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Oleksandr Faryna

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Oleksandr Faryna

Exchange rate pass-through and cross-country spillovers: Some evidence from Ukraine and Russia

Abstract

This paper studies exchange rate pass-through to consumer prices in Ukraine and Russia considering cross-country linkage and spillover effects. We relax the assumption of "isolated islands" and employ a bilateral panel VAR (BPVAR) approach to estimate a pass-through effect from the ruble to hryvnia exchange rate (UAH/RUB) movements, taking into account cross-unit heterogeneities as well as dynamic and static interdependencies. We then compare BPVAR estimates with those from individual VAR models and find that, while results for Russia do not change significantly, spillover effects are identified for Ukraine. In particular, ruble depreciation (e.g. hryvnia appreciation) results in increasing Ukrainian prices instead of declining as suggested by individual VAR analysis. We also estimate alternative BPVAR including hryvnia and ruble exchange rates with respect to the US dollar and find that prices in Ukraine respond to changes in USD/RUB to a larger extent than to UAH/USD.

Keywords: exchange rate pass-through, Ukraine, Russia, spillovers, bilateral panel VAR.
JEL classification: E31, E52, E58.

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1 Introduction

Exchange rate pass-through (ERPT) is traditionally defined as the percentage change in the price of imported good in local currency resulting from a one percent change in the nominal exchange rate.[1] The puzzle of incomplete ERPT to import prices has become a trending research topic in theoretical and empirical literature since the breakdown of the Bretton Woods system. Furthermore, its importance from the monetary policy perspective extended the focus of such interest to capture the effect of exchange rate movements to all domestic price indices. Understanding the mechanism of exchange rate shocks transmission into domestic inflation might be a useful tool for inflation forecasting allowing the monetary authority to react efficiently to such shocks and maintain price stability.

Although existing empirical studies are consistent in findings that exchange rate pass-through is incomplete, the extent to which domestic prices respond to exchange rate fluctuations varies among countries, leading to a natural question of what are the underlying determinants of ERPT. Such phenomena is traditionally well explained by a set of macroeconomic factors, including country's size and openness (see Goldfajn & Werlang, 2000; McCarthy, 2000), import composition (see Campa & Goldberg, 2005), inflation environment and monetary policy (see Taylor, 2000; Bailliu & Fujii, 2004; Choudhri & Hakura, 2006), exchange rate regime (as in Beirne & Bijsterbosch, 2009).

All of these studies assume that countries are small open economies treated as "isolated islands". In this respect, domestic prices of each country are affected by external shocks from abroad, while the possibility of transmission of such shocks to across countries is neglected. As argued in Canova & Ciccarelli (2013), in the new global order with international interdependencies, however, economies and regions can no longer be treated in isolation and the multilateral perspective is crucial. Thus, potential cross-country spillovers may be additional determinant of the degree to which domestic prices respond to exchange rate movements. In particular, Comunale (2015) studies heterogeneities in exchange rate pass-through in the euro zone and finds common unobserved factors which play significant role in determining the asymmetry in inflation between core and periphery countries. Although the origin of such unobserved factors are not directly expressed in the analysis, these results may indicate the presence of considerable spillover effects across individual countries. Comunale & Simola (2016), in turn, examine the

[1] Goldberg & Knetter (1997) provide the definition.

pass-through effect in the CIS[2] countries and find that spillovers and common factors appear to be important for the consumer price development and hence the exchange rate pass-through mechanism.

Indeed, for countries, such as Ukraine and Russia, linked together through trade, credit and other channels, omitting potential interdependencies can result in biased estimates of the pass-through effects. Therefore, in our empirical analysis we relax the assumption of "isolated islands" and study exchange rate pass-through in Ukraine and Russia from the perspective of cross-country linkage explicitly taking into account potential spillover effects. First, we employ bilateral panel VAR (BPVAR) taking into account dynamic and static interdependencies and estimate impulse response coefficients of the pass-through effect from hryvnia-ruble exchange rate movements. Then we compare results with individual VAR estimates which neglect potential spillover effects. In addition, we extend our benchmark setup and employ alternative BPVAR specification taking into account interdependencies of hryvnia and ruble exchange rates with respect to the US dollar (e.g. USD/UAH and USD/RUB) and estimate the extent to which prices in Ukraine and Russia respond to USD/RUB and USD/UAH fluctuations.

To preview the results, we find that ERPT estimates from individual and bilateral panel VAR frameworks do not change significantly for Russia, while spillover effects are identified in the case of Ukraine. In particular, ruble depreciation (e.g. hryvnia appreciation) results in increasing Ukrainian prices instead of declining as suggested by individual VAR analysis. Alternative BPVAR estimates suggest that Russian prices are independent to USD/UAH changes, while prices in Ukraine respond to USD/RUB movements to a larger extent than to USD/UAH. These results show that cross-country interdependencies is an important determinant of the pass-through effect and can not be neglected.

The rest of the paper proceeds as follows. The second section provides a brief overview of the literature on theoretical evolution of exchange rate pass-through; in the third section we provide stylized facts regarding Ukrainian and Russian economies; methodology and data peculiarities are presented in section 4; empirical results are reported in section 5, followed by conclusions in the last section.

[2] CIS – Commonwealth of Independent States – include Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Tajikistan, Turkmenistan, and Uzbekistan. Comunale & Simola (2016) also include Ukraine and Georgia to their analysis although they are no longer formally members of the CIS.

2 Theoretical evolution of exchange rate pass-through

In the remaining section we draw on the literature on exchange rate pass-through to study the evolution of benchmark theoretical frameworks of ERPT analysis. We also discuss arguments on existence of cross-country spillovers affecting the degree of the pass-through effect.

2.1 Pass-through to import prices

Traditional macroeconomic open-economy models assume that markets are characterized by a perfect competition where purchasing power parity (PPP) holds, implying that market participants taking advantage of their arbitrage opportunities equalize prices of tradable goods, expressed in the same currency, across countries. Hence, the exchange rate changes should be completely reflected in prices. However, despite an increased openness of most developed countries and adoption of floating exchange rate regimes since early 70s, a large stand of empirical literature finds that exchange rate pass-through to import prices is far from complete even in the long run[3].

Most of these studies were typically micro-founded in nature and analyzed price responsiveness from the industrial-organization perspective in the climate of imperfect competition. Starting from Dornbusch (1987) and Krugman (1987), the relationship between prices and exchange rates has been represented within a "pricing to market" theory which implies that foreign exporting firm has a pricing power on the importing country's market and tends to adjust its mark-up in response to exchange rate fluctuations[4]. Mark-up responsiveness will depend mainly on the market share of domestic producers relative to foreign producers.

More recently, a class of New Open Economy Models (NOEM) has incorporated microeconomic evidence of incomplete ERPT into the macroeconomic framework. Betts & Devereux (1996) extended the pioneer general equilibrium model with nominal rigidities and market imperfections, firstly introduced by Obstfeld & Rogoff (1995), allowing for pricing to market and, thus, incomplete pass-through. In particular, in their theoretical set-up the degree of ERPT to domestic prices depends on the pricing strategy of firms which are able to choose between producer (PCP) and local currency pricing (LCP) strategies. Under the PCP, when the price is set in the currency of exporter, exchange rate movements are fully reflected in the price of imported product expressed in the local currency, resulting in complete ERPT. In contrast, LCP

[3] Menon (1995) provides an overview of 43 empirical studies.
[4] Goldberg and Knetter (1997) provide a comprehensive review of this literature.

implies that prices are pre-set in domestic currency and ERPT is zero. The aggregate pass-through, thus, depends on the combination of firms with different pricing strategies.

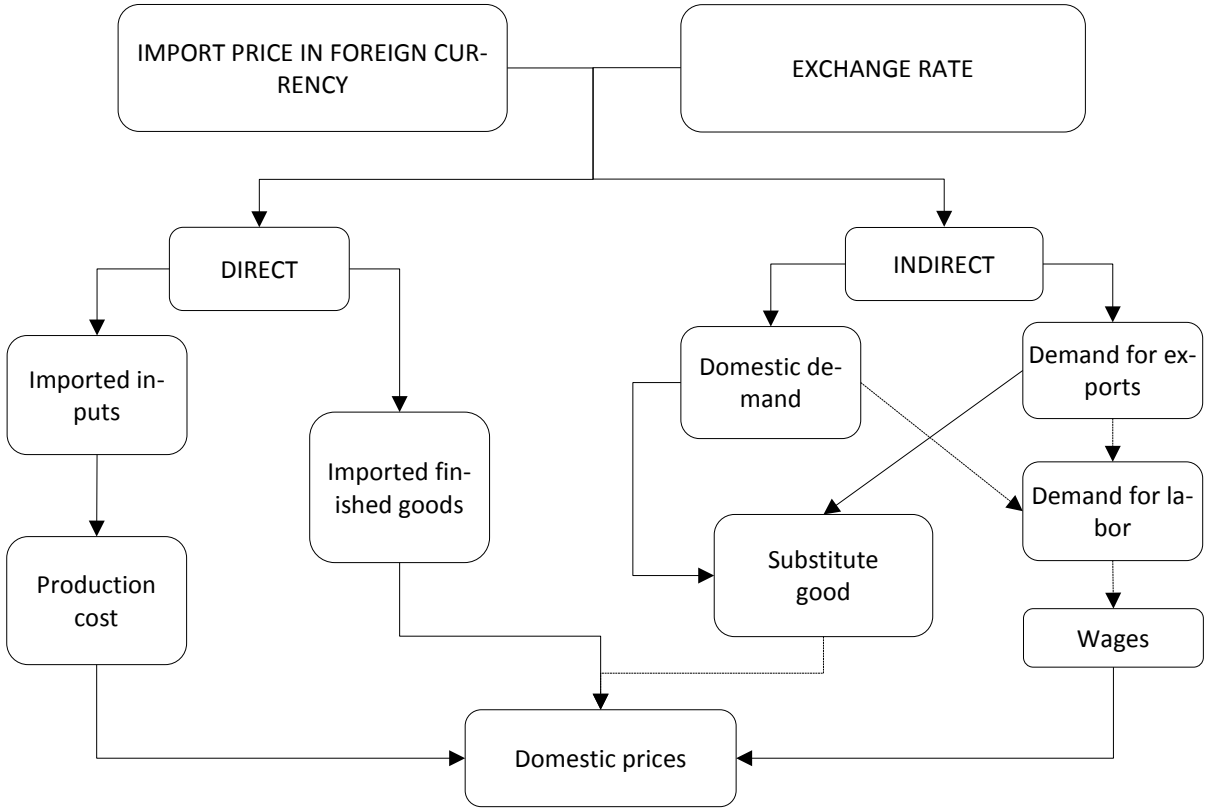
2.2 Pass-through to consumer prices

Empirical literature commonly utilize described above theoretical frameworks to study the direct effect of exchange rate changes on prices of imported goods for domestic consumption as well as imported inputs used in domestic production. However, these goods are only a part of the total consumer basket, while the extent to which exchange rate movements affect the aggregate domestic price level has additional determinants. In particular, Lafleche (1996–97) discuss several indirect channels of exchange rate pass-through. Indirect transmission of external shocks affects consumer prices through changes in the domestic demand. In this respect, depreciation of the currency increases domestic as well as foreign demand for domestic goods. Higher prices for imported goods increase the demand for domestically produced substitutes, while cheaper prices for domestic exports in turn raise foreign demand which puts additional pressures on domestic prices. Furthermore, the increase in demand for domestic goods eventually increases labor demand and wages, which, in turn, causes prices to rise. In addition, the transmission of other external shocks (e.g. the increase in import prices in foreign currency) affect domestic price level through similar direct and indirect channels. Figure 1 summarizes both direct and indirect pass-through effects of external shocks.

2.3 Pass-through and cross-country spillovers

Although existing theoretical frameworks cover both direct and indirect channels of exchange rate pass-through to domestic prices, the small open economy assumption is commonly considered as fundamental. In particular, countries are treated as “isolated islands”, while external shocks affect domestic prices in a single direction. However, from the perspective of globalized world with deeply integrated economies, the presence of cross-country interdependencies suggests that there is ample room to study how external shocks are transmitted across units. Relaxing the assumption of “isolated islands” implies that potential spillover effects may arise from described above direct and indirect transmission channels. In particular, consider two countries A and B which are characterized by a tight trade and market linkage (e.g. country A imports and exports goods from and to country B, and vice versa). Following the depreciation of currency A with respect to currency B, prices in A increase through direct and indirect transmission channels.

Figure 1 Channels of external shocks transmission to domestic prices[5]



Furthermore, if country A exports domestically produces goods to country B, prices of A's goods for B rise which subsequently affect the level of B's domestic prices. An opposite effect occurs from the perspective of currency B appreciation. In this simple example, depreciation of one currency has a positive as well as negative effect on domestic prices of this country due to the existence of cross-country linkages and depends on the import composition, size, and openness of both countries. Thus, neglecting this aspect of reality is likely to induce distortions in the evaluation of the degree to which aggregate consumer prices respond to exchange rate fluctuations.

3 Stylized facts

In this section, we briefly describe peculiarities of Ukrainian and Russian economies, provide empirical evidence on exchange rate pass-through estimates for both countries, and discuss their tight linkage. Understanding differences and similarities of Ukrainian and Russian economies may shed the light on how two countries are interrelated in terms of transmission of external shocks.

[5] Based on Lafleche (1996–97)

Being open economies, Ukraine and Russia are sensitive to external shocks. Despite their close relationship, these two countries are different in terms of size, import structure, monetary and exchange rate policies. Russia has experienced an increase in exchange rate volatility in the past few years compared to the period before the global financial crisis, as the authorities have chosen to allow a higher degree of ruble exchange rate flexibility in preparation for the adoption of inflation targeting (see IMF, 2013 for further details). In Ukraine, the policy of exchange rate peg to the US dollar was in place for the entire period of Ukrainian hryvnia existence in order to provide nominal anchor for the economy. However, two stages of home currency devaluation in 2008 and 2014, consequently, passed-through to a large extent to domestic prices aggravating macroeconomic turbulences. A gradual shift to inflation targeting with more volatile exchange rates, energy import dependence of Ukraine, and energy export dependence of Russia increases their sensitivity to external shocks. Figure 2 shows the dynamics of consumer prices and exchange rates in Ukraine (A) and Russia (B).

Given the particular importance of the ERPT mechanism for open economies in transition, the literature on exchange rate pass-through in Ukraine and Russia is not conclusive. Table 1 provides empirical estimates of ERPT coefficients for both countries. Korhonen & Wachtel (2005) study ERPT to consumer prices in CIS countries. Authors use VAR approach and impulse response analysis and estimate ERPT to consumer prices for Ukraine at 0.63–0.64 level and for Russia – (–0.42). Comparing to other CIS countries, results for Ukraine are relatively high. Interestingly, excluding oil prices from the endogenous VAR representation results in 0.20 ERPT coefficient for Russia both in the short as well as long run. Following a similar approach, Beckmann & Fidrmuc (2013) provide ERPT estimates for seven CIS countries and confirm results for a high pass-through in Ukraine and negative ERPT for Russia. In addition, authors employ panel vector error correction model (VEC) and estimate average long-run ERPT for CIS countries. They find ERPT to be 0.52 – 0.77 from USD and 0.31 – 0.75 from EUR exchange rate movements. Novikova & Volkov (2012) also employ a VEC framework and find long-run ERPT to core inflation in Ukraine at 0.35–0.47 level. Faryna (2016) studies ERPT in Ukraine using disaggregated CPI indices and finds that different price groups respond to NEER changes by 0.15 – 0.27%.

Figure 2 Consumer prices and exchange rates in Ukraine and Russia

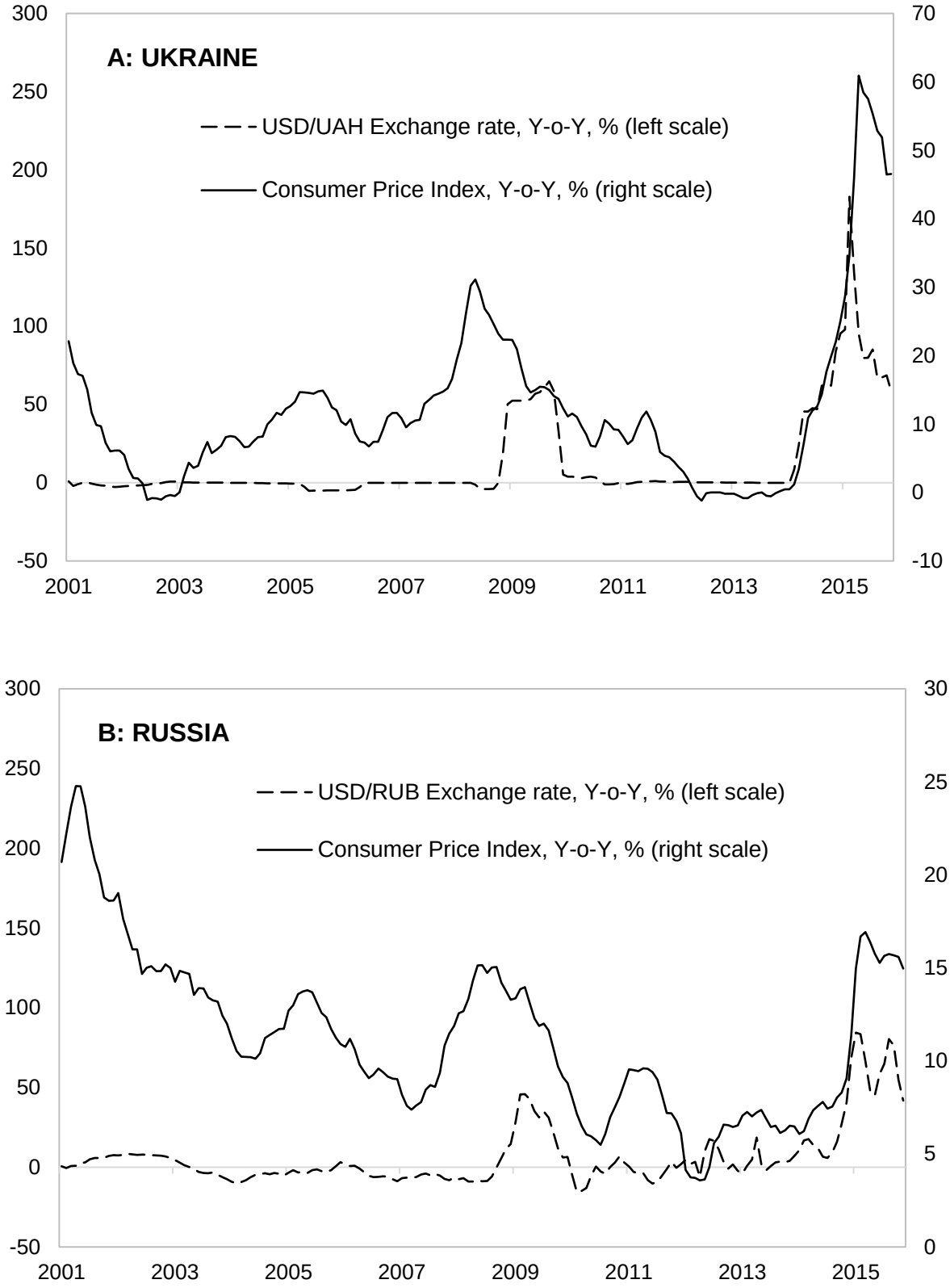


Table 1 ERPT estimates for Ukraine and Russia in empirical literature

Source	Price index	Data set	Exchange rate	Period	Ukraine	Russia
Korhonen & Wachtel (2005)	CPI	1999 – 2004	USD	12 month	0.63	–0.42 (0.2 no oil)
				24 month	0.64	–0.42 (0.2 no oil)
			EUR	12 month	0.24	–0.21
				24 month	0.28	–0.24
Beckmann & Fidrmuc (2013)	CPI	1999 – 2010	USD	12 month	0.45	–0.17
			EUR		0.25	0.02
			USD	long-run (panel cointe-gration)	0.52 – 0.77	
			EUR		0.31 – 0.75	
Novikova & Volkov (2012)	Core CPI	2003 – 2012	NEER	long-run (cointegration)	0.35 – 0.45	–
Faryna (2016)	CPI (panel)	2007 – 2016	NEER	long-run (lagged infla-tion)	0.15 – 0.27	–
Ponomarev et al. (2014)	CPI	2000 – 2012	NEER	3 month	–	0.10
				12 month	–	0.48
			USD	3 month	–	0.11
				12 month	–	0.86
			EUR	3 month	–	0.06
				12 month	–	0.57
International Monetary Fund (2015)	CPI 28 EMs	2013 – 2015	NEER	12 month	0.22	
Kataranova (2010)	CPI	2000 – 2008	USD	short-run	–	0.06 – 0.12
				long-run (lagged infla-tion)	–	0.14 – 0.20
		2003 – 2008		short-run	–	0.08
				long-run (lagged infla-tion)	–	0.14
Oomes & Ohnsorge (2005)	CPI	1996 – 2004	NEER	long-run (cointegration)	–	0.47 – 0.49
Dobrynskaia (2007)	CPI	1998 – 2005	NEER	12 month	–	0.35
		2003 – 2005			–	0.08

Kataranova (2010) find that consumer prices in Russia respond to 1% USD/RUB exchange rate changes by 0.06 – 0.12 % in the short-run and 0.14 – 0.20% in the long-run. Dobrynskaia (2007), in turn, argue that the pass-through effect in Russia has declined from 0.35 to 0.08. Oomes & Ohnsorge (2005) and Ponomarev et al. (2014) provide somewhat higher ERPT estimates in Russia varying from 0.47 to 0.86 percent in the long-run.

IMF (2015) in their Country Report for Russian Federation provide average ERPT estimates for a panel of 28 emerging markets (EMs) which might be a good benchmark in studying the pass-through effect in such countries. They find that EM's consumer prices respond by 0.22 percent after 12 month of exchange rate depreciation.

Noteworthy, existing empirical studies consider exchange rates of hryvnia and ruble with respect to the US dollar, euro, or nominal effective exchange rates (NEER). However, to our knowledge, there is no literature that deal with bilateral hryvnia-ruble exchange rate which might be of particular importance for these countries due to their close interrelation.

Historical and geographical conditions explain a tight linkage between Ukraine and Russia through trade, credit and other channels. Russia, being a large oil exporter, has a considerable weight in the import structure of Ukraine. On the other hand, Ukraine is one of the major exporting market for Russia. Potential spillover effects in exchange rate pass-through mechanism may arise through direct as well as indirect transmission channels. Moreover, both economies are linked by common exporting markets and following the depreciation in one country, the currency of the other may experience additional pressure due to the drop in competitiveness of its goods abroad. Hence, the assessment of external shocks transmission to domestic prices in one country should account for specific conditions in the other.

4 Methodology and data

This section introduces the analytical framework and data used in estimation of exchange rate pass-through to aggregate consumer prices in Ukraine and Russia taking into account cross-country interdependencies and transmission of external shocks across countries. We follow existing studies on exchange rate pass-through which utilize VAR approach and extend their analysis by developing bilateral panel vector autoregressive model considering cross-section heterogeneities as well as dynamic and static interdependencies. We then provide data description that is used in our empirical analysis.

Over last decades, a considerable improvement and unification in the standards of comparable data collection enabled the addition of a panel dimension to empirical studies for developed as well as developing and emerging economies. One way of examining economic issues in interdependent world is the development of Panel VAR models being considered as a powerful tool to address interesting questions related to transmission of shocks across units[6]. In this respect, Panel VAR models are of much interest for our analysis of exchange rate pass-through from the multilateral perspective.

Although panel VARs have the same structure as standard VARs where all variables enter endogenous structure of the model, the addition of cross-sectional dimension implies that variables of all units are treated as endogenous and interdependent as well. In particular, consider a vector of endogenous variables of each unit $y_{it}, i = 1, \dots N,$ while $Y_t = [y_{1t}, y_{2t}, \dots, y_{Nt}]$. Then, panel VAR is

$$\begin{aligned} y_{1t} &= A_{01}(t) + A_{1i}(\ell)Y_{t-1} + \epsilon_{1t} \\ y_{2t} &= A_{02}(t) + A_{2i}(\ell)Y_{t-1} + \epsilon_{2t} \\ &\vdots \\ y_{Nt} &= A_{0N}(t) + A_{Ni}(\ell)Y_{t-1} + \epsilon_{Nt} \end{aligned} \tag{1}$$

where $A_{0i}(t)$ and $Ai(\ell)$ are respectively deterministic components of the data and a polynomial in the lag operator for each unit i, $\epsilon_t \sim iid(0, \Sigma)$ vectors of random disturbances.

The structure of equation 1 suggests that panel VARs have three characteristics features allowing the analysis of cross-sectional heterogeneities as well as static and dynamic interdependencies across units. Dynamic interdependencies imply that lags of all endogenous variables of all units enter the model for each unit i. Static interdependencies, in turn, assume that ϵ_{it} are generally correlated across units i. Lastly, cross-sectional heterogeneity requires unit specific intercept, slope, and variance of shocks ϵ_{it}. Additional complexity of panel VARs generates several estimation problems related with dimensionality (e.g. inclusion of dynamic interdependencies) and shock identification (e.g. inclusion of static interdependencies). Thus, empirical literature usually does not utilize all of these distinguishing features simultaneously. In particular, as argued in Canova & Ciccarelli (2013), analyzing how shocks affect countries in monetary union it may be more important to allow for slope heterogeneities than for variance heterogeneities. Furthermore, when analyzing the transmission of shocks across units, static and dynamic interdependencies may be sufficient if the time period is a month of a quarter and the panel includes

[6] For further discussion on Panel VAR and its practical implications see Canova & Ciccarelli (2013)

units which have different characteristics (e.g. small and large economies, developed and developing countries).

A large body of empirical literature utilize panel VAR framework when estimating exchange rate pass-through to domestic prices from the multilateral perspective including common (e.g. oil prices) as well as country-specific (e.g. output gap) control variables. However, they restrict specification by neglecting potential interdependencies and assuming dynamic homogeneity across units. This setup does not allow the estimation of individual unit specific coefficients and neglects the transmission of shocks across units. Impulse response analysis, in such cases, is used to compute an average price responsiveness to exchange rate movements across countries, regions, specific goods or group of goods, etc. In particular, Landau & Skudelny (2009) employ panel VAR deriving homogenous pass-through dynamic coefficients for the euro area as a whole. Beckmann & Fidrmuc (2013), in turn, extend panel VAR approach by addition of panel cointegration and estimate average long-run ERPT for CIS countries. Nalban (2015) estimates average as well as individual countries' ERPT to producer and consumer price indices in four Central and Eastern Europe countries within a Panel Bayesian VAR model. Authors argue that this method makes it possible to simultaneously consider individual characteristics of the units and common features shared by all members.

In our research, we use data from Ukraine and Russia and employ two-country panel VAR considering all characteristics of multivariate and multilateral analysis allowing for cross-section heterogeneity, dynamic and static interdependencies across countries. In this respect, Ukrainian and Russian specific variables enter endogenous representation of the model as well as bilateral hryvnia-ruble exchange rate. However, we consider several assumptions in order to avoid estimation problems. First, a two-country model implies that the number of cross sectional units is small which solves the dimensionality problem while including dynamic interdependencies. Second, we follow the recursive VAR framework presented by McCarthy (2000, 2007) and Hahn (2003) who study exchange rate pass-through over the price distribution chain. This approach implies that reduced form residuals are Cholesky orthogonalized[7]. In order to deal with cross-sectional residual correlation, we assume that Russia is a relatively larger economy than Ukraine and, thus, Russian variables should be first in the Cholesky ordering which enables the estimation of recursive bilateral panel VAR model and computation of IRFs from structural shocks Thus, the ordering of variables in BPVAR is

[7] In this respect, ordering of variables matters. Typically: *Supply conditions → Demand conditions → Exchange rate → Domestic prices.* See McCarthy (2000) for details.

$$S \rightarrow Y_{RU} \rightarrow Y_{UA} \rightarrow UAH/RUB \rightarrow P_{RU} \rightarrow P_{UA}$$

where S – supply conditions (e.g. energy prices), Y_{RU} and Y_{UA} – demand conditions in Russia and Ukraine, P_{RU} and P_{UA} – aggregate prices in Russia and Ukraine, and UAH/RUB – bilateral exchange rate of hryvnia to ruble.

In addition, we estimate individual VAR models for Ukraine and Russia, which neglect cross-country linkages, for the comparison purposes. Following this approach we then compute Impulse Response Functions (IRFs) from bilateral panel VAR as well as individual VARs in order to derive dynamic ERPT coefficients in Ukraine and Russia and study the sufficiency of cross-country spillovers.

We also employ alternative BPVAR including potential interdependencies of hryvnia and ruble exchange rates with respect to US dollar. In this case, the Cholesky ordering of variables is

$$S \rightarrow Y_{RU} \rightarrow USD/RUB \rightarrow P_{RU} \rightarrow Y_{UA} \rightarrow USD/UAH \rightarrow P_{UA}$$

In our econometric setup we use Core Consumer Price Index[8] for Ukraine and Russia and nominal bilateral exchange rate of hryvnia to ruble (UAH/RUB) as well as nominal bilateral exchange rates with respect to US dollar (USD/RUB and USD/UAH) for the alternative specification[9]. In order to take into account demand conditions in both countries we use Industrial Production Index (IPI)[10] as it is available on the monthly basis frequency. Supply conditions are represented in the model by Fuel Price Index[11] from IMF statistics which includes oil, gas, and coal prices. In the alternative BPVAR specification we also use OECD prices to consider the effect of external conditions on domestic prices in Ukraine and Russia.

Our analysis is based on the monthly frequency data covering the period 2000M1 – 2015M11. A starting point was selected to avoid the period of Russian crises in late 90s, which also caused macroeconomic turbulences in Ukraine, and the ending point represents the latest available data updates. All variables are used in logarithms and first differences. Table A1 of the Annex provides detailed data peculiarities.

[8] In the robustness section we also provide estimates for Consumer Price Index (CPI).
[9] We also estimate price responsiveness from changes in exchange rates of hryvnia and ruble with respect to US dollar, euro as well as nominal effective exchange rates (NEER) in Ukraine and Russia in the individual VAR analysis for the robustness check purposes. In these specifications we respectively use consumer prices in the USA, Euro area, and trade-weighted prices in the main trading partners on Ukraine and Russia as exogenous variables.
[10] In the basic setup we utilize m-o-m change of IPI. For the robustness check, however, we also consider IPI gap derived from HP filtered IPI index.
[11] Fuel Index is the PNRG index from IMF Primary Commodity Prices.

5 Results

In the remaining section, we report our empirical estimates of exchange rate pass-through to aggregate consumer prices in Ukraine and Russia from the bilateral panel VAR analysis. First, we estimate BPVAR (A) model and report cumulative impulse response of core consumer prices in Ukraine and Russia to changes in hryvnia-ruble exchange rate. We compare results with those from individual VAR models that treat countries as "isolated islands" in order to identify cross-country spillovers. In addition, we estimate alternative BPVAR (B) specification with hryvnia and ruble exchange rates to the US dollar. Lastly, we check the robustness of our empirical results and discuss research limitations.

5.1 Spillover evidence from BPVAR (A)

Figure 3 presents standardized cumulative response of core consumer prices in Ukraine and Russia to 1% UAH/RUB exchange rate depreciation from bilateral panel VAR (A) (dashed curve) and individual VAR (solid curve) analyses. As seen from the graph, individual VAR analysis suggests that 1% ruble depreciation (e.g. hryvnia appreciation) increases Russian prices by 0.1% and declines Ukrainian prices by 0.1% after 12 month. Coefficients obtained are higher than one would expect given that both countries have been particularly dependent to the US dollar exchange rate. External shocks from the US dollar exchange rate movements can reflect changes in the risk premium for individual economy, while hryvnia-ruble exchange rate variations, in turn, reflect the relative change of countries' risk premium. Hence, ruble depreciation with respect to hryvnia occurs due to both ruble depreciation as well as hryvnia appreciation with respect to the US dollar which can explain a high degree of the pass-through effect.

According to BPVAR (A), results for Russia does not change significantly. For Ukraine, however, the dynamic effect of exchange rate changes has a different pattern. In particular, in the short-run the response of Ukrainian prices from BPVAR (A) is similar to one from individual VAR. In the long-run the direction of dynamic response changes leading to the rise of Ukrainian prices.

Figure 3 Cumulative response of core consumer prices to 1% UAH/RUB exchange rate depreciation: results from BP VAR (A) and individual VAR analysis

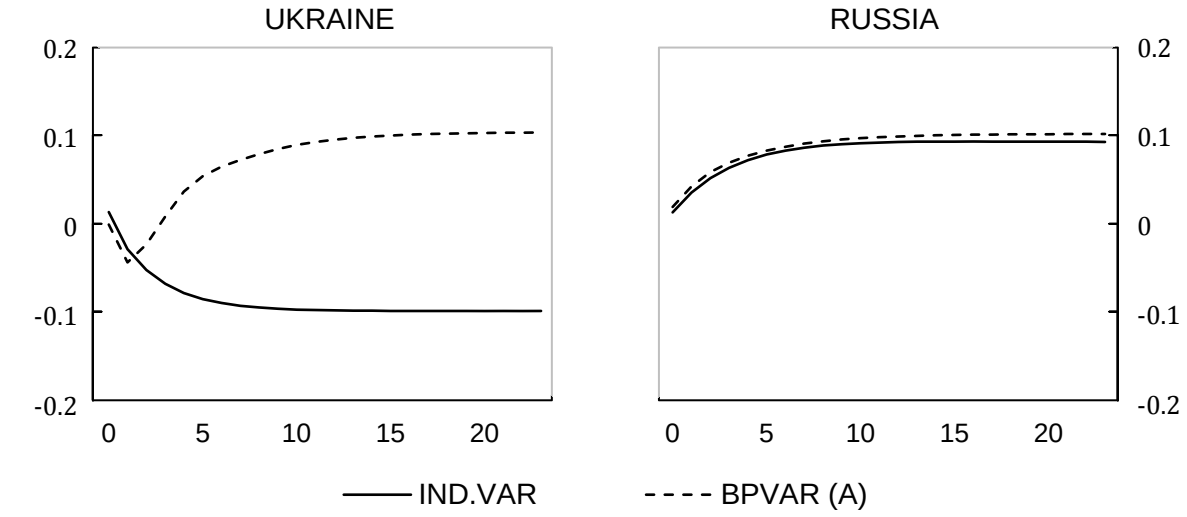
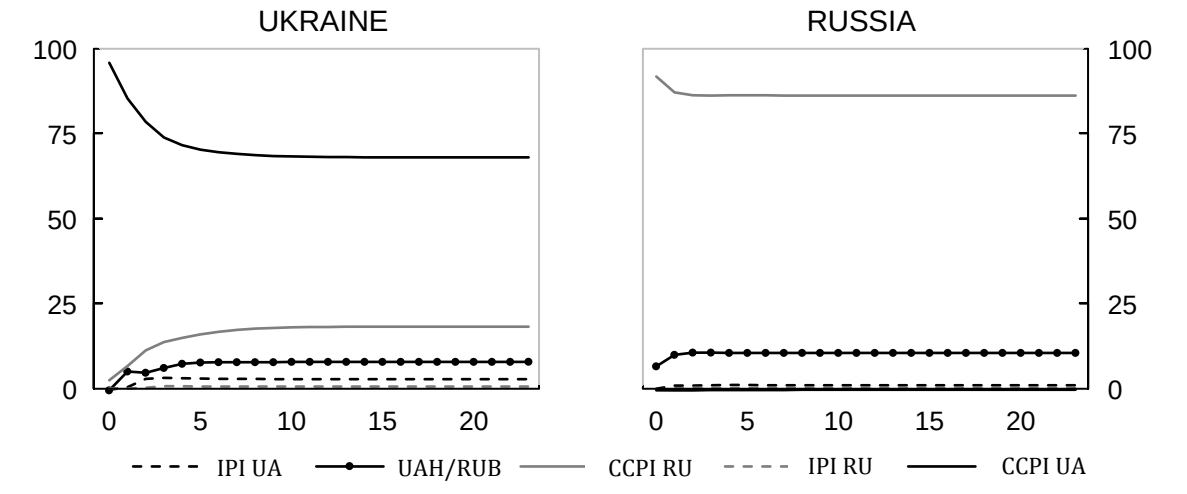


Figure 4 Variense decomposition of core consumer prices in Ukraine and Russia from BPVAR (A)



While impulse response functions trace the effect of a one-time shock to exchange rate on current and future values of prices, analyzing variance decomposition is a useful tool in exploring the relative importance of each variable in the model. Bilateral representation of our analysis implies that domestic prices in Ukraine and Russia are affected by country-specific as well as foreign endogenous variables. Decomposing variance of prices in both countries (Figure 4) indicates that variance of shocks of Ukrainian prices attribute mainly to past inflation values. Exchange rate and Russian prices, however, contribute to over 8% and 18% of fluctuations in Ukrainian prices

respectively. Variance of shocks of domestic prices in Russia, in turn, refer to past inflation values (87%) as well as exchange rate (11%).

Economic interpretation of these results suggests that hryvnia-ruble exchange rate movements have a modest effect on Ukrainian inflation, while changes in foreign prices (e.g. Russian) pass through to domestic prices in Ukraine to a larger extent which can be explained by the presence of important cross-country interdependencies. In this respect, depreciation of ruble decreases prices of goods imported from Russia by Ukraine denominated in hryvnias which, in turn, decreases aggregate consumer price level in Ukraine through direct and indirect transmission channels. Simultaneously, hryvnia appreciation has an opposite effect on Russian domestic prices through similar transmission channels. However, higher prices of goods produced in Russia and exported abroad induce rising import prices for Ukraine in rubles which, in turn, transmits to domestic Ukrainian price level and, eventually, overwhelms the effect from exchange rate shock.

5.2 Spillover evidence from BPVAR (B)

In the alternative BPVAR (B) specification we include exchange rates of hryvnia and ruble to the USD instead of bilateral UAH/RUB exchange rate. Figure 5 presents cumulative response of core consumer prices in Ukraine and Russia to 1% USD/UAH (dashed curve) and USD/RUB (solid curve) exchange rates depreciation. Although empirical literature does not provide consistent estimates of the extent to which prices in Ukraine and Russia respond to the US dollar exchange rate, our results are in line with Novikova & Volkov (2012) and Faryna (2016) for Ukraine and Kataranova (2010) for Russia. In addition, results for Russia are also consistent with Korhonen & Wachtel (2005) when energy prices are excluded. BPVAR (B) results suggest that 1% USD/RUB change passes through to prices in Russia by 0.2% after 12 month which is also very close to the average ERPT in emerging markets provided by IMF (2015).

Figure 5 Cumulative response of core consumer prices to 1% USD/UAH and USD/RUB exchange rates depreciation: results from BPVAR (B)

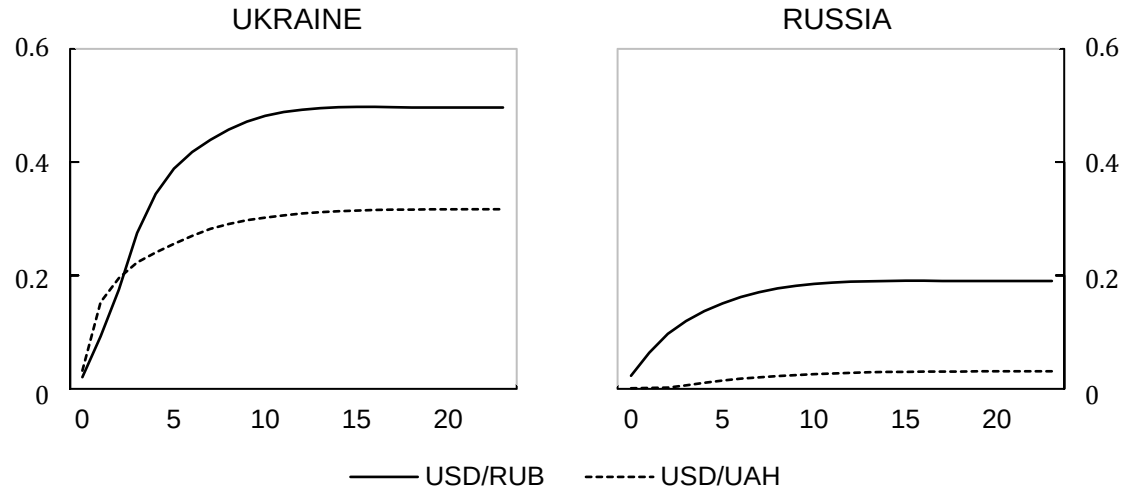
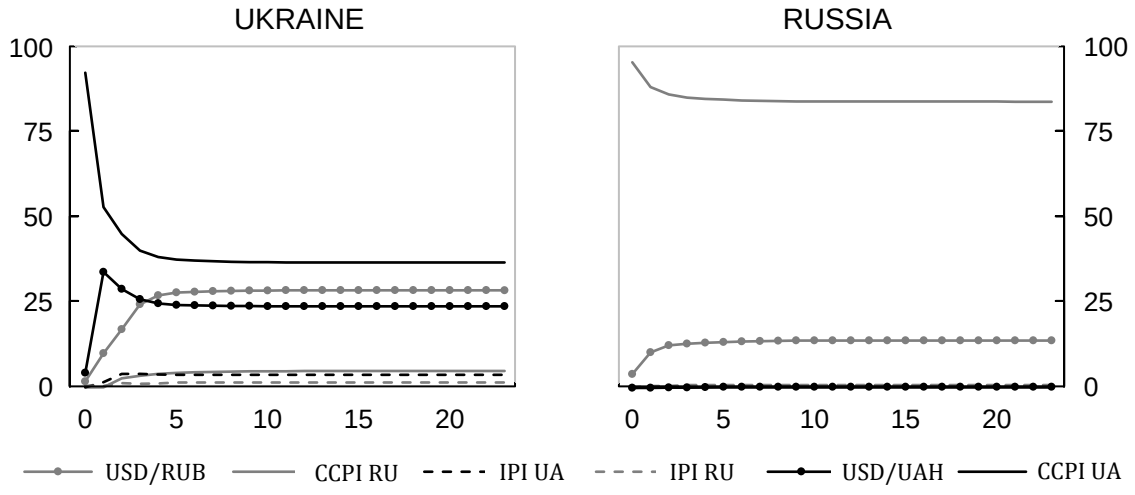


Figure 6 Variense decomposition of core consumer prices in Ukraine and Russia from BPVAR (B)



Meanwhile, USD/UAH depreciation has insignificant effect on Russian prices. On the contrary, prices in Ukraine respond to ruble depreciation to a larger extent than to hryvnia depreciation. In particular, USD/UAH depreciation passes through to Ukrainian prices by around 0.32% after 12 month, while USD/RUB by around 0.5%.

Analyzing variance decomposition of consumer prices from BPVAR (B) model (Figure 6) indicates the relative importance of ruble to US dollar exchange rate both for Ukrainian and for Russian prices. Moreover, shocks to ruble exchange rate contribute to price fluctuations in

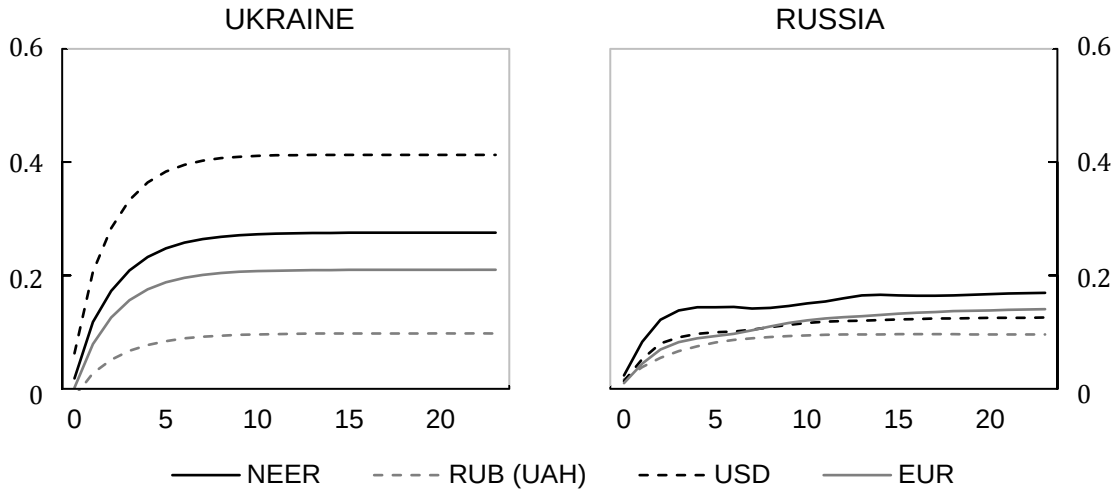
Ukraine to a larger extent (29%) than in the case of Russia (14%). Interestingly, Russian inflation has much lower weight in explaining the variance of shocks of Ukrainian prices comparing to BPVAR (A) results (<2%).

Allowing for exchange rate interdependencies enables the identification of additional cross-country spillovers. Given the fact that Ukraine and Russia have common exporting markets, currency depreciation in one country may affect exchange rate in the other. In particular, following the depreciation of ruble with respect to US dollar, prices of goods produced in Russia and exported abroad become cheaper in the foreign markets. Ukrainian goods, however, become less competitive leading to the drop in foreign demand for exports. Eventually, it results in hryvnia depreciation and passes through to Ukrainian prices through direct as well as indirect transmission channels.

5.3 Robustness and limitations

As discussed in the third section, there is no literature which examines price responsiveness in Ukraine and Russia to changes in hryvnia-ruble exchange rate as well as empirical studies which explicitly model cross-country spillovers in the pass-through mechanism. Thus, we present a series of robustness checks that address several particularly important concerns that could lead our estimates to overvalue the sufficiency of cross-country spillovers in estimating the pass-through effect. In particular, we test the accuracy of our results by inclusion of Industrial Production Index gap derived from HP filtering and by exclusion of foreign prices from the analysis. Moreover, we provide estimates for Consumer Price Index (CPI) instead of core inflation. Although most of empirical studies utilize CPI in their analysis of the pass-through effect, a large weight of administratively regulated prices in the CPI basket in Ukraine may result in biased estimates. ERPT coefficients from each model specification (see Table A2 of the Annex) do not change significantly indicating the accuracy of our results.

Figure 7 Cumulative response of core consumer prices to 1% exchange rate depreciation: averaged results from individual VAR analysis



In addition, we estimate the pass-through effect from the US dollar, euro, and nominal effective exchange rates to prices in Ukraine and Russia within the individual VAR analysis and compare results with existing empirical literature in order to test the reliability of our approach. In these models we use similar variables as in our basic setup and include respectively prices in the USA, Euro area, and trade weighted prices of the main trading partners of Ukraine and Russia as exogenous variables. Table A3 reports the summary of estimates for each individual VAR models. Results from all specification for both Ukraine and Russia does not change significantly, thus, we present the average cumulative price responsiveness to different exchange rate changes (Figure 7). One percent US dollar exchange rate change in Russia passes through to CCPI by 0.11 – 0.14% and to CPI by 0.14 – 0.18 after 12 month. Our results are in line with Kataranova (2010) and relatively close to Korhonen & Wachtel (2005) if oil prices are excluded. In the case of Ukraine, the average pass-through effect from the US dollar exchange rate movements is estimated at 0.41% level, from NEER – 0.27%, and EUR – 0.21%, which is close to Novikova & Volkov (2012) and Faryna (2016) for NEER.

Although we find that our results are robust to different specifications and consistent with existing studies, identification of spillover effects from the bilateral perspective may result in possible practical consequences. As argued in Georgiadis (2015) spillover estimates obtained from bilateral models are in general inconsistent asymptotically and less accurate than those obtained from a multilateral model in finite samples due to omitted variable bias and failure to

account for higher-order transmission channels. In this respect, our results from the bilateral perspective may not indicate all possible cross-country interrelations in the globalized world. However, they provide some empirical evidence on the existence of important and sufficient spillovers in estimation of exchange rate pass-through effect. In order to increase accuracy of the analysis, estimation of the pass-through effect and cross-country spillovers from the multilateral perspective including more countries (e.g. as in Global VARs) may be a subject of further research.

Furthermore, drawing on existing empirical literature one could notice that the pass-through effect might be time varying both for Ukraine and Russia. In particular, ERPT coefficients are usually higher if the time span of the analysis includes periods of crises, rapid depreciation, and macroeconomic turbulence. IMF (2015) provides evidence that ERPT in Russia is much higher during periods of crisis which is also in line with Dobrynskaia (2007). On the other hand, Faryna (2016) finds that consumer prices in Ukraine are much more sensitive to small and extremely large NEER changes than in the case of moderate exchange rate variations. This suggests that the relative importance of cross-country spillovers in the pass-through mechanism may also depend on various factors. In order to test this hypothesis we attempted to divide time series used in our analysis to periods of crisis and macroeconomic stability. However, given that the bilateral perspective requires a relatively large number of observations, narrowing the data set resulted in unstable specifications both of BPVAR (A) and (B). One way to deal with such problem is to use disaggregated data for consumer prices which expands the overall number of observations and helps to avoid biased estimates. Data disaggregation can be also useful for examining higher-order transmission channels within separate sectors of each economy. We leave these issues for further research.

6 Conclusions

In the new global order with deeply integrated economies cross-country interdependencies and spillover effects have become an important element for policymakers when analyzing the transmission of external shocks across countries. In this respect, there is ample room in the literature to study exchange rate pass-through from the multilateral perspective. For countries, such as Ukraine and Russia, linked together through trade, credit and other channels, potential important spillovers may arise through direct as well as indirect channel of external shock transmission. Therefore, in this paper we relax the small open economy assumption and study exchange rate pass-through issues in Ukraine and Russia taking into account cross-country linkage by developing panel vector autoregressive models. The analysis of the paper suggests that the extent to

which Russian prices respond to changes in hryvnia-ruble exchange rate are not affected by inclusion of panel dimension. On the contrary, sufficient spillovers are identified in the case of Ukraine. Comparing the pass-through estimates from BPVAR with those from individual VARs, we find that dynamic response of Ukrainian prices to ruble depreciation changes its direction and results in increasing of aggregate price level instead of decreasing. In addition, in the alternative BPVAR specification we find that prices in Ukraine are much more sensitive to changes in ruble to US dollar exchange rate than to hryvnia to US dollar exchange rate movements. Although spillover estimates obtained from bilateral models may be less accurate than those from a multilateral model, our results are robust to different specifications and may provide some empirical evidence on the existence of important and sufficient spillovers in estimation of exchange rate pass-through effect.

References

Bailliu, J., and E. Fujii (2004). "Exchange Rate Pass-Through and the Inflation Environment in Industrialized Countries: An Empirical Investigation." Bank of Canada Working Paper, 2004–21.

Beckmann, E., and J. Fidrmuc (2013). "Exchange Rate Pass-Through in CIS Countries." *Comparative Economic Studies*, 55(4), 705–720.

Beirne, J., and M. Bijsterbosch (2009). "Exchange rate pass-through in central and eastern European member states." ESB Working Paper, 1120.

Betts, C. and Devereux, M. (1996). "The Exchange Rate in a Model of Pricing-to-Market." *European Economic Review*, 40, 1007–21.

Campa, J. M., and L. S. Goldberg (2005). "Exchange Rate Pass-Through into Import Prices." *Review of Economics and Statistics*, 87(4), 679–90.

Canova, F., and M. Ciccarelli (2013). "Panel Vector Autoregressive models: A survey." European Central Bank Working Paper, 1507.

Choudhri, E. U., and D. S. Hakura (2006). "Exchange Rate Pass-through to Domestic Prices: Does the Inflationary Environment Matter?" *Journal of International Money and Finance*, 25(4), 614–639.

Comunale, M. (2015). "Euro-Dollar Polarization and Heterogeneity in Exchange Rate Pass-Throughs within the Euro Zone," CEIS Tor Vergata Research Paper Series, Vol. 13, Issue 1, No. 333.

Comunale, M., and H. Simola, (2016). "The Pass-Through to Consumer Prices in CIS Economies: The Role of Exchange Rates, Commodities and Global Factors." BOFIT Discussion Paper (forthcoming).

Dobrynskaya, V. (2007). "Exchange rate pass-through and monetary policy in Russia: What changed after 1998 crisis?" (in Russian) *HSE Economic Journal*, 2, 213–233.

Dornbusch, R. (1987). "Exchange Rates and Prices." *American Economic Review*, 77, 93–106.

Faryna, O., (2016). "Nonlinear Exchange Rate Pass-Through to Domestic Prices in Ukraine." *Visnyk of the National Bank of Ukraine*, No. 236, 30–42.

Georgiadis, G. (2015). "To bi, or not to bi? Differences in spillover estimates from bilateral and multilateral multi-country models." Globalization and Monetary Policy Institute Working Paper, 256.

Goldberg, P., and M. Knetter (1997). "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature*, 35, 1243–1292.

Goldfajn, I., and S. R. Werlang (2000). "The pass-through from depreciation to inflation: a panel study." Central Bank of Brazil, Research Department, Discussion Paper, 423.

Hahn, E. (2003). "Pass-Through of External Shocks to Euro Area Inflation." ECB Working Paper, 243.

International Monetary Fund (2013). Russian Federation, 2013 Article IV Consultation. IMF Country Report No. 13/311.

International Monetary Fund (2015). Russian Federation, Selected Issues. IMF Country Report No. 15/212.

Kataranova, M. (2010). "The Relationship Between the Exchange Rate and Inflation in Russia." *Problems of Economic Transition*, 53(3), 45–68.

Korhonen, I., and P. Wachtel (2006). "A note on exchange rate pass-through and its asymmetry in CIS countries." *Research in International Business and Finance,* 20(2), 215–226.

Krugman, P. R. (1986). "Pricing to Market When the Exchange Rate Changes." National Bureau of Economic Research Working Paper, 1926.

Laflèche, T. (1996–97). "The Impact of Exchange Rate Movements on Consumer Prices." *Bank of Canada Review*, 21–32.

Landau, B., and F. Skudelny (2009). "Pass-Through of External Shocks along the Pricing Chain: A Panel Estimation Approach for the Euro Area." ECB Working Paper, 1104.

McCarthy, J. (2000). "Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialised Economies." BIS Working Papers, 79.

McCarthy, J. (2007). "Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies." *Eastern Economic Journal*, 33(4), 511–537.

Menon, J. (1995). "Exchange rate pass-through." *Journal of Economic Surveys*, 9(2), 197–231.

Nalban, V. (2015). "Exchange Rate Pass-Through in Central and Eastern Europe: A Panel Bayesian VAR Approach." *Czech Journal of Economics and Finance*, 65(4), 290–306.

Novikova, N., and D. Volkov (2012). "Modelling Core Inflation in Ukraine on 2003–2012." Economics Education and Research Consortium Working Paper, 12/12E.

Obstfeld, M. and K. Rogoff (1995). "Exchange Rate Dynamics Redux." *Journal of Political Economy*, 103, 624–60.

Oomes, N., and F. Ohnsorge (2005). "Money Demand and Inflation in Dollarized Economies: The Case of Russia." *Journal of Comparative Economics*, 33(3), 462–483.

Ponomarev, Y., P. Trunin, and A. Ulyukayev (2014). "Exchange Rate Pass-through in Russia." *Problems of Economic Transition*, 58:1, 54–72.

Taylor, J. B. (2000). "Low Inflation, Pass-through, and the Pricing Power of Firms," *European Economic Review*, 44(7), 1389–1408.

Annex

Table A.1 Data peculiarities

	Variable	*Name*	*Seasonally adjusted*	*Unit root*	*Source*
Price index	*UA CPI*	*Consumer price index*	*Yes*	*I(1)*	*IFS*
	UA CCPI	*Core consumer price index*	*Yes*	*I(1)*	*NBU stat.*
	RU CPI	*Consumer price index*	*Yes*	*I(1)*	*IFS*
	RU CCPI	*Core consumer price index*	*Yes*	*I(1)*	*State St. Serv. of RF*
Exchange rate	*UA NEER*	*UAH Nominal effective exchange rate*	*No*	*I(1)*	*IFS*
	USD/UAH	*Bilateral US dollar exchange rate to UAH*	*No*	*I(1)*	*IFS*
	EUR/UAH	*Bilateral EUR exchange rate to UAH*	*No*	*I(1)*	*IFS*
	UAH/RUB	*Bilateral UAH exchange rate to RUB*	*No*	*I(1)*	*IFS*
	RU NEER	*RUB Nominal effective exchange rate*	*No*	*I(1)*	*IFS*
	USD/RUB	*Bilateral US dollar exchange rate to RUB*	*No*	*I(1)*	*IFS*
	EUR/RUB	*Bilateral EUR exchange rate to RUB*	*No*	*I(1)*	*IFS*
Demand conditions	*UA IPI*	*UA industrial production index*	*Yes*	*I(1)*	*IFS*
	UA IPI gap	*UA industrial production gap*	*Yes*	*I(0)*	*HP filtered IPI*
	RU IPI	*RU industrial production index*	*Yes*	*I(1)*	*IFS*
	RU IPI gap	*RU industrial production gap*	*Yes*	*I(0)*	*HP filtered IPI*
Prices abroad	*PUS*	*US consumer price index*	*Yes*	*I(1)*	*OECD stat.*
	PEU	*Euro area consumer price index*	*Yes*	*I(1)*	*OECD stat.*
	PRU	*Trade-weighted prices of trading partners of Ukraine*	*Yes*	*I(1)*	*derived from NEER, CPI, and REER data for Ukraine*
	PRR	*Trade-weighted prices of trading partners of Russia*	*Yes*	*I(1)*	*derived from NEER, CPI, and REER data for Russia*
	POE	*Consumer prices in OECD countries*	*Yes*	*I(1)*	*OECD stat.*
Energy prices	*PF*	*Fuel (Energy) Index, includes Crude oil (petroleum), Natural Gas, and Coal Price Indices*	*No*	*I(1)*	*IMF stat.*

Table A.2 Results from bilateral panel VAR

PANEL VAR A	**UKRAINE**								**RUSSIA**							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of lags	2	1	2	1	2	2	2	2	2	1	2	1	2	2	2	2
RUB/UAH 1% depreciation pass-through to CPI	**0.16**	**0.10**	**0.16**	**0.10**	**0.13**	**0.07**	**0.13**	**0.07**	**0.10**	**0.10**	**0.09**	**0.10**	**0.11**	**0.11**	**0.10**	**0.11**
T-stat	3.55	2.48	3.59	2.48	2.82	1.60	2.79	1.61	5.28	6.20	5.00	6.26	5.58	5.85	5.36	6.29
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Number of lags	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
UAH/RUB 1% depreciation pass-through to Core CPI	**0.01**	**-0.09**	**0.02**	**-0.07**	**-0.04**	**-0.11**	**-0.04**	**-0.11**	**0.08**	**0.11**	**0.07**	**0.10**	**0.09**	**0.11**	**0.09**	**0.10**
T-stat	0.29	-2.22	0.57	-1.78	-1.06	-2.75	-1.07	-2.79	4.39	5.26	4.21	4.96	4.68	5.13	5.14	5.23
PANEL VAR B	**UKRAINE**								**RUSSIA**							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of lags	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
USD/UAH 1% depreciation pass-through to CPI	**0.48**	**0.46**	**0.48**	**0.45**	**0.48**	**0.43**	**0.48**	**0.43**	**0.00**	**0.00**	**0.02**	**0.01**	**0.00**	**0.00**	**0.00**	**0.01**
T-stat	7.94	7.39	7.95	7.79	8.03	8.22	7.94	8.28	0.00	0.00	0.94	0.46	0.00	0.00	0.00	0.51
USD/RUB 1% depreciation pass-through to CPI	**0.36**	**0.50**	**0.37**	**0.47**	**0.36**	**0.42**	**0.36**	**0.41**	**0.16**	**0.18**	**0.17**	**0.18**	**0.18**	**0.19**	**0.18**	**0.19**
T-stat	4.83	5.92	5.03	5.92	5.12	5.98	5.09	5.85	5.37	5.45	6.28	5.69	6.33	6.18	6.91	6.66
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Number of lags	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
USD/UAH 1% depreciation pass-through to Core CPI	**0.31**	**0.32**	**0.33**	**0.33**	**0.32**	**0.30**	**0.32**	**0.30**	**0.02**	**0.04**	**0.04**	**0.05**	**0.02**	**0.02**	**0.02**	**0.02**
T-stat	7.44	6.59	7.73	7.01	7.71	7.28	7.63	7.33	1.05	1.84	2.24	2.26	1.04	0.99	1.18	1.11
USD/RUB 1% depreciation pass-through to Core CPI	**0.42**	**0.56**	**0.43**	**0.55**	**0.46**	**0.53**	**0.46**	**0.52**	**0.16**	**0.22**	**0.18**	**0.22**	**0.17**	**0.19**	**0.17**	**0.19**
T-stat	6.19	6.72	6.30	6.88	7.11	7.59	7.06	7.50	4.73	5.43	5.88	5.48	5.20	5.05	6.00	5.68
Control variables:																
Industrial Production Index	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom
Endogenous Fuel Prices	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	No	No	No
Prices abroad (exogenous - OECD)	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes

Table A.3 Results from individual VAR models

UKRAINE	**NEER UAH**				**USD/UAH**				**EUR/UAH**				**RUB/UAH**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Number of lags	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
ERPT to CPI	**0.48**	**0.45**	**0.48**	**0.44**	**0.55**	**0.52**	**0.54**	**0.51**	**0.35**	**0.30**	**0.35**	**0.29**	**0.32**	**0.30**	**0.29**	**0.27**
T-stat	10.17	9.93	9.86	9.547	11.30	11.07	11.085	11.03	8.05	7.63	8.175	7.516	8.59	8.31	7.16	6.824
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
Number of lags	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ERPT to Core CPI	**0.28**	**0.27**	**0.27**	**0.28**	**0.42**	**0.42**	**0.41**	**0.40**	**0.21**	**0.21**	**0.21**	**0.20**	**0.10**	**0.10**	**0.10**	**0.09**
T-stat	9.20	8.77	8.74	9.27	11.97	12.04	12.01	11.87	8.17	8.24	8.25	7.94	4.47	4.48	3.56	3.20
RUSSIA	**NEER RUB**				**USD/RUB**				**EUR/RUB**				**UAH/RUB**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Number of lags	4	4	4	4	4	4	4	4	4	4	4	4	1	1	2	1
ERPT to CPI	**0.19**	**0.20**	**0.21**	**0.21**	**0.14**	**0.18**	**0.14**	**0.18**	**0.14**	**0.15**	**0.14**	**0.14**	**0.10**	**0.11**	**0.11**	**0.09**
T-stat	5.60	5.32	4.74	4.3	4.37	5.05	4.284	5.02	4.70	4.64	4.574	4.276	6.79	7.14	6.65	6.234
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
Number of lags	4	4	7	7	4	4	4	4	4	4	4	4	2	1	2	1
ERPT to Core CPI	**0.17**	**0.17**	**0.15**	**0.17**	**0.12**	**0.14**	**0.11**	**0.14**	**0.15**	**0.14**	**0.15**	**0.12**	**0.10**	**0.09**	**0.10**	**0.09**
T-stat	6.11	5.63	2.91	3.31	3.96	4.19	3.42	4.01	4.88	4.42	4.51	3.52	5.24	6.19	5.77	6.33
Control variables:																
Industrial Production Index	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom	IPI gap	IPI mom
Prices abroad (exogenous)	trade weight.	trade weight.	No	No	US CPI	US CPI	No	No	EU CPI	EU CPI	No	No	RU/UA CPI*	RU/UA CPI*	No	No
Fuel Prices (exogenous)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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