# Industrial output and foreign trade dynamics in large devaluations: The case of Ukraine

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**Abstract**

Using monthly data for the 2000-2014 period, this paper discusses the macroeconomic effects of two large devaluations of the Ukrainian currency, which had occurred in November-December 2008 and recently in February-November 2014. Employing a time-varying parameter framework (the Kalman filter), it is shown that a positive effect of nominal depreciation (as measured by the changes in the nominal effective exchange rate) on exports tend to disappear since 2009, while a restrictive impact on imports had been strengthened since then. The expansionary output effect of nominal devaluation has disappeared since 2009, with a weak evidence of the restrictionary effect in the wake of the latest devaluation of 2014. However, the impact of a large devaluation (or currency collapse) as measured by the appropriate dummy is likely to be restrictionary in respect to exports, imports and industrial output. Among other results, it is found that export dynamics is stimulated by the world prices of metals and agricultural goods as well as by industrial output in the eurozone and Russia. There is a strong correlation of imports with the domestic industrial output. Since the 2008–2009 financial crisis, the Ukraine's industrial output has become stronger linked to the performance of foreign trade partners.

***Keywords*:** exchange rate devaluation; Ukraine; industrial output; foreign trade; the Kalman filter
***JEL Classification*:** C32, F31

## 1. Introduction

Over the 2000-2014 period, Ukraine had experienced two large devaluations of the *hryvna* in November-December 2008 and February-November 2014, both being associated with a sharp drop in the amount of exports, imports and industrial output (Fig. 1). Based on similar devaluation episodes (or currency collapses) of Argentina (December 2001), Brazil (January 1999), Korea (October 1997), Mexico (December 1994), Russia (August 1998), and Thailand (July 1997), a rapid decline in imports, with only gradual recovery to follow, is among a few salient features of large downward exchange rate realignments in developing countries (Alessandria et al., 2010). Similar to other countries, a decline in imports is especially large relative to the change in relative prices in the short run (Burstein et al., 2005). On the other hand, a sluggish response of Ukraine's exports to relative prices is consistent with another stylized fact of large devaluations (Alessandria et al., 2013). As there is improvement in the

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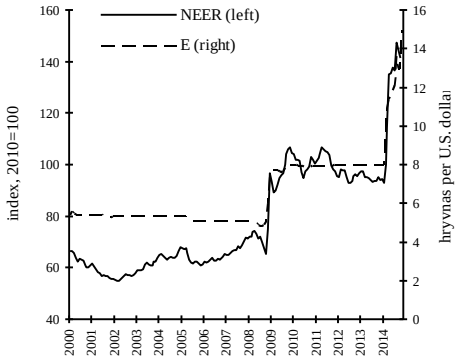
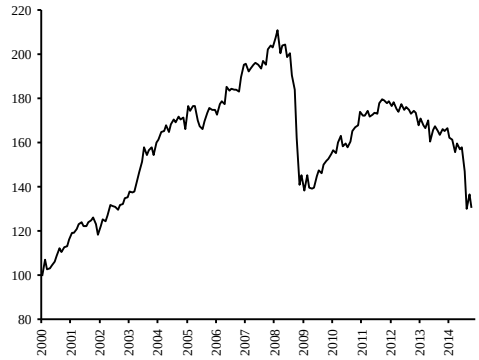
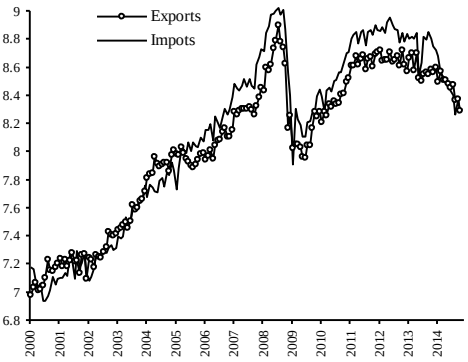
trade balance due to a collapse of imports, it runs counter to the traditional view of the J-curve pattern of short-run response to the increase in the relative price of imported goods that is common in developed countries.



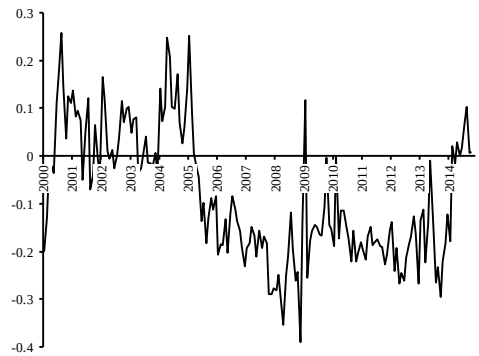

**a)** nominal exchange rate;



**b)** industrial output (index, 2000=100);




**c)** exports and imports (bn U.S. dollars);



**d)** trade balance (bn U.S. dollars);

**Fig. 1.** Ukraine: selected macroeconomic indicators.

Source: IMF International Financial Statistics.

Although a contractionary drop in output seems to be quite natural in the wake of a decrease in both exports and imports, the impact of large nominal devaluations on the output is rather ambiguous in the empirical studies (Bussière et al., 2012). Contractionary effects of exchange rate devaluation prevail in studies for low- and middle-income countries (Hutchison and Noy, 2005; Bahmani-Oskooee and Miteza, 2006), especially for Latin American countries (Bebczuk et al., 2006; Pineres and Cantavella-Jorda, 2010). A short-run contractionary effect is found for the crisis-affected Asian economies (Chou and Chao, 2001). However, examples of expansionary devaluations in East Asian countries are not lacking as well, especially for the pre-1997 period (Kim and Ying, 2007). For Central and East European countries, earlier studies demonstrated a restrictionary effect (Miteza, 2006), but more recent

ones bring about rather ambiguous country-specific results (Bahmani-Oskooee and Kutan, 2008). Heterogeneity of exchange rate output effects are explained by such factors as a business cycle, capital inflows, dollarization of domestic and external liabilities, export growth or trade openness, real exchange rate overvaluation, and slow growth abroad (Bebczuk et al., 2006; Bussière et al., 2012).

For the purpose of this study it is assumed that large currency devaluations occur if the *monthly* exchange rate change exceeds 10 percent against the backdrop of relative exchange rate stability over the previous periods[2]. The remainder of the paper is organized as follows. Section 2 surveys analytical issues. Section 3 outlines data and statistical methodology. Section 4 discusses the estimation results. Section 5 concludes.

## 2. Analytical framework

Following a large devaluation, there are several mechanisms of pronounced restrictionary effects on foreign trade, well above what is implied by the change in relative prices. Alessandria et al. (2010) explain a sharp drop in imports by delivery lags and economies of scale in the transaction technology. In response to an unanticipated devaluation, importers reduce inventories by not importing for a while and cut their markups in order to sell existing inventories more rapidly. As argued by Alessandria et al. (2013), sluggish recovery in exports could be explained by the costs of the entry decisions of non-exporters and the exit decisions by exporters. It is demonstrated that significant export costs lead to a deeper contraction and stronger recovery in output, with the interest rate being an instrumental tool affecting the future benefits of exporting. Given high costs of investments and patient consumers (it affects the speed of export expansion through the consumption smoothing mechanism), there are weaker incentives to invest in expanding exports.

For the "crisis" country, an open economy model by Forbes (2002) relates the effect of devaluations to capital/labour ratios and changes in the cost of capital. Restrictionary effects in the real sector are expected in the economies with high capital/labour ratios and substantial increases in the interest rate. In a similar fashion, a variant of the Open Economy Financial Accelerator model by Delli Gatti et al. (2007) does not rule out a contractionary effect of devaluation in the case when a decline in the net worth of domestic firms leads to an increase

[2] Such an assumption meets popular definitions for currency collapses. For example, a currency collapse is defined by Bussière et al. (2012) as the case in which the annual nominal exchange rate change in any month during a given calendar year exceeds 15 percent, being by at least 10 percent above that of the previous year which in turn must not exceed 10 percent on the annual basis.

in the domestic interest rate. The contractionary effect could be aggravated by a further increase of the interest rate in an effort to stabilise the exchange rate.

Besides costs of structural adjustment and unfavourable interest rate developments, a simultaneous devaluation-driven decline in exports and output can be explained by several other factors as the negative wealth effect, capital outflows or strong inflationary pass-through (Kamin and Rogers, 2001; Lizondo and Montiel, 1988). A combination of the balance sheet effect, capital outflow and decline in investments is behind the inverse relationship between devaluation and exports in the Latin American countries (Pineres and Cantavella-Jorda, 2010).

Krugman and Taylor (1978) were among the first who explained the importance of inflation mechanism in a devaluation-driven decline in output. Redistribution of purchasing power in favour of wealthier households with higher propensity to save leads to a simultaneous decrease in aggregate demand, output and imports. If there are *ad valorem* taxes on exports or exporters dominate among taxpayers, which is the Ukraines's case, demand is further reduced by the budget surplus, as the government has a saving propensity of unity in the short run. The higher is the trade balance deficit at the moment of devaluation, the stronger is decline in output to be expected. As both imports and exports are not very sensitive to relative price changes in the short-run, any favourable effects of devaluation on the trade balance come primarily through economic contraction rather than substitution in aggregate demand. In order to prevent a sharp decline in output, it is suggested that devaluations should be complemented with policies designed to encourage private investments in the traded goods sector aimed at exporting or substituting for imports (subsidies, tariffs, preferential credit).

## 3. Data and statistical methodology

It is rather easy to identify large devaluation episodes in Ukraine, as all currency downward realignments had been sharp and not persistent (Fig. 1a). The exchange rate of the *hryvna* had depreciated by 19% and 27.7% in November-December 2008, being preceded by a long period of exchange rate stability since the beginning of 2000. The second devaluation episode had started in February-March 2014, with the *hryvna* having been weakened by 24.9% and 9.7%, respectively. Then the currency has lost another 12.5% of its value in August 2014 and further 15.6% in October 2014.

Following Bussière et al. (2012), the dynamics of Ukraine's industrial output, $ind_t$ (index, 2000 = 100), exports and imports, $exports_t$ and $imports_t$ respectively (in million of US

dollars), is linked to the nominal effective exchange rate, $neer_t$ (index, 2010 = 100), and to a set of exchange rate dummies, reflecting a timing of large devaluation.

Our time-varying parameters (TVP) model is given by the following two equations:

$$x_t = \sum_{i=-m}^{m} \alpha_i D_{t-i} + \beta_{1,i} x_{t-1} + \beta_{2,t} neer_t + \beta_{3,t-l} neer_{t-l} + \beta_{4,t} \mathbf{K}_t + \varepsilon_t, \quad (1)$$

$$\beta_{j,t} = \beta_{j,t-1} + \xi_{j,t}, \quad j = 1, 2, 3, 4 \quad (2)$$

where $x_t$ is the dependent variable, i.e. $ind_t$, $exports_t$ or $imports_t$, $neer_t$ is the exchange rate, $\mathbf{K}_t$ is the vector of exogenous variables, $\varepsilon_t$ is the stochastic factor, and $D_t$ is the dummy for large devaluations. Specifically, $D_t$ is equal to one if there is a large devaluation in period *t*, which is measured by several six-month intervals, up to 6 months $(T \pm 6)$, from 7 to 12 months $(T \pm 12)$, and from 13 to 18 months $(T \pm 18)$. Except $D_t$, all variables are used in the form of first differences of logarithms, i.e., $y_t = \log Y_t - \log Y_{t-1}$, where $Y_t$ is the level of a variable.

Equations (1) and (2) are respectively the measurement equation and transition equation. The disturbance terms, $\varepsilon_t$ and $\xi_{j,t}$ are mutually uncorrelated and independently normally distributed. Majority of the time-varying parameters are modelled in a recursive manner $(\xi_{j,t} = 0)$, but those ones on the lagged exports and wholesale price inflation (among exogenous variables) follow a random walk without drift.

The fixed coefficients $\alpha_i$ measure effects of large devaluations as sharp realignments of a nominal exchange rate. In this context, the parameter $\beta_{2,i}$ measures 'pure' time-varying response to the nominal effective exchange rate devaluation. Among other components, parameters $\beta_{1,i}$ and $\beta_{3,i}$ measure time-varying response to the lagged value of endogenous and exogenous variables, respectively. The vector of exogenous variables include the wholesale price level (index, 2010=100), $wpi_t$, the lending rate, $rl_t$ (%), world prices for crude oil, metal and industrial inputs, $brent_t$, $metal_t$ and $pind_t$ (index, 2010 = 100), industrial output in the eurozone and Russia, $indeuro_t$ and $indrus_t$ (index, 2010 = 100), as Ukraine's two largest trade partners. Most of the monthly series are obtained from the IMF's *International Financial Statistics* database. The world price indices are taken from the IMF dataset as well.

Export and import series are used in constant 2000 dollars, deflated by the U.S. Consumer Price Index. Data sample for the 2000M1:2014M10 period is utilized in order to minimize the influence of the initial conditions that are used to start the estimation of the TVP model.

## 4. Estimation results

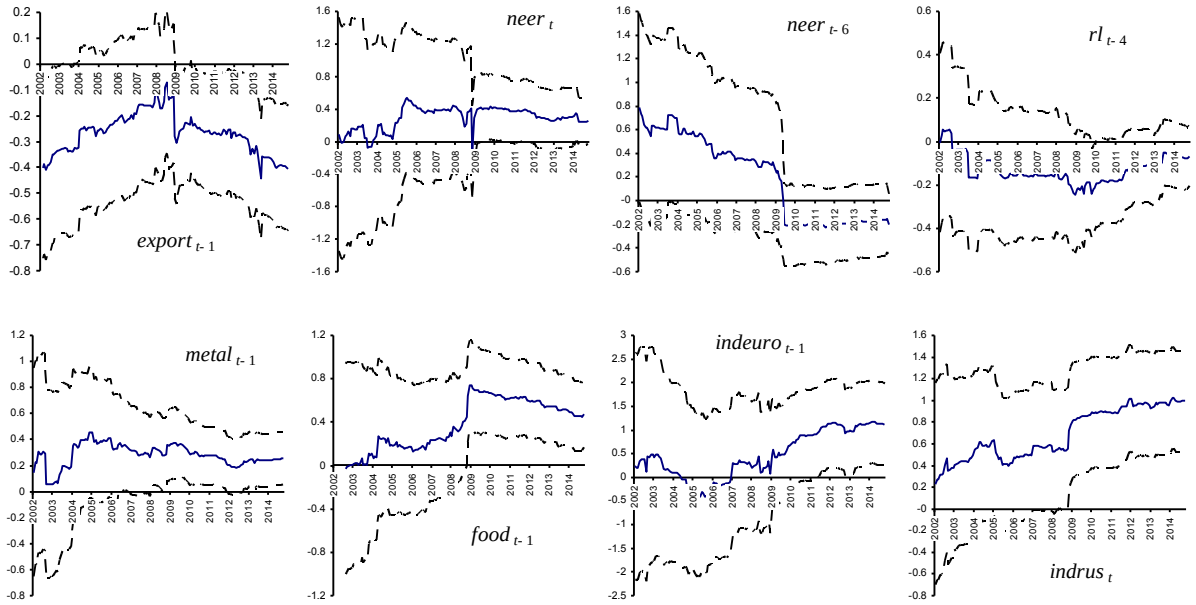
The fixed coefficient estimates of devaluation dummies are reported in Table 1. As it is given by the coefficient of the dummy variable with subscripts $T$+6, $T$+12 and $T$+18, a large devaluation is not preceded by any significant changes in either foreign trade or industrial output. Thus findings by Bussière et al. (2012) are not confirmed in that countries experiencing a currency collapse witness output growth rates below the equilibrium level. However, it is confirmed that large devaluations lower growth rates in time of the event (the coefficient on $D_T$ is statistically significant at the 1 % level), with a decrease in both exports and imports as well. Statistically significant post-devaluation effects are found for the dynamics of exports only, half a year after the event.

| Dependent variables | Exports | Imports | Industrial output |
|---|---|---|---|
| $D_{T+18}$ | –0.013 [0.015] | –0.002 [0.099] | –0.003 [0.006] |
| $D_{T+12}$ | 0.003 [0.014] | 0.012 [0.658] | 0.003 [0.366] |
| $D_{T+6}$ | 0.020 [0.006] | 0.023 [0.020] | –0.007 [0.006] |
| $D_T$ | –0.091** [0.042] | –0.059** [0.028] | –0.035*** [0.008] |
| $D_{T-6}$ | –0.038 [0.025] | 0.008 [0.023] | –0.002 [0.008] |
| $D_{T-12}$ | 0.031* [0.018] | –0.008 [0.017] | 0.001 [0.008] |
| $D_{T-18}$ | –0.015 [0.017] | 0.005 [0.015] | 0.006 [0.006] |

Note: Standard errors are in brackets. *** denotes statistical significance at the 1% level (**, * at the 5% and 10% level, respectively).

**Table 1.** Macroeconomic effects of large devaluations.

Filtered estimates of the time-varying parameters based on the information available up to time $t$ are presented on Figures 2-4. The exchange rate depreciation contributes to an increase of exports on impact (Fig. 2). Till the beginning of 2009, there had been the same positive exchange rate effect with a lag of six months, but it has disappeared since then. There is a strong relationship between Ukraine's exports and world metal prices (since 2003) and world food prices (since 2006, with a spike at the end of 2008). The effects of industrial output in the eurozone and Russia have shown a tendency to grow over time, with the coefficients on $indeuro_{t-1}$ being in excess of those on $indrus_t$ since the beginning of 2011. Weak evidence of the inverse relationship between exports and interest rate is consistent with findings by Alessandria et al. (2013).




Note: The solid line is the point estimate, while the dotted lines represent a one-standard error confidence band around this point estimate; the estimated components begin in 2002: M1 because a two-year training sample is used to start up the Kalman filter.

**Fig. 2.** Determinants of exports.

Our results suggest a decrease in Ukraine's imports in the wake of exchange rate depreciation (Fig. 3). The coefficient on $neer_t$ has been on a decline from a level of 0.9 until around 2006, then slightly increased to a level of 0.3, and took a sharp decrease to a level of −1 in 2009 to remain stable till the end of 2013, with a moderate increase at the end of the sample period. The lagged coefficient on $neer_{t-6}$ has been on an upward trend for the 2002−2008 period, being relatively stable over next few years. There is a strong link between imports and industrial output, as the coefficient on $indukr_t$ fluctuates between 1.51 and 0.85 over the sample period. An increase in imports is expected from higher prices of industrial inputs (the coefficients on $pind_{t-1}$ have become statistically significant around 2008). Import exposure to the world crude oil prices has shown a steady tendency to grow since 2006, but the coefficients on $brent_{t-1}$ are much smaller if compared with those ones on $pind_{t-1}$.

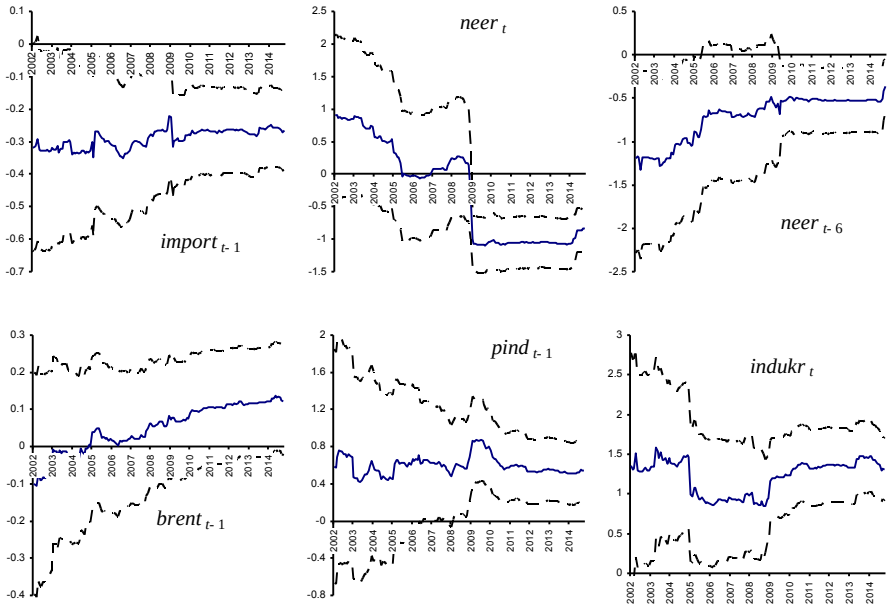



**Fig. 3.** Determinants of imports.

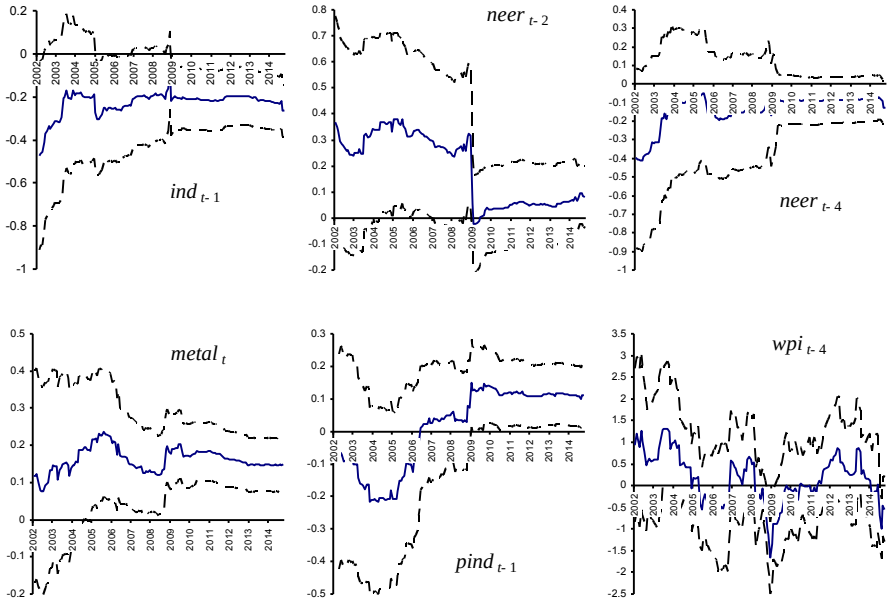



**Fig. 4.** Determinants of industrial output.

Regarding exchange rate effects on industrial output with two lags, there is a clear structural shift at the beginning of 2009 (Fig. 4). The coefficients on $neer_{t-2}$ fluctuate between 0.24 and 0.38 during the 2002-2008 period, implying a substantial expansionary effect. Between 2009 and 2014, the response to $neer_{t-2}$ becomes insignificant. Given the size of the confidence interval, the response to exchange rate depreciation with four lags seems to be

rather neutral till the middle of 2009. Summing up the value of coefficients on $neer_{t-2}$ and $neer_{t-4}$, the exchange rate effects had been expansionary till 2008 but have turned slightly restrictionary for the rest of the sample period, with a stronger negative impact in the wake of recent 2014 devaluation. Accounting for the exchange rate dummies tends to strengthen the dynamic response of industrial output to shocks in the exchange rate.

Industrial output is positively correlated with the world metal prices (since 2004) and the world industrial input prices (since 2009), hinting on the demand and supply links to exports and imports, respectively. The response to wholesale price inflation seems to be positive during periods of a relatively low inflation of 2002-2004 and 2011-2012 periods while becoming negative during the crisis episodes of 2008-2009 and 2014.

## Conclusion

Controlling for the timing of large downward exchange rate realignment, our results suggest that a nominal depreciation improves the trade balance mainly through a decrease in imports. The expansionary effect on industrial output has been lost since the beginning of 2009, with a weak evidence of the lagged restrictionary effect in the wake of a steep devaluation of 2014. However, a large devaluation itself as measured by the appropriate dummy is likely to be restrictionary in respect exports, imports and industrial output. Among other results, it is found that export dynamics is stimulated by the world commodity prices and industrial output in major trade partners. There is a strong correlation of imports with the domestic industrial output. Since the 2008-2009 financial crisis, the Ukraine's industrial output has become stronger linked to the performance of foreign trade partners.

## Acknowledgements

This paper is part of the research project F-4/100/2015/DS, and the financial support provided by the Cracow University of Technology is gratefully acknowledged.

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