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Working Paper Number	2004-034C
Revision Date	October 2007
Citable Link	https://doi.org/10.20955/wp.2004.034
Suggested Citation	Gavin, W.T., Kemme, D.M., 2007; Using Extraneous Information to Analyze Monetary Policy in Transition Economies, Federal Reserve Bank of St. Louis Working Paper 2004-034. URL https://doi.org/10.20955/wp.2004.034

Published In	Journal of International Money and Finance
Publisher Link	https://doi.org/10.1016/j.jimonfin.2008.09.005

Using Extraneous Information to Analyze Monetary Policy in Transition Economies

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Revised October 29, 2007

Abstract: Empirical macroeconomics is plagued by small sample size and large idiosyncratic variation. This problem is especially severe in the case of the transition economies. We utilize a mixed-estimation method incorporating prior information from OECD country data to estimate the parameters of a reduced-form transition economy model. An exactly identified structural VAR model is constructed to analyze monetary policy in the transition economies. The OECD information increases the precision of the impulse response functions in the transition economies. The method provides a systematic way to analyze monetary policy in the transition economies where data availability is limited.

Keywords: Transition Economy, Monetary Transmission Mechanisms, Structural VAR, Mixed Estimation, Macroeconomic Forecasting

JEL Classification: C32, C33, E52, F41

We thank Dick Anderson, Zsolt Darvas, Csilla Horvath, Tom Garrett, Garrett Jones, Chris Neely and Bob Rasche for helpful comments. Athena Theodorou provided excellent research assistance. Views expressed here are those of the authors and do not necessarily reflect official positions of the Federal Reserve System or the Federal Reserve Bank of St. Louis.

1. Introduction

The nature of the monetary transmission mechanism in market economies is difficult to ascertain.[1] It is even more difficult to identify these mechanisms in transition economies.[2] During the planned-economy era and the early-transition period, a market-type economy (MTE) monetary transmission mechanism did not exist in the formerly centrally planned, now transition, economies because of the underdevelopment of financial institutions and markets. Nor could such a mechanism be measured, since the data generation and collection processes also didn't exist. By the middle of the 1990s, institutions and financial markets had developed sufficiently for policymakers to begin employing traditional MTE monetary policy tools, resulting in consistent and purposeful monetary policy.[3] However, data availability still limits policy analysts' ability to do quantitative analysis.

When time series are short, economists rely on common theories and experience gleaned from economic history in other countries. Even in the Organization for Economic Co-operation and Development (OECD) countries, macroeconomists use common theories to do analysis across time and national borders. Typically, the structures of the models are similar, but the particular empirical estimates vary. The variation may be due to systematic differences in institutions or policy. It may also reflect the presence of idiosyncratic shocks that can

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[1] See, for example, Boivin and Giannoni (2002) and Ciaccarelli and Rebucci (2002).
[2] See Wrobel and Pawlowska (2002), Golinelli and Rovelli (2005), and recently, Borys and Horvath (2007).

dominate econometric estimates in data sets. Forecasters typically find that in-sample model-selection procedures are of little use in choosing models that will do well in out-of-sample forecasting experiments. Stock and Watson (2003) attribute this result to large idiosyncratic shocks.

In a similar vein, Devereux (2003) argues that the structures of transition economies (TEs) are similar to the MTEs, but that the shock processes are different. This implies that the typical MTE macroeconometric model and even MTE data may be employed to improve the precision of estimated TE models. Using a small structural vector autoregression (SVAR) Kim (2002) compares the reaction function and effects of monetary policy across West European countries. He found similarities in the effects of policy across Denmark, France, Germany and Italy. We suggest that using data from OECD countries can improve the confidence we have in empirical policy analysis for some transition economies. In particular we suggest using information from the MTEs in those economies where basic reforms have been enacted, but in which there is little history from which to estimate econometric relationships. By basic reforms we mean only that 1) disciplined monetary, fiscal and regulatory institutions have operated effectively for some time; 2) prices and output are determined by market forces in most sectors; and 3) a standardized system of national income and product accounts have been implemented and corresponding economic data are reported. If the economy is thought to be operating like a market economy, but there is only a short history of macroeconomic time-series data, our

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[3] See Jonas and Mishkin (2003) for a discussion of alternative policy regimes and the evolution of monetary policy toward inflation targeting in transition economies, the Czech Republic, Hungary and Poland in particular.

approach can reduce the sampling error associated with small data sets. The Czech Republic, Hungary and Poland fit these criteria--the above reforms have taken place, but there is insufficient data to estimate models with high precision. Our approach should prove useful in forecasting macroeconomic aggregates and analyzing potential effects of monetary policies.[4]

In this paper we evaluate the impact of monetary policy in these three transition economies using a structural vector autoregressive (SVAR) model that has been widely used to analyze policy in developed market economies. The monetary policy shocks are identified in a Wold recursive ordering as in Eichenbaum and Evans (1995) and Christiano, Eichenbaum, and Evans (1999, 2005). This framework, presented in Section 2, requires more data than is typically available in the TEs. Therefore, we explore the use of OECD country data as extraneous information to improve the precision of our estimates for the three TEs. Section 3 explains the panel SVAR model and the mixed estimation procedures that are used to analyze the effects of a contractionary monetary policy shock. As a preliminary check on the robustness of our method, we compare the impulse responses to a contractionary monetary policy shock estimated using the 15-country OECD MTE panel with those from a model estimated using a 3-country TE panel. The dynamic patterns evident in the two models are quite similar. In Section 4 we examine the impulse response functions and variance decompositions from the three TE country models estimated individually and with the extraneous information taken from the

[4] See Gavin and Theodorou (2004) for evidence that the common model often predicts individual country macro variables better than models estimated using only the own-country data. We extend that exercise to forecast the transition economies and report the results in a forecasting appendix that is available from the authors.

OECD MTE panel. The individual country model with extraneous information from the MTE model provides more precise estimates regarding the monetary policy shock than the models with only that single country's data. Although the results are conditioned by the MTE data and look similar, differences remain. Section 5 offers a summary of the analysis and a discussion of policy implications.

2. The Monetary Transmission Mechanism in a Structural VAR

We estimate the monetary policy shock following a method similar to that used by Christiano, Eichenbaum, and Evans (2005). In the policy function the central bank adjusts the domestic money market interest rate in response to incoming information. The central bank is assumed to react to current and past information about domestic output, the price level, and the world interest rate. They are assumed also to react to past information about the exchange rate. We assume that the world interest rate is exogenous and, following a neutral policy, the central bank moves the domestic interest rate one-for-one with the world interest rate. Therefore, the policy variable in the model is the difference between domestic and world interest rates. These assumptions are implemented in a 4-variable SVAR with a Wold recursive ordering of the variables output, the price level, the policy variable, and the nominal exchange rate. With the recursive ordering the monetary policy shock is the error term on the policy equation.

The SVAR may be written as

$$G(L)Y_t = \varepsilon_t, \tag{1}$$

where $G(L)$ is a matrix of polynomials in the lag operator L; Y_t is a k x 1 data vector; and ε_t is a k x 1 vector of structural innovations that are assumed to have zero means and a diagonal variance-covariance matrix, Λ. The structural innovations are assumed to be serially and mutually uncorrelated.

The reduced form of equation (1) may be written as

$$Y_t = B(L)Y_{t-1} + u_t, \tag{2}$$

where B is a k×k matrix of polynomials in the lag operator, L, u_t is a vector of reduced form residuals with variance covariance matrix Σ. We restrict our attention to a small model. Using a small model risks omitting important information, but including too many variables rapidly exhausts degrees of freedom. The vector of endogenous variables is given as, $Y_t^{'} = (y_t \ p_t \ r_t \ e_t)$, where the four variables are the logarithm of real GDP (y_t), the logarithm of the GDP deflator (p_t), the interest rate differential (r_t)—the domestic money market interest rate minus the U.S. interest rate, and the logarithm of the exchange rate (e_t), the domestic currency price of the US dollar.[5]

A key identifying assumption is that output and the price level adjust only after a lag of one period or more to financial market shocks. Output and the price level form a recursive block; the effects of monetary policy shocks are invariant to this ordering. The third equation, for the interest rate differential, represents the policymaker reaction function. The fourth equation represents equilibrium in the foreign exchange market where the contemporaneous values of all variables in the model affect the exchange rate. We use the nominal exchange rate here, but results from Eichenbaum and Evans (1995) show that the results in this specification are nearly identical for real exchange rates. The reason, from Mussa (1986), is that nominal and real exchange rates are highly correlated under floating exchange rate regimes.

3. Mixed Estimation and the Panel SVAR Model

Measures of the goodness of fit and statistical significance of the parameter estimates are typically very poor for VAR models of the TEs because the sample size is so small.[6] The efficiency of these estimates can be improved using extraneous information in the mixed-estimation technique of Theil and Goldberger (1961). In the case at hand, we believe that by the mid-1990s the TEs operated much like MTEs. Thus, we use macro data from a panel of 15 OECD countries as extraneous information to improve the precision of the VAR estimates for the TEs. Adding a subscript to indicate country *i*, equation (1) is rewritten as

$$Y_{it} = B_i(L)Y_{it-1} + u_{it}\,. \tag{3}$$

The model for the panel has the same form as the VAR for the individual country. That is, there are no cross country effects in the panel model. In the usual case, panel methods are used to exploit differences across countries. Here we are using panel data to exploit the similarities.

To construct the common MTE model, we impose homogeneity restrictions on the slope coefficients and the variance-covariance matrices. The vector of

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[5] Specific definitions of each variable for each country are reported in the appendix.

[6] To expand the number of observations some analysts employ monthly data, using industrial production as a proxy for GDP, as in Anzuini and Levy (2004) and Jarocinski (2005). However, for purposes of monetary policy analysis in transition economies, where the non-industry sectors of the economy are developing rapidly, GDP is the preferred measure of aggregate economic activity even though it is only available quarterly. Also, using higher frequency data does not necessarily increase the amount of relevant information for many issues involving monetary policy.

constants is not constrained and picks up fixed effects. Then after filtering for fixed effects by transforming the data into deviations from means, we can rewrite the equation without the constants and the individual country subscripts,

$$Y_{MTE,t} = B_{MTE}(L)Y_{MTE,t-1} + u_{MTE,t} \ , \tag{4}$$

and the variance-covariance matrix of residuals is given by $\sum_{MTE}$. For purposes of explication only, we use the subscript MTE to indicate that the data and parameters are for the MTE panel.

Mixed Estimation and the TE Model. When estimating the TE model using the Theil-Goldberger method, we constrain the parameter estimates with the information gleaned from the MTE model.[7] Under our maintained assumptions, we estimate each equation separately using OLS. Define X to be a vector of the right hand side variables in the VAR:

$$X_t = (y_t, \dots y_{t-3}, p_t, \dots, p_{t-3}, r_t \ , \dots, r_{t-3}, e_t, \dots, e_{t-3}) .$$

Then, to illustrate the mixed estimation method for one of the equations, consider the equation for the log of the price level (the second row of the system given by equation (2)) as

$$p_{i,t} = X_{i,t-1}\beta_i^p + u_{i,t}^p ,$$

where the subscript i is used to indicate the particular TE, the superscript p refers to the parameters of the price equation, and the random disturbance term, $u_{i,t}^p$, has zero mean and variance σ_i^p. The mixed system can be written as:

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[7] See also Theil (1971), p. 349.

$$\begin{bmatrix} p_{it} \\ \hat{\beta}^p_{MTE} \end{bmatrix} = \begin{bmatrix} X_{i,t-1} \\ R \end{bmatrix} \beta_i^p + \begin{bmatrix} u^p_{i,t} \\ \hat{v}^p \end{bmatrix}, \tag{5}$$

where $R = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$, $E\begin{bmatrix} u^p_{i,t} \\ \hat{v}^p \end{bmatrix} = 0$, and $Var\begin{bmatrix} u^p_i \\ \hat{v}^p \end{bmatrix} = \begin{bmatrix} \sigma^p_i & 0 \\ 0 & \hat{V}^p_{MTE} \end{bmatrix}$.

The extraneous information is in the parameter estimates for the price equation from the MTE model, $\hat{\beta}^p_{MTE}$. Using the MTE data, we can estimate the parameter variance-covariance matrix, $\hat{V}^p_{MTE}$, and use it to weigh the value of the extraneous information.[8] The matrix R is a 24 × 24 identity matrix. There are four equations of this form, one for each of the four variables in the model.

The MTE data are from 1980:Q1 to 1996:Q4. The countries are Austria, Australia, Belgium, Canada, Finland, Germany, Japan, France, Italy, Korea, the Netherlands, Norway, Spain, Switzerland, and the United Kingdom. In most cases, the national statistical agencies or the International Monetary Fund seasonally adjusted the data. In cases where they did not (some output data from the Scandinavian countries and the transition economies), we seasonally adjust the series using the Census X-12 method. The data for the MTE countries is described in the appendix to Gavin and Theodoru (2004). The TE data are from 1995:Q1 to 2006:Q4. The United States is not included in the OECD panel because the U.S. federal funds rate is treated as the exogenous "world" interest rate with data from 1980:Q1 to 2006:Q4. A detailed description of the TE data is included in the appendix.

[8] Amato and Gerlach (2001) recommend using prior information to add precision to parameter estimates in transition economies and present a simple example using a mixed estimation strategy.

4. Impulse Response Functions

This section provides a description of results from the estimation of two panel models—the MTE model estimated with OECD data and the TE model estimated with data from the Czech Republic, Hungary and Poland. It also includes two models for each TE, one for each of the TEs alone and one for each TE estimated using the MTE parameters as extraneous information, as in equation (5).

Filtering the data for fixed effects and assuming homogeneity across slope parameters allows us to estimate the model directly using OLS and to estimate confidence bands for the impulse response functions using the Sims and Zha (1999) Monte Carlo method. We report the average as well as the 2-standard deviation bands for each impulse response from 2500 simulations.

Monetary policy shocks. Figure 1 displays average impulse response functions to a monetary policy shock for both the panel of MTEs (for which we had 960 observations) and those from the panel of TEs (for which we had 132 observations). The figure also includes 2-standard deviation bands. The size of the shock is standardized to 25 basis points here and in the other figures so that the results are more easily compared. Generally, the patterns are similar, especially for the first few quarters. Only in the case of the price level is there a pronounced difference. The MTE model displays the price puzzle that is commonly found in small SVARs, that is, the price level tends to rise following a contractionary policy

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See Jarocinski (2004) for a Bayesian treatment of our issue using a different model and different countries.

shock. This price puzzle is less evident in the average response of the TEs, but it is never significant at a 5 percent critical level.

The effect of a monetary policy shock on the price level remains an open issue in the macroeconomic literature. There is a substantial VAR literature showing that inflation initially rises in response to a monetary policy shock. Many researchers have added other variables in attempts to eliminate the price puzzle. It is not clear, however, that a positive price response should be considered a puzzle. Gavin, Keen and Pakko (2005) show that in modern general equilibrium models (both the New Keynesian and New Classical versions) there is a positive price response to both transitory and persistent monetary policy shocks that increase the interest rate. Even with sticky prices, the monetary policy shock has only a muted effect on real returns and some prices adjust upward immediately. In the New Keynesian model, the Fisher equation will be satisfied by a combination of both higher real rates and higher inflation.

Following a contractionary monetary policy shock, interest rates rise and real output falls. These effects persist for many quarters following the interest rate shock. In neither model is there a significant response of the U.S. dollar exchange rate to a monetary policy shock. This is at odds with the results in Eichenbaum and Evans (1995), but consistent with the empirical literature on the predictability of exchange rates. Another key fact to take from Figure 1 is the relative size of the confidence intervals. The impulse responses for the MTE model are estimated much more precisely than are those for the TE model.

In the next three figures we present results using two models for each one of the TEs. The first model is estimated using only the 44 quarters of data that are available for TE since 1995. In the second model, we use the data from the MTE model as extraneous information. Figures 2-4 report the response functions to a 25-basis-point interest rate shock for each of the four variables for each country, without and with extraneous information. Each response is measured in each period as the percent deviation from the path that the variable would follow in the absence of a shock. We display the confidence bands (±2 standard deviations) for the case in which the extraneous information is included in the estimation. The confidence bands for the individual country results are not displayed in the figures because they are so wide and the estimated responses are rarely statisitically significant. Exceptions are reported in the text below.

First consider the impulse responses for the Czech Republic in Figure 2. The output response to a 25 basis point monetary policy shock is shown in the upper left hand panel. When no extraneous information is included, the initial decline in output is greater than the case when extraneous information is employed. Adding the extraneous information does not affect the response after the second year. Note that the Czech output response with the prior is larger than the MTE model response displayed in Figure 1.

The price level response is shown in the upper right hand panel. Using only Czech Republic data produces a response that is negligible in the first three quarters, but then jumps in the fourth quarter to the level that occurs in the case with the MTE information. As we saw with output, the price level response is larger and more persistent than the response in the MTE model of Figure 1.

The persistence of the increase in the interest rate differential to a monetary policy shock is well below both that of the MTE model and the response estimated using the MTE parameters as prior information. It declines by about half after the first quarter and then declines slowly, reaching zero after a couple years. Here the estimated responses are significant for the first 3 quarters. The korona/$US exchange rate response is shown in the lower right hand panel. Of all Czech Republic impulse response functions, the exchange rate response without extraneous information is most different from the MTE model. The positive response after 4 quarters is nearly 2 standard deviations above zero and above the wide standard deviation bands of the MTE model. Adding the extraneous information results in a very small positive response that is never statistically significant.

Figure 3 shows the results for Hungary. Using only data from Hungary, we estimate a brief and transitory output effect of a monetary policy shock. For the first year, output declines as in the MTEs, but by the end of the second year output is back to the pre-shock trend. Applying the mixed estimation procedure with the MTE prior produces a more pronounced and prolonged negative effect on output that is similar to the response estimated in the MTE model. The price effects also differ from the MTE case. For Hungary there is a delay of three quarters before the price level begins to decline, but the average response is never consistently positive and becomes negative after 4 quarters. Only the response at the 5th quarter is 2 standard devaitons from zero. The average response with the extraneous information is similar in shape of the response in the MTE model, but estimated with more uncertainty.

On average, the interest rate differential declines smoothly to zero in just 6 quarters. As was the case with the Czech Republic, the estimated responses for the first three quarters are statistically significant. Here, also, the interest rate differential is less persistent than in the case for the MTEs. The lower right hand panel of Figure 3 shows the response of the forint/$US exchange rate to a monetary policy shock. Using only data for Hungary, there is a sharp appreciation of the currency that is significantly different from zero in quarters 2 through 5. This result differs sharply from the no significant effects that we found in the common models for both the MTEs and the TEs in Figure 1. Again, applying the Theil-Goldberger technique with the MTE data makes the result look much like the MTE response. On average, the currency appreciates, but the response is never statistically significant.

Figure 4 displays the results for Poland. Following a monetary policy shock, there is little response of output in the first four quarters, but it is followed by a negative response in the second and third years. Estimating the model with the MTE prior generates an output response that has the same shape as the MTE model, but the response is slightly larger and more persistent. Using only data from Poland, the price level response is positive initially, but reverses quickly and looks, on average, similar to the response in Hungary. Again, the use of the MTE data as extraneous information reproduces the positive price level response seen in the MTE model.

The response of the interest rate differential for Poland is also similar to the responses in the Czech Republic and Hungary. This is consistent with the smaller positive price level response. Inflation rises along with a contractionary monetary policy shock, but the effect is smaller and reverses much more quickly in the transition economies. The zloty/$US exchange rate appreciates in response to a contractionary monetary policy shock. The responses are never statistically significant. The use of MTE information makes the response smoother and the estimates more precise, but still never significantly different from zero.

Summary. The output response is negative for all three countries. It is largest, most well defined and statistically significant for the Czech Republic, behaving essentially like the MTE panel response. There is a smaller price puzzle effect in the TEs and the interest rate differential response is less persistent than in the MTEs. When we use the MTE estimates as extraneous information the responses of all variables except the exchange rate are statistically significant for as least some part of the response pattern.

What is the prior inherent in our extraneous information? What sort of prior are we imposing when we use the MTE data to restrict the estimation for one of the transition economies? Table 1 shows the sum of the lagged coefficients from the MTE and TE models. The first column shows the sums of the coefficients in the output equation, the second column shows the sums for the price equation, and so forth. The top panel displays the MTE case. For all the domestic variables except the interest rate, the sums of coefficients on the lagged dependent variables tend to be close to unity and the sums of the coefficients on the other variables tend to be closer to zero.

The second panel of Table 1 shows the sums of the lagged coefficients for the panel TE model. These coefficient sums are not quite as close to unity for the autoregressive coefficients and to zero for the other variables as are the MTE estimates. The interest rate differential has a large and significant effect on output and output has a non-zero sum effect on the exchange rate. Otherwise, the pattern looks much like that in the MTE economies.

The next three panels show the results for the TE economies. Interestingly, the sums for output and the price level in the Czech Republic are similar to those in the MTE. For Hungary and Poland the sums are well below unity. For all the transition economies, the sums of the coefficients on the lagged dependent variables are well below those for the MTE economies for both the interest rate differential and the exchange rate. Adding the extraneous information is akin to assuming a prior that these sums should be closer to unity.

In effect, the MTE prior is offsetting the small sample downward bias in OLS estimates when the model includes a lagged dependent variable. Under our null hypothesis, the MTE estimates will have less bias because the sample size is larger. If, contrary to our null, there is heterogeneity in the panel, Pesaran and Smith (1995) show that this heterogeneity will bias estimates of persistence upward. Using Bayesian methods, Jarociński (2005) reports that similar SVAR estimates for the EU countries of Western Europe are likely to be consistent with the homogeneity restriction, but that the restriction is less likely for the transition economies of Eastern Europe.

Variance Decomposition. The impulse responses indicate that the real output effect of a monetary policy shock is large and long lasting. Table 2 shows the variance decomposition for the two common models and each of the individual TE models. In the two common models, monetary policy shocks contribute significantly to the variation in output, but not to the price level or the exchange rate. Although estimated imprecisely, the effects of monetary policy shocks appear to be larger in the transition economies. Jarocinski (2005) suggests several reasons for this, but most importantly because financial markets are less developed, and therefore firms have fewer alternatives to domestic credit sources.

5. Conclusions

This paper illustrates how one might incorporate cross-country information in a time-series analysis of the monetary transmission mechanism. Our method is quite general and could be applied to a variety of identification schemes, economies and empirical models. We use the panel data to estimate the common elements in the mechanisms that propagate shocks. Our main point is to demonstrate that the OCED histories could be used to improve the analysis of TE policies.

Our results for the MTE common model are consistent with the conventional wisdom about a monetary policy shock. Our method is more likely to be useful if the emerging market economy is operating much like a typical OECD country. Some evidence in favor of this assumption is that the general patterns in the impulse responses for a common model estimated using a panel of data for only the transition economies look much like the patterns found in the common model estimated using panel data for OECD countries. Our interpretation is that the underlying economic dynamics are quite similar, but difficult to recognize for individual economies because of the small sample size and large idiosyncratic shocks. Augmenting the structural VARs with information from the OECD countries provides more confidence in the empirical model. This is a systematic method for quantitative analysis in countries where the economic structure has changed in important ways, whether through the emergence of markets or a fundamental reform in economic policy, yet data is limited.

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Table 1: Sums of the Lagged Coefficients in the Reduced-form

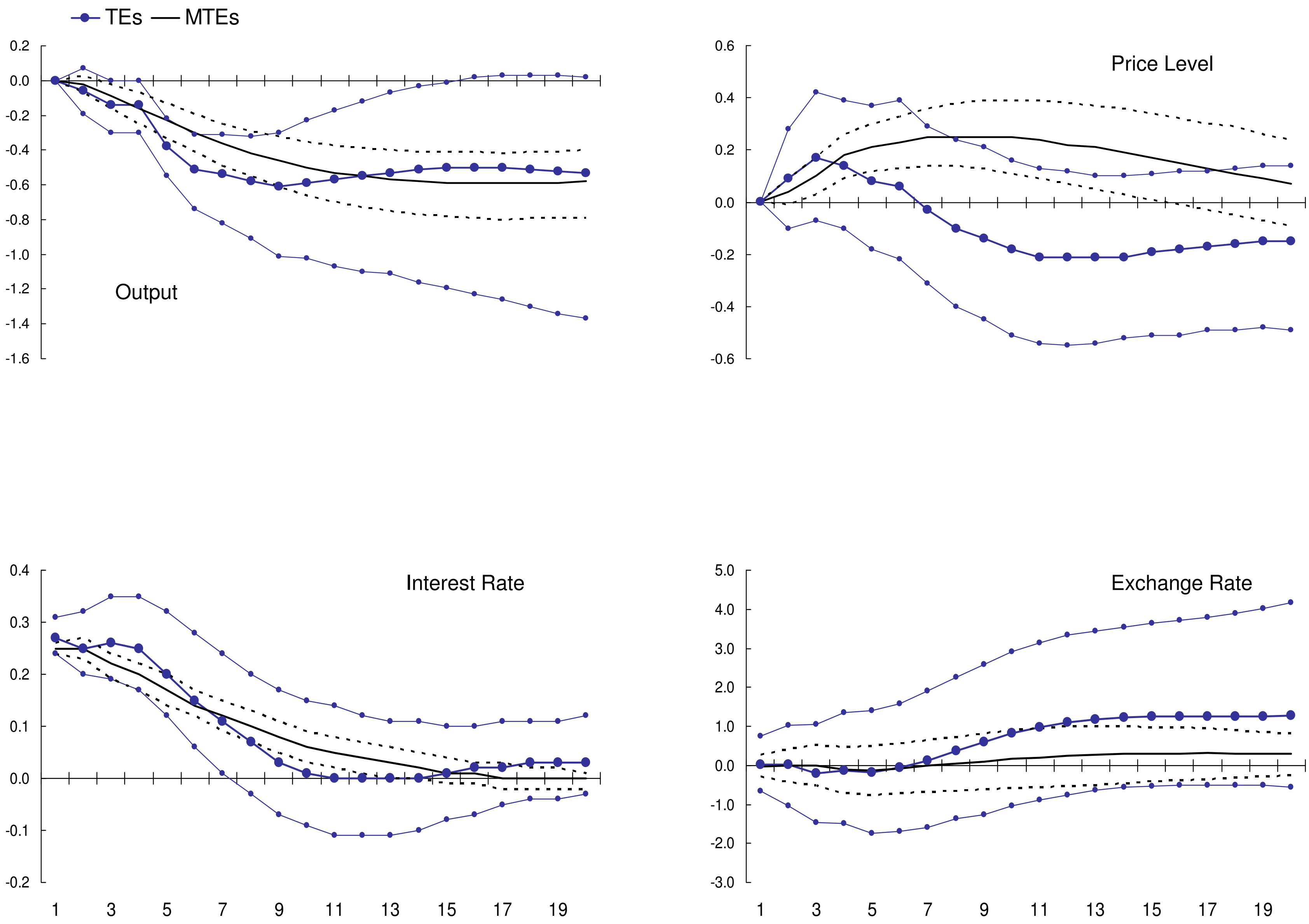
Market-Type Economies	Output	Price level	Interest rate differential	Exchange rate
Output	0.99	0.02	0.00	-0.04
Price level	0.00	0.97	0.00	-0.01
Interest rate differential	-0.34	0.21	0.88	-0.32
Exchange rate	0.01	0.00	0.00	0.94
Transition Economies				
Output	0.86	0.02	0.00	-0.22
Price level	0.04	0.90	0.00	0.01
Interest rate differential	-0.97	-0.09	0.80	-0.28
Exchange rate	-0.05	0.00	0.00	0.92
Czech Republic				
Output	0.98	0.09	0.04	-0.66
Price level	0.00	0.93	-0.04	0.31
Interest rate differential	-0.29	-0.04	0.46	4.73
Exchange rate	-0.01	0.02	0.00	0.85
Hungary				
Output	0.87	0.15	-0.02	-0.48
Price level	0.03	0.72	0.00	-0.01
Interest rate differential	-0.91	-2.11	0.48	-3.96
Exchange rate	-0.04	-0.01	-0.01	0.83
Poland				
Output	0.64	0.39	-0.04	-1.55
Price level	0.18	0.56	0.00	0.85
Interest rate differential	-1.33	-0.11	0.59	-2.57
Exchange rate	-0.11	0.08	0.01	0.71

Note: There are 960 observations in the MTE estimation, 132 observations in the TE case and 44 observation in each of the Czech Republic, and Poland.

Table 2: Percent of Variation Due to the Monetary Policy Shock

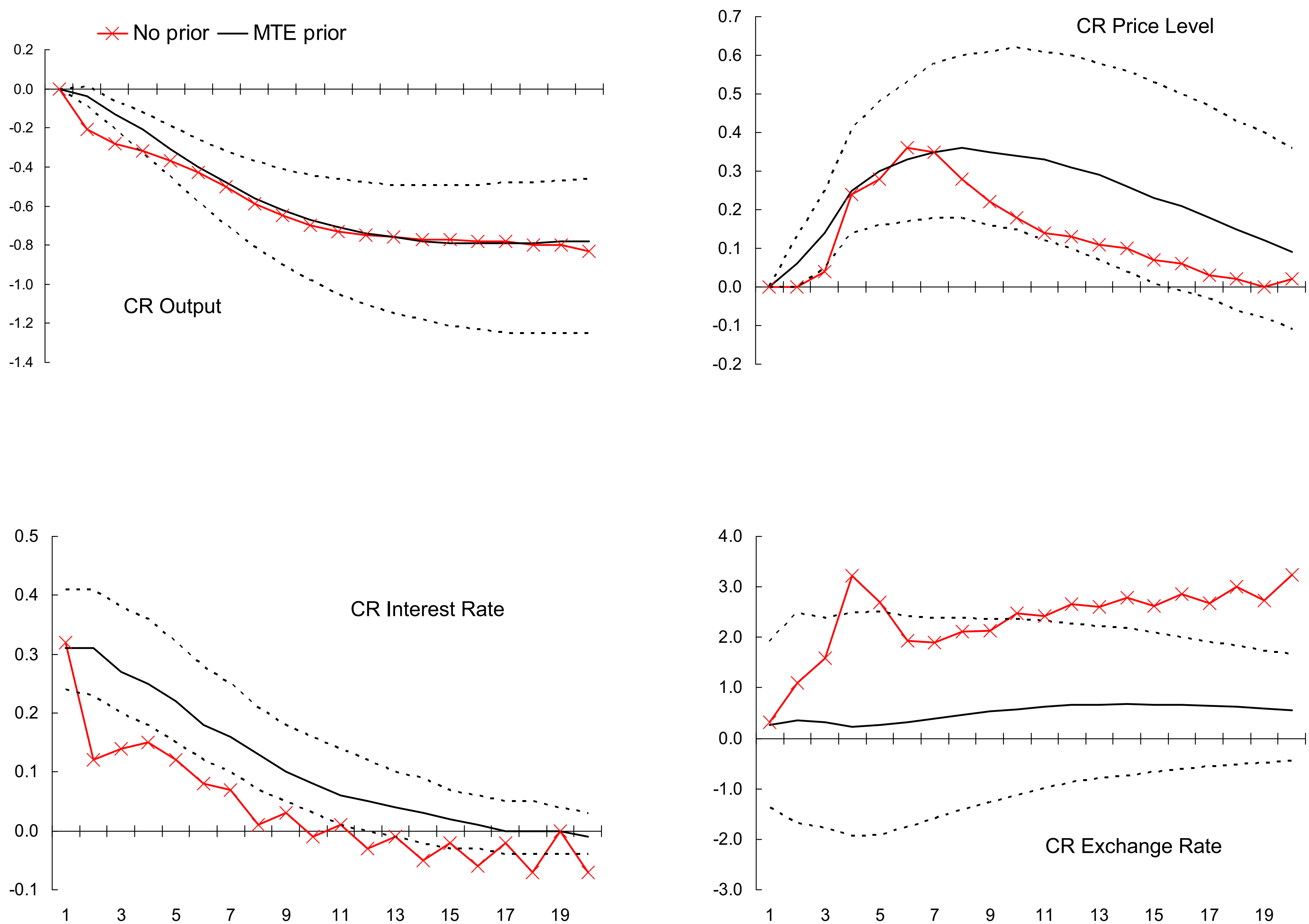
Horizon	Output	Price level	Interest rate	Exchange rate
MTEs				
4	1.2	1.8	94.5	0.0
8	8.1	5.0	90.6	0.0
12	16.8	6.3	89.4	0.1
16	23.8	6.3	88.8	0.2
20	28.7	5.7	88.3	0.4
TEs				
4	4.4	2.1	86.1	0.1
8	31.6	2.1	80.7	0.2
12	30.6	5.2	80.3	2.2
16	27.4	7.8	79.9	4.5
20	25.2	9.0	79.7	6.1
Czech Republic				
4	10.1	1.6	56.2	13.3
8	13.4	5.9	50.0	18.7
12	18.0	5.3	41.5	23.6
16	21.2	4.7	37.0	23.7
20	23.2	4.7	35.9	24.1
Hungary				
4	11.0	8.1	82.4	32.0
8	26.2	33.0	68.6	35.1
12	22.6	39.0	68.7	32.4
16	17.8	43.7	68.1	31.4
20	15.8	44.3	68.0	30.9
Poland				
4	1.4	0.6	70.9	4.7
8	7.7	7.9	60.6	10.2
12	6.8	18.2	62.4	7.8
16	5.8	17.6	52.9	6.5
20	3.9	16.4	45.1	6.1

Figure 1. Response to a Monetary Policy Shock in the MTE and TE Common Models



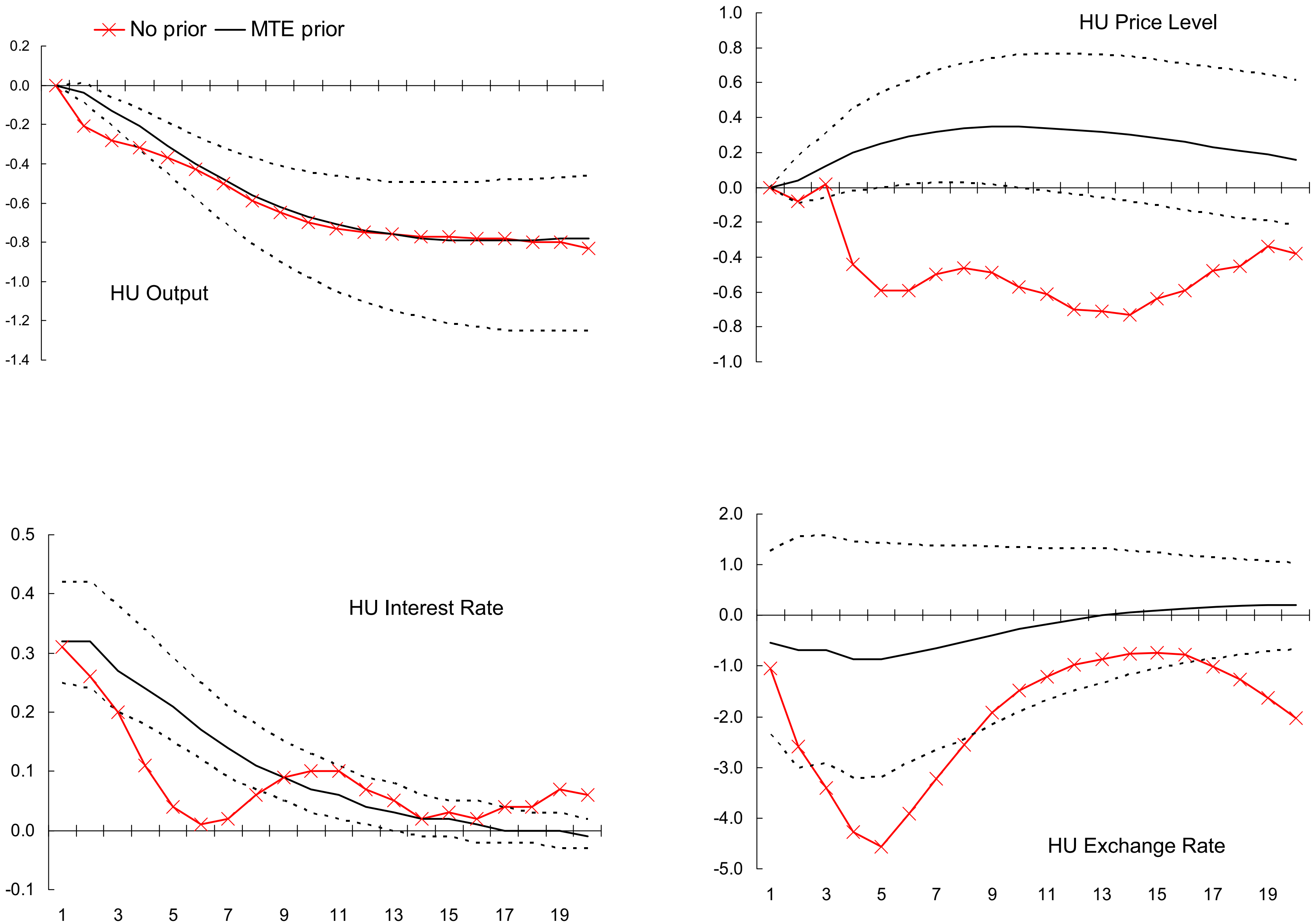
Note: Confidence bands are for plus and minus 2 std devs using the Sims/Zha method.

Figure 2. Response to a Monetary Policy Shock in the Czech Republic



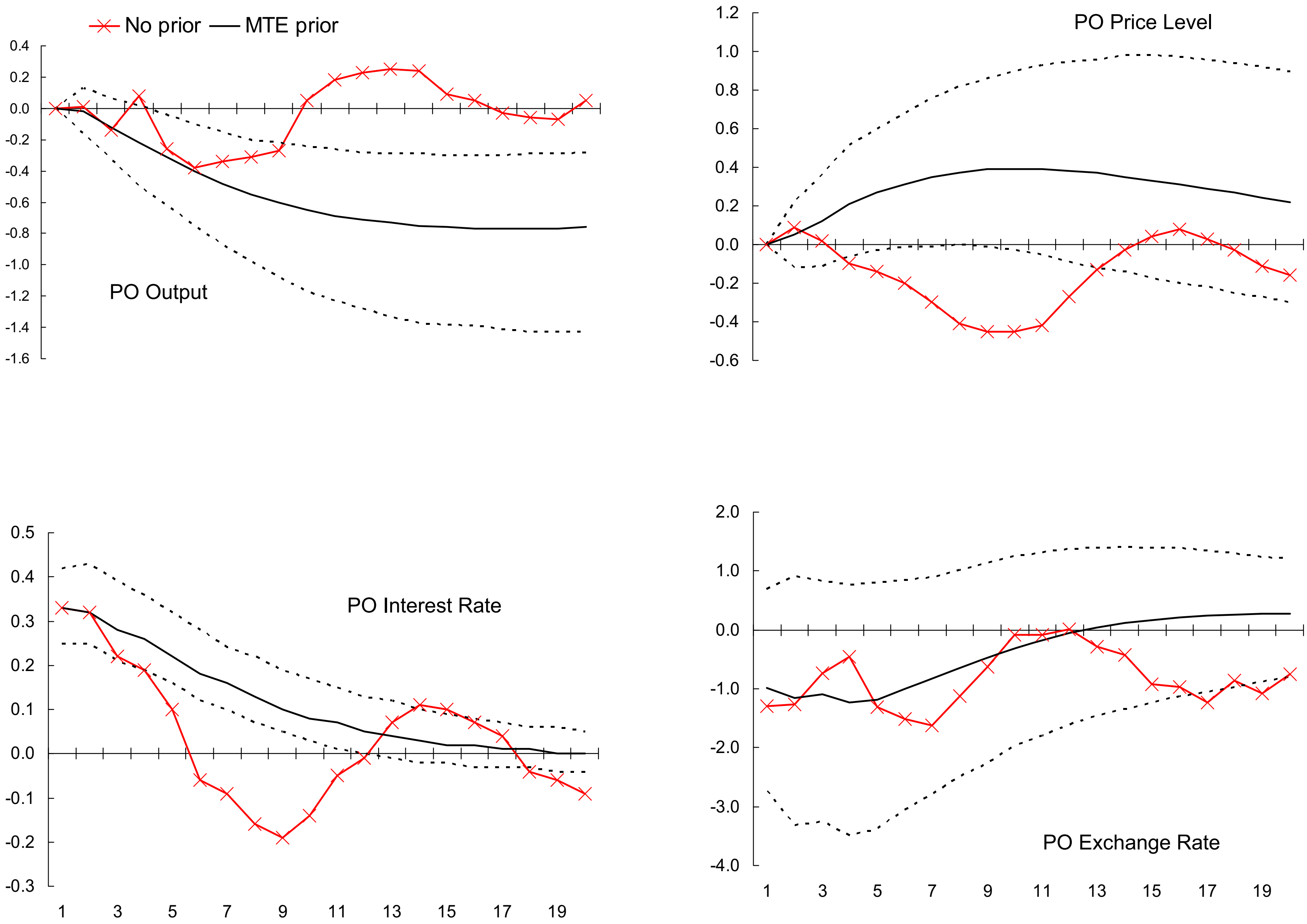
Note: MTE Confidence bands represent plus and minus 2 std devs using Sims/Zha method.

Figure 3. Response to a Monetary Policy Shock in Hungary



Note: MTE Confidence bands represent plus and minus 2 std devs using Sims/Zha Method.

Figure 4. Response to a Monetary Policy Shock in Poland



Note: MTE Confidence bands represent plus and minus 2 std devs using Sims/Zha Method.

APPENDIX: Data sources used in estimating the transition economy models

Our data were downloaded from Haver Econometrics who supply data from both the IMF and OECD. In most cases, the IMF or the OECD seasonally adjusted the data. In cases where they did not we seasonally adjusted the series. Nominal exchange rates are not seasonally adjusted. See Gavin and Theodorou (2004) for MTE data sources.

Czech Republic

Output: Gross Domestic Product (SA, Mil.95 Koruny), Source: OECD, Haver series c935gdpc@oecdnaq.

Price Level: Implicit Price Deflator: GDP (SA, 1995=100), Source: OECD, Haver series c935j@oecdnaq.

Interest Rate: 3-Month PRIBOR: Prague Interbank Offer Rate (% p.a.), Source: OECD Haver series c935frio@oecdmei.

Exchange rate: Average (Koruny/US$), Source: OECD, Haver series c935fxda@oecdmei.

Hungary

Output: Gross Domestic Product (SA, Mil.2000.Forint), Source: OECD, Haver series c944gdpc@oecdnaq.

Price Level: GDP: Implicit Price Deflator (SA, 2000=100), Source: OECD, Haver series c944gjn@oecdmei.

Interest Rate: 90-day Treasury Bill Rate (% per annum), Source: OECD, Haver series c944fril@oecdmei.

Exchange rate: Average (Forint/US$), Source: OECD, Haver series c944fxda@oecdmei.

Poland

Output: Gross Domestic Product (NSA, Mil.Chn 2000.Zlotys) seasonally adjusted using Census X12, Source: OECD, Haver series c964gdpc@oecdnaq.

Price Level: Implicit Price Deflator: GDP (NSA, 2000=100) seasonally adjusted using Census X12, Source: OECD, Haver series. c964j@oecdnaq.

Interest Rate: Money Market Rate: 1-Month or Less Interbank Deposits (%) Source: IMF, Haver series C964IM@IFS.

Exchange rate: Average (Zloty/US$), Source: OECD, Haver series c964fxda@oecdmei.

United States

US Short Term Money Market Rate. Source: IFS, IMF, Haver Series: C111IM@IFS.