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RELATIONSHIP BETWEEN THE POLAND´S TRADE FLOWS AT THE COMMODITY LEVEL AND THE ZLOTY EXCHANGE RATE

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Abstract. The aim of this study is to examine the short run and the long run effects of exchange rate changes of Polish zloty on trade flows in the context of disaggregated industry data of Poland´s foreign trade flows. For this purpose, the Johannsen cointegration test and the vector error correction model are used. Examined industries are determined on the basis of SITC classification. We used quarterly data over the sample period 1997–2013. Our findings suggest that the respond to exchange rate depreciations are different accross examined segments of industries. There is revealed, that only some of the product groups are in the long run relationship with exchange rate. Positive effect of depreciations was detected for the majority of these segments.

Keywords: exchange rate, commodity data, trade balance, export, import, cointegration.

JEL classification: F10, F14, F31.

1. Introduction

The exchange rate is often discussed macroeconomic topic, as it has an extensive impact on the economy as a whole, not exluding the international trade.

If we focus on the case of Poland, although the volume of its international trade has been increasing in time, we can see economy with relatively low level of participation in the international trade. In adition, until 2013 it was constantly characterised by a long-term negative trade balance.

Economic theory suggests that a deficit in the trade balance may be eliminated through currency depreciation, at least in the long-run. According to Abeysinghe and Yeak (1998), policies prescriptions have generally assumed that currency depreciation stimulates exports and curtail imports, while currency appreciation is detrimental to exports and encourage imports.

The impacts of depreciation on the trade balance can be, by and large, analyzed by price and volume effects.A traditional method of assessing the impact of currency devaluation on the trade balance has been one of estimating the Marshall-Lerner condition. The Marshall-Lerner condition states that the sum of export and import demand elasticity has to be at least one and then the currency depreciation or devaluation (in fixed currency regimes) will have a positive impact on trade balance. As depreciation (devaluation in fixed currency regime) of the currency means a reduction in the price of exports, quantity demanded for these will increase. At the same time, price of imports will rise and their quantity demanded will decrease. In general, it has been found that goods tend to be inelastic in the short run, as it takes time to change consuming patterns. Thus, the Marshall–Lerner condition is not met in the short run and depreciation deteriorates the trade balance initially. In the long run, consumers can adjust to the new prices, and trade balance will improve.

Short run effect of currency depreciation was first advanced by Magee (1973). He pointed that the short run deterioration and long run improvement after depreciation resemble the letter “J”.

Junz and Rhomberg (1973) has attributed the J-curve phenomenon to lags in the recognition of exchange rate changes, in the decision to changes of real variables, in delivery time, in the replacement of inventories and materials, and in production. Krueger (1983) has explained the phenomenon by the fact that at the time an exchange rate change occurs, goods already in transit and under contract have been purchased, and the completion of those transactions dominates the short term change in the trade balance. Therefore, exchange rate change first deteriorates the trade balance, but as the elasticity increase, it improves the trade balance.

According to literature review by Bahmani-Oskoee and Ratha (2004), empirical examination of the Marshall-Lerner condition has a long history with very different views and although it is expected that depreciations should result in increased exports, reduced imports, and an improvement in the overall trade balance, this has definitively been shown not to be the case. Many countries do not respond as predicted. Their findings are mixed and depend on region and period under estimation as well as data and methodology used.

The aim of this study is to examine the short run and the long run effects of exchange rate changes on trade flows in the context of disaggregated industry data of Poland´s foreign trade flows. For this purpose, the cointegration test and the vector error correction model are used. Examined industries are determined on the basis of SITC classification. Data used in this study covers period from 1997 to 2013.

Hence, this study provides additional evidence on the effect of exchange rate development on the different industry-level trade flows in the context of emerging market after the most turbulent part of economic transformation. One aspect of this transformation was a transition from fixed exchange rate arrangement into a crawling peg and recently to a free-float regime. In addition, Poland is interesting objective to study the J-curve effect because international trade serves as a major channel of economic integration within the Group of Visegrad countries or the EU as a whole. Usually, international trade tends to be a driver of the economy in countries neighbouring with economies with open trade regimes, high presence of multinational companies and large volume of re-exports. The fact that this example fits to Poland can be illustrated with increasing share of merchandise trade on Poland's GDP. The latest data of the World Bank says about 77.5%, as compared to 36.5% in 1997.

2. Literature review

The literature concerning the J-curve issue tends to fall into one of the following three categories: (1) studies that used aggregate trade data, (2) studies that employed disaggregate trade data at bilateral level, and (3) recent studies that used disaggregate trade data at industry/commodity level (Baek 2013).

The first type of studies concentrates on the use of aggregate export and import data between a country and the rest of the world in assessing the effectiveness of currency devaluation (e.g., Bahmani-Oskooee 1986; Felmingham 1988; Mahdavi and Sohrabian 1993). These studies provide mixed conclusions for the effectiveness of devaluation on the trade balance. The different results could be related to aggregation bias of data. Studies investigating relationship between whole trade balance and world have to employe the effective exchange rate. According to Bahmani-Oskoee and Brooks (1999), a problem with this approach is that a country´s currency could appreciate against one currency and simultaneously depreciate against another currency. The weighted averaging will therefore smooth out the effective exchange rate fluctuations, yielding an insignificant link between the effective exchange rate and the total trade balance. Furthermore, as Rose and Yellen (1989) argue, when estimating a trade balance model using aggregate data one needs to construct a proxy for the world income. This constructs can be partly misleading.

Therefore many other studies employ bilateral exchange rates and bilateral trade balance data between a country and its major trading partners (e.g., Arora et al., 2003; Bahmani-Oskooee and Ratha, 2004; Wilson, 2001).

Since the seminal work by Bahmani-Oskooee and Ardalani (2006), there has recently been a growing body of literature that argues that the second-generation study may still suffer from the aggregation bias problem, because significant exchange rate impacts with some industries/commodities in a country could be more than offset by insignificant exchange rate effects with others, thereby resulting in an insignificant exchange rate impact and vice versa. Therefore the newest studies disaggregate data to industry level as well (Bahmani-Oskooee and Hegerty 2011; Bahmani-Oskooee *et al.* 2010).

Despite of numerous J-curve studies, just few of them are focused on Central and Eastern European countries, including Poland. An extensive study for emerging Europe (Bulgaria, Croatia, Cyprus, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Turkey and Ukraine) was written by Bahmani-Oskooee and Kutan (2007). They used monthly data over the period January 1990 and June 2005 and applied ARDL cointegration approach and corresponding error correction model. They found empirical support for the J-curve effect (short run deterioration combined with long run improvement) in Bulgaria, Croatia and Russia. In Poland, they did not find out any characteristics or signs of the J-curve effect existence.

Stučka (2003) also applied ARDL cointegration approach on quarterly data and showed the existence of the J-curve also in Croatia. Hsing (2009) examined the J-curve for bilateral trade between Croatia, Czech Republic, Hungary, Poland, Slovakia, Slovenia and the USA. This paper came to conclusion that the J-curve is not empirically confirmed for any of these six countries.

Using generalized impulse response functions, Hacker and Hatemi (2004) tested the J-curve for three transitional Central European countries (Czech Republic, Hungary, and Poland) in their bilateral trade with respect to Germany. Their findings suggest that for Poland there are some characteristics associated with the J-curve effect. In particular, trade balance deteriorates within a few months after depreciation and then rises to a long run equilibrium value higher than the initial one.

Trade balance in Central and Eastern European countries were studied also by Lopes and Sequeira (2010). They assessed the existence of an S-curve pattern, which represents the relationship between trade balance and the terms of trade using cross correlation. Empirical results support the existence of this curve for Slovenia, Czech Republic, and Hungary, but no evidence for Poland.

Study by Nusair (2013) tested the J-curve phenomenon for seventeen transition economies using monthly data over the period 1991–2012. He used, for this purpose, conditional autoregressive distributed lag bounds cointegration approach and error correction modelling. He used aggregated data and real effective exchange rate. The results suggest evidence the J-curve phenomenon support for Armenia, Georgia and Ukraine, but no for Poland.

Šimáková and Stavárek (2013) investigated the impact of exchange rate changes on bilateral export and import flows between Poland and its major trading partners. They used quarterly data over the period 1997 – 2011 and employed Johansen cointegration test to analyse the long run relationship, for the short run ones they used vector error correction model and impulse-response functions. Their results suggest that a depreciation of the Polish złoty is accompanied by deterioration of the Poland's trade balance with France and Italy. Partial J-curve effect can be observed in case of Poland's trading flows with Germany and Czech Republic. By contrast, they reveal an inverse J-curve in international trade with the United Kingdom.

In summary, the existing empirical literature on the J-curve phenomenon concerning Poland and its international trade is very limited. Results of the few previously published studies indicate almost no evidence for the J-curve effect. i.e. no effect of the złoty depreciation on the Poland's trade balance. Therefore, this study substantially contributes to scientific discussion in this field and fills the gap in literature. As compared to other papers we use the most recent available data on international trade on the industry level to avoid the aggregation problem which can influence the results.

3. Model specification

The consensus among all recent studies is that the trade balance should depend on domestic income, income of a trading partners and development of exchange rate. In order to detect the long term co-movement among the variables, the cointegration procedure developed by Johansen (1997) is used. This avoids the main criticism of early studies, whose results could suffer from regression problem because of non-stationary data. Thus, following Bahmani-Oskooee and Kutan (2009), equation (1) is adopted in empirical modelling of long term relationship between exchange rates and trade balance:

$$ln\,TB_t = \alpha + \beta\, ln\,Y_{d,t} + \gamma\, lnY_{f,t} + \lambda\, ln\,ER_t + \varepsilon_t, \quad (1)$$

where TB is a measure of trade balance in time period t defined as the ratio of exports of Poland to countries f over the Poland's imports from countries f in a given product group. Y_d is measure of the Poland's income set in index form to make it unit free (Bahmani-Oskoee 1991); Y_f is the index of incomes in trading partners f and ER is the nominal exchange rate. The exchange rate is defined in a manner that an increase reflects a depreciation of the Polish zloty.

Since an increase in foreign income Y_f is expected to increase the Polish exports to respective country, an estimate of γ is expected to be positive. On the other hand since an increase in Polish income Y_d is expected to increase the Polish imports, an estimate of β is expected to be negative. Finally, estimate of λ is expected to be positive as the trade balance of respective industry is to improve due to zloty depreciation.

The above defined trade balance model represents the long run relationships between the trade balance and its determinants. To test the J-curve phenomenon in short run, a short term dynamics must be incorporated into the long run model. According to Hsing (2009) we apply for this purpose the following modified error correction model:

$$\Delta\, ln\,TB_t = \alpha + \sum_{i=1}^{n} \omega i \Delta\, ln\,TB_{t-i} + \sum_{i=1}^{n} \beta_i \Delta\, ln\,Y_{d,t-i} + \sum_{i=1}^{n} \gamma_i \Delta\, ln\,Y_{f,t-i} + \sum_{i=1}^{n} \lambda_i \Delta\, ln\,ER_{t-i}. \quad (2)$$

4. Empirical results

This section reports the estimates of the impact of exchange rate on trade balance disaggregated into different product groups. The vector error correction model (2) is estimated by using quarterly data over the period 1997 – 2013. All data are obtained from the OECD iLibrary statistical database. The data are in current prices and denominated in the US dollars. Estimated product groups are determined on the basis of SITC classification:

- TT: Total trade
- *T0*: Food and live animals;
- *T1*: Beverages and tobacco;
- *T2*: Crude materials, inedible, except fuels;
- *T3*: Mineral fuels, lubricants and related materials;
- *T4*: Animal and vegetable oils, fats and waxes;
- *T5*: Chemicals and related products, n.e.s;
- *T6*: Manufactured goods;
- *T7*: Machinery and transport equipment;
- *T8*: Miscellaneous manufactured articles;
- *T9*: Commodities and transactions, n.e.c.

Average shares of the individual product groups on total merchandise trade of Poland for the entire sample period are reported in Table 1.

Table 1. Average shares on total trade of Poland in period 1997 – 2013 (source: compiled by author)

Product group	Share on total imports	Share on total exports	Share on total trade turnover
T0	8.84%	8.63%	7.16%
T1	0.75%	0.77%	0.66%
T2	2.50%	2.45%	2.90%
T3	4.84%	4.72%	7.73%
T4	0.15%	0.15%	0.29%
T5	7.40%	7.37%	11.18%
T6	23.07%	22.81%	21.16%
T7	36.82%	37.96%	36.56%
T8	15.79%	15.33%	11.93%
T9	0.08%	0.08%	0.75%

Before conducting necessary tests and empirical estimations, the time series used in the analysis are adjusted by a logarithmic transformation. This helps to reduce skewness and heteroscedasticity and to stabilize variability. The stability of regressors is needed in initial testing. Before estimation of the cointegration parameters, the order of integration for each time series should be examined. Integration is determined using the augmented Dickey-Fuller test recommended by Engle and Granger (1987). The augmented Dickey-Fuller test for each individual time series confirmed the presence of unit roots, i.e. the first-difference stationarity was found for all variables. According to Blake and Fomby (1997), non-stationarity on levels is the basic precondition of cointegration between variables.

Since the choice of the lag orders of the variables in the vector error correction model specification can have a significant effect on the inference drawn from the model, another step of analysis we sequentially determine the appropriate lag length for each variable by using Akaike Information Criterion and Schwarz Bayesian Criterion. In general there is no agreement on which criterion is better, but in case of different results for optimal lag we prefer Schwarz-Bayesian criterion, which is more consistent.

The number of lags can differ across the trading partners due to different character and elasticity of trading goods and time lags in the consumers search for acceptable, cheaper alternatives (Auboin and Ruta 2012). The optimal lags for each estimated product group are reported in Table 2.

Table 2. Number of optimal lags (source: compiled by author)

Product group	Optimal lag
TT	2
T0	2
T1	2
T2	2
T3	1
T4	2
T5	2
T6	3
T7	2
T8	2
T9	2

When the optimal lag order is determined, we can perform cointegration analysis and test existence of a stable long run equilibrium between non-stationary variables. The results from Johannsen cointegration test can be seen in Table 3, where *C* states if the time series are cointegrated or not.

No every time series were found to be cointegrated. The unstable parametres were detected for product groups of *T3*: Mineral fuels, lubricants and related materials; *T5*: Chemicals and related products, n.e.s; *T8*: Miscellaneous manufactured articles and *T9*: Commodities and transactions, n.e.c. These four groups represent about 32% share of total merchandise trade which is not supposed be in the long term relationship with exchange rate development. These traded goods seem to be affected more by other factors, or can be traded in different currency (e.g. USD) than Polish zloty.

Table 3. Results of Johannsen cointegration test. (source: compiled by author) *denote significance at the 10% level

Product group	Trace statistic	Critical value on 0.05 level	Critical value on 0.1 level	C
TT	45.89640	47.85613	44.49359	no*
T0	79.24326	47.85613	44.49359	yes
T1	50.23579	47.85613	44.49359	yes
T2	53.07527	47.85613	44.49359	yes
T3	35.66071	47.85613	44.49359	no
T4	53.24725	47.85613	44.49359	yes
T5	38.77865	47.85613	44.49359	no
T6	49.25807	47.85613	44.49359	yes
T7	57.91129	47.85613	44.49359	yes
T8	37.14633	47.85613	44.49359	no
T9	40.11935	47.85613	44.49359	no

Other segments of international trade flows are characteristic by long term relationship with exchange rate. Product groups included into analysis and their estimation parameters can be seen in Table 4.

Since an increase in foreign income is supposed to raise the Polish exports as it represents higher demand for goods, an estimate of γ was expected to be positive. This assumption was revealed in all cases, except product group *T4*: Animal and vegetable oils, fats and waxes, which represents less than 1% of total merchandise trade. On the other hand since an increase in Polish income Y_d is expected to increase the Polish imports (with raising domestic demand), an estimate of β was expected to be negative. This statement is valid for time series of *T0*: Food and live animals; *T2*: Crude materials, inedible, except fuels and *T7*: Machinery and transport equipment.

Finally, estimate of λ is expected to be positive as the trade balance of respective industry is to improve due to zloty depreciation. This presumption applies across all product groups, again except product group *T4*: Animal and vegetable oils, fats and waxes.

Table 4. Estimated long-run coefficients of trade models.(source: compiled by author)

Product group	Y_d	Y_f	*ER*
*TT**	-0.227168	2.908108	0.522746
	(0.21863)	(0.50061)	(0.22889)
T0	-0.757787	4.148446	1.646149
	(0.56492)	(1.31094)	(0.57314)
T1	1.582944	4.285780	1.217493
	(0.55488)	(1.28674)	(0.56343)
T2	-0.528558	2.702630	0.582577
	(0.14762)	(0.34261)	(0.14947)
T4	7.910002	-12.41069	-7.970218
	(1.47719)	(3.40629)	(1.55258)
T6	0.247014	1.435830	0.495931
	(0.18842)	(0.43768)	(0.19553)
T7	-0.465829	5.868771	0.344738
	(0.23833)	(0.54844)	(0.24230)

On one hand, as can be seen from results, if we take aggregated data of total foreign trade, the theory about examined relationship is revealed from the long run perspective. On the other hand, after disaggregating data, we can see that long term effecs differ across the examined industries. There is revealed, that only 69% of product groups are in the long run relationship with exchange rate and only 34% of disaggregated industies are affected as supposed, but we can say, that almost whole cointegrated foreign trade is affected by exchange rate depreciation as predicted.

Table 5. Estimated short-run coefficients of trade models (source: compiled by author)

	ΔT0	ΔT1	ΔT2	ΔT4	ΔT6	ΔT7
CointEq1	-0.204225 (0.10086)	-0.888467 (0.18611)	-0.404102 (0.22136)	0.061777 (0.07162)	-0.489831 (0.08999)	-0.098622 (0.09188)
Δ(T(-1))	-0.048140 (0.11661)	0.047609 (0.15209)	-0.234365 (0.18182)	0.071198 (0.15118)	-0.366878 (0.11572)	-0.228910 (0.15446)
Δ(T (-2))	-0.470628 (0.10834)	-0.086612 (0.12314)	-0.277009 (0.14094)	-0.127213 (0.14316)	-0.076282 (0.10629)	0.156657 (0.14359)
Δ(Yd(-1))	-0.957298 (2.25296)	-5.088081 (5.35621)	-3.374754 (2.06921)	-12.55761 (6.37452)	-3.638297 (1.02127)	-1.579272 (1.37539)
Δ(Yd(-2))	-1.593569 (2.25665)	0.407803 (5.43120)	-4.302879 (2.11589)	5.845465 (6.24466)	-2.268490 (1.11133)	-0.380942 (1.42135)
Δ(Yf(-1))	-4.638169 (3.47321)	-8.769346 (8.19983)	1.434803 (3.35377)	-12.85672 (9.07998)	2.628168 (1.52014)	1.597433 (2.10787)
Δ(Yf(-2))	5.641672 (3.46437)	0.514212 (8.14163)	4.204760 (3.11889)	8.716464 (9.07642)	0.870159 (1.54316)	0.923624 (1.95518)
Δ(ER(-1))	-0.490215 (0.36767)	-0.616512 (0.85369)	0.133449 (0.31144)	-0.915616 (0.90070)	-0.035692 (0.16236)	0.425757 (0.20137)
Δ(ER(-2))	0.376936 (0.36308)	-0.945715 (0.84007)	0.553378 (0.30740)	0.212568 (0.89392)	0.376937 (0.15372)	0.098009 (0.19870)
C	0.026582 (0.02645)	0.105550 (0.06363)	0.061555 (0.02411)	0.100966 (0.07654)	0.048590 (0.01234)	0.027047 (0.01698)

As indicated before, the short run effects of depreciation are reflected in the coefficient estimates obtained for the lagged value of the first differenced exchange rate variable. These estimated values can be seen in Table 5. The J-Curve phenomenon should be supported by negative coefficients of exchange rates followed by the positive ones. The J-curve effect is revealed for product groups *T0*: Food and live animals; *T4*: Animal and vegetable oils, fats and waxes; *T6*: Manufactured goods. As was mentioned in the introduction of this paper, it has been found that goods tend to be inelastic in the short run, as it takes time to change consuming patterns. Thus, the Marshall–Lerner condition is not met in the short run and depreciation deteriorates the trade balance initially. In the long run, consumers can adjust to the new prices, and trade balance is improving. This perfectly fits to this product groups which in global contains more elastic traded goods than others. If we compare these results to the long run effects, we find out, that only product group affected as supposed is *T6*: Manufactured goods. So this paper shows that only 21% of traded goods are affected according to ecomic theory in both, short run and long run perspective as well.

5. Conclusions

The aim of this study was to examine the short run and the long run effects of exchange rate changes on trade flows in the context of disaggregated industry data of Poland´s foreign trade. For this purpose, the Johannsen cointegration test and the vector error correction model were used.

We included ten product groups based on SITC classification into the analysis and the results suggest that effect of depreciation of the Polish złoty is different across the countries. We revealed that only some segments of Polish international trade are in the long run relationship with exchange rate development, but these product groups represent more than 78% share of total merchandise trade. Moreover, the estimation of the short run effects suggest, that only more elastic product groups are affected in accordance to J-curve theory. This paper shows that only 21% of traded goods are affected according to ecomic theory in both, short run and long run perspective as well.

The likely reason why the results are not quite consistent with theory is, that development of the Poland's international trade is affected by other factors as well. According to Mandel and Tomšík (2006), foreign direct investments in Poland have a positive impact on real exports and they also reduce imports of final products. On the other hand, foreign direct investments in industrial sector usually need to import an input which increases the total volume of imports and makes the import intensity of Poland's export very high. Next important factor in determination of trade balance is the structure and demand elasticity of traded goods.

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