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The Choice of Monetary Policy Tool(s) and Relative Price Variability: Evidence from Turkey

[1]M.H. Berument, [2]A. Sahin and [3]B. Saracoglu
[1]Department of Economics, Bilkent University, 06800 Ankara, Turkey
[2]Republic of Turkey, Ministry of Agriculture and Rural Affairs,
Department of Foreign Relations and European Union, Eskisehir Yolu,
9 km Lodumlu, 06530 Ankara, Turkey
[3]Department of Econometrics, Gazi University, 06500 Ankara, Turkey

Abstract: The aim of this study is to assess any regularity relative price dispersion for the effect of monetary policy tool selection. Central banks use tools such as interbank rate and exchange rate when pursuing their (monetary) policies. The selected tools affect economic variables differently. By using Turkish monthly data for the 1988:2-2008:2 period, this study suggests that pure policies (such as interbank rate only or exchange rate only) increase relative price variability more than mixed policies, where the monetary authorities use the above tools simultaneously.

Key words: Monetary policy tool(s), relative price variability

INTRODUCTION

The goal of modern central banks is to provide price stability. The phrase price stability is often associated with lower levels of price inflation. However, Relative Price Variability (RPV) also affects resource allocations and investment decisions and is associated with welfare losses. This paper assesses how the selection of monetary policy tool(s) affects this relative price variability.

Balke and Wynne (2007) argued that monetary policy shocks increase the dispersion of a cross-section of relative prices, due to the non-neutrality of money in the short term that may arise from different sources and that higher dispersion of the cross-section disturbances creates adverse-supply side effects. Central banks have various tools at their disposal to pursue their monetary policies with. This study argues that the dispersion of the cross-section prices will be different for different monetary policy tools and that this dispersion is lower if a monetary authority chooses to mix policies in a Poole (1970) sense, rather than choosing pure policies, such as interest rate only or exchange rate only.

The most widely used tool of central banks is the short-term interest rate (often the overnight interbank interest rate). Short-term rates are crucial to economic performance (Bernanke and Blinder, 1992). An increase in interest rates decreases investment expenditures and the demand for consumer durable goods (Jones, 1954; Kau and Keenan, 1980; Meltzer, 1974). Moreover, the durable-goods sector is more interest sensitive than the non-durable goods sector (Erceg *et al*., 2000). Furthermore, contractual monetary policies affect crude goods prices more than processed goods prices (Balke and Wynne, 2007). Thus, prices of different products are affected differently when the short-term interest rate increases. Consequently, the price dispersion among different types of products will be higher.

The second most-common tool that central banks of small open economies have is the exchange rate, whereas large open economies may not utilize this tool so effectively because the role of the exchange rate is small for the latter group of economies. The presence of the exchange rate pass-through suggests that higher levels of exchange rate (low values of domestic currency compared to foreign currency) increase domestic prices. Kamin and Rogers (2000) and Berument and Pasaogullari (2003) claimed that after an increase in exchange rate, prices increase. The exchange-rate sensitivity of tradable goods is greater than for non-tradable goods, which causes a higher-level dispersion in relative prices after an increase in exchange rate. Dunn (1970), Magee (1974) and Takagi and Yoshida (2001) also claimed that the response of tradable goods prices to a change in the exchange rate is quicker. In addition, the technology shocks in the non-tradable sector and the demand shocks in the tradable sector are strongly connected to the real exchange rate. Frenkel and Taylor (2006) also noted that exchange rate influences price dispersion between tradable and non-tradable goods, capital-intensive goods and labor-

Corresponding Author: Mahmut Hakan Berument, Department of Economics, Bilkent University, 06800 Ankara, Turkey
Tel: +90-312-2902342 Fax: +90-312-2665140

intensive goods, as well as changing the costs of intermediate inputs and capital-intensive goods. Thus, the conduct of exchange-rate-based policies affects prices of different products differently.

An increase in relative price dispersion leads to a reduction in the information content of relative prices, which is often associated with the implementation of more costly institutional arrangements such as a shorting of optimal contract length and a consequent misallocation of resources, the result of which decreases output (Kaul and Seyhun, 1990; Blejer and Leiderman, 1980).

In order to analyze the effects of monetary policy tool selection on relative price dispersion, we gathered data from Turkey. Turkey is an important emerging economy and is the 17th largest economy in the world as of 2006. Turkey also has conducted its monetary policies by using exchange rate, interest rate and mixed policies for the time period that we consider (1998:2-2008:2). Thus, analyzing the effects of various monetary policy tools on relative price dispersion for Turkey is feasible. Turkey has well-developed and liberal markets with no price controls or freezes during our sample period; thus, a change in relative prices is due to market forces rather than administrative arrangements. Lastly, Turkey has had high, persistent and volatile inflation rates without running into hyperinflation for more than three decades. For present sample period, the average monthly Consumer Price Index (CPI) inflation was 3.46 and the variance of the monthly inflation was 7.45. This high volatility in inflation series decreases the chance of a type II-error: not rejecting the null when it is false. A type II-error is made when one does not reject the null hypothesis when, in fact, the null is false. One method to decrease the incidence of type II-errors is to increase the level of significance (α) or to decrease the confidence co-efficient ($1-\alpha$). However, Neter *et al.* (1985) also suggest increasing the dispersion of the collected data. They show that increasing the spacing decreases the standard errors of the parameters of interest and increases the t-statistics for a given estimated parameter, the sample size and variance of the errors. Since, Turkey has a high level of inflation compared to the most other economies, spacing is higher and type II-error is lower (Berument *et al.*, 2005). The above factors make Turkey a unique country for assessing any regularity of the effect of monetary policy tool selection on the relative price dispersion.

CONDUCT OF TURKISH MONETARY POLICY

The second half of the 1980s was the era of economic liberalization for Turkey. The interbank money market was created in 1986 and the Central Bank of the Republic of Turkey (CBRT) started to engage in open-market operations in 1987. From the beginning, the CBRT conducted its operations by using the exchange rate and interbank interest rates simultaneously. During this period, the CBRT announced the exchange rate every morning prior to the opening of the financial markets and depreciated the basket daily by a fixed rate each month. Thus, economic agents learned what the daily depreciation of the Turkish Lira (TL) would be for the whole month after a couple of business days had passed; however, the short-term interest rate fluctuated daily. Thus, the spread between the interbank rate and depreciation assesses the excess return that the CBRT offers on the Turkish lira above the depreciation rate-that is, the depreciation rate of the TL against the US Dollar (USD). Therefore, spread can be evaluated as the opportunity cost of holding TL against foreign exchange. However, this does not mean that the CBRT controlled both instruments simultaneously. The monetary authority may choose to control one of them and monitor the other (Berument, 2007). Turkish monetary authorities had been using a mixed policy, set up by using both exchange rate and interest rates, to conduct their monetary activities.

At the beginning of 2000, Turkey adopted a new disinflation program. As part of this program, at the end of 1999, the CBRT announced daily (crawling) exchange rates for the 12 months of 2000. The CBRT also declared that the crawling peg would be abandoned in July 2001 and after this date, the crawling peg would be continued with an expanding band. We can claim that this to be an exchange-rate-based policy. Following the excess demand for foreign currency and the financial crisis that was triggered by a speculative attack on foreign currency on February 19, 2001, the CBRT let the exchange rate float. After March 2001, the CBRT started to use interest rates as its policy tool. After 2006, the CBRT adopted (explicit) inflation targeting and continued to use the overnight interest rate as a policy tool. Therefore, Turkey has utilized both types of pure policies as well as mixed policies to conduct its monetary activities.

DATA AND MODEL SPECIFICATION

The data is gathered from the Turkish Statistical Institute (TURKSTAT) and the Central Bank of the Republic of Turkey, covering the monthly periods from February 1988 to February 2008. Inflation is the logarithmic first difference of the CPI as defined below:

$$\pi_t = 100*(\ln P_t - \ln P_{t-1}) \tag{1}$$

where, π_t is inflation and P_t is the consumer price index at time t.

Inflation can be calculated by taking the logarithmic first difference or its growth from the earlier period as:

$(P_t - P_{t-1})/P_{t-1}$. Hamilton (1994) show that discrete changes of an index number is approximately equal to the logarithmic first difference. Calculating inflation by taking the logarithmic first difference is quite common in study; for example, Holden and Driscoll (2003), Banerjee *et al.* (2007), Siklos and Abel (2002) and Reitz and Taylor (2008).

The CPI has seven basic components:

- Group index of clothing
- Group index of culture
- Training and entertainment
- Group index of food-stuffs
- Group index of home appliances and furniture
- Group index of medical health and personal care
- Group index of housing and group index of transportation and communication

However, in 2005, TURKSTAT changed the calculating method of the CPI, discontinuing some of the subcomponents of the seven CPI subgroups; hence we could gather from the main seven groups only. Inflation for each subgroup is defined as:

$$\pi_{i,t} = 100*(\ln P_{i,t} - \ln P_{i,t-1}) \quad (2)$$

where, $\pi_{i,t}$ is the inflation of each subgroup and $P_{i,t}$ is the price index for each subgroup.

Fischer (1981), Smith and MacKinnon (1987) and Chang and Cheng (2002) calculated relative price variability (V) using Eq. 1 and 2 as:

$$V = \sum_{i=1}^{n} w_i (\pi_{i,t} - \pi_t)^2 \quad (3)$$

where, w_i is the ith weight of the group index in CPI.

Berument (2007) spread had been taken as the difference between the monthly simple interbank rate and monthly exchange as a measure of monetary policy. In particular, spread is the difference between the monthly interest rate return and the depreciation of the TL against the USD. The growth rate of industrial production is y and exchange rate (depreciation) is the logarithmic first difference of the TL value of the USD. The exchange rate, interbank rate and industrial production are gathered from the CBRT electronic data delivery system; price indices are gathered from TURKSTAT.

ESTIMATION

Before going over the estimation specification, we plot relative price variability (V) and seasonally adjusted real Gross Domestic Product (GDP) growth series to see if there is any pattern between these two series, shown in Fig. 1. Figure 1 suggests that especially after 1993, this relationship is negative. The correlation coefficient for the full period is -0.10. This correlation coefficient is -0.20 after 1992 and after April 1994 and February 2001, when economic crises and other turbulences were a crippling shock to the system, GDP growth diminishes, but the relative price variability increases.

In order to explore the effect of monetary policy shocks on relative prices we set up a five-variable VAR model. The VAR specification includes y, exchange rate, spread, V and Inflation (benchmark VAR specification). It is important to recognize that the exchange rate enters the VAR specification twice: once as an exchange rate and once as the difference between the interbank rate and the percentage change in the exchange rate. This might be considered a problem. Here, we impose the constraint that the difference between the interbank rate and the depreciation rate can be used as an indicator of monetary policy and we treat the interbank rate above the depreciation rate as a variable separate from the exchange rate. Entering different interest rate spreads along with their components is also common in the literature (Bernanke, 1990; Friedman and Kuttner, 1992) or the difference of a series along with its level can be used (Bernanke, 1983).

When the VAR analysis were performed, each equation had 11 monthly dummies to account for seasonal

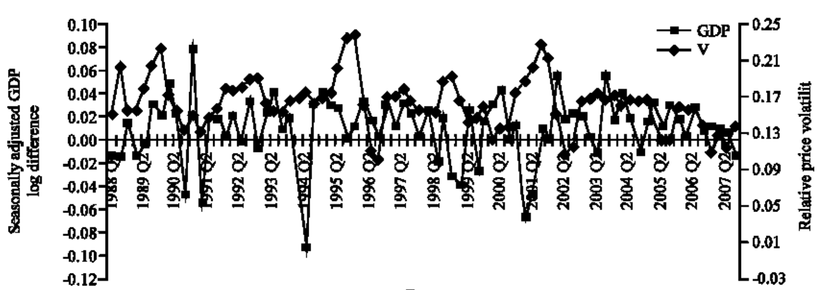

Fig. 1: Quarterly graphs of relative price volatility and GDP growth

changes as well as dummies for the 1994 and 2001 financial crises, for the time span from 1988:02 to 2008:02. The lag length of the VAR specification is determined by Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC), which suggest that the lag length should be 1. Once the model(s) is estimated, the impulse responses are gathered with the Generalized Impulse Responses (GIR), as suggested by Pesaran and Shin (1998). The GIR produces impulses that are insensitive to ordering of variables. Similar to Berument (2007), we also calculate the impulse responses with the Chelosky decompostion and the results are similar.

In order to explore the effect of mixed policies that are measured by spread innovations compared to exchange rate (depreciation) and interbank rate, we utilized two sets of VAR specifications. Because spread is the linear combination of exchange rate and interbank rate, we could not include these three variables simultaneously, but only two of them at a time. Figure 2a and b show the responses of volatility (V) to one-standard deviation shock in the exchange rate and spread and Fig. 3a and b show the responses to one-standard deviation shock in the interbank rate and spread. The Bayesian simulation method, with replications of 500 iterations, is used to obtain the confidence intervals for the impulse response functions. In our model, the impulse response functions are gathered from Monte Carlo simulations, in which the confidence intervals of impulse responses are ±2SE bands. In Fig. 2, 3, the middle lines show the impulse response functions and the upper and lower lines represent the confidence intervals. When the confidence interval contains the horizontal line, the null hypothesis that there is no effect of any of the shocks that we consider on RPV cannot be rejected. Hence, adding the horizontal line for that particular period shows evidence of statistical insignificance.

Shock to exchange rate increases V contemporaneously. It reaches its peak at the second period and higher V is observed for the 10 periods that we consider; this effect is statistically significant. When we introduce a one-standard deviation shock to spread, V decreases immediately. The effect reaches its bottom in the second period but lower V persists for the 10 periods that we consider. Moreover, this effect is statistically significant. In order to assess how the interbank rate and spread contribute to RPV, we estimate another five-variable VAR model by replacing exchange rate (depreciation) with the interbank interest rate (the alternative VAR specification). Figure 3 shows how interbank rate and spread affect V. Similar to the impulse responses shown in Fig. 2, innovation in spread decreases V. A shock to the interbank rate increases V and it reaches its peak in the second period; again this effect persists for 10 periods. Figure 4 and 5 also report the impulse response

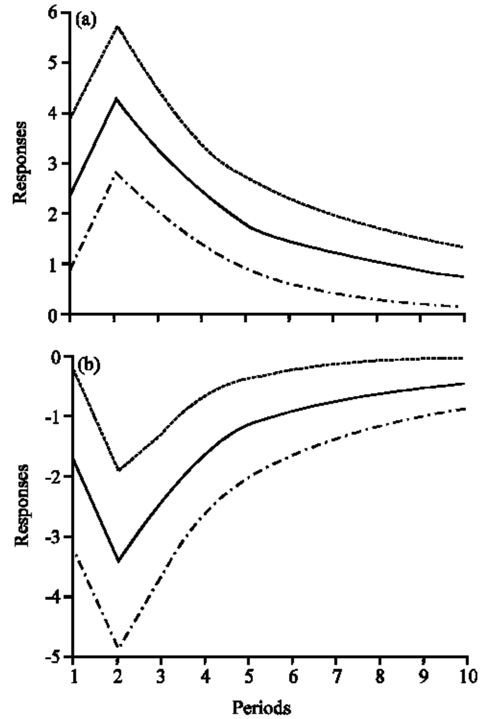

Fig. 2: Impulse response functions, (a) response of V to exchange and (b) response of V to spread

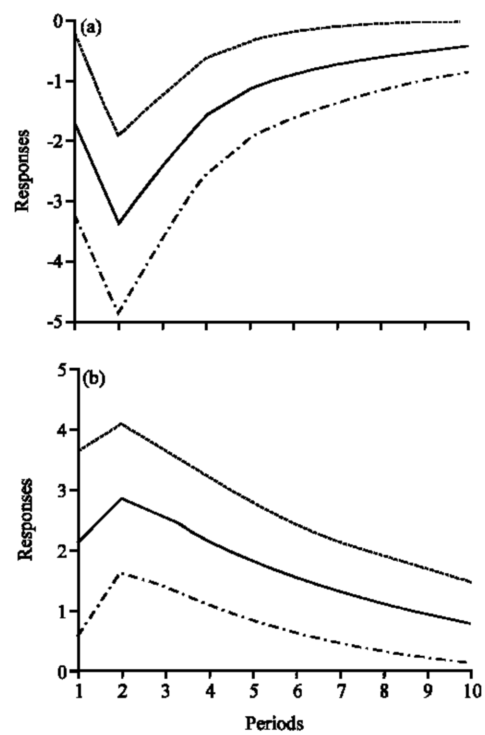

Fig. 3: Impulse response functions, (a) response of V to spread and (b) response of V to interbank

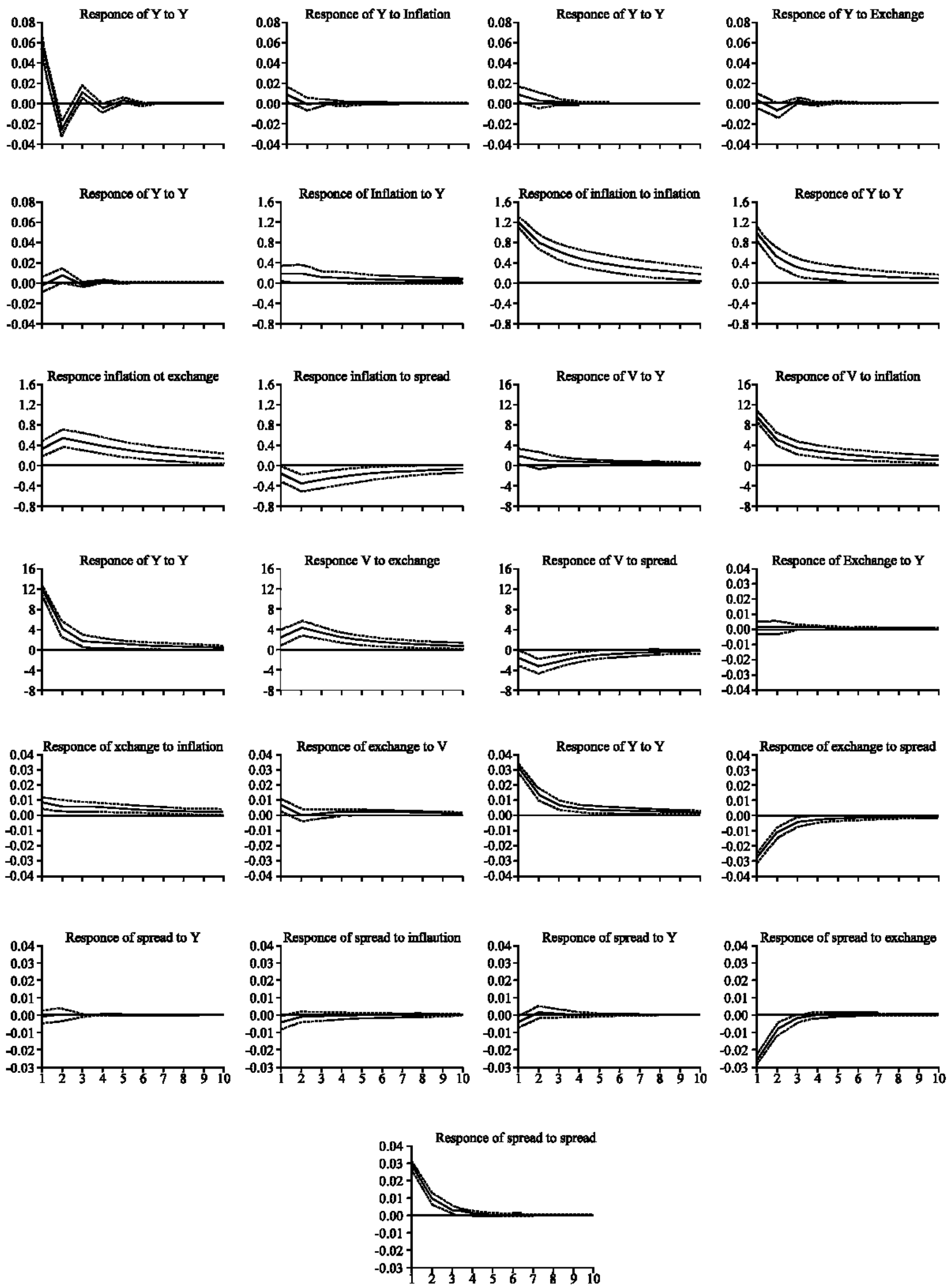

Fig. 4: Impulse responses for the benchmark specification. Response to generalized one SD innovations ±2SE

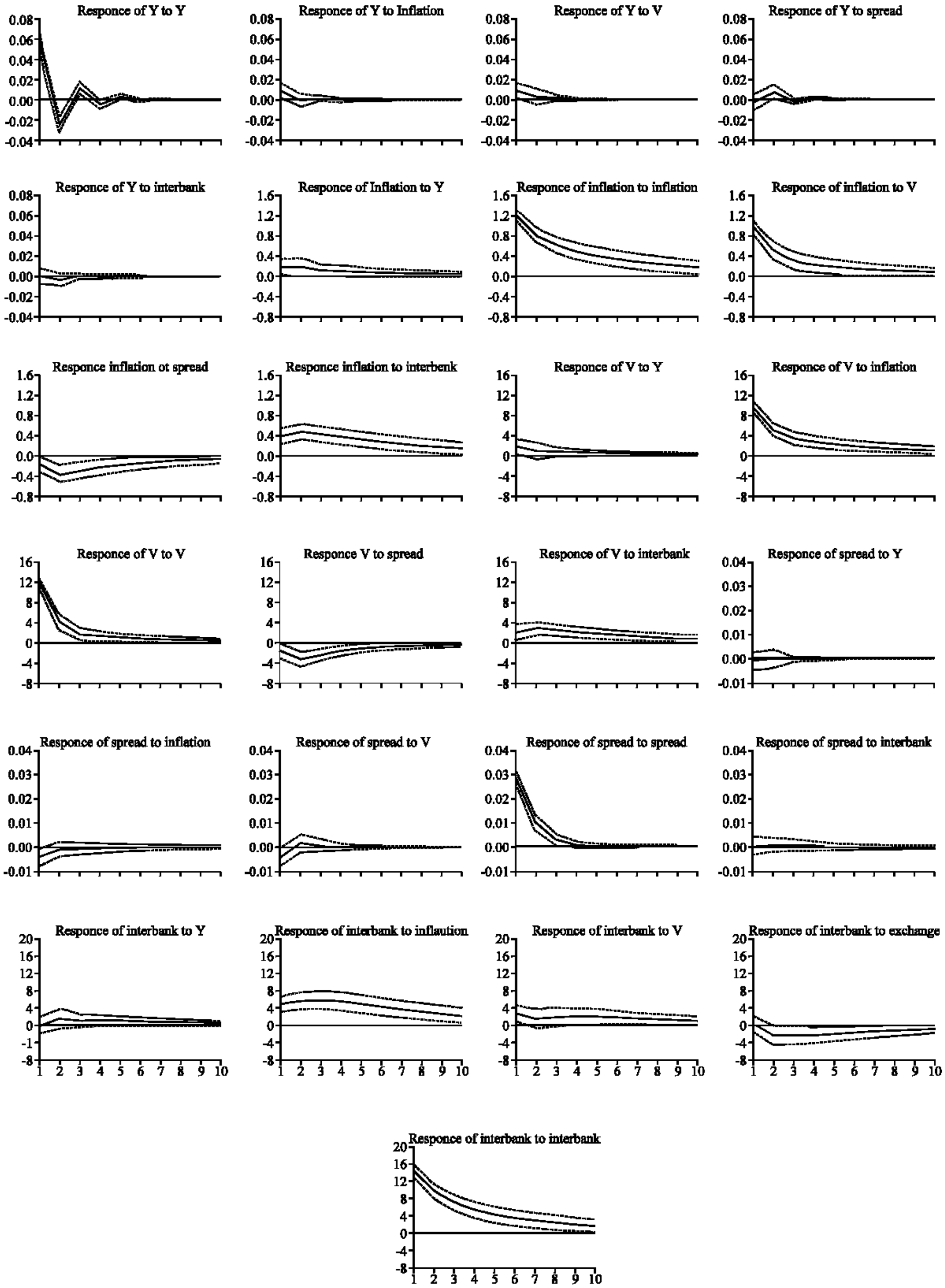

Fig. 5: Impulse responses for the alternative specification. Response to generalized one SD innovations ±2SE

Table 1: Forecast error variance decompositions for the Benchmark specification

Variables	Periods	y	π_t	V	Exchange	Spread
y	6	96.9233**	0.2170**	1.2119**	1.5585**	0.0894
	12	96.9003**	0.2310**	1.2172**	1.5609**	0.0906
	18	96.8973**	0.2327**	1.2180**	1.5612**	0.0908
	24	96.8969**	0.2329**	1.2181**	1.5613**	0.0908
	30	96.8969**	0.2329**	1.2181**	1.5613**	0.0908
π_t	6	2.6476	77.0964**	10.3408**	8.5935**	1.3216
	12	2.6175	74.8775**	11.8081**	9.0701**	1.6268
	18	2.6141	74.6278**	11.9724**	9.1231**	1.6626
	24	2.6137	74.5967**	11.9929**	9.1297**	1.6670
	30	2.6137	74.5928**	11.9954**	9.1305**	1.6676
V	6	2.1371	61.9022**	26.6941*	8.7453	0.5213
	12	2.1496	61.5170**	26.6016*	8.9997	0.7321
	18	2.1510	61.4704**	26.5906*	9.0297	0.7583
	24	2.1512	61.4646**	26.5892*	9.0335	0.7616
	30	2.1512	61.4638**	26.5890*	9.0340	0.7620
Exchange	6	0.4948**	13.4892**	10.1575**	75.5188**	0.3397**
	12	0.5610**	14.9687**	10.6807**	73.3061**	0.4835**
	18	0.5690**	15.1462**	10.7446**	73.0388**	0.5014**
	24	0.5700**	15.1685**	10.7526**	73.0053**	0.5036**
	30	0.5701**	15.1713**	10.7536**	73.0010**	0.5039**
Spread	6	0.1587**	2.2205**	2.3761**	79.6627**	15.5820**
	12	0.1593**	2.2327**	2.3792**	79.6496**	15.5793**
	18	0.1593**	2.2338**	2.3797**	79.6482**	15.5790**
	24	0.1593**	2.2339**	2.3798**	79.6480**	15.5790**
	30	0.1593**	2.2339**	2.3798**	79.6480**	15.5790**

*, **Indicate significance at the 0.10 and 0.05% level, respectively

Table 2: Forecast Error Variance Decompositions for the Alternative Specification

Variables	Period	y	π_t	V	Exchange	Spread
y	6	96.9232**	0.2169**	1.21186**	1.1016**	0.5462**
	12	96.9003**	0.2309**	1.2172**	1.1026**	0.5488**
	18	96.8973**	0.2326**	1.2179**	1.1028**	0.5491**
	24	96.8969**	0.2329**	1.2180**	1.1028**	0.5492**
	30	96.8968**	0.2329**	1.2180**	1.1028**	0.5492**
π_t	6	2.6476	77.0963**	10.3408**	5.2354**	4.6796**
	12	2.6174	74.8774**	11.8080**	5.3792**	5.3176**
	18	2.6141	74.6277**	11.9724**	5.3944**	5.3912**
	24	2.6137	74.5966**	11.9928**	5.3963**	5.4004**
	30	2.6136	74.5927**	11.9954**	5.3965**	5.4015**
V	6	2.1371	61.9022**	26.6941*	6.2732	2.9932
	12	2.1496	61.5170**	26.6016*	6.2957	3.4360
	18	2.1509	61.4704**	26.5905*	6.2978	3.4902
	24	2.1511	61.4645**	26.5892*	6.2980	3.4969
	30	2.1511	61.4638**	26.5890*	6.2980	3.4978
Spread	6	0.1587**	2.2205**	2.3760**	94.7557**	0.4888**
	12	0.1592**	2.2326**	2.3792**	94.7393**	0.4894**
	18	0.1592**	2.2337**	2.3797**	94.7375**	0.4897**
	24	0.1593**	2.2339**	2.3797**	94.7373**	0.4897**
	30	0.1593**	2.2339**	2.3797**	94.7372**	0.4897**
Interbank	6	1.1149	27.1050	16.7420	2.4403	52.5976**
	12	1.2437	30.0206	17.6473	2.8601	48.2282*
	18	1.2584	30.3522	17.7460	2.9100	47.7331*
	24	1.2603	30.3934	17.7583	2.9162	47.6716*
	30	1.2605	30.3986	17.7598	2.9170	47.6638*

SE are reported in columns under the corresponding coefficient. *,** Indicate significance at the 0.10 and 0.05% level, respectively

functions when a one-standard deviation shock is given to each variable and how the other variables react to it. Pure policies increase but mixed policies decrease the relative price variability.

The dynamic effects of monetary policy shocks are gathered by impulse response functions obtained from two VAR estimates. However, in order to investigate the contribution of monetary policy shocks to the volatility of various economic aggregates, the forecast error variance decompositions have been estimated. These help to assess whether monetary policy shocks have been an important independent source of shocks for RPV, inflation and output. Table 1 and 2 show the forecast error variance decompositions for these two five-variable VAR specifications. 6, 12, 18, 24 and 30 step-ahead forecast error variance decompositions are reported for the variables in interest.

Table 1 suggests that RPV explains approximately 1.2% of the variability of output and 11% of the variability of inflation. Even if these explanatory powers for output and inflation may be considered low, RPV has more power to explain the behavior of output than the inflation rate and spread for output and inflation. Similarly, PRV explains the behaviour of inflation more than exchange rate and spread. Considering the importance attributed to exchange rate and interest rate that affects spread in the literature, the role of relative price volatility is something that we cannot ignore. Table 2 shows the estimates of the same analyses but uses interbank rate rather than spread and basically reveals the same information: The contribution of RPV cannot be dismissed in output and inflation.

In addition, exchange rate volatility has more power to explain the volatility of output and inflation than the interbank rate does. This makes sense, as Turkey is a small open economy with a small financial market, compared to the European Union average (financial deepness = Total asset of Turkish financial assets/GDP was 116% as of September 2007 and 270% for the European Union). RPV is mostly explained with lag values of inflation volatility and this parallels Parks (1978), Fischer (1981) and Chang and Cheng (2002).

CONCLUSION

Central banks have various tools in their arsenals to conduct their monetary policies. Each of these tools affects prices of different products differently. Using only one tool may require the prices of a set of products to adjust too much, compared to prices of other products whose prices are less sensitive. On the other hand, using mixed policies involving more than one policy tool may affect the prices of a bigger pool of products; the required adjustments will be lower on the prices of those products and thus may not increase relative prices as much. This study provides empirical evidence that interest-rate-only and exchange-rate-only policies increase the relative price variability and using interest and exchange rates simultaneously decreases the relative price variability; thus, to stabilize the economy, mixed policies might be preferred to pure policies.

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