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Determinants of Ukraine's Agricultural Trade: The Time-Varying Estimates

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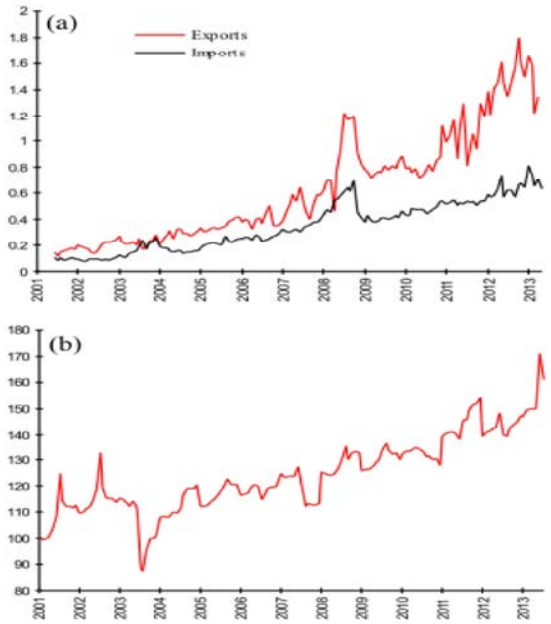
Abstract: In this paper we analyze the determinants of agricultural trade in Ukraine. Based on the monthly data for the period 2004M1:2013M3, it is established by the Kalman filter estimates that the agricultural export growth is stimulated by international food prices (since 2008), domestic agricultural production and output in Russia. There is weak evidence that agricultural exports and imports are neutral in respect to the real exchange rate. Agricultural export is crowded out by agricultural imports, but the reverse causality implies an increase in imports following higher exports. Higher wages at least do not constraint export growth, while contributing to an increase in agricultural imports. It is possible to argue that there is an import substitution in Ukraine's agrarian sector, as higher agricultural production is associated with lower import growth.

Key words: Agricultural exports and imports · Real exchange rate · Ukraine · The Kalman filter

INTRODUCTION

Agricultural sector used to be considered as one of the most important sectors of the Ukrainian economy, given the high quality and availability of fertile land [1]. A remarkable increase of Ukraine's exports and imports over the 2008-2013 period has happened against the backdrop of a sizeable revival in the agricultural production (Fig. 1). Such factors as the exchange rate depreciation, an increase in investments (partly as a result of diversification away from steelmaking and other heavy industries), agricultural trade liberalization, efforts to catch up with its maximum production in the agriculture or better marketing efforts are among explanations of an increase in agricultural production in general and its export in particular [1-3]. Also, the effects of technologies spillovers and improvements in infrastructure are to be mentioned. For example, the increase in Ukrainian crops over last decade was supported by a significant extension of the capacity of Ukraine's commercial seaports [4]. It is worth noting that a steep growth of agricultural production in Ukraine over the 2008-2013 period has been continuing despite macroeconomic disruptions caused by the 2008-2009 financial crisis. Based on the Ukrainian AGMEMOD mo, there are projections of steady increase in soft wheat, barley, maize and oilseeds production over the period until 2025 [4].



a) agro-food exports and imports (US$ bn);
b) agricultural production (index, 2001=100);

Fig. 1: Ukraine: value of agricultural trade and agricultural production, 2001-2013 Note: indicators are seasonally adjusted with Census X-11 method. Source: Ukraine's State Statistical Committee

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However, there are still obstacles for agricultural developments, such as: (i) low productivity as a result of ineffective production methods and management, (ii) neglect of sustainability issues in the field of renewable energy, (iii) lack of modern processing facilities [2], (iv) lack of proper access to financial facilities [4]. As the structure of the change in agro-food trade flows between Ukraine and its trading partners is still predominantly inter-industry, it implies potentially high adjustment costs in the volume and the geographical structure of trade flows [5]. Another obstacle is the use of export restrictions, as it had been the case during the price spikes of 2007/08 and 2010/11 [6], though it happened against the backdrop of rising food prices creating a difficult macroeconomic and social policy challenge [7].

The primary purpose of this paper is to obtain empirical estimates of determinants of agricultural trade in Ukraine. The time-varying parameters (TVP) approach is chosen, which allows account for possible instability in statistical relationships. The rest of the paper is organized as follows. Section 2 reviews main results of empirical studies on the determinants of agricultural trade. Section 3 presents data and statistical methodology. Section 4 discusses empirical results. Section 5 concludes.

Analytical framework: Among determinants of agricultural trade, world commodity prices and exchange rate are a standard choice. As the major part of agro-food trade is of the inter-industry type and thus a product of underlying comparative advantages (Luka and Levkovych 2004), it implies a close relationship with the dynamics of price indicators. A positive link between the exchange rate depreciation and agricultural exports is obtained in many empirical studies [7;8;9]. The elasticity of the relationship between exchange rate and exports is different across regions. In Eastern Asia, international trade is discouraged by exchange rate volatility to a larger extent, as compared with European countries [10]. For Ukraine, effectiveness of the foreign price channel is potentially weakened by a proportional increase in domestic food prices, which could divert agricultural production from exports. Contrary to other agro-food exporters (for example, Argentina or Brazil), effective dollar peg meant in the past that increases in commodity prices, especially those fuelled by dollar weakness, had not been buffered by nominal appreciation [3].

Ferto and Fogarasi (2011) explore the effects of exchange rate and institutional quality on international trade between 1999 and 2008 and find a negative relationship between the exchange rate depreciation and agricultural export in the Central European countries [11]. Another study on Romania and Bulgaria reports an insignificant impact on exports of the real exchange rate appreciation [12].

Terzi and Zengin (1999) emphasize the importance of investigating the relationship between real exchange rate, imports and exports on sectoral disaggregation [13]. In order to measure monetary policy effects on agriculture, Dorfman and Lastrapes (1996) impose the theory-derived long-run restriction of monetary neutrality to identify policy shocks and utilize Bayesian techniques to investigate sensitivity of their results to various aspects of model specification. It is found that the price level, sectoral prices and money rise equi-proportionately in the long run, in full accordance with the monetary neutrality assumption [14].

Higher food prices have radically different effects across countries. Net food exporters benefit from improved terms of trade, although some of them are missing out on this opportunity by banning exports to protect their consumers, as it had been the case in Ukraine in 2007/08 and 2010/11 [6;3]. Net food importers, however, will face difficulties to meet domestic food demand [15].

Regarding the relationship between exports and income, Huchet-Bourdon and Korinek (2011) confirm that income is a strong driver of trade, with a rise in national income leading to an increase in the value of domestic imports through the increased purchasing power of domestic consumers [8]. At the same time foreign income is a driver behind domestic exports, which generally include a high import content, so that the impact of exchange rate depreciation or appreciation on any finished product becomes therefore complex. A more pronounced impact of exchange rates on exports of agriculture than that of manufacturing is explained by relative easiness in changing suppliers of agricultural goods than manufacturing and different price transmission mechanisms in agriculture as compared with manufacturing or mining products.

Senhadji and Montenegro (1999) emphasized the fact that the higher the income elasticity of export demand, the more powerful exports will be as an engine of growth [16]. The higher the price elasticity, the more competitive is the international market for exports of the particular country and thus a real devaluation will be more successful in promoting the export revenues. Although higher output is likely to increase the supply of agricultural products, agricultural exports usually decrease in line with the size of the economy measured by gross domestic product per capita (it could be interpreted as the level of development

as well). For example, it is obtained by Sevela (2002) for the Czech Republic that there is a negative correlation between gross domestic income per capita and agricultural exports [17]. This finding is interpreted as an indicator of lower competitiveness of local agricultural exporters.

Data and Statistical Model: Monthly data for the 2004-2013 period are used, as provided by the State Committee of Statistics of Ukraine (agro-food exports and imports, agricultural production, wages) [18], the online IMF International Financial Statistics (the real effective exchange rate, international food prices, foreign output) [19]. Agricultural export-import series are in constant dollars, deflated by the U.S. Consumer Price (Fig. 1a). Agricultural production is presented on Fig. 1b.

Our baseline model for the Ukraine's agricultural sector presents as follows:

$$AEXP_t = \alpha_0 + \alpha_1 AEXP_{t-1} + \alpha_2 RER_t + \alpha_3 P_t^* + \alpha_4 W_t + \alpha_5 A_t + \alpha_6 Y_t^* + \alpha_7 AIMP_t, \quad (1)$$

$$AIMP_t = \beta_0 + \beta_1 AIMP_{t-1} + \beta_2 RER_t + \beta_3 P_t^* + \beta_4 W_t + \beta_5 A_t + \beta_6 AEXP_t, \quad (2)$$

$$A_t = \gamma_0 + \gamma_1 A_{t-1} + \gamma_2 RER_t + \gamma_3 P_t^* + \gamma_4 AEXP_t + \gamma_5 AIMP_t, \quad (3)$$

where $AEXP_t$ is agricultural exports (in dollars), $AIMP_t$ is agricultural imports (in dollars), RER_t is the real exchange rate (index, 2005=100), W_t is the real wage (index, 2000=100, A_t is the agricultural production (index, 1998=100), P_t^* and Y_t^* are international food prices (index, 2005=100) and output abroad, respectively. Foreign output is proxied with the industrial output in Russia (index, 2005=100).

Assuming standard foreign trade relationships, it is possible to hypothesize that the RER depreciation or higher international food prices contribute to an increase in exports (α_2, α_3 >0), while constraining imports (β_2, β_3 >0). Real wages are likely to increase domestic demand for agricultural imports (β_4>0) and divert resources from exports (α_4>0). It is intuitively appealing that both higher agricultural production and output abroad have favorable effects on exports (α_5, α_6 > 0). At the same time, it is possible to assume that domestic agricultural production has import-substitution properties (β_5 < 0). Considering a possible two-way causality between exports and imports, both 'crowding out' and 'crowding in' effects are possible (α_7, β_6 <>0).

Table 1: Unit Root Test

	Variables					
Lags	Agricultural exports		Agricultural imports		Agricultural production	
3	-1.18	-7.24*	-1.52	-2.20*	-1.39	-7.16*
6	-0.75	-6.29*	-1.54	-4.23*	-0.19	-5.89*
9	-0.76	-4.98*	-2.04	-4.62*	-0.34	-4.45*
12	-0.93	-5.08*	-1.66	-4.64*	-0.34	-4.21*
15	-0.46	-3.98*	-2.01	-4.28*	0.02	-4.57*

Note: test values for levels and first differences are given in left and right columns, respectively.

If demand factors dominate over supplied side ones, depreciation of the RER can stimulate agricultural production; otherwise a decline in output is expected (α_7, β_6 <>0). For Ukraine, a low energy efficiency in the agricultural sector, which implies high demand for imported fuels, as well as reliance on other so-called 'critical' imports as seeds, chemicals and machinery, argues in favor of a possible restrictionary impact of the RER depreciation. Despite availability of exchange rate hedging mechanisms, their use is somewhat prohibitive for small and medium-sized enterprises [9], not to mention institutional environment of 'emerging' financial markets, as in Ukraine. International food prices and agricultural exports are likely to be expansionary (γ_3, γ_4 > 0), while agricultural import could have an opposite effect (γ_5, < > 0). It is assumed that exports and imports can affect agricultural production in a way that is relatively independent of international price effects.

The stationarity of variables in the model (1) is tested using the Augmented Dickey-Fuller (ADF) unit root test procedure (Table 1). According to the MacKinnon critical values, for all series, the null of unit root cannot be rejected at 1 and 5% significance level for levels, while it is the case for first differences. It means that the use of variables in first differences would be appropriate for empirical estimates.

As income and price elasticities of export demand can change over time, the choice of TVP methods seems to be reasonable. In order to analyse whether some significant variation in the estimates of coefficients occurs (especially, in the context of significant world price instability since the middle of last decade), the TVP estimator (the Kalman filter) is used. For this purpose, statistical model can be defined in a state space formulation:

$$X_{i,t} = Y_t \beta_t + \varepsilon_t, \quad (4a)$$

$$\beta_t = \beta_{t-1} + \xi_t, \quad (4b)$$

where equations (4a) and (4b) are respectively the measurement equation and transition equation.

Vector of endogenous variables includes agricultural exports, imports and production $X_t = [\Delta \log AEXP_t, \Delta \log AIMP_t, \Delta \log A_t]$, where all variables are used in first differences of natural logarithms. Vector of exogenous variables Y_t contains explanatory variables (also in first differences of logarithms), as they are defined in equations (1)-(3). Time-varying coefficients are modelled in a recursive manner.

RESULTS AND DISCUSSION

Figure 2 illustrates the behavior of TVP estimates of determinants of agricultural exports over the sample period. Autoregressive coefficient on agricultural exports is negative, with a tendency to increase (in absolute value) since the beginning of 2011. Depreciation of the RER seems to be neutral in respect to agricultural exports, but higher international food prices contribute to a higher demand for exports (since 2008), as expected. To the same extent, it is not surprising that agricultural export is stimulated by domestic agricultural production and industrial output in Russia (both relationships are quite stable over time). Agricultural imports is a factor behind lower export growth, while an increase in real wage at least is not an obstacle for agricultural exports.

The TVP estimates for agricultural imports (Fig. 3) reveal the same negative autoregressive relationship and neutrality in respect to the RER, as in the case of exports. Higher international food prices and stronger growth in domestic agricultural production both lead to a decrease in agricultural imports. On the contrary, agricultural exports and wages contribute to an increase in agricultural imports, reflecting the realities of demand expansion.

While depreciation of the RER does not affect either exports or imports of agricultural goods, it has a clear restrictionary impact on the agricultural production. A positive link between agricultural production and international food prices looks strong enough, although slightly weakening over last decade. It is worth noting that the effects of RER and international food prices on the agricultural production are asymmetrical. The former reflects unfavorable supply-side considerations of a weaker currency, as it leads to more expensive critical import of fuel, chemicals and machinery. Though an undervalued exchange used to be viewed as an instrument of protecting domestic firms from foreign competition (conceptually, it could be viewed as equivalent to tariff protection) and providing them with greater incentives to export (an undervalued exchange rate could be compared to an export subsidy), this is not the case in Ukraine.

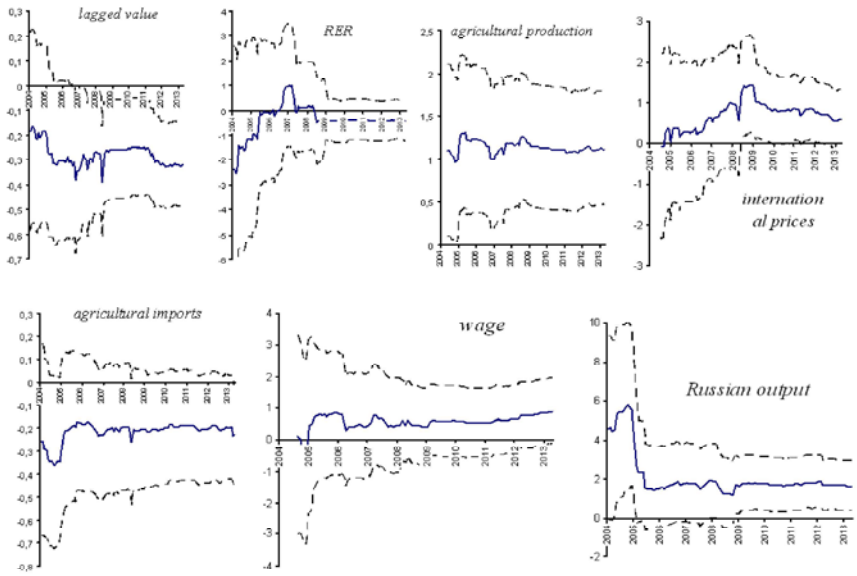

Fig. 2: Determinants of agricultural exports

Note: the solid line is the point estimate, while the dotted lines represent a two-standard error confidence band around this point estimate.

Source: the author.

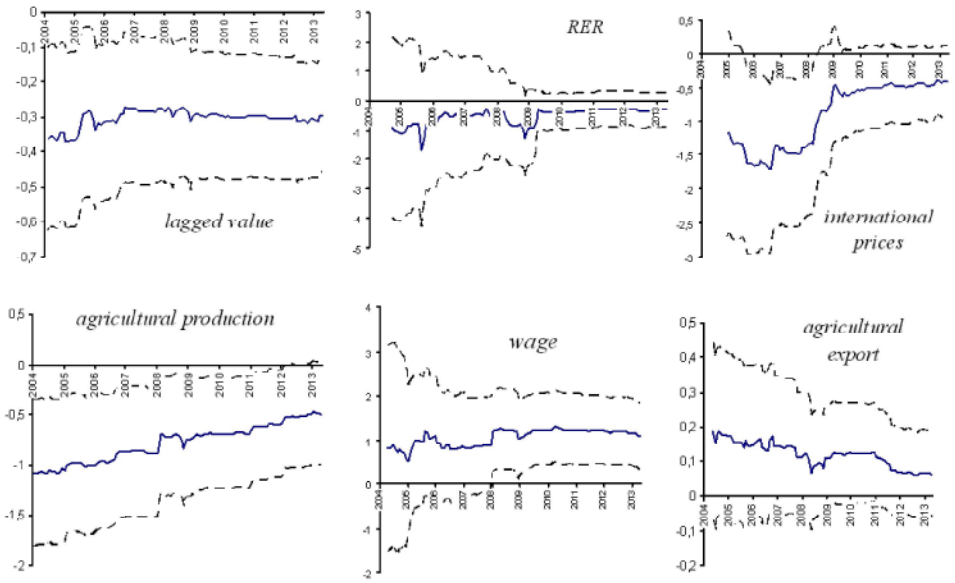

Fig. 3: Determinants of agricultural imports
Source: the author

It is interesting that either agricultural exports or imports are expansionary. More exactly, a positive link between exports and agricultural production is a recent phenomenon, gaining ground since 2008 (a year of entering the World Trade Organization). On the other hand, favorable effect of agricultural imports on the agricultural production are present since the middle of last decade. Our estimates confirm that there is no fear of 'crowding out' local agricultural production by imports in Ukraine. Among explanations, stronger competition and better specialization in a more open environment could be mentioned.

CONCLUSION

Our results demonstrate that international food prices, foreign output, domestic wages and export-import linkages play a role in shaping agriculture trade in Ukraine. Depreciation of the RER is neutral in respect to either agricultural exports and imports, but it has a clear restrictionary impact on the agricultural production. As export growth may be more dependent to factors like foreign demand, production capacity, productivity, diversification of exported goods and production of technology-intensive goods rather than price changes, low price elasticity may not be surprising. Anyway, effects of exchange rate policies on agricultural exports seem to be fairly limited in Ukraine and at the cost of a decline in the agricultural production. In order to achieve a stable export growth, efforts in the direction of diversification of exported products and production of processed goods are to be undertaken.

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