Dr Piotr Misztal
The Radom Technical University
Poland
e-mail: misztal@msg.radom.pl

EXCHANGE RATE CHANGES AND PRICE DYNAMICS IN POLAND

1. The essence and cause of incomplete exchange rate pass-through

An exchange rate pass-through is defined as a total percentage response of prices to a one percent shock in the form of the local currency exchange rate change with reference to foreign currencies. For a long time the literature on the topic had assumed a complete pass-through of such changes to prices in conformity with the law of one price and purchasing power parity. Only in the 1980s empirical analyses revealed that it is rather an incomplete exchange rate pass-through of into domestic and foreign prices which is a common phenomenon. Such a situation is a result of a specific market structure (perfect or imperfect competition), the occurrence of individualized products, activities of transnational corporations and the occurrence of different types of barriers in foreign trade.

One of the first economists analyzing the phenomenon of incomplete exchange rate pass-through to prices were Krugman and Dornbush (1987). They came to a conclusion that pricing to market is an important factor determining deviations from the law of one price [Krugman 1987; Dornbush 1987]. On the other hand, Taylor (2000) indicated also a different factor determining the degree of exchange rate pass-through to prices, which is the rate of inflation. He proves that a low inflation rate leads to a lower degree of exchange rate pass-through to domestic prices [Taylor 2000]. This thesis is also confirmed by results of empirical analyses indicating that in the situation of a high inflation rate the monetary shock effect lasts for a longer period of time and implies a higher degree of exchange rate pass-through to prices. The situation is reverse in the countries of a low inflation rate [Choudhri, Hakura 2001].

However, Campa and Goldberg (2006) are of the opinion that price strategies applied in foreign trade by particular countries – Producer Currency Pricing (PCP) or Local Currency Pricing (LCP) [Campa, Goldberg 2006] - are another factor, apart from the inflation rate, determining the scale of exchange rate pass-through to prices.

Among the most crucial causes of the incomplete exchange rate pass-through to prices, economic literature names:

a) occurrence of imperfect competition;
b) tendency to invoicing transactions in local currency;
c) growing marginal costs of goods suppliers;
d) enterprises' strategies orientated to increasing a market share.

Theoretical analyses and results of empirical research concerning the phenomenon of incomplete exchange rate pass-through to prices reveal the following regularities [Gross, Schmitt 1999; Meurers 2003; Takagi, Yoshida 2001]:

a) exchange rates changes are correlated to a much higher degree with changes in inflation than with changes in import prices;
b) differences between countries in degrees of the exchange rate pass-through to prices are significant and, to a large extent, depend on inflation changeability;
c) the degree of the exchange rate pass-through to inflation is generally higher than in the case of import price pass-through to inflation;
d) the degree of the exchange rate pass-through to prices in the short-term is lower than in the long-term.

The latest empirical analyses showed that the phenomenon and degree of incomplete exchange rate pass-through to prices are not constant in time. According to Campa and Goldberg (2006), in the last several years in majority of world countries a distinct decrease in the degree of exchange rate pass-through to prices occurred [Campa, Goldberg 2006]. Many factors influence this decline. Some economists, such as Goldfajn, Werland (2000), Ho, Cauley (2003) and Edwards (2006) point out a negative correlation between exchange rate stability and the degree of exchange rate pass-through to prices. They are of the opinion that at a stable exchange rate price adjustments to exchange rate changes are smaller. It results from the fact that exchange rate changes are treated as momentary deviations from the equilibrium. What is more, enterprises have limited possibilities of raising their prices in the situation of low inflation [Goldfajn, Weleng 2000; Cauley 2003; Edwards 2006]. Another factor determining the scale of exchange rate pass-through to prices is the monetary policy run, especially when it aims at exchange rate stability [Monacelli 2003].

A relatively low level of exchange rate pass-through to prices in the short term is a result of the fact that in the initial phase exporters tend to pass exchange rates through to prices of exported goods only to a slight degree but with time they adjust their prices more and more to changes in the exchange rate. One of the reasons for such a pricing strategy of

exporters is willingness to maintain their market share in the future. In the situation of domestic currency depreciation, foreign enterprises may decide against raising the prices of sold products to prevent significant reduction of their market share.

A change in the relationship between exchange rate and the price of an imported product can also result from lags in supplies of exported raw materials, semi-products and final products. The fact is that that the exchange rate level at the moment of concluding an import transaction can differ significantly from the one at the moment of the ordered product delivery. Thus, costs of imported products and prices of products sold depend on the exchange rate which was reported at a specific time in the past that is at the moment of carrying out the import transaction [Webber 1999].

Results of empirical examinations reveal also a negative correlation between the degree of exchange rate pass-through to prices and the degree of using the importer's currency for invoicing the import. If enterprises agree on prices exclusively in the importer's currency, then the lack of exchange rate pass-through to prices of imported products must be expected. On the other hand, if prices are set in the exporter's currency, then full exchange rate pass-through to prices of imported products must be expected [Bacchetta, van Wincoop 2002] .

Results of empirical investigations indicate also that the degree of the exchange rate pass-through to prices in foreign trade is positively correlated with the degree of openness of a given economy and the time of the exchange rate change duration. On the other hand, the index of the exchange rate pass-through is negatively correlated with the exchange-rate changeability [Rowland 2004].

Moreover, empirical analyses indicate that the following factors influence the scale of exchange rate change pass-through to foreign trade prices [Rincon, Caicedo, Rodríguez 2005]:

a) structure and concentration degree of a given market;
b) degree of homogeneity and substitutability of exchanged goods;
c) enterprises' costs of entry and costs of exit on a given market;
d) trade policies of enterprises operating in a given country;
e) the scale of inter-branch turnover (between branches of the same enterprises);
f) inflation rate in a given country.

Kardasz, Stollery (2001) and Feinber (1989) believe that the degree of exchange rate pass-through to domestic prices increases together with the increase in the degree of the substitutability of imported and domestic products. In industries where products are

diversified, domestic prices react less to changes in exchange rates. Relative prices of these goods can change only when in the situation of change in the exchange rate consumers will not quickly substitute products manufactured in one country for the products manufactured in another country. This situation is more likely to occur when products on a given market are more diversified [Baldwin, Beiling 2006].

Moreover, Sibert (1992), who assumes the occurrence of behavioral differences, states that the reaction of domestic prices to a change in exchange rate is positively correlated with the ratio of the number of foreign enterprises to the total number of enterprises. Thus, the higher the share of import in total sales is, the higher price adjustment in the situation of the exchange rate change is [Silbert 1992].

2. Effect of incomplete exchange rate pass-through to prices on production and consumption

The phenomenon of incomplete exchange rate pass-through to prices influences, among others, the scale of exchange rate impact on production and consumption at home and abroad. The ultimate effect of exchange rate on consumption depends on the degree of incomplete exchange rate pass-through to prices at home and abroad. A positive effect of the exchange rate on consumption decreases with the increase in the degree of incomplete exchange rate pass-through to prices at home. On the other hand, a positive effect of exchange rate on consumption increases with the increase in the scale of incomplete exchange rate pass-through to prices abroad.

When we deal with a high degree of incomplete exchange rate pass-through to prices at home, then exchange rates do not have a significant impact on prices of exported goods denominated in foreign currency and in this way the effect of exchange rates on a shift in world's demand from foreign goods to domestic goods is weaker. What is more, the higher the degree of exchange rate pass-through to prices of exported goods is, the lower the growth rate of foreign consumption is. As a result it leads to lower growth rates of export, real income and consumption at home.

And the other way round. When the degree of exchange rate pass-through to prices is high abroad, then, despite depreciation of domestic currency, import prices rise to a slight degree and the terms of trade referring to prices do not worsen to such an extent as in the case of complete exchange rate pass-through to prices. It leads to an increase in the country's real income, which, eventually, brings about an increase in domestic consumption. Thus a high degree of exchange rate pass-through to prices abroad results in a significant effect of

exchange rate changes on domestic consumption, whereas a high degree of exchange rate pass-through to prices at home brings about a negligible effect of exchange rate changes on domestic consumption.

Table 1. The effect of incomplete exchange rates pass-through to prices on domestic production and consumption

Production and consumption	Degree of exchange rate pass-through	Effect of exchange rate changes
Production in home	High degree of exchange rate pass-through to home prices	Decreasing growth rate of home production
	High degree of exchange rate pass-through to foreign prices	Decreasing growth rate of home production
	Low degree of exchange rate pass-through to home prices	Increasing growth rate of home production
	Low degree of exchange rate pass-through to foreign prices	Increasing growth rate of home production
Production abroad	High degree of exchange rate pass-through to home prices	Increasing growth rate of production abroad
	High degree of exchange rate pass-through to foreign prices	Increasing growth rate of production abroad
	Low degree of exchange rate pass-through to home prices	Decreasing growth rate of production abroad
	Low degree of exchange rate pass-through to foreign prices	Decreasing growth rate of production abroad
Consumption in home	High degree of exchange rate pass-through to home prices	Decreasing growth rate of home consumption
	High degree of exchange rate pass-through to foreign prices	Increasing growth rate of home consumption
	Low degree of exchange rate pass-through to home prices	Increasing growth rate of home consumption
	Low degree of exchange rate pass-through to foreign prices	Decreasing growth rate of home consumption
Consumption abroad	High degree of exchange rate pass-through to home prices	Decreasing growth rate of consumption abroad
	High degree of exchange rate pass-through to foreign prices	Increasing growth rate of consumption abroad
	Low degree of exchange rate pass-through to home prices	Decreasing growth rate of consumption abroad
	Low degree of exchange rate pass-through to foreign prices	Increasing growth rate of consumption abroad

Source: Own study.

The effect of changing exchange rates on domestic production is limited in the situation of a large scale of incomplete exchange rate pass-through to prices at home and abroad. On the other hand, the lower the degree of exchange rate pass-through to prices at home and abroad is, the higher the influence of exchange rate on domestic production is. This situation results from the fact that a large scale of incomplete exchange rate pass-through (both at home and abroad) limits the reaction of prices of exported goods denominated in the local currency to exchange rate changes leading to a smaller shift in demand between domestic and foreign goods (a decreased substitution effect).

In a particular case, when the degree of incomplete exchange rate pass-through to prices at home and abroad equals zero (no exchange rate change pass-through), both domestic and foreign export prices remain at unchanged level despite changing exchange rates. In such a situation, production at home and abroad grows to the same extent in line with the world's growth rate of consumption [Otani 2002].

3. Exchange rate pass-through to import, producer and consumer prices

This paper analyses exchange rate change pass-through to prices in the Polish foreign trade using the vector autoregression (VAR) model put forward by Sims in 1980. This approach was used for the first time by McCarthy (1999) who analyzed the phenomenon of exchange rate pass-through to prices in the OECD (Organization of Economic Co-operation and Development) member countries [McCarthy 1999]. In the VAR method the phenomenon of exchange rate pass-through to prices is analyzed with the use of a set of equations, which at the same time eliminates the problem of exogenous explanatory variables [Sims 1980]. Then the estimation of the exchange rate effect on particular price aggregates in the model is isolated from the effect of other factors which the exchange rate may be correlated with.

The starting point for the model of exchange rate pass-through to prices in Poland is an analysis of the so called distribution chain proposed by Blanchard (1982). The distribution chain is a series of economic shocks (chain links) between which a cause and effect relation occurs over the same time unit in which the shock occurred [Blanchard 1982]. Naturally this type of approach must be revised and in the VAR model an appropriate lag length between variables must be taken into account as in economy there is no immediate cause-and-effect relation and the effect always occurs with some lag in relation to the moment at which a given economic shock appears. In the analyzed VAR model, the distribution chain looks as follows.

$$s \rightarrow imp \rightarrow ppi \rightarrow cpi$$

where:

s – exchange rate;

imp – import price;

ppi – producer price index;

cpi – consumer price index.

Another stage of the analysis is a measurement of the strength of the exchange rate change pass-through to domestic prices. The so-called impulse response function is used to this purpose, that is a function of a given price aggregate (import prices, producer prices, consumer prices) response to an impulse in the form of the exchange rate change. The index of exchange rate change pass-through to prices after the period *t* is defined by the following equation [Cholewiński 2008].

$$PT(z)_t = \frac{\sum_{i=1}^{k} \Delta z_{t-i}}{\sum_{i=1}^{k} \Delta s_{t-i}}$$

where;

Δz_{t-i} – change of given price index (import price, producer price, consumer prices), in the period form „*t-i*" to „*t*";

Δs_{t-i} – change of exchange rate, in the period form „*t-i*" to „*t*".

Changes in a given price aggregate equal the values of the impulse response function of the analyzed aggregate to the exchange rate shock, and changes in the exchange rate equal the impulse response function of the exchange rate to the exchange rate shock.

Shock occurrence is connected with each of the distribution chain links. However, only in the case of the first chain link (exchange rate) the original shock occurs and in subsequent links the shock results from the transmission of shocks in the former links. Hence, the shock occurring in subsequent chain links can be decomposed into an autonomous part (occurring in a given chain link) and the one transmitted from earlier links. Chain link decomposition is accomplished with the use of Cholesky decomposition matrix. Establishing the strength of the

shock transmission is indispensable to analyze the phenomenon of exchange rate pass-through to prices in a more detailed way.

On the basis of the distribution model presented earlier, a VAR model was constructed which analyzes the phenomenon of exchange rate pass-through to prices. This model is a set of 4 equations and it looks as follows:

$$\Delta s_t = \sum_{i=1}^{k} \gamma_{11}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{12}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{13}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{14}^{i} \Delta cpi_{t-i} + \varepsilon_{1t} \quad (1)$$

$$\Delta imp_t = \sum_{i=1}^{k} \gamma_{21}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{22}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{23}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{24}^{i} \Delta cpi_{t-i} + \varepsilon_{2t} \quad (2)$$

$$\Delta ppi_t = \sum_{i=1}^{k} \gamma_{31}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{32}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{33}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{34}^{i} \Delta cpi_{t-i} + \varepsilon_{3t} \quad (3)$$

$$\Delta cpi_t = \sum_{i=1}^{k} \gamma_{41}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{42}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{43}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{44}^{i} \Delta cpi_{t-i} + \varepsilon_{4t} \quad (4)$$

where:

s – seasonally adjusted logarithm of nominal, effective exchange rate index of the Polish zloty (previous quarter = 100);

imp – seasonally adjusted logarithm of import price index in the Polish foreign trade (previous quarter = 100);

ppi – seasonally adjusted logarithm of producer price index in Poland (previous quarter = 100);

cpi – seasonally adjusted logarithm of consumer price index in Poland (previous quarter = 100);

yt – given period;

k – lags (in quarter).

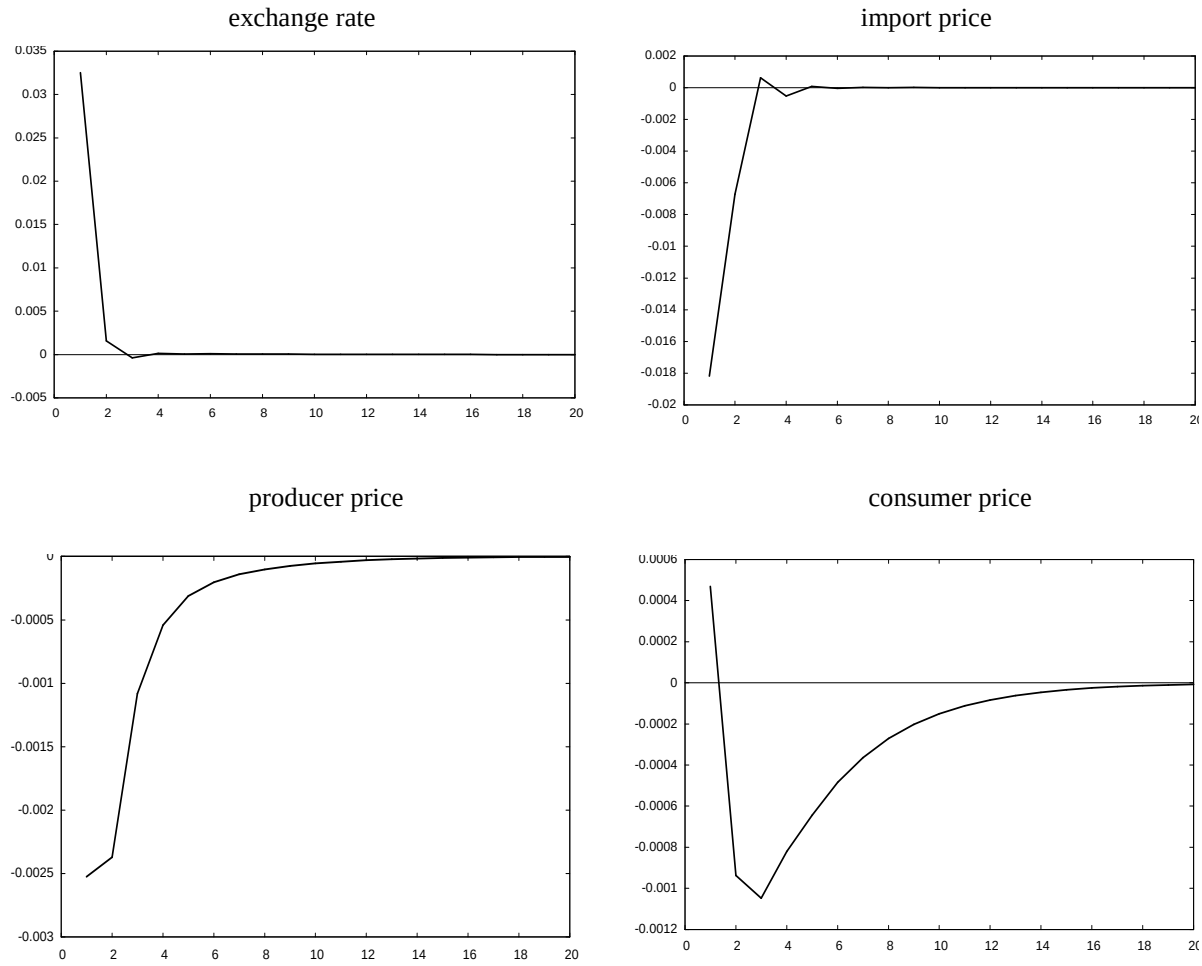
All the above mentioned time series have a quarterly frequency and cover the period from the first quarter of 1997 to the fourth quarter of 2007. Logarithming of particular model variables aimed at elimination of possible regression between variables. Before the model structural parameters were estimated, it was necessary to isolate a seasonal factor from the time series. The occurrence of the seasonal factor in the time series could lead to difficulties in interpreting changes in a given phenomenon in the analyzed period. To purge the time series from seasonal fluctuations, the X12-ARIMA procedure was applied.

This paper analyzes the phenomenon of exchange rate pass-through to domestic prices of imported, production and consumer goods over a short period of time (after 1 quarter) and over a long period of time (after 4 quarters). For the purposes of the analyses, one lag period (one quarter) between explanatory variables was adopted. The choice of lag lengths is in line with results of the information criteria of the Akaike, Schwartz-Bayesian and the Hannan-Quinn models. According to these criteria, a model with one lag length is characterized by the biggest information capacity.

Before the VAR model estimation it was necessary to specify stationarity of the analyzed time series. To this purpose the Augmented Dickey-Fuller Test (ADF) was used. The last stage of the analysis of time series was co-integration estimation. Having a set of integrated variables of order 1, a co-integration test was carried out according to the method put forward by Johansen (1988). The choice of the lag lengths for co-integration testing was made on the basis of the earlier mentioned results of the Akaike, Scwartz-Bayesian and Hannan-Quinn information criteria. Another stage of the analysis was an estimate of structural parameters of the VAR model. Results of the parameter estimate of the VAR model consisting of 4 equations are in the Appendix.

Below one can see respective graphs of the impulse response functions of exchange rate, import prices and consumer prices to a one-time unit change of the exchange rate.

Figure 1. Impulse response function of exchange rate, import price, producer price and consumer price to a one shock of exchange rate



Source: Own calculations on the basis of *International Financial Statistics*, (2008).

In the case of import prices the highest exchange rate pass-through is noted in the course of 3 subsequent quarters following a change in the exchange rate, which then weakens and eventually stabilizes after the 5th quarter elapses. A similar situation like the one described above occurs in the case of the producer price response to a shock in the form of a change in the exchange rate. The highest pass-through of exchange rate follows within the first four quarters after the occurrence of the shock and after the next four quarters stabilization occurs. In the case of consumer prices, the highest exchange rate pass-through occurs after three quarters; then it decreases and stabilizes after eighteen quarters. A similar situation is observed in the case of a one-time exchange-rate shock and its effect on a further change in the exchange rate. Namely, a shock change in the exchange rate by a unit leads to an instant change in the exchange rate within the first three quarters and then the exchange rate stabilizes after the third quarter elapses.

Eventually the magnitude of indices of the exchange rate pass-through to consumer prices is smaller than it is indicated by the analysis of the above drawings because changes in the exchange rate paralleled changes in consumer prices.

Table 2. Indexes of exchange rate pass-through to import prices, producer prices and consumer prices in Poland

The number of quarter after shock	Import prices	Producer prices	Consumer prices
1	55,9%	7,8%	1,4%
2	73,1%	14,4%	1,4%
3	72,1%	17,7%	4,5%
4	73,4%	19,3%	6,9%
5	73,0%	20,2%	8,8%
6	72,9%	20,7%	10,2%
7	72,7%	21,1%	11,2%
8	72,6%	21,3%	12,0%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

It is obvious that import prices respond more rapidly to changes in the exchange rates than producer and consumer prices [Hüfner, MSchröder 2002]. The average level of exchange rate pass-through to import prices stood at 55.9% in the short-term. However, after one year only 73.4% of exchange rate changes were passed through to import prices. Producer prices responded less to changes in the nominal, effective exchange rate. The average level of the exchange rate pass-through index to producer prices in the short-term amounted to 7.8%. However, after one year only 19.3% of changes in the exchange rate were passed through. The least affected by exchange rates, both in the short- and long-term, were consumer prices. The average level of exchange rate pass-through index to consumer prices reached 1.4% in the short-term. However, after one year only 6.9% of changes in the exchange rate were passed through to consumer prices. Presented calculations indicate that the unanticipated 10% growth of the nominal effective exchange rate of the Polish zloty, in the course of the first 4 quarters, resulted in an increase of import prices by 7.3%, an increase in the producer price index by 1.9 percentage points and an increase in the inflation rate measured by a consumer price index by 0.7 percentage points.

The last stage of the analysis is the residual component variance decomposition of subsequent price aggregates. This procedure specifies the contribution of the exchange rate shock affecting each of the price variables in accounting for the variances of the individual model variables (price aggregates).

Table 3. The error variance decomposition in the import price equation

The number of quarter after shock	Exchange rate	Import prices	Producer prices	Consumer prices
1	49%	51%	0%	0%
2	49%	49%	1%	0%
3	49%	49%	1%	0%
4	49%	49%	1%	0%
5	49%	49%	1%	0%
6	49%	49%	1%	0%
7	49%	49%	1%	0%
8	49%	49%	1%	0%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

Table 4. The error variance decomposition in the producer price equation

The number of quarter after shock	Exchange rate	Import prices	Producer prices	Consumer prices
1	12%	23%	65%	0%
2	18%	21%	61%	0%
3	19%	20%	60%	1%
4	19%	20%	60%	1%
5	19%	20%	60%	1%
6	19%	20%	60%	2%
7	19%	20%	60%	2%
8	19%	20%	60%	2%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

Table 5. The error variance decomposition in the consumer price equation

The number of quarter after shock	Exchange rate	Import prices	Producer prices	Consumer prices
1	1%	8%	31%	60%
2	2%	10%	33%	54%
3	3%	11%	35%	51%
4	4%	11%	35%	49%
5	4%	11%	36%	49%
6	5%	11%	36%	48%
7	5%	11%	36%	48%
8	5%	11%	36%	48%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

On the basis of the data from the above Table it can be noted that changes in the nominal effective exchange rate of the Polish zloty accounted for almost half of the price variances in the short- and long-term (ca. 49% changes in import prices were accounted for by changes in the exchange rate). However, the effect of changes in the exchange rate on producer price variances in the short- and long-term was significantly smaller. In the short-term, ca. 12% of producer price changes could be accounted for by a change in the nominal, effective exchange rate of the Polish zloty and in the long-term – ca. 19% producer price changes.

The role of exchange rate in accounting for consumer price variances in the short- and long-term was even smaller. In the short-term, less than 1% of consumer price changes could be accounted for by changes in the nominal effective exchange rate of the Polish zloty. This effect grew slightly as the time passed from the moment of change in the exchange rate. In the long-term the change in the nominal effective exchange rate of the zloty accounted for 4% of consumer price changes.

4. Exchange rate pass-through to prices of imported goods according to the SITC classification's two-digit level

To assess the level of exchange rate pass-through to prices of imported products in Polish foreign trade, the model of exchange rate pass-through to import prices put forward by Bussière (2007) can be applied. It is represented by the following expression [Bussière 2007]:

$$\Delta imp_t = \alpha_0 + \alpha_1 \Delta imp_{t-1} + \alpha_2 \Delta s_t + \alpha_3 \Delta ppi_t$$

The short-term level of exchange rate pass-through to prices of imported goods is defined by the α2 and $\overline{\alpha_2}$, respectively. On the other hand, respective long-term levels of exchange rate changes pass-through to prices in foreign trade are defined by the expressions $\alpha_2 / (1-\alpha_1)$ and $\overline{\alpha_2} / (1-\overline{\alpha_1})$. Results of the estimations of the model of exchange rate pass-through to import prices in the Polish foreign trade are presented in the Table below.

Table 6. The degree of exchange rate pass-through to import prices in Poland according to the 2-digit level SITC classification

SITC 2	Text	Short-run exchange rate pass-through	Long-run exchange rate pass-through
00	Live animals	-0,20	-0,41
01	Meat and meat preparations	-0,65	-0,77
02	Dairy products and eggs	-0,88	-1,25
03	Fish, crustaceans, molluscs etc.	-0,24	-0,28
04	Cereals and cereal preparations	-0,09	-0,12
05	Vegetables and fruit	-0,66	-1,03
06	Sugars, sugar prep. and honey	-0,41	-0,64
07	Coffee, tea, cocoa, spices	-1,08	-1,27
08	Animal feeds, excl. unmilled cereals	-1,33	-1,34
09	Miscellaneous edible products	-0,47	-0,66
11	Beverages	-1,38	-1,92
12	Tobacco and tobacco manufactures	0,17	0,28
21	Hides, skins and furskins, raw	-0,58	-1,30
22	Oil seeds and oleaginous fruit	-0,36	-0,46
23	Crude rubber, synth. and recycled	-0,92	-1,23
24	Cork and wood	-0,71	-0,99
25	Pulp and waste paper	-0,87	-1,17
26	Textile fibres and their wastes	-0,80	-0,84
27	Crude fertilizers, crude minerals	-0,21	-0,30
28	Metalliferous ores, metal scrap	-0,11	-0,13
29	Crude animal and veget. materials	-0,47	-0,87
32	Coal, coke and briquettes	0,61	1,01
33	Petroleum, petroleum products	0,05	0,06
34	Gas, natural and manufactured	0,71	0,93
35	Electric energy	-1,39	-2,78
41	Animal oils and fats	-1,41	-2,10
42	Fixed vegetable fats and oils	-0,86	-0,91
43	Animal/vegetable fats/oils, processed	-1,01	-1,22
51	Organic chemicals	-0,62	-0,81
52	Inorganic chemicals	-0,34	-0,60
53	Dyeing, tanning and col. materials	-0,80	-0,87
54	Medicinal and pharmaceutical prod.	-0,37	-0,41
55	Oils, toilet and cleansing prep.	-0,89	-1,14
56	Fertilizers, other than of 27	0,02	0,04
57	Plastics in primary forms	-0,70	-0,92
58	Plastic manufactures	-0,75	-1,05
59	Chem. materials & products n.e.s.	-0,27	-0,46
61	Leather and dressed furskins	-0,81	-1,50
62	Rubber manufactures, n.e.s.	-0,56	-1,05
63	Cork and wood manufactures	-0,44	-0,90
64	Paper, paperboard, articles thereof	-0,57	-0,61

65	Textile yarn etc., n.e.s.	-0,74	-1,19
66	Non-metallic min. manufactures n.e.s.	-0,54	-0,90
67	Iron and steel	-0,50	-0,64
68	Non-ferrous metals	-0,49	-0,60
69	Manufactures of metal n.e.s.	-0,57	-1,19
71	Power generating machinery	-0,60	-1,20
72	Machinery for part. industries	-0,53	-1,06
73	Metalworking machinery	-1,15	-2,05
74	Gen. industr. machinery & equipm.	-0,67	-1,22
75	Office machines and computers	-0,30	-0,73
76	Telecom equipment etc.	-0,54	-0,88
77	Elec. machinery, app. and appliances	-0,69	-0,90
78	Road vehicles	-0,68	-1,11
79	Other transport equipment	-0,02	-0,05
81	Prefab. buildings; fixtures	-0,20	-0,34
82	Furnit., mattr., cushions etc.	-0,78	-1,59
83	Travel goods, handbags etc.	-0,30	-0,58
84	Apparel and clothing accessories	0,47	0,80
85	Footwear	0,04	0,06
87	Prof., scient. & contr. instruments	-0,68	-1,13
88	Photogr. equip., opt. goods; watches	-0,03	-0,11
89	Misc. manufactured articles n.e.s.	-0,87	-1,34
	Average	-0,52	-0,79

Source: Own calculations on the basis of *The Central Statistical Office*, Poland (2008).

On the basis of the model estimation results it can be noted that the average level of the exchange rate change pass-through index to import prices in Poland in the short-term reached -0.52, which meant that in the short term more than a half of exchange rate changes were passed through to prices of imported goods. However, a long-term index of exchange rate pass-through to import prices stood at -0.79, which meant that in the long run ca. 79% of the exchange rate changes were passed through to prices in the Polish imports.

If the goods structure of the Polish foreign trade is considered according to the two-digit level of the SITC classification, then it is possible to note that in general the least degree of exchange rate pass-through to import prices characterizes processed products, in particular, "photographic equipment, optical products, clocks" and "other transport equipment". In this case the short- and long-term indices of exchange rate pass-through to prices were close to zero. A similar level of exchange rate pass-through to prices (i.e. close to zero) occurred also in the case of some low processed products characterized by limited substitution. Such a situation referred in particular to such groups of goods as "oil and oil products" and "artificial fertilizers".

What is more, in the case of some energy raw-materials ("coal and briquettes and natural and produced gas") we dealt with the so-called perverse exchange rate pass-through to prices in both, short- and long-term. Indices of exchange rate pass-through were positive, which meant a rise (decline) of import prices of these products expressed in domestic currency as a result of appreciation (depreciation) of the zloty. On the other hand, the highest level of exchange rate pass-through to prices characterized products which were relatively less processed. The highest indices of exchange rate pass-through to import prices were noted in the case of electricity and animal oils and fats. In this case the values of short-term indices of exchange rate pass-through were lower than -1, whereas the values of long-term indices oscillated around -2.

5. Concluding remarks

The paper performed an empirical analysis of transmission mechanism of exchange rate changes to import, producer and consumer prices in Poland. I found, that there are exist in Poland the phenomenon of incomplete exchange rate pass-through to import producer and consumer prices in the short-run as well in the long-run.

The results of the conducted research are conformable with theoretical arguments and indicate that in general the degree of the exchange rate pass-through to import prices is smaller in the case of goods which are more processed but higher in the case of goods which were less processed. This situation seems natural because in the case of goods which are less processed (raw-materials, and agricultural and food products) there are many close substitutes. There are no such substitutes in the case of industrial products. What is more, it was noted that that the degree to which exchange rates are passed through to prices of industrial goods increases together with the increase in their substitutability and the scale of exchange rate pass-through to import prices of raw materials and agricultural and food products decreased together with their lower substitutability.

Bibliography

Bacchetta P., van Wincoop E., *A Theory of the Currency Denomination of International Trade*, "Federal Reserve System Discussion Papers" 2002, No 747, July.

Baldwin J. R., Beiling Y., *Exchange Rate Cycles and Canada–U.S. Manufacturing Prices*, "Statistics Canada Economic Analysis Research Paper"2006, No 041, June.

Blanchard O.J., *Price Desynchronization and Price Level Inertia*, "NBER Working Paper" 1982, No 900.

Bussière M., *Exchange rate pass-through to trade prices the role of non-linearities and asymmetries*, "ECB Working Paper" 2007, No 822, October.

Campa J.M., Goldberg L.S, *Pass-Through of Exchange Rates to Consumption Prices: What Has Changed and Why*, „Federal Reserve Bank of New YorkStaff Reports" 2006, No 261.

Cholewiński R., *Wpływ zmian kursu walutowego na dynamikę procesów inflacyjnych*, "Materiały i studia" 2008, nr 226.

Choudhri E.U., Hakura D.S., *Exchange Rate Pass-through to Domestic Prices: Does the Inflationary Environment Matter?*, "IMF Working Papers" 2001, No.01/194.

Dornbush R., *Exchange rate and prices*, "American Economic Review" 1987, No 77.

Edwards S., *The Relationship between Exchange Rates and Inflation Targeting Revisited*, "NBER Working Paper" 2006, No. 12163.

Goldfajn I., Weleng S.R.C., *The Pass-through From Depreciation To Inflation: A Panel Study*, „Departamento De Economia Puc-Rio TEXTO PARA DISCUSSÃO" 2000, No. 423.

Gross D. M., Schmitt N., *Exchange Rate Pass-Through and Dynamic Oligopoly: An Empirical Investigation*, "International Monetary Fund Working Paper" 1999, No47/99.

Ho C., Cauley R.N., *Living with flexible Exchange rates: issue and recent experience In inflation targeting emerging market economies*, "Bank for International Settlement Working Papers" 2003, No 130.

Hüfner F. P., Schröder M., *Exchange Rate Pass-Through to Consumer Prices: A European Perspective*, "Center for European Economic Research Discussion Paper" 2002, March.

International Financial Statistics, (2008) International Monetary Fund, Washington, July.

Krugman P., *Pricing to Market When the Exchange Rate Changes*, w: *Real-financial linkages among open economics*, S. W. Arndt, J. D. Richardson (red.), MIT Press, Cambridge 1987.

McCarthy J., *Pass-through of Exchange rates and import prices to domestic inflation in some industrialized countries*, "Bank for International Settlement Working Papers" 1999, No 79.

Meurers M., *Incomplete pass-through in import markets and permanent versus transitory exchange rate shocks*, "Institute for Economic Research Diskussionsbeiträge" 2003, No 83, December.

Monacelli T., *Monetary Policy In a Low Pass-through Environment*, „European Central Bank Working Paper" 2003, No 227.

Otani A., *Pricing-to-Market (PTM) and the International Transmission Effect of Monetary Policy: The New Open-Economy Macroeconomics Approach*, "Bank of Japan, Institute for Monetary and Economic Studies Discussion Paper" 2002, No 5.

Rincon H., Caicedo E., Rodríguez N., *Exchange Rate Pass-Through Effects: A Disaggregate Analysis of Colombian Imports of Manufactured Goods*, "Banco de la República" 2005, March.

Rowland P., *Exchange Rate Pass-Through to Domestic Prices: The Case of Colombia*, "Banco de la República – ESPE" 2004, No. 47.

Sibert A., *Exchange rates, market structure, prices and imports*, "Economic Record" 1992, No 68.

Sims Ch. A., *Macroeconomics and Reality*, "Econometrica" 1980, vol. 1.

Takagi S., Yoshida Y., *Exchange Rate Movements and Tradable Goods Prices in East Asia: An Analysis Based on Japanese Customs Data, 1988–1999*, "IMF Staff Papers" 2001, Vol. 48, No. 2.

Taylor J.B., *Low inflation, pass-through, and the pricing power of firms*, "European Economic Review" 2000, vol. 44.

Webber A. G., *Dynamic and Long Run Responses of import prices to the Exchange rate in the Asia-Pacific*, "University of Wollongong Working Paper" 1999, No 11.

Appendix. Results of the parameter estimate of the VAR model

Ordinary least squares (OLS) estimates using 43 observations 1997:2-2007:4, 1 quarter lag
Log. likelihood = 530,33414
Covariance matrix = 2,2776613e-016
Akaike Information Criterion (AIC) = -23,7365
Schwartz Bayesian Criterion (BIC) = -22,9173
Hannan-Quinn Criterion (HQC) = -23,4344
Test Portmanteau: LB(10) = 192,064 (df = 144, p-value 0,004589)

Equation 1: s

	Coefficient	*Standard error*	*t-ratio*	*p-value*
const	4,21684	2,88902	1,4596	0,15262
s_1	0,105698	0,222856	0,4743	0,63801
imp_1	0,0941488	0,30087	0,3129	0,75605
ppi_1	0,027414	0,919939	0,0298	0,97638
cpi_1	-0,142608	0,764336	-0,1866	0,85298

Equation 2: imp

	Coefficient	*Standard error*	*t-ratio*	*p-value*
const	6,37666	2,31208	2,7580	0,00889
s_1	-0,36403	0,178351	-2,0411	0,04823
imp_1	-0,403907	0,240785	-1,6775	0,10166
ppi_1	0,808503	0,736225	1,0982	0,27904
cpi_1	-0,423953	0,611697	-0,6931	0,49248

Equation 3: ppi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
const	2,49143	0,637063	3,9108	0,00037
s_1	-0,0480772	0,0491424	-0,9783	0,33410
imp_1	-0,00872497	0,0663453	-0,1315	0,89607
ppi_1	0,404161	0,202857	1,9923	0,05355
cpi_1	0,112518	0,168545	0,6676	0,50843

Equation 4: cpi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
const	0,929793	0,495353	1,8770	0,06821
s_1	-0,020852	0,0382111	-0,5457	0,58846
imp_1	0,0195024	0,0515873	0,3780	0,70750
ppi_1	0,093606	0,157733	0,5934	0,55640
cpi_1	0,706263	0,131054	5,3891	<0,00001

Source: Own calculations by using GRETL.