Symmetry of output effects of government expenditure and government revenue in Ukraine

Victor Shevchuk[1], Roman Kopych[2]

Abstract

This paper empirically analyzes the effects of fiscal policy in Ukraine, using the vector error correction model (VECM). For quarterly data of the 2001–2016 period, we find a robust positive impact of both government expenditure and revenue upon output in Ukraine. Otherwise, the fiscal policy transmission mechanism exhibits several standard features (e.g., as an increase in government expenditure after a positive shock to government revenue or widening of the budget deficit following an interest rate hike). Our results reflect the prediction of the Mankiw─Summers model that tax cuts could be restricted under (i) strong demand for money of consumption expenditure in comparison to the investment-based demand for money combined with (ii) significant interest rate elasticity of investments. The results suggest feasibility of revenue-based austerity policies in Ukraine, as higher tax rates and better tax collection may contribute to economic growth even in the short run. The findings also imply that the real exchange rate depreciation brings about a decline in output and a symmetrical decrease in either government revenue or government expenditure. Also, there is a rather strong inverse relationship between interest rate and output.

Keywords**:** *fiscal policy, interest rate, real exchange rate, the Mankiw─Summers model, Ukraine*
JEL Classification: C5, E1, E6, H6

1 Introduction

As of the beginning of 2017, fiscal austerity is still among top priorities of macroeconomic stabilization policies in Ukraine. However, it is not clear whether expenditure-based or revenue-based austerity measures should be implemented in a specific Ukrainian case. IMF experts admit that the particular mix of fiscal policy measures could depend on country-specific conditions, capacities and preferences (IMF 2015). To complicate matters even more, different theoretical models often offer opposite results, with sign and magnitude of the fiscal policy effects being dependent on assumptions regarding such structural features as the existence of nominal rigidities in the economy, the elasticity of the labour supply, the interest rate elasticity of investment, the degree of openness of the economy, the exchange-rate

[1] Corresponding author: Cracow University of Technology, Institute of Economy, Sociology and Philosophy, Warszawska 24, 31-155 Kraków, Poland, e-mail: vshevchuk@pk.edu.pl.
[2] Lviv National University named by Ivan Franko, Ukraine, Universytetska 1, 79-005 Lviv, Ukraine, e-mail: kopych_r@bigmir.net.

regime, the magnitude of the wealth effects, the role played by rational expectations or the interest rate and income elasticities of money demand (De Castro and de Cos, 2008).

Despite the fact that macroeconomic theories developed since the late 1980s have de-emphasized the role of money aggregates in the transmission of monetary policy, the demand for money remains relevant for macroeconomic discussions (Duca and VanHoose, 2004). One point of interest refers to the specification of money demand. As it is assumed by Mankiw and Summers (1986), disaggregated income explains money demand better, being consistent with economic theories and empirical studies. Consequently, it is shown that lower taxes are not necessarily expansionary with respect to the aggregate demand and output, while it is still the case that the government expenditure multiplier is positive. Using a modified demand equation within the theoretical framework of IS─LM model, the authors show that tax cut can be contractionary to the U.S. economy. It is worth noting that standard Keynesian models imply contractionary effects of higher taxes and government expenditure cuts, while the models of so-called non-Keynesian effects provide with positive output responses to both type of abovementioned fiscal consolidation measures.

Although empirical studies of the U.S. economy are overwhelmingly in support of a Keynesian assumption that expansionary fiscal shocks increase output (Ahtiala and Kanto, 2002; Blanchard and Perotti, 2002; De Castro and de Cos, 2008), there are numerous empirical studies for other countries that suggest that the fiscal consolidation programs do not incur costs in terms of output losses (Adam and Bevam, 2005; Afonso, 2010; Afonso et al., 2006; Ardagna, 2004; Giavazzi and Pagano, 1995; Giudice and Turrini, 2003). However, it is common for studies of expansionary fiscal consolidations that a favorable outcome is brought about by cutting government spending rather than by increasing taxes (Alesina and Ardagna, 2010; Alesina et al., 2015). On the other hand, Giavazzi et al. (2005) find that higher taxes could stimulate private consumption.

The aim of this study is to estimate the effects of fiscal policy in Ukraine. Section 2 reviews the Mankiw─Summers model. Data and statistical methodology are presented in Section 3. Estimates of the implied VECM are interpreted in Section 4, which is followed by a conclusion.

2 Theoretical framework

Conventional econometric models relate the demand for money to the level of GDP, serving as the scale variable determining the transactions demand for money balances. Referring to portfolio and transaction models of money demand as justification for the disaggregated

money equation within the familiar IS–LM framework, Mankiw and Summers (1986) demonstrate that tax cuts can constrain the aggregate demand, holding that money supply is constant. The model presents as follows:

$$Y = C(Y-T,r) + I(Y,r) + G + CA(E,Y,Y^*), \tag{1}$$

$$C_Y, I_Y > 0, C_Y, I_Y > 0, CA_E, CA_{Y^*} > 0, CA_Y < 0,$$

$$M/P = L(C,I,G,r), \quad L_C > L_I > L_G > 0, L_r < 0, \tag{2}$$

$$CA(E,Y,Y^*) + k(r-r^*) = 0, \tag{3}$$

where Y and Y^* are domestic and foreign output, C is consumption, I is investment, r and r^* are domestic and foreign interest rate, G and T are government expenditure and government lump-sum taxes, respectively, CA is the current account, M is the money supply, P is the price level, E is the nominal exchange rate.

Equation (1) relates the aggregate demand to private consumption, investments, government expenditure, and price and income effects on foreign trade. Both consumption and investments are proportional to income and inversely related to interest rate. Similar contracted channel is provided by the relationship between income and imports. Aggregate demand is stimulated by exchange rate depreciation and higher income abroad. In Equation (2), the money supply in real terms is balanced with the demand for money, which is an increasing function of disaggregated income and a lower interest rate. For simplicity, there is no difference between nominal and real interest rates in specifications for the goods and money markets. Equation (3) defines the balance-of-payments (BOP) equilibrium. The current account balance is equated with the net capital inflows. It is assumed that capital flows are dependent on the differential interest rate. For the case of capital immobility ($k = 0$), the BOP equilibrium is achieved solely through the relative price adjustment. Under inefficiency of the relative price mechanism, a decline in income is necessary to improve the external balance through a decrease in demand for imports.

For a flexible exchange rate regime, a comparative static analysis yields fiscal policy multipliers as follows:

$$\frac{dY}{dG} = \frac{CA_q\left[(L_G - L_I)I_r + (L_G - L_C)C_r - L_r + kL_G\right]}{\Omega}, \tag{4}$$

$$\frac{dY}{dT} = -\frac{CA_q C_Y\left[(L_C - L_I)I_r - L_r + kL_C\right]}{\Omega}, \tag{5}$$

where $\Omega = -CA_q\left[(1-C_Y-I_Y)(L_r + L_C C_r + L_I I_r) + (C_r + I_r)(L_C C_Y + L_I I_Y) + k(L_C C_Y + L_I I_Y)\right]$.

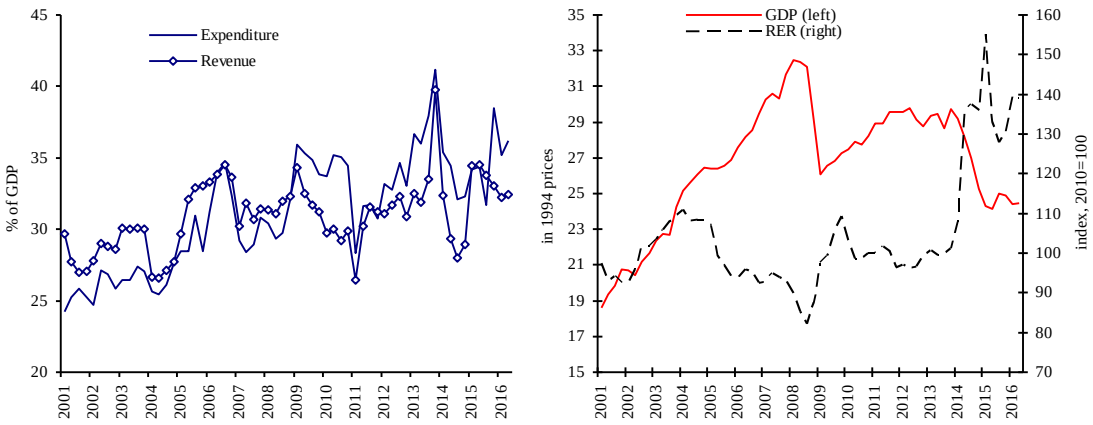
Regardless of the capital mobility, the determinant Ω is unambiguously negative under the standard assumptions that $C_Y, I_Y > 0$, $C_r, I_r < 0$, $L_r < 0$, and $C_Y + I_Y < 1$.

For a closed economy ($k = 0$), the multipliers reduce to those obtained by Mankiw and Summers (1986). The fiscal multiplier for government expenditure is positive if $L_G < (I_r L_I + C_r L_C + I_r)(I_r + C_r + k)$, as long as the government spending generates less money demand than a weighted average of consumption, investments and the capital mobility is rather low. As for the tax multiplier, higher taxes positively contribute to income only under the condition that the consumption-based demand for money is stronger in comparison to the investment-based demand for money, i.e. $L_C > L_I$, and if the money demand is sufficiently rigid with respect to the investment. However, a stimulating effect becomes not sensitive to structural features for the case of perfect capital mobility ($k = \infty$), as the tax multiplier becomes unambiguously positive: $dY/dt = L_C C_Y / (L_C C_Y + L_I I_Y)$.

As for stability of money demand being an important assumption behind viability of the Mamkiw─Summers model, the evidence for the stability of long-run demand functions for the M1 money aggregate is obtained for the U.S., Japan, Canada, U.K. and West Germany (Hoffman et al., 1995), as well as for seven East European countries (Bahmani and Kutan, 2010) and four South Asian countries (Narayan et al., 2009).

3 Data and statistical methodology

The data are quarterly observations from 2001Q1 to 2016Q2 made in the Ukraine's Ministry of Finance, which publishes quarterly time series on government finance statistics since 2000, and the IMF *International Financial Statistics* online database. Seasonally adjusted time series (in percent of GDP) for the current government expenditures on goods and services and the net revenues, G_t and REV_t respectively, are plotted in Fig. 1. Government expenditure has unevenly increased over the sample period, with local peaks in 2006, 2009, 2010 and 2013. The net revenue had been greater than the expenditure over the 2001–2007 period, but the budget balance deteriorated significantly in the wake of the world financial crisis of 2008–2009. Some fiscal consolidation efforts were made in 2011, but the budget deficit grew since then. Another financial crisis of 2014 brought about a steep decline in the level of both government expenditure and revenue, but the former recovered by the end of 2015 against the backdrop of a decline in the latter. GDP (Y_t) steadily increased in the 2001–2008 period, but financial crises of 2008–2009 and 2014–2015 brought it to the level of 2004, despite a steep depreciation of the real effective exchange rate (RER_t).



a) fiscal indicators b) GDP and real exchange rate

Fig. 1. Ukraine: selected macroeconomic indicators, 2001–2016.

Source: Ukraine's Ministry of Finance, IMF *International Financial Statistics*.

As revealed by the augmented Dickey-Fuller (ADF) test (results are available on request), for all series the null of the unit root cannot be rejected at 1 and 5 percent of statistical significance level for their levels, while it is the case for the previous differences. As endogenous variables are found to be integrated of order 1, i.e. I(1), it is necessary to investigate the co-integration relationship between them.. The results of the Johansen co-integration test are summarized in Table 1. Both the trace test and the maximum eigenvalue test suggest the co-integration rank r=1 with 5 percent confidence level.

Data trend	None (I)	None (II)	Linear (III)	Linear (IV)	Quadratic (V)
Trace	57.87 (0)	93.1** (1)	85.6** (1)	99.7** (1)	89.6* (1)
Max-Eng	27.89 (0)	48.1** (1)	47.58** (1)	49.0** (1)	44.79** (1)

Note: we use test types I (no intercept, no trend), II (intercept, no trend), III (intercept, no trend), IV (intercept, trend), V (intercept, trend); ** denotes rejection of the null hypothesis at the 5 percent level (* at the 10 percent level); number of co-integration vectors are in brackets.

Table 1. Johansen Co-integration Test.

As there is a co-integration of endogenous variables, the VAR system with error correction (VECM) should be used. If the endogenous variables are $I(1)$ and co-integrated with rank r ($0 < r < n$), then the VECM representation is as follows:

$$A(L)\Delta z_t = -\alpha\beta z_{t-1} + \delta D_t + u_t, \tag{6}$$

where $z_t = (REV_t, G_t, R_t, RER_t, Y_t)$ is the vector of endogenous variables, with R_t standing for lending rate, $A(L)$ is a matrix polynomial in the lag operator L, D_t is the vector of deterministic variables, u_t is a $k \times 1$ vector of reduced-form disturbances which are assumed to be normally distributed white noise $\mathrm{E}[u_t] = 0$ with a constant covariance matrix $\mathrm{E}[u_t u_t^{'}] = \Sigma_u$ and $\mathrm{E}[u_t u_s^{'}] = 0$ for $s \neq t$, Δ is the operator of the first differences. In addition to the lagged values of the endogenous variables, the VECM includes the level of external public debt (bn USD), the world metal and crude oil prices (index, 2010=100), and a crisis dummy (1 for 2008Q3-2009Q4, 2013Q4-2016Q2 and 0 otherwise).

The number of lags is set to two according to LR, FPE, AIC and HD tests. We use a constant in the VECM model, as it brings about better statistical properties of the residuals according to the tests of normality, serial correlation and homoscedasticity.

4 Estimation results

Estimates of the long-run co-integration relationships are as follows (the absolute values of standard deviations of parameter estimates are given in the brackets):

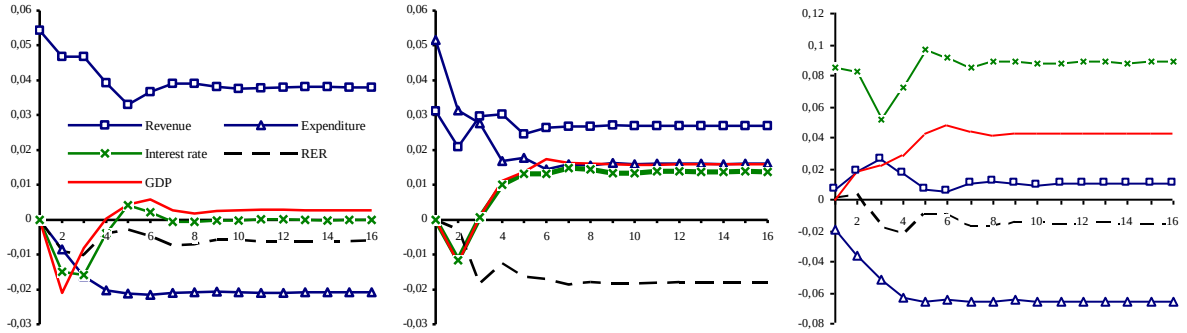
$$\begin{array}{lcccc} REV_t = & -4.188 G_t & +2.299 R_t & +0.183 RER_t & +7.732 Y_t. \\ & (0.69) & (0.53) & (0.92) & (0.17) \end{array} \qquad (7)$$

The co-integration relationship (7) implies that government revenue decreases in line with higher expenditures. A direct relationship between the interest rate and REV_t could reflect stronger tax-collection efforts in the high interest rate environment. Depreciation of the RER is not a strong factor behind higher government revenue, as the statistical significance of the coefficient on RER is rather low. The long-run estimates are in favor of a strong link between GDP and the government revenue.

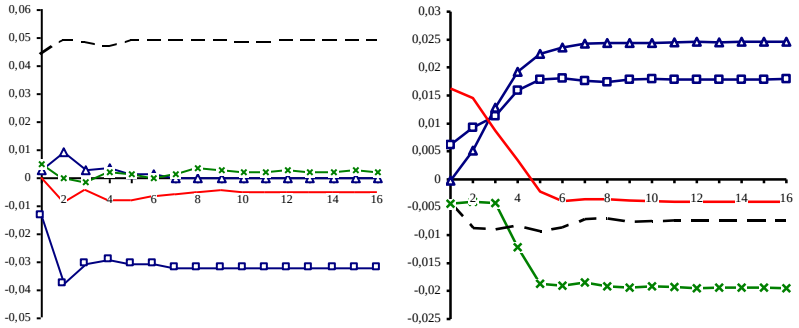
Figure 2 presents the impulse-response functions for endogenous shocks. Table 2 reports the portion of the forecast error variance decomposition (FEVD) for endogenous variables.

Our main result is that both government expenditure and revenue shocks have symmetrical positive effects on output, being very persistent either. Impulse responses are consistent with the predictions of the Mankiw─Summers model. It seems that together fiscal shocks explain more than 50 percent of variation in the output. Among other fiscal policy effects, an increase in government revenue contributes to higher government expenditure and RER appreciation, with no significant impact upon the interest rate. A positive government expenditure shock brings about a reduction in government revenue and a decrease in the interest rate, both being not conventional outcomes. Shocks to REV_t explain up to 40 percent

of changes in government expenditure, while the reverse causality is half that strong. The fraction of REV_t in decomposition of RER_t is as high as 29 percent, while G_t is more influential in respect to changes in the interest rate.



a) response of revenue; b) response of expenditure; c) response of interest rate;



d) response of RER; e) response of GDP;

Fig. 2. Impulse response functions of endogenous variables.

The government expenditure is likely to be pro-cyclical in the long-run, as higher output is associated with an increase in government spending on goods and services. The response of revenue to output shock is negative but low and short-lived. The effects of RER depreciation on the government revenue and expenditure are also negative.

An increase in the interest rate has no significant effect on the government revenue, while the effects on the expenditure turn out positive after three quarters. Shocks to the interest rate have negligible effects on the RER. However, there is a strong negative impact of the interest rate hikes upon output. It is worth noting that output shock is a factor behind an increase in the interest rate. Somewhat surprisingly, interest rate does not react to the RER shock.

Apart from the deterioration of the fiscal indicators, the depreciation of the RER has receding effect on the output. In the presence of the fiscal shocks, the RER does not react to changes in the output and the interest rate.

Responses of	Innovations in	Forecast horizons			
		4	**8**	**12**	**16**
REV	*REV*	82	78	77	77
	G	7	14	16	18
	R	4	3	2	2
	RER	2	2	2	2
	Y	5	3	2	2
G	*REV*	35	37	39	39
	G	53	35	30	26
	R	3	6	8	8
	RER	6	11	13	17
	Y	3	8	10	11
R	*REV*	4	2	1	1
	G	25	28	28	29
	R	64	59	57	56
	RER	3	2	2	2
	Y	5	10	11	12
RER	*REV*	27	28	29	29
	G	1	0	0	0
	R	0	0	0	0
	RER	70	70	69	69
	Y	1	1	1	1
Y	*REV*	24	24	24	24
	G	27	38	41	42
	R	10	22	25	26
	RER	12	7	6	5
	Y	27	8	5	4

Table 2. Forecast error variance decomposition.

Conclusions

The main results of the study can be summarized as follows. First, there is a robust positive impact of both the government expenditure and the revenue upon output in Ukraine. Such symmetry of fiscal policy effects is in accordance with the prediction of the

Mankiw─Summers model for a low capital mobility case that tax cuts could be restricted under (i) strong demand for money of consumption expenditure in comparison to the investment-based demand for money combined with (ii) significant inverse link between investments and interest rate. Second, there is an increase in government expenditure after a positive shock to the government revenue, with the budget deficit widening after an interest rate hike. Third, the real exchange rate depreciation brings about a decline in output and a symmetrical decrease in either government revenue or government expenditure. Fourth, there is a rather strong inverse relationship between the interest rate and the output. Contrary to recommendations by Alesina and Ardagna (2010) that spending cuts are more appropriate for stabilizing the sovereign debt than tax increases, our results suggest feasibility of revenue-based austerity policies in Ukraine, as higher tax rates and better tax collection may contribute to economic growth even in the short run.

References

Adam, C., & Bevan, D. (2005). Fiscal growth and deficits in developing countries. *Journal of Public Economics*, *89*(4), 571-597.

Afonso, A. (2010). Expansionary fiscal consolidations in Europe: new evidence. *Applied Economics Letters*, *17*(2), 105-109.

Afonso, A., Nickel, C., & Rother, P. C. (2006). Fiscal consolidations in the Central and Eastern European countries. *Review of World Economics*, *142*(2), 402-421.

Ahtiala, P., & Kanto, A. (2002). Contractionary effects of expansionary fiscal policy: theory and tests. *Economic Modelling*, *19*(1), 137-152.

Alesina, A., & Ardagna, S. (2010). Large changes in fiscal policy: taxes versus spending. *Tax policy and the economy*, *24*(1), 35-68.

Alesina, A., Favero, C., & Giavazzi, F. (2015). The output effect of fiscal consolidation plans. *Journal of International Economics*, *96*, S19-S42.

Ardagna, S. (2004). Fiscal stabilizations: When do they work and why.*European Economic Review*, *48*(5), 1047-1074.

Bahmani, S., & Kutan, A. M. (2010). How stable is the demand for money in emerging economies?. *Applied Economics*, *42*(26), 3307-3318.

Blanchard, O., & Perotti, R. (2002). An empirical characterization of the dynamic effects of changes in government spending and taxes on output. *The Quarterly Journal of economics*, *117*(4), 1329-1368.

De Castro, F., & de Cos, P. H. (2008). The economic effects of fiscal policy: the case of Spain. *Journal of Macroeconomics*, *30*(3), 1005-1028.

Duca, J. V., & VanHoose, D. D. (2004). Recent developments in understanding the demand for money. *Journal of Economics and Business*, *56*(4), 247-272.

Giavazzi, F., & Pagano, M. (1995). *Non-Keynesian effects of fiscal policy changes: international evidence and the Swedish experience* (No. w5332). Cambridge, MA: National Bureau of Economic Research.

Giavazzi, F., Jappelli, T., Pagano, M., & Benedetti, M. (2005). *Searching for non-monotonic effects of fiscal policy: new evidence* (No. w11593). Cambridge, MA: National Bureau of Economic Research.

Giudice, G., & Turrini, A. (2003). *Can fiscal consolidations be expansionary in the EU? Ex-post evidence and ex-ante analysis* (No. 195). Directorate General Economic and Financial Affairs (DG ECFIN), Brussel: European Commission.

IMF. (2015). Fiscal Policy and Long-Term Growth. *IMF Policy Paper*.

Hoffman, D. L., Rasche, R. H., & Tieslau, M. A. (1995). The stability of long-run money demand in five industrial countries. *Journal of Monetary Economics*, *35*(2), 317-339.

Mankiw, N. G., & Summers, L. H. (1986). Money demand and the effects of fiscal policies. *Journal of Money, Credit and Banking*, *18*(4), 415-429.

Narayan, P. K., Narayan, S., & Mishra, V. (2009). Estimating money demand functions for South Asian countries. *Empirical Economics*, *36*(3), 685-696.