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MODELLING OF FISCAL POLICY EFFECTS ON AGRICULTURE AND INDUSTRY IN UKRAINE

VICTOR SHEVCHUK [a)], ROMAN KOPYCH [b)]

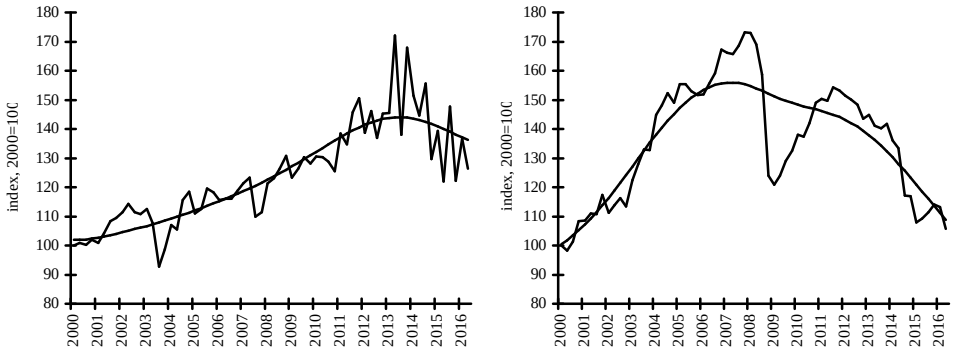
[a)] *Institute of Economics, Sociology and Philosophy, Cracow University of Technology*
[b)] *Department of International Economic Relations, Lviv National University named by Ivan Franko*

This paper analyses the effects of fiscal policies upon agriculture and industry in Ukraine, with the SVAR model using quarterly data for the 2001–2016 period. The results indicate a positive effect of the government spending on both agricultural production and industrial output, while an increase in the government revenue is of the same expansionary impact for the latter only. Among other results, there is a weak negative short-lived spillover from agriculture to industry, with no causality running on the reverse. As agricultural production in Ukraine is associated with a higher level of government spending in the short run, a direction of causality seems to be just the opposite for industrial output. Both agriculture and industry bring about higher budget revenues in the short run, but for the latter this effect is lagged and more persistent. Controlling for fiscal policy effects, the nominal (real) exchange rate depreciation seems to be expansionary for industrial output. For agriculture, a nominal exchange rate depreciation is restrictionary in the short run, with an expansionary effect in the long run (however, this result is not supported in specification with the real exchange rate). Several implications of fiscal policy effects are discussed.

Keywords**:** agriculture, industry, fiscal policy, nominal (real) exchange rate, Ukraine

1. Introduction

Agricultural production in Ukraine has been on an upward trend since 2000 but this trend seems to be reversed over the 2014–2016 period, with much higher instability around a declining growth path (Fig. 1). Recent developments in Ukraine's agriculture provide extra evidence to a well-known fact that the agricultural industry is extremely vulnerable to risk and uncertainty. Besides such factors, as volatility on the world commodity markets, weather conditions or infrastructural problems, macroeconomic policies often have unintended and harmful effects on the agricultural economy. On the other side, government transfers to farmers and public investments in rural infrastructure could be a factor behind agricultural production and rural development, as it is demonstrated by the experience of European Union countries [3].



a) agricultural production b) industrial output

Figure 1. Ukraine: sectoral output in agriculture and industry, 2000–2016
Note: trend values are obtained with the Hodrick─Prescott filter
Source: Ukraine's State Statistical Committee (www.ukrstat.gov.ua)

Changes in the fiscal policy stance have important supply-side and demand-side effects on agriculture. Importance of fiscal policy is higher for low-income economies that are heavily dependent on primary exports [7]. Fiscal policy options for agriculture have been discussed in Ukraine for several recent years. Though the amount of direct financial support for producers in agriculture is well below the level of European countries, Ukrainian farmers and especially large agro-industrial holdings nevertheless benefit from lower VAT rates for foodstuff, VAT rebates for exporters and indirect government spending policies (rural infrastructure, storage facilities etc.). As the IMF and other international financial organizations exert pressure for the Ukrainian authorities in order to abolish most of tax privileges for agriculture, local producers are lobbying in favor of keeping *status quo* and

extending programs of government spending on agriculture. However, any efforts of government financial support could be blocked by unsustainable fiscal position. It is worth noting that a dynamic growth in agricultural production in 2011–2013 had coincided with an increase in government spending (Fig. 2). Since the beginning of 2014, there has been a downward correction of government spending but it is reversed recently. In general, government revenues follow the pattern of government spending, with the exception of the 2009–2010 period when a decrease in the former is observed against the backdrop of an increase in the latter.

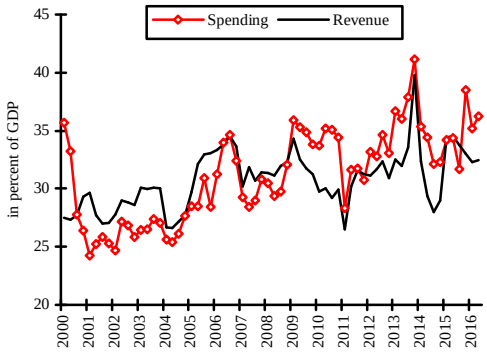


Figure 2. Ukraine: government spending and revenues, 2000–2016
Source: Ukraine's Ministry of Finance (www.minfin.gov.ua)

In this article fiscal policy sectoral effects are studied with a structural vector autoregression (SVAR) model that jointly models the share in GDP of government revenue and spending, the levels of output in agriculture and industry and the level of nominal (real) exchange rate. The remainder of this paper is organized as follows. The next section reviews the relevant literature on the fiscal policy sectoral effects. Section 3 presents data information and discusses the econometric methodology. In Section 4 empirical findings are discussed. The last section concludes.

2. Fiscal policy sectoral effects

Fiscal policy can have different demand-side and supply-side sectoral effects, depending on the impact of nominal (real) exchange rate, sectoral capital intensities and labour supply elasticity. A standard result is such that a rise in government spending (a tax cut) brings about the appreciation of the RER, which is supposed to asymmetric output effects on the traded and non-traded goods sectors, Q^T and Q^N respectively. Assuming that agriculture produces tradable goods and industry is

predominantly engaged into production of non-tradable goods, expansionary fiscal policy should have a restrictionary effect upon the former and an expansionary effect upon the latter, though a co-movement between them is not ruled out as well, for example, if government spending is intensive in non-traded goods [13].

As the relative price effect in favour of demand for traded goods is likely to increase investments which used to be of significant import content, a combination of the persistent RER overvaluation and worsening of the current account is working in the opposite direction. However, Cardi and Restout [5] demonstrate that under assumptions of a two-sector neoclassical open economy model with traded and non-traded goods a drop in investment and in the current account, in line with empirical evidence, is the case only if the traded sector is more capital intensive than the non-traded sector, and labour is supplied elastically. Regardless of sectoral capital intensities, a fiscal shock raises the relative size of the non-traded sector substantially in the short-run. Also, a possibility of the RER depreciation is not ruled out if the markup depends on the number of competitors. Similar results are obtained by Bénétrix and Lane [4]. It is found that expansionary fiscal shocks lead to an increase in the relative size of the non-traded sector, thus mattering not only for aggregate variables but also for the sectoral composition of output.

Fiscal policy effects are further complicated in the countries where budget revenues are dependent on commodity exports. Studying fiscal policy response to an adverse trade shock that reduces national wealth and reallocates domestic inputs from the production of non-traded goods to tradables, Steigum and Thøgersen [15] obtain within a framework of dynamic dependent economy model that a gradual process of optimal reallocation of capital and labour between Q^N and Q^T sectors implies running fiscal deficits during the sectoral adjustment process. As the non-traded sector is excessive in the short run, there should be more consumption on non-traded goods to the present generations than to the future which implies that the stimulating effect on agriculture (sector Q^T) should be weaker.

Supply-side effects of fiscal policy are quire heterogenenous, being dependent on the effectiveness of public investments, tax elasticities and labour market sectoral spillovers. As agriculture is still labour-intense in most of the countries outside industrial world, functioning of the labour market is of special interest. As early as in the 1970s, Helpman [11] modelled a differential employment effect from government spending on traded versus non-traded goods in a two-sector small open economy. Utilizing the DSGE model with search and matching frictions in the labour market and with both public and private sectors, Gomes [10] establishes that higher wages in the public sector lead to higher public sector jobs and raise private sector wages, which could be harmful for sectors with labour-intense technologies. However, it is possible to speculate that outflows of labour in favour of the public sector would enhance the level of technologies in agriculture and thus

stimulate growth, in addition to a positive demand shock. As suggested by the experience of Thailand, the increase in the government consumption spending coupled with acceleration in money supply growth leads to an increase in agricultural production, but at the expense of lower employment in agriculture [12]. On the other hand, it is not ruled out that some workers would leave industry and return to the countryside, thus contributing to either output or employment in agriculture.

Distinguishing between the goods and the employment spending components of government consumption, Cavallo [6] shows that the latter acts as a transfer payment for households, thereby dampening substantially the negative wealth effect on consumption and labour supply associated with fiscal shocks. However, it is common to obtain in empirical studies that government investment shocks are much more effective in stimulating the economy than spending shocks; for example, it is the case for the U.S. [16]. Easterly and Rebelo [8] obtain that government spending contributes to the growth through investment in transportation and communication, with agricultural investment being negatively related to private investment with a regression coefficient between −0.64 and −0.94. Higher tax revenues have negative effects on the growth, possibly proxying for general instability in the economy or for variability associated with the tax system. Tax effects are usually weaker if compared with expenditure effects, probably due to lower incidence of wage pressure for the private sector [2].

More recent results are more favourable for the growth effects of government spending on agriculture. Based on panel data of 23 countries in Africa, Asia and Latin America for the 1993-2006 period, Gaiha et al. [9] find that government spending has a major role in growth acceleration both in GDP and agriculture, despite the decline in the share of agriculture in GDP. It is demonstrated that public spending, particularly on health and education has positive growth effects, with poverty reduction impact being quite significant. For India, it is argued that deficit-financed expenditures lead to an increase in unproductive investment in general but with the exception of agriculture [1]. Moreover, a favourable crowding in of private investment seems likely by higher government spending on agriculture.

Empirical results for CEE countries are rather scarce. Bach et al. [3] obtain that the transfers from EU taxpayers to farmers in the CEE countries result in significant welfare gains, while having limited macroeconomic costs for the EU For Albania, it is found that tax exemption on inputs such as agrochemicals and fuel would significantly affect positively the profitability at the farm level and the overall agriculture sector competitiveness [17].

3. Empirical methodology

We use quarterly series for the 2001Q1:2016Q2 period of the following variables: government revenue and spending (in percent of GDP), agricultural and industrial output (index, 2000=100), nominal and real effective exchange rates (index, 2010=100). Agricultural and industrial output series are taken from the Ukraine's State Statistical office (www.ukrstat.gov.ua) while the nominal (real) exchange rate is obtained from the IMF's *International Financial Statistics* database (www.imf.org). All variables enter in logs in order to reduce variation in time series, with government revenue and spending, agricultural and industrial output series being seasonally adjusted with the Census X-11 method.

Assuming infinite vector moving average representation of $A_0 X_t = A(L) X_{t-1} + B\varepsilon_t$, the reduced-form of the VAR model is as follows:

$$X_t = A_0^{-1} A(L) X_{t-1} + A_0^{-1} B\varepsilon_t = C(L) X_{t-1} + u_t, \quad (1)$$

where X_t is a $N \times 1$ vector of the endogenous variables including a budget revenue measure (rev_t), a government spending measure (g_t), real output in agriculture ($agro_t$) and real output in industry (ind_t), as well as an exchange rate (e_t). In empirical analysis, exchange rate e_t is proxied with both nominal and real effective exchange rates, $neer_t$ and $reer_t$ respectively. The crisis dummy, $CRISIS_t$, controls for crisis developments, taking the value 1 from 2008Q3 to 2009Q4 and from 2014Q1 to 2016Q2 and 0 otherwise.

Matrix A_0 captures the contemporaneous relations between the endogenous variables. Matrix $A(L)$ is a polynomial variance-covariance matrix, L is the lag operator, $C(L)$ is a matrix representing the relationship between lagged endogenous variables, ε_t is a $k \times 1$ vector of normally distributed, serially uncorrelated and mutually orthogonal white noise disturbances, and u_t is $N \times 1$ vector of normally distributed shocks that are serially uncorrelated but could be contemporaneously correlated with each other.

The specification of our SVAR is as follows (in terms of the contemporaneous innovations):

$$rev = u_1, \quad (2)$$

$$g = a_1 rev + a_2 agro + u_2, \quad (3)$$

$$agro = b_1 g + b_2 ind + u_3, \quad (4)$$

$$e = c_1 rev + c_2 agro + u_4, \quad (5)$$

$$ind = d_1 agro + d_2 e + u_5. \quad (6)$$

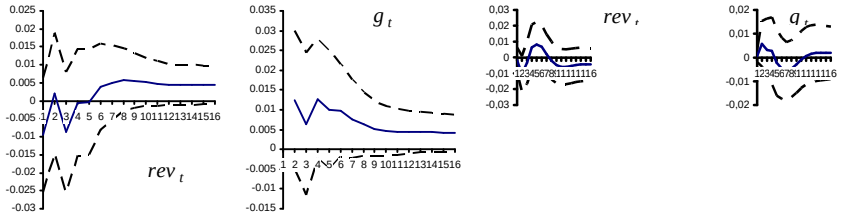
All variables in equations (2)–(6) represent the first stage VAR residuals. It is assumed that both government revenues and spending do not respond contemporaneously to output shocks (equations (2) and (3)). On the other hand, government spending is dependent positively upon government revenues and agricultural production thus reflecting two most frequently mentioned features of Ukraine's budget process, $a_1, a_2 > 0$. As it is customary to assume, Ukraine's agriculture benefits from both government spending and industrial output, $b_1, b_2 > 0$ (equation (4)). On impact, nominal (real) exchange rate is expected to appreciate following an increase in government revenues and agricultural production, $c_1, c_2 > 0$ (equation (5)). Finally, industrial output is affected contemporaneously by agricultural production and nominal (real) exchange rate, with both effects being rather ambiguous in empirical studies, i.e. $b_1, b_2 <> 0$ (equation (6)).

For computational purposes, EViews 6.1 program is used. We include two lags into the SVAR model, as suggested by the Akaike criterion. Although there might be some concerns about nonstationarity of industrial output and exchange rate series, minimal requirements of adequacy are met as the unit root tests indicate stationarity of residuals. Also, it is worth noting that no cointegration between endogenous variables is detected. It is important that the SVAR model in levels is more informative if compared with the case with first differencing the time series as it is associated with a loss of information.

4. Empirical results and discussion

The selected impulse responses of endogenous variables are presented in Fig. 2–6. Table 1 reports the portion of the forecast error variance decomposition (FEVD) in the endogenous variable at different forecast horizons that is attributable to innovations in other variables (the dominant shock is in bold type).

The impulse responses of nominal and real effective exchange rates to a 1 percent of GDP shock of government revenue and spending are presented in Fig. 2. Contrary to standard economic theory predictions, there is a uniform depreciation of $neer_t$ in the long run for both fiscal shocks. The lack of any impact upon the $reer_t$ suggests significant inflationary spillovers by revenue and spending shocks. However, the fraction of fiscal variables in the changes of nominal (real) exchange rate does not exceed 20 percent (Table 1).



a) nominal effective exchange rate (NEER) b) real effective exchange rate (REER)

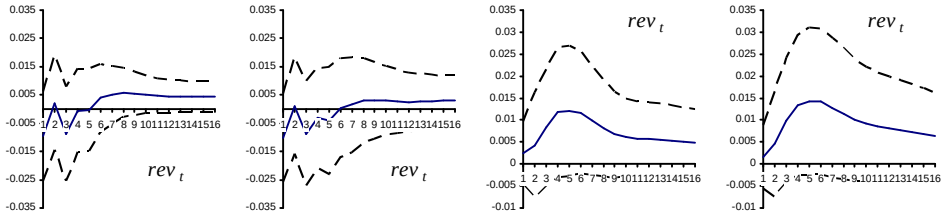
Figure 2. Fiscal policy effects on nominal (real) exchange rates
Note: the solid line is the point estimate, while the dotted lines represent a two-standard error confidence band around this point estimate

Table 1. Forecast error variance decomposition

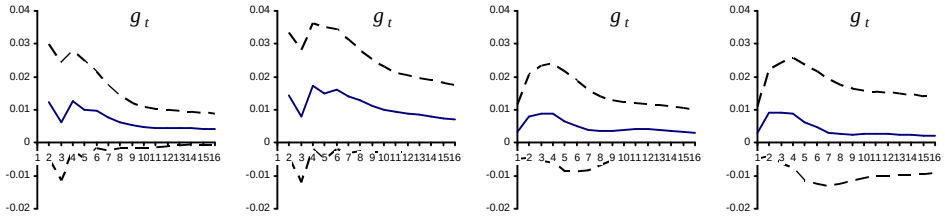
Impulses	Responses to	Forecast horizons			
		4	8	12	16
Government revenue (*rev*)	*rev*	**79 (83)**	**73 (76)**	**72 (75)**	**71 (74)**
	g	7 (6)	8 (8)	9 (9)	9 (10)
	agro	5 (4)	6 (5)	6 (5)	6 (5)
	e	4 (3)	5 (3)	5 (3)	5 (3)
	ind	4 (4)	7 (7)	8 (7)	8 (8)
Government spending (*g*)	*rev*	**38 (34)**	**35 (27)**	**35 (25)**	**34 (24)**
	g	**43 (41)**	**41 (37)**	**40 (37)**	**39 (37)**
	agro	**10 (19)**	**11 (29)**	**10 (31)**	**9 (32)**
	e	5 (3)	8 (2)	10 (2)	11 (2)
	ind	3 (3)	5 (4)	6 (4)	6 (5)
Agricultural production (*agro*)	*rev*	3 (3)	4 (2)	5 (2)	6 (2)
	g	**9 (11)**	**12 (17)**	**13 (19)**	**13 (20)**
	agro	**83 (83)**	**77 (77)**	**72 (75)**	**69 (73)**
	e	1 (1)	2 (2)	4 (2)	6 (2)
	ind	5 (2)	5 92)	5 (3)	5 (3)
Nominal effective exchange rate (*neer*)	*rev*	2 (5)	9 (6)	9 (7)	10 (7)
	g	6 (2)	7 (3)	8 (2)	9 (2)
	agro	**14 (1)**	**9 (14)**	**7 (28)**	**6 (36)**
	e	**75 (90)**	**67 (70)**	**67 (54)**	**66 (45)**
	ind	2 (1)	7 (7)	8 (8)	9 (10)
Industrial output (*ind*)	*rev*	6 (7)	12 (14)	13 (15)	13 (16)
	g	6 (6)	6 (5)	6 (4)	6 (4)
	agro	**22 (21)**	**20 (22)**	**18 (21)**	**17 (20)**
	e	13 (9)	9 (10)	9 (12)	8 (14)
	ind	**53 (57)**	**52 (49**	**54 (47)**	**56 (46)**

Note: results for a specification with the real exchange rate are given in brackets

Figure 3 shows that output responses to a government spending shock in both agriculture and industry are positive though less persistent for the latter (a stimulating effect on the industrial output is rather short-lived). On the other hand, industry is stronger positively influenced by a higher government revenue. Though there is the same positive effect of a revenue shock upon agriculture in a specification with the NEER, the response becomes insignificant in an alternative specification with the REER. As expected, FEVD analysis suggests that agriculture is stronger influenced by government spending if compared to government revenues (Table 1). The results are just the opposite for industry which is more dependent on government revenues. For both sectors, a combined fraction for fiscal shocks is about 25 percent.



a) $rev_t \Rightarrow agro_t$; b) $rev_t \Rightarrow ind_t$;



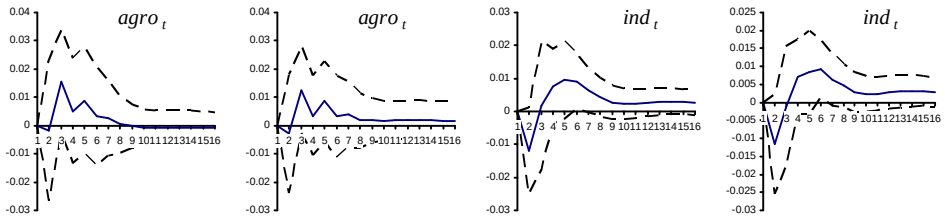
c) $g_t \Rightarrow agro_t$ b) $g_t \Rightarrow ind_t$

Figure 3. Fiscal policy sectoral effects

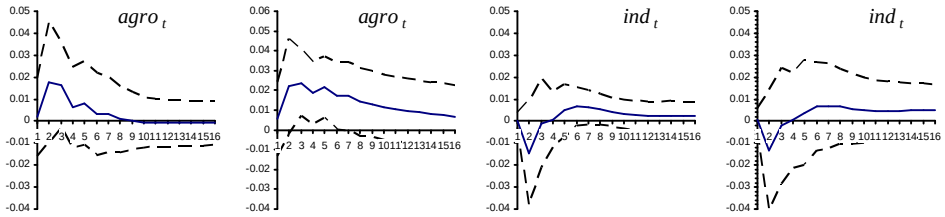
There is weak evidence that agricultural production has a positive impact on government revenues with a two quarters lag (however, this effect is statistically insignificant in later periods) (Fig. 4). By contrast, shocks to industrial output seem to produce a negative effect on the government revenue in the short run, while being of opposite direction on longer horizons. Shocks to agricultural production produce larger increases in government spending if compared with shocks to industrial output. According to the FEVD analysis, both agriculture and industry have a marginal significance for changes in rev_t. As for government spending, the result is similar for industrial output shocks but the fraction of agricultural shocks progressively increases up to 32 percent in the specification with RER.

For agriculture, the largest expansions are produced by shocks to a nominal exchange rate, while this sector seems to be neutral in respect to changes in the RER (Fig. 5). By contrast, the response of industrial output to the RER

depreciation seems to be larger in comparison to changes in the NEER. Also, there are asymmetrical responses of agricultural production and industrial output to the RER shock on impact. The effect of nominal (real) exchange rate shocks on industry is of more importance than on agriculture, but its share in the FEVD is below 15 percent.

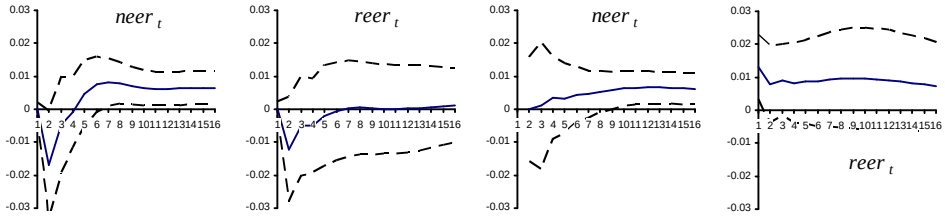


a) $agro_t \Rightarrow rev_t$ b) $ind_t \Rightarrow rev_t$



c) $agro_t \Rightarrow g_t$ d) $ind_t \Rightarrow g_t$

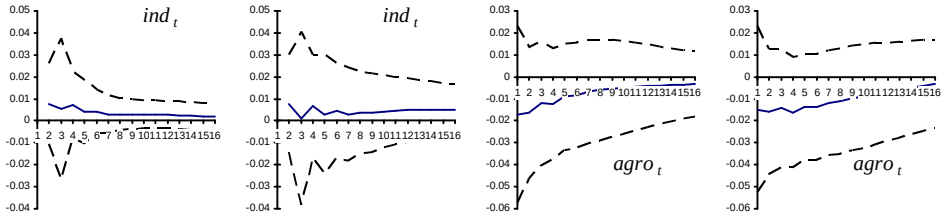
Figure 4. Sectoral effects on fiscal variables



a) $e_t \Rightarrow agro_t$ b) $e_t \Rightarrow ind_t$

Figure 5. Sectoral exchange rate effects

If control for fiscal shocks, there is no any industry spillovers to agriculture, while there is weak evidence of crowding out of the former by the latter (Fig. 6). It runs counter to the results obtained with monthly data for a SVAR model with no fiscal variables [14]. The fraction of industrial output explained by agricultural shocks is at 20 percent, with shocks to industrial output accounting for just 5 percent of changes in agricultural production.



a) $ind_t \Rightarrow agro_t$ b) $agro_t \Rightarrow ind_t$

Figure 6. Sectoral spillovers under controlling for fiscal policy and exchange rate effects

As expected, crisis developments of 2008-2009 and 2014-2016 periods are of clear negative impact upon industry, while being at least neutral in respect to agriculture (the coefficient on a crisis dummy is positive but not statistically significant). Also, there is evidence in favor of a direct link between crisis developments and nominal (real) depreciation of exchange rate. On the other hand, crisis developments seem to have no any effect on the level of both government spending and government revenue as measured by percent of GDP.

6. Conclusions

Government spending contributes to growth in both agriculture and industry, while only the latter benefits from an increase in government revenues. Positive relationship between industrial output and government revenues is more persistent and robust in respect to the choice of the exchange rate indicator if compared with reaction of revenues to agricultural production. Government spending increases in line with both agricultural production and industrial output. Nominal and real depreciation is favourable for industry, but the exchange rate effect is quite ambiguous for agriculture. As it is likely that nominal (real) depreciation is restrictionary in the short run, predictions of the long run effects are ranging from expansion (NEER) to neutrality (RER). There is weak evidence that an increase in agricultural production has a short-run 'crowding out' effect upon industry.

Our study reveals that withdrawal of government financial support could be harmful for both agriculture and industry. Assuming a possibility of the tax-financed budget deficit, a higher tax burden seems not to be a big problem as a correspondent increase in the government revenue has no any restrictionary effect. However, the policy of higher government revenue and spending seems to bring about a nominal exchange rate depreciation which is likely to depress agricultural production in the short run.

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