange rate. A increase (depreciation) in real exchange rate mimic supply side shocks and we claim that depreciations in real exchange rate accelerate inflation while decelerating economic growth. In contrast, appreciations increase growth rate of output and reduce inflation. The reasons for real exchange rate being a good candidate for this third variable effect are noted below.

In the literature there are many studies that examine the effects of exchange rate on output. Their main arguments can be classified and summarized as follows:

- **Rigidities in the economy:** If prices are inflexible, a devaluation will decrease real wages and hence weaken demand. *Ceteris paribus* this will result in a decrease in output.
- **Debt dynamics:** After a real devaluation, foreign debt liabilities, measured in domestic currency increase proportionately. This assumes significance in economies where dollarization is high and agents have high foreign currency liabilities. The consequent increase in liabilities will force agents to make adjustments in their budgets and balance sheets and most probably to reduce their expenditures. Banks for example will curtail their credits to firms who suffer losses and this may result in a decrease in output.
- **Consumer confidence:** A devaluation will affect the long-run adjustment of the prices. It will raise costs of production as well as expected inflation rate. These are events that decrease consumer confidence, leading to a cut in expenditures and hence in production.
- **Capital outflows:** A devaluation, even a signal of a devaluation, will cause foreign capital outflow. A prime facie example is the experience of the Turkish economy in 2000 and 2001 when expected devaluations caused substantial capital outflows which in turn led to a severe economic crisis.
- **Income distribution:** Effects of a devaluation on income distribution are ambiguous. But if a devaluation adversely affects groups with high marginal propensity to consume, this may decrease output.
- **Economic policies:** After a devaluation, policy makers may implement contractionary policies to curtail inflation. Such policies will lead to a decline in output.
- **Supply-side problems:** If imported inputs are used in production, a devaluation will increase production costs causing a leftward shift in the aggregate supply curve and hence a reduction in output.

The Turkish data show just the opposite of what the Phillips curve oriented theories predict. In Turkey periods with high inflation overlap with periods of low growth rates of output. Nas and Perry (2001), for instance, state that from 1960's to 1980, low growth rates of output in Turkey have been associated with high inflation rates. Especially after the 1973-1974 oil crises, inflation rose rapidly and output growth declined dramatically for an extended period. When inflation made its first peak in 1979, by rising over 80%, GDP declined by 11%. In 1994, Turkey underwent a financial crisis and industrial production dropped to one of its lowest levels while inflation rose sharply. Macroeconomic data show that since 1990's Turkey has been experiencing a negative correlation between output gap and inflation. Obviously this contradicts the conclusion of the Philips Curve oriented theories and supports the prediction of Real Business Cycles model. Hence, in this study, we will analyze the reason behind this correlation. We note that one early evidence has been provided by Ozbek and Ozlale (2005), who estimate the output gap for Turkey with Extended Kalman Filter and then analyse the correlation between output gap and inflation. They find a negative correlation between these variables and a negative correlation between lagged output gap and inflation.

There are several studies on the relationship between output and real exchange rate in the Turkish economy. Berument and Pasaogullari (2003) show that these two variables are negatively related in Turkey. They report that the response of output to a real devaluation is negative and permanent. An overvalued currency may increase output but simply because it entails a risk of a depreciation it may eventually result in substantial output losses. These authors also find that a one-standard deviation shock to the real exchange rate increases inflation and a one-standard deviation shock to inflation appreciates the currency. One strong relation between exchange rate and inflation is provided by the exchange rate pass-through. Evidence for the importance of this mechanism in the Turkish economy has been provided by Leigh and Rossi (2002) who employ a recursive vector auto regression model to investigate the impact of exchange rate movements on prices. They report that the impact of exchange rate movements on inflation is over after a year and is mostly felt in the first four months. The effect is more pronounced on the wholesale price index than the consumer price index. Their third important finding is that the impact is over in Turkey in a shorter time and stronger than in other key emerging markets. Another study on Turkey has been undertaken by Mendoza (2003) who investigates inflation and output trade-off within the dynamics of nominal exchange rate and finds significant evidence that lags of the nominal exchange rate depreciation explain a big part of the inflation rate and volatility. His results reconfirm the existence of causality from exchange rate to inflation and shows that nominal depreciations raise inflation.

Turkey is a small-open developing economy without heavy government regulations. Therefore, it is possible to observe the effects of financial market developments on economic performance. Turkey has also suffered from high and volatile inflation without running into hyperinflation, along with high variability in real exchange rate and output growth for almost three decades. This provides a unique environment to observe the interactions among certain macroeconomic variables. High volatility in output, inflation and real exchange rate for long periods play a magnifying role and allow us to avoid type II error; not rejecting the null hypothesis even if the null is false.

In this study, we do not argue that increases in output do not lead to higher inflation, but we say that the evidence we examine shows a negative (not a positive) relationship between growth and inflation. We analyze this relationship and assert that this negative association is due to a third variable effect, that of real exchange rate.

THE DATA AND AN HISTORICAL OVERVIEW

For the purpose of this paper the real exchange rate is computed using the nominal exchange rate basket of the Central Bank of Turkey, deflated by domestic prices and multiplied with foreign prices. Until the adaptation of the Euro, the exchange rate basket consisted of 1.5 Deutsche marks and 1 US dollar. After the acceptance of the Euro by European countries the basket has been calculated with 0.77 Euro and 1 US dollar. The inflation rate is calculated as the first logarithmic difference of the GDP deflator and growth is calculated as the logarithmic difference of the real GDP. The analyses pertain to the 1988:Q3 to 2007:Q2 period and all data are quarterly. Data on the Turkish economy are available on the website of the Central Bank of Turkey (http://tcmbf40.tcmb.gov.tr/cbt.html) and those on foreign countries have been gathered from IMF-IFS tape.

Figure 1 shows quarterly data on real GDP growth and inflation. GDP data are seasonally adjusted. We observe that these two variables move in opposite directions. Inflation reaches its peak in 1994:Q2 when Turkey suffered one of the biggest financial crises of its history. In this crisis period GDP fell dramatically. Subsequently, fluctuations in both variables subside. A noticeable drop in inflation has occurred after the 2000 stabilisation program. However, this program has ended with two big financial crises. Inflation rose sharply while declines in output have reoccurred. After the November 2000 and February 2001 crises, inflation tended to decelerate while output growth tended to accelerate. This tendency has become more pronounced after the reform program of Transition to Strong Economy launched in 2001. Since then Turkey has been simultaneously

Table 1: Cross correlations of real GDP in various forms and inflation

Lag	Log	First difference	Deviation from linear trend	Deviation from quadratic trend	Deviation from cubic trend	HP-filtered
-4	-0.212	-0.165	0.109	0.109	0.086	-0.339
-3	-0.385	-0.140	-0.116	-0.116	-0.131	-0.378
-2	-0.401	-0.009	-0.134	-0.135	-0.145	-0.388
-1	-0.107	0.299	0.299	0.299	0.292	-0.376
0	-0.324	-0.243	-0.040	-0.040	-0.043	-0.376
1	-0.387	-0.092	-0.166	-0.166	-0.168	-0.353
2	-0.336	-0.019	-0.135	-0.135	-0.139	-0.312
3	-0.068	0.286	0.269	0.269	0.271	-0.309
4	-0.246	-0.209	-0.022	-0.023	-0.018	-0.296

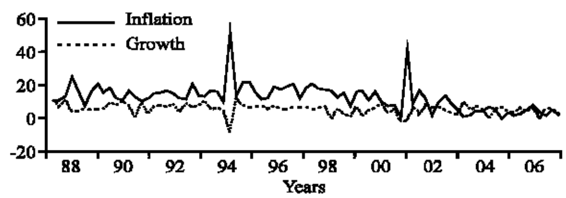

Fig. 1: Historical movements of inflation and GDP growth in Turkish economy

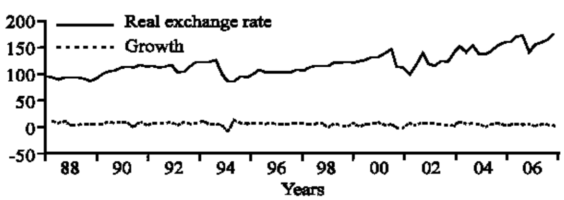

Fig. 2: Historical movements of GDP growth and real exchange rate in Turkish economy

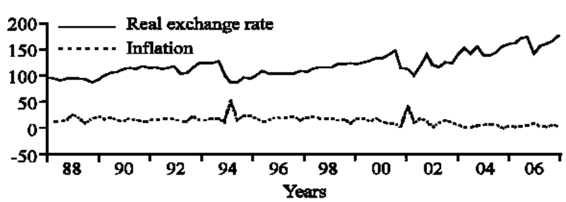

Fig. 3: Historical movements of inflation and real exchange rate in Turkish economy

experiencing a steady increase in output with steady declines in inflation. This has constituted one of the motivating factors of the present study.

Figure 2 plots output growth along with real exchange rate using quarterly data pertaining to the 1988:Q3-2007:Q2 period, while Fig. 3 plots inflation along with real exchange rate for the same period. As observed from Fig. 2, large devaluations are coupled with large declines in output and appreciations are coupled with growth in output. This suggests a negative relationship between these variables. On the other hand, from Fig. 3, we observe that increases in inflation are coupled with real devaluations while disinflation periods are coupled with real appreciations. These two figures provide a hint that the underlying reason for the opposite movements in inflation and GDP growth may be the behavior of the real exchange rate.

PRELIMINARY DATA ANALYSIS

Apart from figures that primarily appeal to the eye but not to the mind, some statistically verified evidence is needed to be sure of the negative correlation between inflation and output. For this purpose, we first calculate the cross correlations between inflation and output. The data on output is used to estimate the output gap. In order to obtain the output gap series, output is detrended using linear, quadratic, cubic trends and HP filter. Residuals give us the output gap. The data are seasonally adjusted and covers the period from 1988:Q3 to 2007:Q2.

Table 1 shows the results of cross correlation between various forms of output gap and inflation for different leads and lags. Lag numbers indicate the number of quarters by which output gap is lagged relative to contemporaneous level of inflation. Negative correlations between inflation and various output gap measures are found in most of the cases. HP filtered output gap and log leveled GDP were always negatively correlated with inflation. Even though almost all of the detrending methods show that the relationship is negative, the current inflation is related with a lagged value of output and is three period ahead of GDP.

We note that simple correlation does not account for the dynamics of inflation and growth. For further investigation of the negative correlation the following equation is estimated with the ordinary least squares:

$$\pi_t = \alpha+\beta_1\pi_{t-1}+\beta_2\pi_{t-2}+\beta_3\pi_{t-3}+\beta_4\pi_{t-4}+\beta_5\pi_{t-5}+\beta_6\pi_{t-6}+\gamma_1 Y_t+\gamma_2 Y_{t-1}+\gamma_3 Y_{t-2}+\gamma_4 Y_{t-3}+\gamma_5 Y_{t-4}+\gamma_6 Y_{t-5}+\gamma_7 Y_{t-6}+\varepsilon_t \quad (1)$$

Where:

π = Used for inflation

Y = Output and both series are seasonally adjusted

Table 2 shows the OLS estimates. We note that the coefficients of growth rates (first column) are mainly negative and mostly statistically significant (The level of significance is at the 10% unless otherwise noted) for the

Table 2: Effects of output on inflation with different trend definitions

Lag	First difference	Deviation from linear trend	Deviation from quadratic trend	Deviation from cubic trend	HP-filtered
Constant	328.543	167.147	167.368	61.266	17222.358
	(1.218)	(0.756)	(0.757)	(0.287)	(2.043)**
π_{t-1}	-0.073	-0.094	-0.094	-0.062	-0.187
	(-0.558)	(-0.745)	(-0.746)	(-0.506)	(-1.441)
π_{t-2}	0.062	0.048	0.048	0.081	0.009
	(0.512)	(0.393)	(0.392)	(0.688)	(0.060)
π_{t-3}	0.227**	0.228	0.228	0.249	-0.076
	(2.122)	(2.170)**	(2.169)**	(2.381)**	(-0.616)
π_{t-4}	0.332**	0.336	0.336	0.348	0.231
	(3.171)	(3.258)**	(3.258)**	(3.339)**	(1.550)
π_{t-5}	0.285**	0.294	0.294	0.295	0.020
	(2.524)	(2.638)**	(2.638)**	(2.621)**	(0.145)
π_{t-6}	-0.023	-0.003	-0.003	-0.021	0.072
	(-0.194)	(-0.024)	(-0.024)	(-0.179)	(0.522)
Y_t	-0.822**	-0.775	-0.775	-0.852	-0.200
	(-3.796)	(-3.593)**	-(3.594)**	(-3.801)**	(-0.594)
Y_{t-1}	-0.748**	0.060	0.060	0.052	0.646
	(-3.254)	(0.211)	(0.211)	(0.182)	(0.489)
Y_{t-2}	-0.513	-0.188	0.188	-0.222	-0.687
	(-2.072)**	(-0.785)	(-0.785)	(-0.935)	(-0.297)
Y_{t-3}	-0.292	0.293	0.293	-0.237	0.222
	(-1.218)	(2.361)**	(-2.361)**	(-1.826)*	(0.084)
Y_{t-4}	0.233	-0.509	-0.509	0.509	-0.062
	(1.002)	(-2.399)**	(-2.400)**	(2.373)**	(-0.027)
Y_{t-5}	0.521	0.315	0.315	0.264	0.171
	(2.261)**	(1.144)	(1.144)	(0.962)	(0.132)
Y_{t-6}	-0.061	-0.505	-0.505	-0.615	-0.090
	(-0.260)	(-2.109)**	(-2.109)**	(-2.624)**	(-0.277)**

Numbers in parenthesis are t-statistics. **: denotes 5% and *: denotes 10% significance level

first three lags of output growth. That is higher output growth reduces the inflation rate. This is consistent with what we have observed in Fig. 1. Moreover, filters used do not seem to matter much across different output transformations.

VAR MODELING

The analysis of the previous section suggests that there is a negative relationship between inflation and output. Moreover, when we look at the historical movements of these variables, real exchange rate seems to be the underlying factor of this opposite movement. Therefore, we form a VAR model; so that we can identify the sources of the shocks and be able to control for important external shocks. VAR models have high predictive power and enable us to observe impulse response functions. We could have used conventional impulse response analysis. But this method is criticized because the results depend on the "orthogonality" assumption and they differ with the ordering choice. Hence we employ Generalised Impulse Response analysis developed by Koop *et al*. (1996) and Pesaran and Shin (1998). This method has two advantages over the standard impulse response analysis. Firstly, it does not presuppose any ordering that may have theoretical implications and it doesn't rely on the ordering choice of the researcher. Secondly, it provides for a meaningful interpretation of the initial impact of the shocks.

Here, we give a brief explanation of the Generalized Impulse Response Analysis. Pesaran and Shin (1998) develop Generalized Impulse Response analysis first by considering an infinite moving average series of the VAR.

$$X_t = \sum_{j=0}^{\infty} A_j u_{t-j} \tag{2}$$

Where, X_t is an $m\times1$ vector of variables under investigation and

$$A_j = \phi_1 A_{j-1} + \phi_2 A_{j-2} + \dots + \phi_p A_{j-p},\ j = 1,2,\dots \text{ with } A_o = I_n \text{ and } A_j = 0 \text{ for } j<0 \tag{3}$$

(Unlike the traditional orthogonalized impulse response analysis which employs a Cholesky decomposition of the positive definite of the covariance matrix of the shocks, the generalized impulse response analysis does not impose such restriction).

The Generalized Impulse Response function for a shock, u_t^0, to the entire system is defined as follows:

$$G_s = E\,(x_{t+N}|u_t = u_t^0, \Omega_{t-1}^0) - E\,(S_{t+N}, \Omega_{t-1}^0) \tag{4}$$

The process up to t-1 period is known and it is denoted by Ω_{t-1}^0. $u_t \sim N(0,\Sigma)$ is assumed and

$$E\,(u_t|u_{jt} = \delta_j) = (\sigma_{1j}, \sigma_{2j}, \dots, \sigma_{mj})'\ \sigma_{jj}^{-1}\delta_j \tag{5}$$

Where, $\delta_j = (\sigma_{jj})^{-1/2}$ denotes one-standard error shocks. If e_i is an $m\times1$ vector with the i-th element equal to 1 and all other elements to 0, then the Generalized Impulse Response (GIR) for a one-standard deviation shock to the i-th equation in the VAR model on the j-th variable at horizon N is:

$$GIR_{ij,N} = e_j' A_N \Sigma e_i / \sigma_{ii}^{1/2},\ i,j = 1,2,\dots,m \tag{6}$$

Since Generalized Impulse Response is invariant to changes in ordering, the results are more robust than those of the orthogonalized impulse response analysis.

Our benchmark model includes growth rate of (real) GDP and inflation. The ordering doesn't matter since we use Generalized Impulse Response. Then we add the real exchange rate to our model and observe how the variables react to shocks. We further extend the model by adding oil prices, M2, government spending and tax revenues. We use quarterly data and our model includes constant terms and seasonal dummies for the first three quarters. Following Hansen and Juselius (1995) the lag order is set at five (We have also considered alternative lag orders, but the results were robust). In the first alternative model we add oil prices given that they may have significant effects on inflation and growth due to a direct supply shock effect. In the second version, we augment our model with M2, hoping to capture the monetary channels that affect inflation, output and real exchange rate. In the third exercise we add government spending, given that this variable is influential on inflation and output. In the fourth exercise we add tax revenues for the same reason. In all these extended experiments, we first check for the benchmark model and then check it again by including the real exchange rate. The estimates of the VAR specifications are not reported here to save space. However, they are available to the interested readers from the corresponding author upon request.

IMPULSE-RESPONSE ANALYSIS

Impulse responses of the benchmark model are obtained by Generalized Impulse Response method and we present them with 90% confidence intervals in Fig. 4 (Monte Carlo simulations with 1000 iterations are used to calculate the standard errors). The magnitude of the shocks is one-standard deviation and responses are also normalized by one-standard deviation. We have a benchmark VAR model with 2 endogenous variables bringing 4 different impulse response functions. In Fig. 4, we analyze this benchmark model.

We observe that one-standard deviation shock to growth reduces inflation in the first five periods but this effect is statistically significant only for the first period. Moreover, inflation shock decreases output growth instantaneously and this effect is statistically significant. Thus, our benchmark model suggests a negative relation between inflation and growth. As elaborated earlier, there might be a third variable effect underlying this relation. To account for this, we include real exchange rate into the system. The analysis is performed and its impulse responses are shown in Fig. 5. We observe that one-standard shock to growth decreases inflation but this is significant only in the first period. Real exchange rate appreciates and this effect is statistically significant instantaneously. On the other hand one-standard shock to inflation decreases growth instantaneously and the real exchange rate initially depreciates. Similarly, one-standard shock to real exchange rate increases inflation and decreases growth immediately. Note that a positive growth innovation decreases inflation and a positive inflation innovation decreases growth. But real exchange rate innovation decreases growth and increases inflation. Thus the correlation between inflation and growth is negative.

The empirical evidence provided here for the negative relationship between inflation and growth parallels the findings of earlier studies such as those of Asirim (1995) and Kirmanoglu (2001), Nas and Perry (2001), Mendoza (2003) and Ozbek and Ozlale (2005). Moreover, present finding that real appreciation leads to a decrease in inflation and higher growth in Turkey confirms those of Berument and Pasaogullari (2003) and Kandil *et al.* (2007).

EXTENDED EXPERIMENTS

Here, we add different variables which theoretically can be expected to affect inflation and growth, to our benchmark and extended benchmark models and observe how inflation and growth react to them.

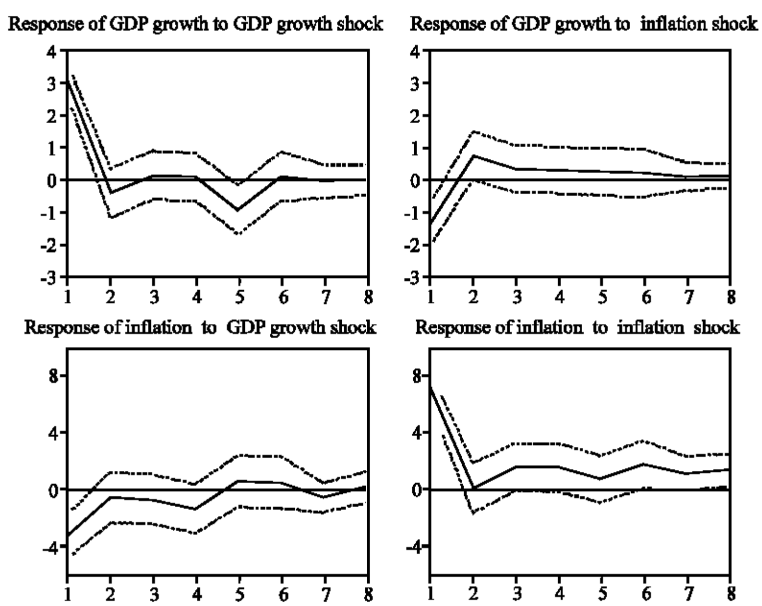

Fig. 4: The Benchmark model

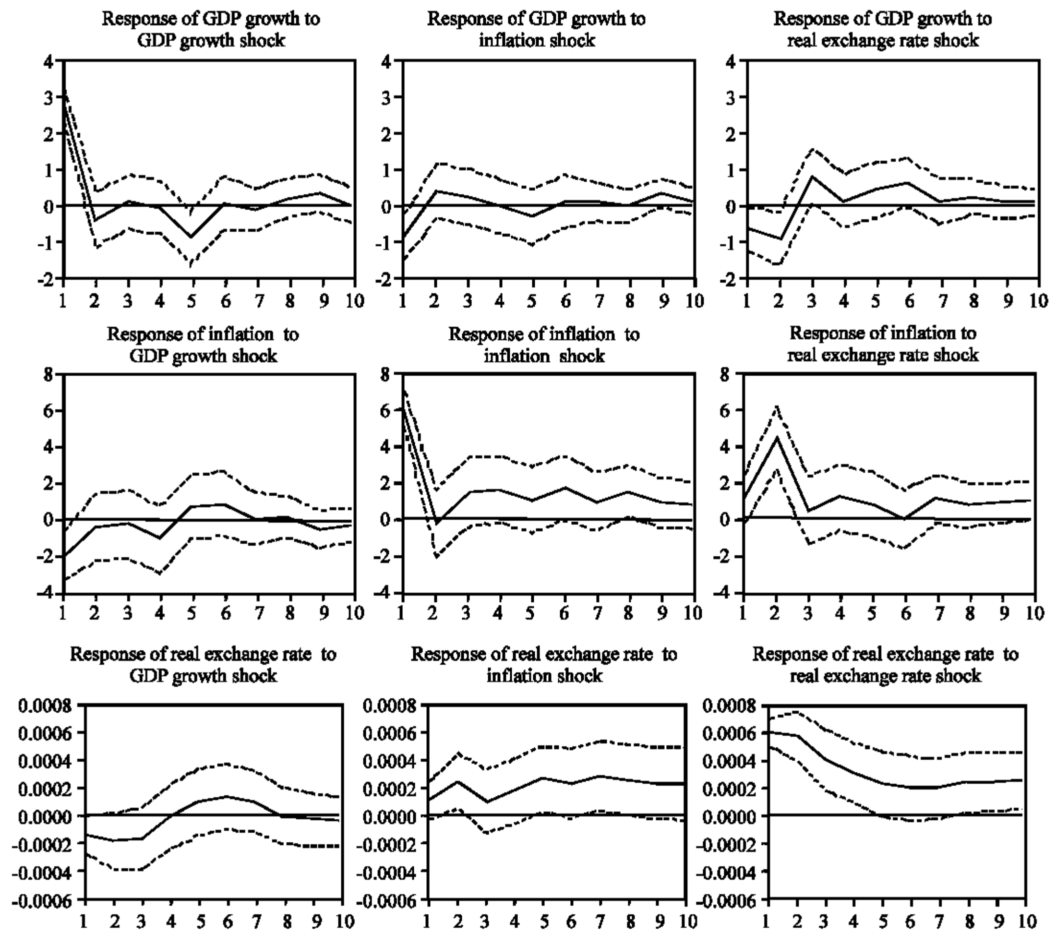

Fig. 5: Benchmark model with real exchange rate (Extended Benchmark model)

Oil price as an exogenous variable: Increases in energy prices may have significant effects on the Turkish economy simply because Turkey is an importer of these resources and they are important inputs to production. Hence, an increase in oil prices will increase production costs; Aggregate supply curve will shift leftward, prices will go up and output will decrease. In this connection Hasen *et al.* (1984) report that oil price shocks result in expenditure and wage reduction to accommodate the shock. Also Berument and Tasci (2002) report that when wages and other factor incomes are adjusted for the general price level that includes oil prices, inflationary oil price increases become important. Hence, we add oil price to our model. Figure 6 shows the impulse responses. One-standard deviation shock to growth rate decreases inflation instantaneously and this effect is statistically significant. This effect is observed up to the fifth period. However, one-standard deviation shock to inflation decreases output growth only instantaneously and this effect is significant. The impulse responses of inflation, growth and real exchange rate when oil prices are taken into the model are shown in Fig. 7. One-standard deviation shock to growth decreases inflation immediately. However, in the remaining periods inflation rises while growth declines, but these movements are not statistically significant. A positive shock to inflation brings down the growth rate, while the response of the real exchange rate is depreciation. One-standard shock to real exchange rate lowers growth and increases inflation. These effects are significant for the first periods.

Figure 6 shows that the negative shock of output growth to inflation is still valid when oil prices are taken into account. Moreover, Fig. 7 supports our claim that the variable underlying this negative relationship is the real exchange rate.

Money as an exogenous variable: McCandless and Weber (1995) examine 110 countries with data covering 30 years and find that the correlation coefficient between inflation and money supply varies between 0.92 and 0.96.

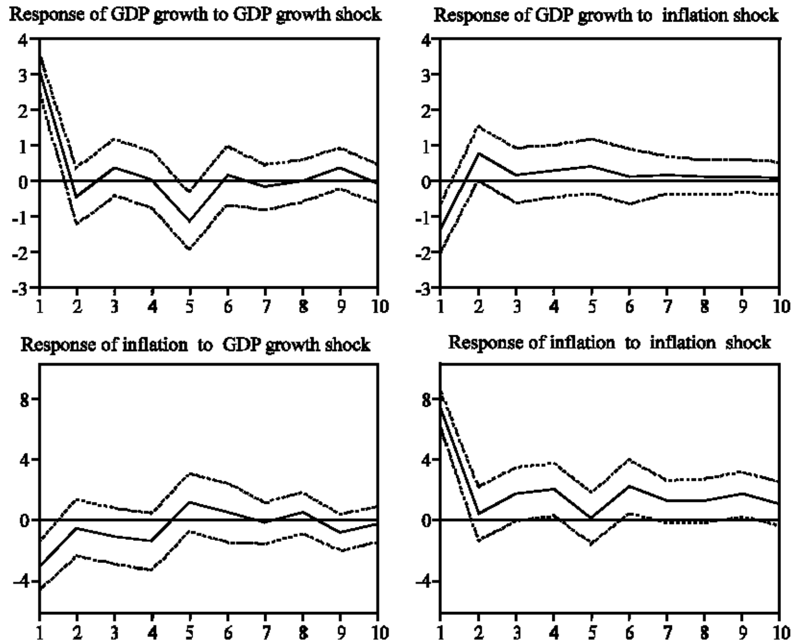

Fig. 6: Oil price as an exogenous variable in the Benchmark model

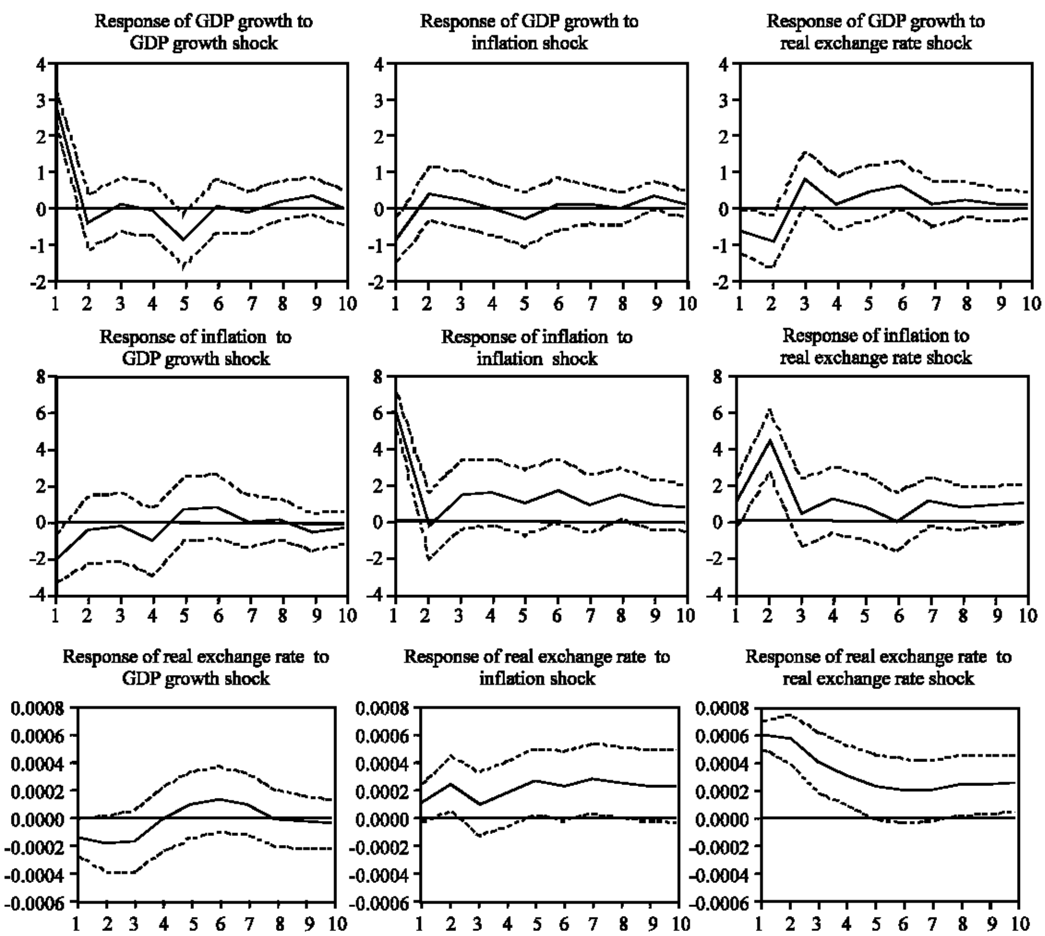

Fig. 7: Oil price as an exogenous variable in the Extended Benchmark model

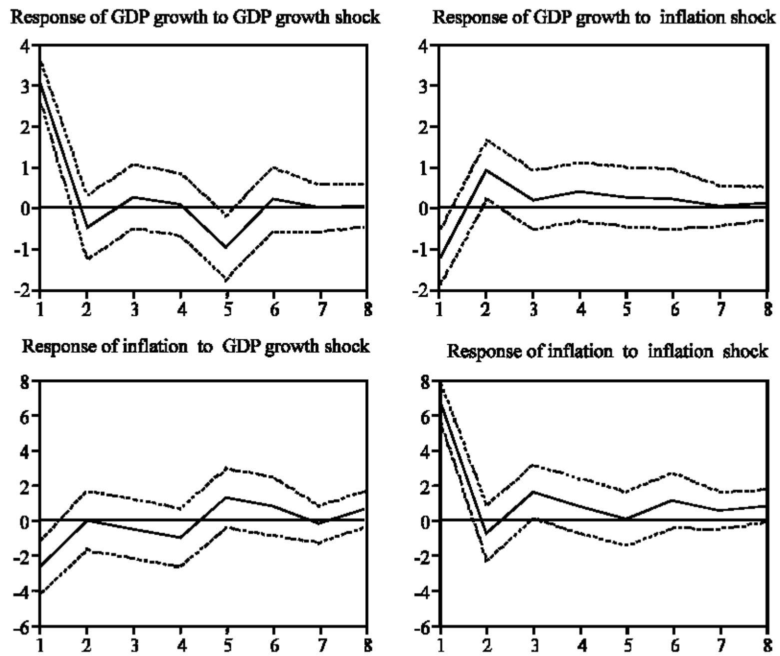

Fig. 8: Money as an exogenous variable in the Benchmark model

Nevertheless, a different story of output-inflation relationship seems to be theoretically plausible. In an environment where income is increasing, money demand will increase. Hence if money supply grows at a rate less than money demand, excess money supply will decrease lowering inflation. Therefore, income rises and inflation decreases; a negative relationship between inflation and growth appears. To control for this effect, money is added to our model as an exogenous variable. Impulse responses of this exercise are shown in Fig. 8. One-standard deviation shock to growth leads to a fall in inflation instantaneously. For the first period, this effect is statistically significant. A positive shock to inflation decreases growth rate. This is again observed in the third period, but it is smaller and insignificant. We therefore conclude that the negative relationship between inflation and growth still holds when money is included in the model.

Figure 9 shows the impulse responses of the Extended Benchmark Model when money is added as an exogenous variable. One-standard deviation shock to growth significantly decreases inflation and appreciates the real exchange rate in the first period. However, following a shock to inflation, output falls at once and the real exchange rate depreciates. These effects are statistically significant in the first period. On the other hand, a depreciation shock to real exchange rate decreases growth and raises inflation. These effects are also statistically significant. We conclude that the extended benchmark model with money gives the same results we have already reached: opposite movements of inflation and growth are supported by real exchange rate movements.

Government spending as an exogenous variable: In a dynamic demand and supply analysis an increase in government spending is generally taken to increase aggregate demand and hence prices. Nevertheless, there is a huge debate about this effect in the literature. For one thing, government purchases may adversely affect competitiveness by allowing inefficient firms to survive, causing a higher price level and *vice versa*. Accordingly, we add government spending as an exogenous variable to our model.

Figure 10 shows the impulse response of the Benchmark Model. One-standard deviation shock to growth decreases inflation instantaneously. But in the subsequent periods inflation goes up while growth rate begins to decelerate. However, these effects are statistically significant only in the first period. On the other hand, a positive shock to inflation decreases growth in the first period. Hence, adding government spending as an exogenous variable to our model do not alter our main conclusion that inflation and growth move in opposite directions.

Figure 11 shows the impulse responses of the Extended Benchmark Model. One-standard deviation shock to growth instantaneously decreases inflation and

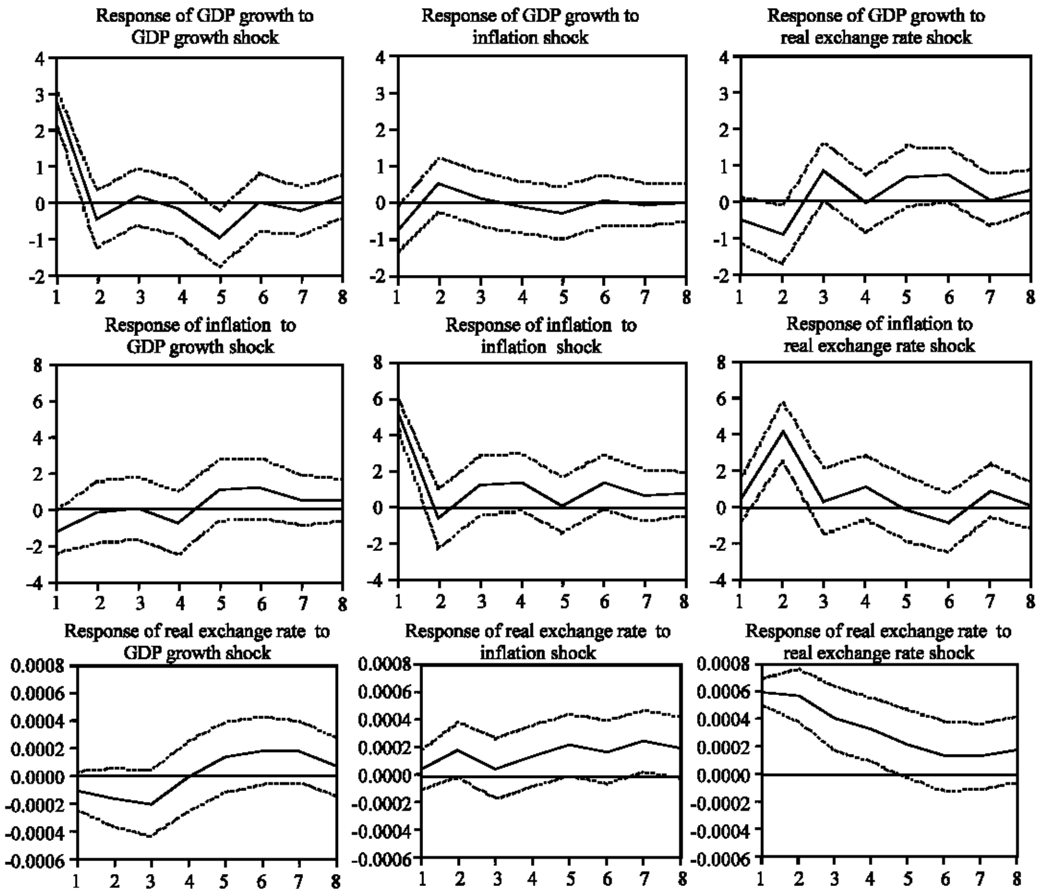

Fig. 9: Money an exogenous variable in the Extended Benchmark model

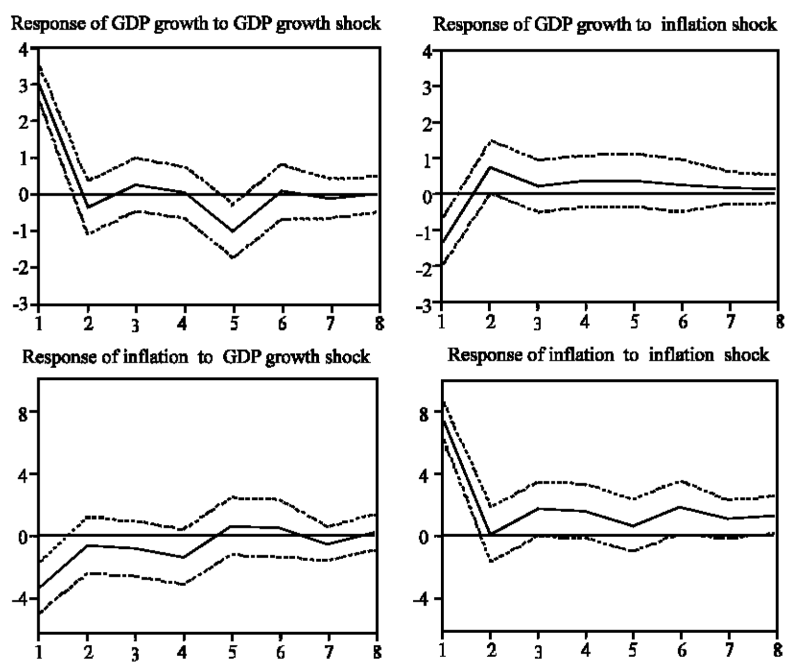

Fig. 10: Government spending as an exogenous variable in the Benchmark model

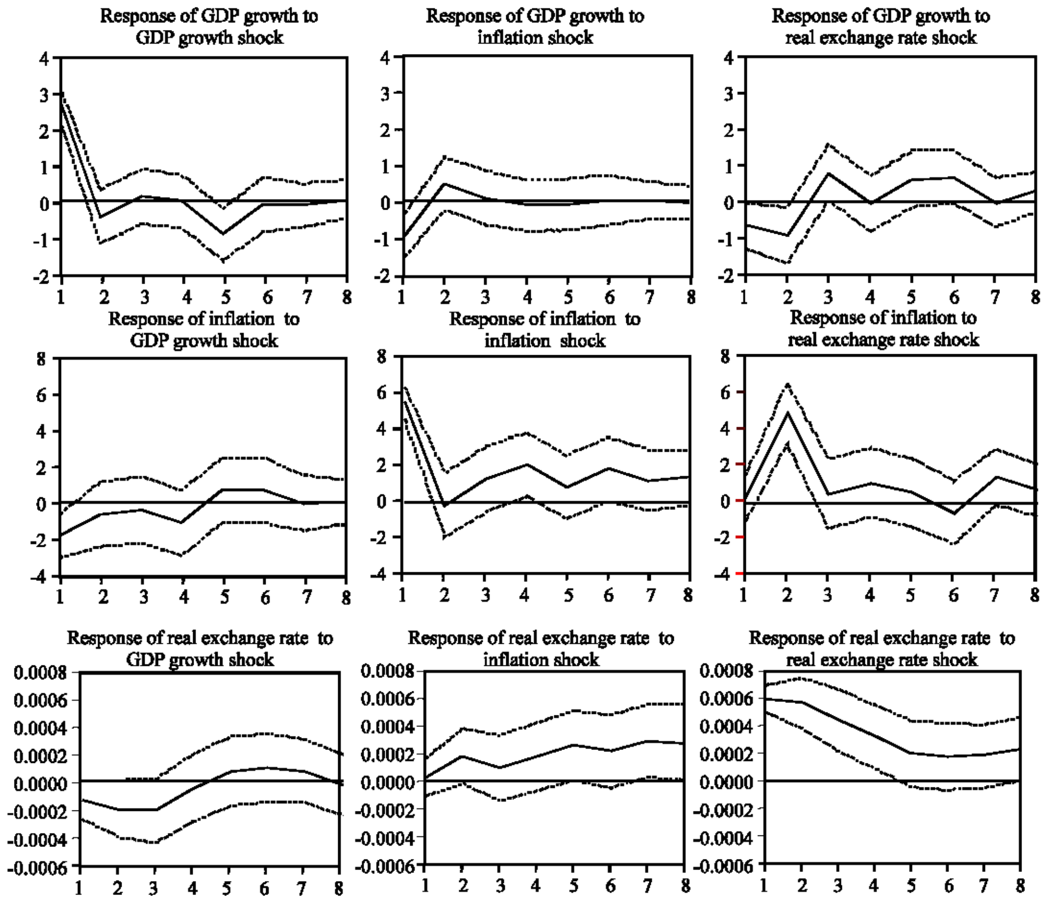

Fig. 11: Government spending as an exogenous variable in the Extended Benchmark model

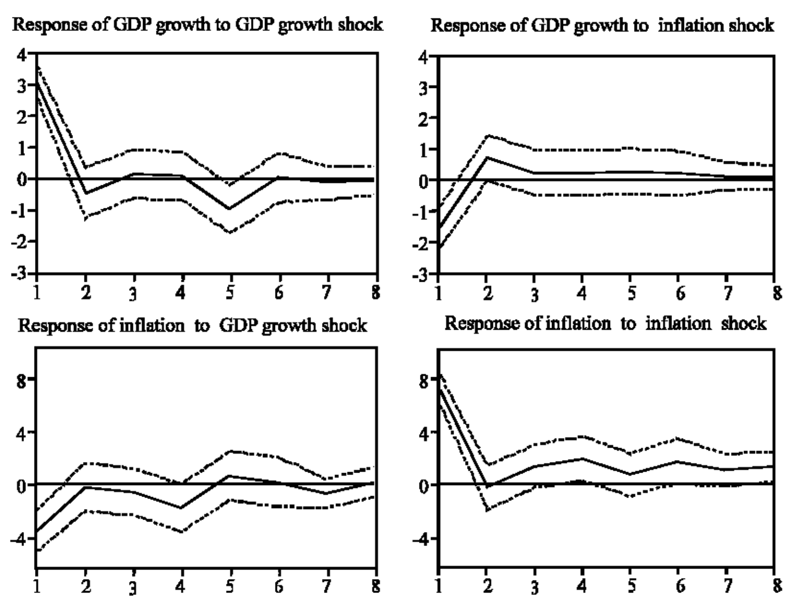

Fig. 12: Tax revenues as an exogenous variable in the Benchmark model

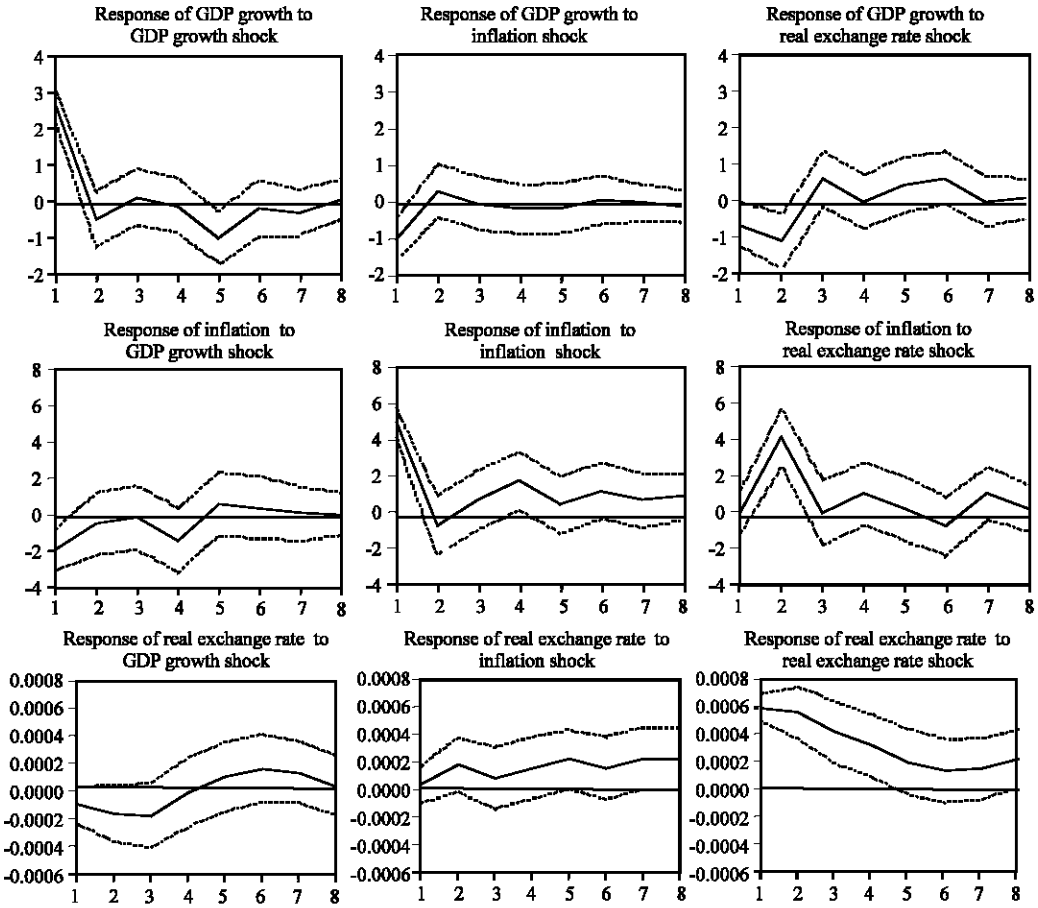

Fig. 13: Tax revenues as an exogenous variable in the Extended Benchmark model

appreciates the real exchange rate. In the following periods inflation rises and the real exchange rate depreciates while the growth rate declines. When we introduce one-standard shock to inflation, growth rate goes down and the real exchange rate depreciates. In contrast, a depreciation shock to the real exchange rate significantly raises inflation and reduces growth in the first period. Accordingly, we conclude that this exercise also supports present finding that there is a negative relationship between growth and inflation, which can be explained by real exchange rate movements.

Tax revenue as an exogenous variable: Taxes affect economic performance. Higher indirect taxes lead to higher prices, given that producers treat taxes as elements of cost and reflect them in prices. On the other hand, higher income taxes reduce the disposable income of the consumers leading to reduced consumption expenditure. Accordingly taxes can justifiably be added as exogenous variables to our model. Figure 12 shows the impulse response of the Benchmark Model. One-standard deviation shock to growth decreases inflation instantaneously and in the following periods, inflation goes up while growth rate begins to decelerate. But these effects are statistically significant only in the first period. On the other hand, a positive shock to inflation decreases growth in the first period. This effect is again observed in the third period but it is relatively smaller.

As a final exercise Fig. 13 reports the impulse responses of the Extended Benchmark Model with taxes. We observe that one-standard deviation shock to growth decreases inflation and appreciates the real exchange rate in the first quarter. In the subsequent periods, inflation rises and real exchange rate depreciates while growth rate declines. When we introduce one-standard shock to inflation, growth rate goes down and real exchange rate depreciates instantaneously. A depreciation shock to the real exchange rate significantly increases inflation and decreases growth in the first period. Thus, Fig. 13 also supports our claim that there is a negative relationship between growth and inflation and this negative relation can be explained by real exchange rate movements.

CONCLUSIONS

This study has been motivated by the recent developments in the literature on the relationship between inflation and growth and the apparent contradictory evidence provided for the developed and developing economies. The Turkish economy has been chosen for her unique experience with inflation and growth which can only be compared with that of Brazil. As a small and open economy Turkey has faced severe external shocks and dramatic shifts in the economic policies, especially the foreign exchange regime. Economic intuition alone would warn us that in such an environment one should not attribute developments in inflation and output growth to a single factor. Hence, to examine the relationship between inflation and growth the paper has employed a VAR model with Generalised Impulse Response analysis so that theoretically plausible determinants of inflation and growth could be controlled for. The results have definitely shown that, in contrast to the prediction of the Phillips curve, there is a negative relationship between inflation and growth and this is due to the movements in the real exchange rate. This basic result has proven to be robust and not change even when shocks in the oil prices, money growth, government spending and taxes are accounted for.

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