What the Data Say about the Effects of Fiscal Policy in the Czech Republic?

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Abstract. In this paper, we provide the estimates of the fiscal multiplier in the Czech economy, based on the methodology of the fiscal VAR. The basic idea, adding fiscal variables into the macroeconomic VAR model, follows Blanchard and Perotti (2002). For estimation of our model, we utilize the dataset with quarterly data on a sample from the first quarter of 1998 to the second quarter of 2009. Our main results are as follows. Firstly, government expenditures have a positive and significant impact on the GDP. By contrast, a response of GDP on a shock to government revenues is slightly negative and in most specifications not significant. Secondly, these results are robust to various sensitivity checks. Consequently, the restoration of sustainable fiscal policy should focus rather on the revenues side than in the government expenditures, since a significant cut in government spending would probably have slowed down economic growth. Finally, we should note, that uncertainty connected with our results is large, namely in comparison with existing studies on the effects of monetary policy.

Keywords: Fiscal policy, fiscal multiplier, vector autoregression.

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1 Introduction

The recent turmoil in financial markets stressed the need for sound economic policies, particularly with regard to sound public finances without chronic budget deficits. Sound public finance allow pursuing expansionary fiscal policies to encourage economic growth, in addition, it reduces possibility of a financial instability caused by the fear of the future solvency of governments. From the viewpoint of the Czech Republic, it is likely that within a few years the Czech government will have to adopt number of measures to restore fiscal balance in order to reduce the potential vulnerability due to the risk of excessive indebtedness.

In order to correct the fiscal imbalances, the government might choose a variety of policy measures: It can either pursue a strong fiscal restriction or follow a path of gradual improvement of the fiscal position. Likewise, it can focus on the cuts in state spending, increase tax revenues, or combine both. It should be noted, that optimally, the adopted policy measures should not result in economic slowdown or even recession. There are several reasons why: alongside the usually considered increases in unemployment benefits and subsidies to enterprises, the decline of the output leads to a rise in the proportion of the debt to GDP simply because of the declining basis.

It is obvious that different measures may lead to different results. Unfortunately, the debate about, whether to focus on the expenditure side or on the revenue side, is too often based either purely on ideologies or on theories, whose predictive power rises and falls with their strong assumptions that it is impossible to verify in any way. Moreover, any empirical works, which would explicitly estimate the effects of fiscal policy on the Czech economy, are still missing.

This article is intended to fill this gap. We provide the estimates of the fiscal multiplier in the Czech economy, that are be based on very few and, hopefully, non-controversial a priori assumptions. Therefore, we use the so-called fiscal VAR – the vector autoregression with fiscal variables, introduced originally by Blanchard and Perotti [3]. Our assumptions are limited to defining the contemporaneous effects of macroeconomic variables and, implicitly, the automatic stabilizers.

For estimation of our model, we utilize the dataset with quarterly data on a sample from the first quarter of 1998 to the second quarter of 2009. The beginning of our sample was chosen with regard to the possibility of structural change or a shift in trend line during the currency crisis in 1997, and also with respect to the launch of the inflation targeting policy. This dataset contains 46 observations and this number is relatively low for the pur-

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poses of vector autoregression: For each equation, we need to estimate ($p.k + 1$) coefficients, where k is the number of variables and p is the number of lags included in the autoregression, so the degrees of freedom decrease rapidly. On the other hand, our dataset covers both, a relatively long period of growth, and two periods of recession.

Our main results are twofold. Firstly, government expenditures have a significant, positive impact on the GDP. By contrast, a response of GDP on a shock to government revenues is slightly negative and not significant in most of the considered specifications. Our results suggest, that restoration of sustainable fiscal policy should focus rather on the revenues side than in the government expenditures, since a significant cut in government spending would probably slow down economic growth. Second, these principal results are relatively robust to various changes in specifications of the model, including ordering of variables, lag order, inclusion of additional variables or a change in the sample. On the other hand, the uncertainty associated to our results is relatively large, much more than in similar applications to monetary policy in the Czech Republic. We suppose this uncertainty can be explained by utilizing of short time series and probably through variable impact of different taxes and spending programmes on the GDP.

As far as qualitative results concerns, our findings are in line with similar studies from other developed countries such as the U.S., Germany, France or Italy, even when taking into account the slight differences in identification of fiscal policy shocks. The details on the related papers are presented in the next section devoted to the literature review. Then, in the third section, we describe the methodology and the dataset used in this paper. Section 4 presents the results and the sensitivity analysis. The fifth part features the conclusion.

2 Literature review

Vector autoregressions, in addition to the New Keynesian DSGE models, have become the most popular tool for investigating the effects of monetary policy during the nineties. Within these frameworks, a change of the monetary policy is usually represented as a change of a short-term interest rate, which is controlled by the monetary authority (Summary of research in this field can be found in Christiano, et al. [7]).

However, application of a similar approach to the investigation of fiscal policy was encompassed with number of difficulties. The main one was the identification of changes of fiscal policy, since both government expenditures and revenues, to some extent, automatically response to fluctuations in economic activity and thus these movements need to be distinguished from policy changes. Moreover, compared with monetary policy, decisions on fiscal policy are usually implemented gradually and with time lag.

Ramey and Shapiro [13] and Edelberg, Eichenbaum and Fisher [8] pioneered the empirical research on the effects of fiscal policy within the VAR framework. They worked with dummy variables associated with periods that are known for exogenous changes in fiscal policy, related to the increases in military build-ups. Later on, their solution to the identification of the fiscal shock was called the "narrative approach". Following the aim to include the fiscal policy in VAR models, Blanchard and Perotti [3] used elasticities of tax-income and expenditures on changes in output to identify the automatic responses of fiscal policy. According to their SVAR model a positive shock to government expenditures has a positive effect on GDP, while the impact of tax increase is negative. In terms of individual components of GDP, their results suggest, that the U.S. economy exhibits strong non-Keynesian features as an increase in expenditures leads to a significant decline in private investment, thus the crowding-out effect is present.

The approach by Blanchard and Perotti was applied for several countries, either using the same SVAR estimator or other variants of the VAR models. A comparative analysis based on the VAR methodology by Caldara and Kamps [5] summarizes the research stating that different identification and calibration schemes lead to similar results as far as the effect of government expenditures concern; however they are strongly diverging, when assessing the responses to changes in taxes. Hence, they conclude, the vector autoregressions are not suitable to policy experiments that should assess whether it is, in terms of the future output loss, to finance an increase in government expenditures with taxes, or through the budget deficit. As a result, it is also not possible to test for the presence of the Ricardian equivalence because the results are highly influenced by the model specification.

The results of the estimated fiscal VARs on other countries than the U.S. indicate that we can hardly construct a set of stylized facts that would hold for all countries. For example, Aarle et al. [1] estimated the effects of fiscal and monetary policy for the members of the European Monetary Union and they found significant differences in reactions among the individual countries of the EMU, despite the EMU as a whole seem to follow a pattern similar to observed in the U.S. and described by Blanchard and Perotti. Heppke-Falk et al. [11] estimated the responses to fiscal shocks for Germany, again with government expenditures having a positive effect on output and with negative effect of taxes, although the effects of direct taxes were more distortionary in comparison with the indirect ones. Similar results were obtained for Italy by Giordano et al. [10], the only difference was that

the effect of an increase of government spendings on investment was positive. Furthermore, number of other studies addresses the problem of changes of the fiscal multiplier since the eighties. For example, Muscatelli et al. [12] found significant decrease in responsiveness of the fiscal policy variables in the U.S. since 1979. Similar results were obtained also for Italy, Germany, France and the United Kingdom.

3 Methodology and data

In this section we present the vector autoregressive methodology used in this paper. First, we present the benchmark reduced form VAR model and then we discuss the identification procedure utilized in our estimation. Assume that we can order all the endogenous variables (output, price level, government expenditures and revenues and interest rate) into a k-dimensional vector Xt. Then the reduced form VAR model is defined as

$$X_t = \mu_0 + \mu_1 t + A(L)X_{t-1} + u_t \ . \tag{1}$$

where μ_0 is a constant, t is a linear trend, A(L) is a p^{th} order lag polynomial and u_t is a k-dimensional vector of reduced-form disturbances with $E[u_t] = 0$ and $E[u_t u_t'] = \Sigma_u$. The lag length was chosen to two quarters. In case of one lag, suggested by the Schwartz information criterion (SIC), there were many significant autocorrelations in the residuals and the impulse response functions implied implausibly small persistence of the effects of structural shocks. Hence, the lag length had to be longer. The other lag length criteria implied 4 lags, but resulting impulse response functions were very oscillating and the degrees of freedom were very low as in case of a five variable model.

Additionally, we include a linear trend in each equation. After inclusion of this linear trend, all characteristic roots of our model lie within the unit circle, suggesting that our model is stable. Estimating the model without the linear trend affects namely the forecasted effects of fiscal shocks at longer horizons, as especially the shocks of government expenditures seems to have larger effects on output.

Generally, the reduced form residuals of the system (1) are correlated, we cannot treat the residuals u_t as structural shocks into each variable. Pre-multiplying the model by the $k \times k$ matrix A_0 gives the structural form of VAR

$$A_0 X_t = A_0 \mu_0 + A_0 \mu_1 t + A_0 A(L)X_{t-1} + B\varepsilon_t \ , \tag{2}$$

where $B\varepsilon_t = A_0 u_t$ defines the relation among the reduced-form residuals u_t and structural shocks ε_t. The matrix A_0 defines the contemporaneous relation among endogenous variables. However without additional restrictions on matrix A_0 as well as matrix B, the structural model (2) is not identified. In this paper, we follow the recursive approach to identification, in which the B matrix is assumed to be an identity matrix with dimension k, and A_0 is a lower triangular matrix with unit diagonal. This identification is often referred as the Cholesky decomposition of variance covariance matrix of reduced-form residuals Σ_u. By this identification the ordering of the variables matters, because the matrix A_0 sets contemporaneous reactions of upper variables with lower variables to zero.

We use the following ordering: the gross domestic product y, the price level p, the government expenditures g, the government revenues t and the interest rate i. This ordering reflects the following assumptions about the economy. (i) The output does not react contemporaneously to shocks into any other variables in the system. (ii) The price level (and thus inflation) does not react contemporaneously to government expenditures, revenues and inflation, but it is affected contemporaneously by output. (iii) Government expenditures do not react contemporaneously to tax and interest rate shocks, but is affected contemporaneously by output and price level. (iv) Government revenues do not react contemporaneously to interest rate shocks, but are affected contemporaneously by all other variables. Thus, this particular ordering captures the automatic effects of fluctuations of economic activity and government expenditures on government revenues, while it rules out potentially important the contemporary effects of shocks to government revenues on output. (v) The interest rate is affected contemporaneously by all shocks in the system. By large, it is set by the central bank with respect to current economic situation and also with respect to the inflation target. Then, after the first periods all variables can react to each other freely.

The confidence intervals of the impulse responses as well as accumulated impulse responses were calculated using bootstrap (following Efron and Tibshirani, [9]) rather than analytically due to the limited scale of the sample. The offset of using bootstrapped impulse responses is that the point estimates are not always in the middle of the confidence bands.

For estimation of our model, we utilize the dataset with quarterly data on a sample from the first quarter of 1998 to the second quarter of 2009. The beginning of our sample was chosen with regard to the possibility of structural change or a shift in trend line during the currency crisis in 1997, and also with respect to the launch of the inflation targeting policy. This dataset contains 46 observations and this number is relatively low for the pur-

poses of vector autoregression: For each equation, we need to estimate (p.k + 1) coefficients, where k is the number of variables and p is the number of lags included in the autoregression, so the degrees of freedom decrease rapidly. On the other hand, our dataset covers both, a relatively long period of growth, and two periods of recession.

The data were extracted from the database maintained at the Institute of the Information Theory and Automation of the AS CR. For the gross domestic product, we used a time series of nominal GDP deflated by the GDP deflator related to the year 2005, the government expenditures and revenues are a cash data of the central government assuming that the regional governments and other institutions have balanced budgets or their deficits are financed by the central government. These time series were deflated by the GDP deflator, too. For the price level, we use the consumer price index (CPI) of GDP and our interest rate is the three months PRIBOR. All variables are taken in natural logarithms and they were seasonally adjusted by the TRAMO/SEATS method prior to further analysis[2].

4 Results

The results of our estimates suggest that the Czech economy behaves in principle in accordance with the characteristics predicted by Keynesian economics. Government expenditures have a positive impact on GDP. The response of GDP is steadily growing, reaching a peak after about four quarters after the respective shock impulse. Until eight quarters, this effect is statistically significant when we consider the level of significance defined by one standard error bands. By contrast, the effect of a shock to government revenue is very uncertain, very close to zero, but most probably rather negative.

For the sake of completeness we report also the effects of the shocks into an interest rate. With respect to the responses of output and price level we can say, that the interest rate has a negative effect both on the price level and the GDP. In both cases the effect is negative and significant. The largest impact on price levels is observed at six quarters, somewhat surprisingly, the impact on GDP is highest earlier, between four and six quarters. In terms of qualitative results, the responses to monetary shocks are in accordance both with the economic intuition and with the existing studies on the monetary transmission mechanism in the Czech Republic (most recently by Borys, Horvath, Fanta (2009)). All impulse response functions tend to return to zeros, also all the roots of the characteristic polynomial lie within the unit circle. Hence we can conclude that our model is stable.

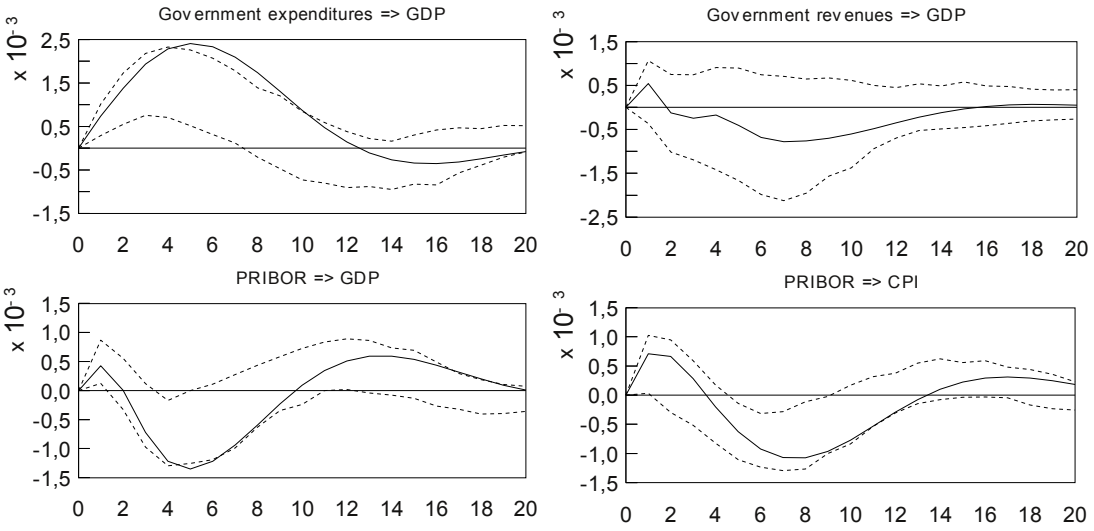

Figure 1: Shocks to Government expenditures, revenues and interest rate, ordering [*y p g t i*]

Accumulated impulse response functions provide information on the total size of the impact of increases in government expenditures, revenue and interest rates on output. The contribution of a shock to government expenditures to GDP is significantly positive at the horizon of 10 quarters. The impact of increased government revenue to GDP is negative but insignificant at the same horizon. The overall impact of increased interest rate on GDP reaches peak again after ten quarters, and then the effect diminishes.

[2]This automatic method of seasonal adjustment generated large spurious decrease in the time series government expenditures in the fourth quarter of 2008. For this observation we include additional dummy variable.

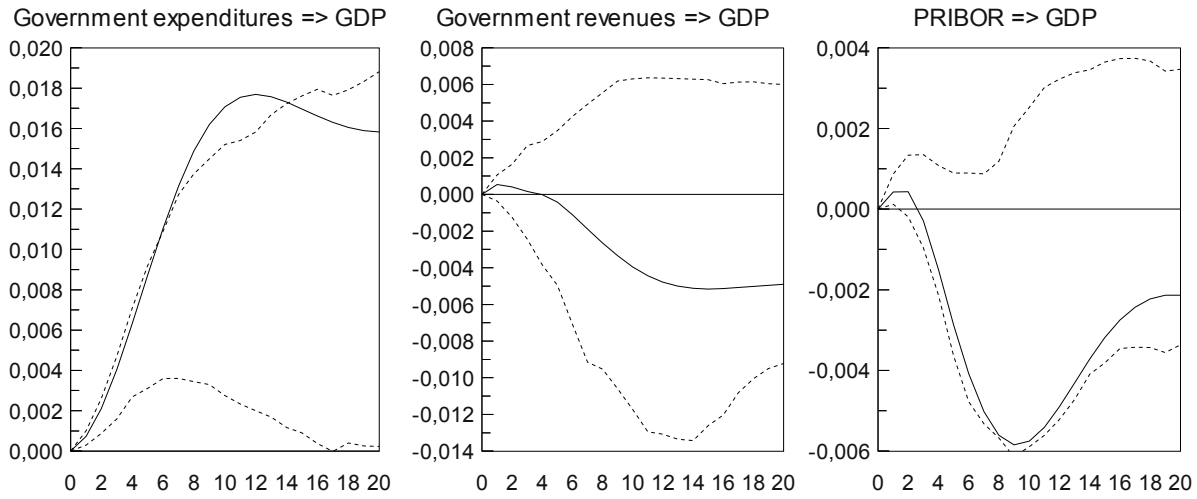

Figure 2: Accumulated impulse responses of output

To address the robustness of our results, we performed some sensitivity analysis. First of all, we have focused on sensitivity to the number of lags included in VAR. We tested both for one and four lags that were recommended either by the Schwartz or by the Akaike information criterion. It turned out that our main results remain valid, however, in both cases the impulse response functions are more volatile.

Then we estimated the model for the whole period for which the data are available, i.e. from the first quarter of 1995. The added observations include the currency crisis that occurred in the second quarter of 1997. Now the impulse response functions indicate larger and long-lasting effects of both fiscal and monetary shocks on output. However, the results indicate an existence of the so called price puzzle, that is, the price level rises after the positive shock to the interest rate. Borys, Horvath and Fanta [4] suggest that in this particular case, the price puzzle can be attributed to the change of the monetary policy regime, tests for developed countries (Sims [14], Balke and Emery [2]) or on simulated data (Casteknuovo and Furico [6]) show that price puzzle is likely to occur, when the monetary policy stance is weak and the central bank reacts to expected inflation just a little. The data for the Czech economy indicate that the price level rises after the increase of interest rate in the short period following the 1997 currency crisis: the Czech koruna depreciated, inflation rose, however the interest rates decreased from its peak levels during the crisis.

5 Conclusions

In this paper, we provide estimates of the effects of fiscal policy in the Czech Republic, based on the methodology of the fiscal VAR. Our principal results are that the shocks to government expenditures have a significant positive impact on the GDP whereas the impact of the changes in government revenues is rather insignificant. These results imply that large spending cuts in the future will most likely result in significant decrease of the GDP. Hence, large cuts might not help to decrease the debt to GDP ratio, but exactly the opposite. On the other hand, it seems that fiscal consolidation focused on increasing government revenues won't be so costly in terms of the loss of the GDP.

It should be noted that the confidence bands of our point estimates are very wide, thus, the uncertainty connected with our results is relatively large. This implies that spending programmes as such might not have positive effects in terms of output growth and that most probably the structure of both, fiscal stimulus or fiscal consolidation package does matter – despite the fact, that purely based on our results, we cannot define the composition of the “right” policy mix.

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