INFLUENCE OF DEPRECIATION ON RETAIL PRICES OF GOODS IN UKRAINE

by

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Abstract

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In this thesis the effect of influence of depreciation on retail disaggregated prices of food products in Ukraine is studied. Using a single-equation Error Correction model pass-through coefficients for locally produced consumer goods and import consumer goods are found. It is found that for Ukraine the level of pass-through effect is slightly higher than the typical result for developing countries.

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The special thanks are devoted to my loving parents for consistent inspiration and encouragement.

GLOSSARY

ERPT. The percentage change, in local currency, of import prices resulting from one percentage change in the exchange rate between the exporting and importing country (Goldberg and Knetter, 1997).

Chapter 1

INTRODUCTION

Over the recent decades the interest of studying the effects of exchange rate fluctuations on the domestic economy occurred both because of the need to test the theoretical frameworks and because of the great influence that exchange rate changes has on the economy, namely the balance of payments and domestic inflation. The main transmission mechanism of the exchange rate fluctuations is through the changes in domestic prices. As a result, a vast literature developed to examine the influence of exchange rate movements on prices of goods. According to the theoretical models the pass-through of the exchange rate changes to import prices should be complete, meaning that import prices should fully reflect the exchange rate movements. The transmission of exchange rate movements to prices is called as the "exchange rate pass-through effect" (ERPT) or in some literature the “pass-through effect” (PTE). Generally, the exchange rate pass-through can be studied to different indicators of prices in given countries – consumer price index, producer price index, import prices, etc. Goldberg and Knetter in 1997 defined the narrowed definition of ERPT as “the percentage change, in local currency, of import prices resulting from one percentage change in the exchange rate between the exporting and importing countries”.

The main stylized fact from the literature is that exchange rate pass-through to prices is incomplete (Isard, 1977; Golberg and Campa, 2006; Frankel, Parsley and Wei, 2005; Feenstra et al., 1989). There are different explanations why exchange rate changes are not fully passed to the price level such as imperfect competition between distributors, presence of non-tradable components in the prices of goods and others.

Recently, it becomes possible to collect a database of prices of narrowly defined goods from retail networks being updated almost daily. Using the disaggregated level data gives us an opportunity to avoid a possibility of biased estimates from the aggregated level data, which ignores heterogeneity of price changes across sectors. In the following thesis, the daily data will be used from a retail network over a period of extreme depreciation, which is of particular interest. A few studies estimated ERPT for Ukraine (Bandura, 2010; Korhonen, 2005), but these studies evaluated the influence on aggregate price measures without the case of such extreme depreciation. Given the existing empirical results for Ukraine, recent large depreciation, and new disaggregated dataset it is important to measure the effect of exchange rate pass-through now in Ukraine. The aim of this thesis is to show how depreciation influences the behavior of retail prices of local and imported goods in Ukraine.

The influence of the exchange rate change on prices of goods is an important factor for policymakers to know, in particular to implement the inflation targeting policy which Ukraine nowadays intends to operate. The knowledge of exchange rate pass-through coefficient gives an opportunity for policymakers to predict inflation at the highly disaggregated level and accordingly adjust the money supply in order to maintain targeted inflation rate. It is a well-documented fact that emerging market economies have a greater sensitivity of prices of goods to exchange rate fluctuations (Corrinne and McCauley, 2003), thus the coefficient of exchange pass-through is of particular importance for policymakers.

In the following thesis, the daily series is used for the period from January 2014 to February 2015 to estimate the ERPT to narrowly defined goods.

The rest of the thesis is organized as follows: chapter 2 provides the review of the literature related to the issue of exchange rate pass-through to the retail prices; chapter 3 consists of the description of the data set used in the estimations; chapter 4 contains the methodology employed in the analysis; chapter 5 provides results and their discussion; conclusions are present in the chapter 6.

Chapter 2

LITERATURE REVIEW

Firstly, I will introduce articles explaining incomplete pass-through with theoretical grounds and empirical articles on developing countries. Then, I will introduce articles that estimated previously ERPT for Ukraine and CIS countries.

Isard (1977) was the first to study exchange rate pass-through. He found that ERPT was incomplete, which led to a lot of empirical papers trying to estimate the pass-through effect (Golberg and Campa, 2006; Frankel, Parsley and Wei, 2005; Feenstra et al., 1989; etc.). To address different reasons for incompleteness of ERPT numerous theoretical models and empirical works emerged. There are a lot of factors that influence the degree of ERPT such as the type of countries taken into account, the type of goods, industries for which it is measured, the overall level of inflation in the country and others. The effect of exchange rate changes is divided into two separate stages: the effect of exchange rate change on the import prices, named as first stage pass-through coefficient, and the effect of the change of import prices on the general price level named as second stage pass-through coefficient. There are different explanations for incompleteness of the first stage pass-through coefficient. First, trade barriers between exporting and importing countries such as tariffs and transportation costs result in incomplete pass-through to prices at the border of importing country. Second, the local costs of retail, storage and transportation goods across importing country reduce price changes of tradable goods introducing a non-tradable component in the cost of goods which doesn't depend on exchange rate fluctuations (Burstein, 2003). Third, distributors can absorb exchange rate changes in their profits in order not to lose the market share or implement other strategic moves (Dereveux, 2008). The strategy in which firms adjust their prices taking into account competition in the local market was named by Krugman (1987) as a "Pricing to Market" strategy.

Explanations provided above result in theoretical models with different assumptions made about the barrier to trade and price-setting behavior of retailer. Frankel and Parsley (2005) distinguished models according to their explanation of price setting behavior: prices are sticky in the local currency in the short run, the exchange rate change will be fully passed into prices and "pricing to market" strategy, introducing competitive behavior between local and foreign firms. A good rationale for "pricing to market" strategy was given by Dornbusch (1987). He introduced an industrial organization model to show how firms compete in foreign markets with local competitors. His model predicts that the extent of pass-through is determined by the proportion of foreign firms present in the market in relation to local firms. If local demand is elastic then foreign firms will absorb the exchange rate change in their prices. Burstein et al. (2003) built a model of exchange-rate-based-stabilizations to find the importance of distribution margins in retail pricing. They found the evidence that fraction of retail prices for distribution costs is equal to 50% for the average good using the disaggregated data for Argentina and the U.S.

There are two stylized facts from the empirical literature: developing countries have a higher ERPT than developed countries (Calvo and Reinhart (2000); Hausmann et al. (2001)) and ERPT for developing countries and industrialized countries decline over the recent years.

The first fact was documented by Calvo and Reinhart (2000) and Hausmann et al. (2001). However Ca' Zorzi et al. (2007) found that for developing countries with low inflation the pass-through to import and consumer prices had no significant difference from developed countries. They estimated a VAR model for main developing countries from three regions: Asia, Central and Eastern Europe and Latin America. Their result provided concrete evidence for the hypothesis that there was a correlation between the level of inflation and ERPT. Different explanations why developing countries tend to have higher pass-through were given by Frankel, Parsley et al. (2005). According to their paper the coefficient of ERPT can be higher for small countries due to the lower number of local substitutes, lower costs of labor and other non-traded inputs.

The fact that ERPT declined over recent years for developed countries was presented by Campa and Goldberg (2004), Otani et al. (2003), Marazzi et al. (2005) and for developing countries by Taylor (2000), Gagnon and Ihrig (2004) and others. There are different hypothesis explaining why ERPT declined over time. First, it can be explained by the overall decline of inflation in the world (Taylor, 2000; Gagnon and Ihrig, 2004). Second, Campa and Golberg (2005) provided the hypothesis that countries may have more imported goods with the less pass-through coefficient, i.e. the composition of import basket changed. Third, Mishkin (2009) found the evidence that there were improvements in the monetary policies. Fourth, the declined pass-through can be explained by a smaller share of traded inputs in the prices of final goods, i.e. the proportion of imported components as constituents of the prices declined.

As existing hypothesis require evaluations of their validity Frankel and Parsley (2005) in theirs paper tried to justify what factors explaining the decline in ERPT and incompleteness of ERPT were important that were introduced in theoretical literature and took into account developing countries. They used the data for individual goods prices and aggregate CPI for 76 countries. Using the error correction model they found that ERPT coefficient had a downward trend for developing countries during 90's, which was twice as much as for high-income countries. Also, developing countries, countries with a high share of foreign firms, countries with higher inflation had larger pass-through coefficients, meaning that Ukraine as a transition country should have rather large coefficient than small in comparison to other countries.

There are two papers that estimated ERPT coefficient for Ukrainian neighbors Russia and Belarus. In 2005 Dobrynska et al. used the monthly data from IFS and State Statistical Committee from 1995 to 2002 for Russia. Using an Error Correction Model it was found that ERPT on consumer prices was equal to 50% which was rather high coefficient. As she concluded Russia was vulnerable to external shocks, so the monetary policy should adjust to exchange rate changes. In 2002 Tsesliuk estimated ERPT for Belarus when part of prices were in the foreign currency. In his work he checked the hypothesis that the pass-through was in positive relation with the currency substitution. He found that ERPT for CPI equal to 14% in the first month and found the evidence supporting this hypothesis.

There are a number of works that try to estimate ERPT for Ukraine. In 2010 a thesis on this topic was written by Pavel Bandura. He estimated the effect of exchange rate fluctuations on domestic prices taking into account endogeneity between the money supply and price level using the VEC model. He used two sets for the price data, one from the Ukrainian State Statistics Committee being monthly indices for individual products and services and the other one from the Ministry of Agriculture for the period of the highest exchange rate change. The extent of the pass-through to CPI equal to 9%, which is not similar to the common result for developing countries (where at least 30% is found). The rate of adjustment was higher for the first month and diminished by the fourth month, which was as predicted for developing countries. He checked the results using the database which is updated every 10 days and found that results were qualitatively the same, so they were not incorrect. However, they need to be estimated more precisely what is the aim of this thesis. Also, I.Korhonen et al. in 2005 estimated in his paper the exchange pass-through rate for CIS countries including Ukraine. They estimated Vector autoregressive model without error correction terms using the CPI from IMF's International Financial Statistic database. They found that the extent of the pass-through is higher in CIS countries than in their comparison group of other emerging market countries (Korhonen et al, 2005). Especially for Ukraine the extent of exchange pass-through was estimated equal to 64% for 12 months and the rate of the pass-through equal to 79% for 6 months and 98% for 12 months. In contrast to Bandura's thesis work they didn't take into account the potential endogeneity problem between money supply and exchange rate.

The following works estimated ERPT to CPI but there are no estimation of ERPT for particular goods for Ukraine. Current work tries to close this gap.

As well, the present thesis can add to the literature by estimating the case of extreme depreciation using disaggregated prices of goods that wasn't previously estimated for Ukraine. Using the daily data can give a possibility of checking a short response of prices to exchange rate changes and avoid bias introduced by using aggregate data. As Ukraine is a transition country the exchange rate pass-through can vary over time given the finding that developing countries has some decline in the ERPT for the recent decade. Estimating the exchange rate pass-through to retail prices give a possibility to predict inflation on the disaggregated level.

Chapter 3

DATA AND DESCRIPTIVE ANALYSIS

A typical dataset for measuring exchange rate pass-through should include price changes occurring in given country, exchange rate changes, monetary indicator for price changes, variable that represents economic activity in given country and variable representing world reasons for price changes. The problem occurs that data are observed in mixed frequencies meaning that some data is available at daily frequency while some data is available at monthly frequency or even at quarterly frequency. Thus, data need to be transformed to a single frequency or estimated by a technique which allows for mixed data. Transformation to a single frequency can be done by aggregating higher-frequency data to lower frequencies or by interpolating lower-frequency data to higher frequencies. As a result of aggregation the information can be lost and the number of observations can become too small. For the case of interpolation it becomes a reason for distortions in the data in the worst case (Zadrozny, 1990). At the beginning stage of research the data are collected both for low frequency estimation and for high frequency estimation.

In the center of analysis is the dataset for prices. It is collected from the online retailer and contains prices for more than 5 thousand consumer goods, most of the prices are updated every 4 days and is relatively complete. All the goods are the food products. As they are the random goods from the retailers it is difficult to classify them because there are single individual goods that can't correspond to any category but some categories were determined. First, imported goods are of the main interest. They were classified in the following categories: dairy products (cheese, butter, creams, ice-creams, yogurts), bakery products (crisps, biscuits, pasta, pizza), candy products (chocolate containing goods and candies), fish and meat (mainly - sausages, ham, bacon; products derived from fish like caviar also correspond to this category), alcohol containing goods (mostly beer and wine, also whiskey and others), vegetables and fruits, spices, coffee and tea, non-alcoholic drinks, spices, sauces and oils. The database contains a lot of cheeses, spices, vegetables and fruits. Other goods are not presented by large amounts. The data have been collected since the last week of January, 2014 to February, 2015. The frequency of collecting data has been changed from 1 day frequency to 4 day during collecting. In order to perform the estimation with the data it is should be transformed to daily frequency, the problem of missed values can be solved by replacing the gap between recorded values with the last recorded observation, linearly interpolating between the last observation before the gap and the first observation after the gap, or "closing up" the series (Giles, 2012). It was chosen to register price changes when they occur because it will introduce less distortions in the data because prices of the goods tend to be fixed in short-run and in the worst case it will just make the lag of the response larger.

With respect to countries-origins of the goods under analysis the main part of the goods is produced in Ukraine – 69%, in EU – 20%, Russia and Belarus – 6%, others – 1%. As Ukraine has a lot of food products produced locally the main part of the imported goods are exotic products that can't be produced in Ukraine.

For exchange rate data the interbank exchange rate can be used, unofficial market exchange rate, the average exchange rate from currency exchangers of different banks and official exchange rate from National Bank of Ukraine. At the beginning of 2014 the official exchange rate was pegged for dollar and as a result, it doesn't represent actual exchange rate moves. Large retail stores make use of banks services to exchange currency, banks supposed to charge commission for their services, that's why the interbank interest rate is not supposed to represent exchange rate faced by retail stores because retail stores should also face additional margins that may vary overtime. Also, interbank exchange rate for some period is fixed and thus don't represent actual exchange rate changes in the currency market. Exchange rate from currency exchangers is provided by banks without obligation to buy or sell currency, thus it is also not a reliable exchange rate. Unofficial exchange rate represent an actual exchange rate at which currency is exchanged at a given date. It is assumed that retail stores face the exchange rate close to unofficial market exchange rate. It is obtained from online sources and available on a daily basis.

As a variable representing monetary factor to price changes money supply is typically chosen, to control economic activity real GDP is used. However, money classification M2 is reported only on a monthly basis and GDP is not reported even on a monthly basis. As a result such variables cannot be included for estimation using daily frequency data. All other factors that can influence prices of goods can be captured by using monthly or quarterly dummy variables.

A daily price for crude oil (Brent) from U.S. Energy Information Administration is taken to represent world factor that influence local prices.

The descriptive statistics of price changes is shown in Table 1 and Table 2. Analysis were made for the goods containing no more than 20 missing values. Mostly the percentage of price changes are small and not frequent, however, there are some outliers that can indicate some pricing strategies of retailers like sales, or typos in the database. However, it is difficult to distinguish cases of sales and real price declines, it is decided not to exclude such cases from the analysis. As expected there is some asymmetry in price changes, the number of increasing changes are almost three times higher than the number of decreasing price changes. From the description of distribution of percentage changes in prices it can be seen that the smallest and the highest percentage changes indicate the presence of discounts in the stores introducing discrepancy in the data. However, the standard deviation is equal to 23.3 and the mean is 7.71, thus it can be concluded that discounts from sales doesn't constitute a significant part of the data set.

Table 1. Description of price changes of goods

Total Number of Goods Analyzed	1475	**Overall Number of Price Changes**	8048
Average Number of Increasing Price Changes per Good	4.11	**Overall Number of Decreasing Price Changes**	1988
Average Number of Decreasing Price Changes per Good	1.35	**Overall Number of Increasing Price Changes**	6060
Average Number of Price Changes per Good	5.46		

Table 2. Description of percentages of price changes

	Percentiles	**Observations**	8048
10%	-9.699	**Mean**	7.711901
25%	0.011378	**Std. dev.**	23.38319
50%	5.772905	**Smallest**	-80.6723
75%	13.5199	**Largest**	529.6296
90%	24.09639		

Figure 1 represents dynamics of exchange rates that are of main interest. As expected exchange rate from unofficial market is higher than interbank exchange rate and the same nature of volatility confirms the validity of the unofficial market exchange rate: peaks of unofficial exchange rate corresponds to peaks of interbank exchange rate mainly without lag. For the period of October, 2014 till November, 2014 it can be seen that interbank exchange rate doesn't have a variability in the values while unofficial exchange rate is variable confirming that unofficial exchange rate is more reliable source of the actual exchange rate movements in Ukraine.

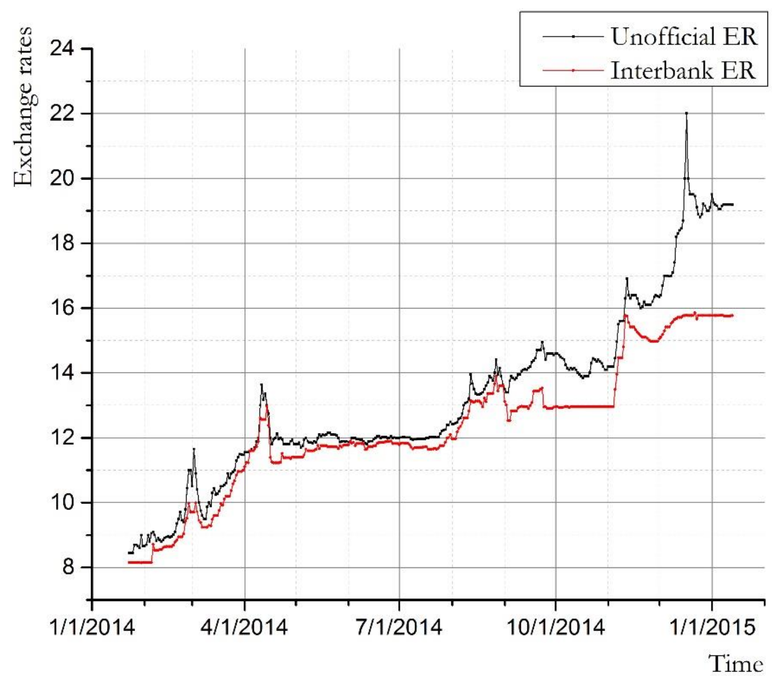

Figure 1. Dynamics of different exchange rates of UAH to USD

Figure 2 shows dynamics of crude oil price. It has a large decline over the period of estimation. It represents the world factor that influence prices in Ukraine.

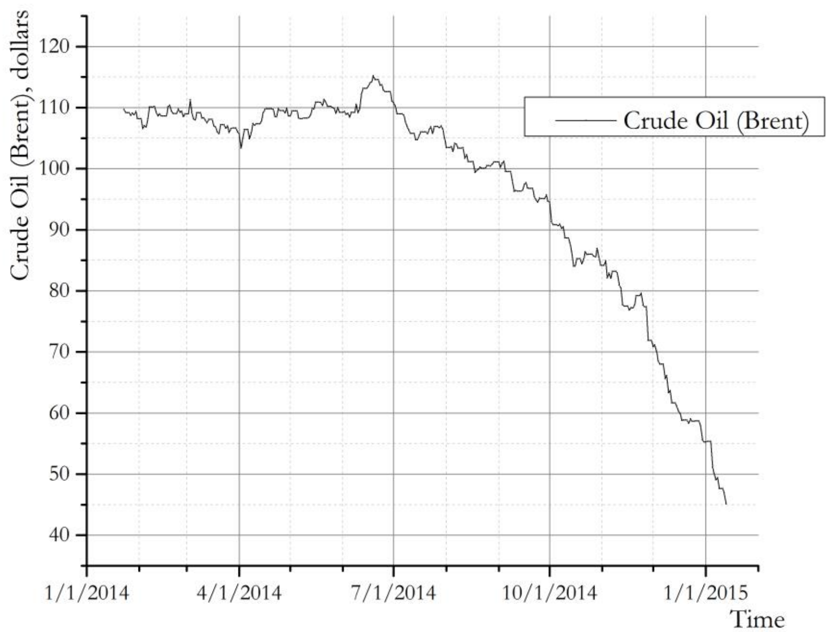

Figure 2. Dynamics of crude oil price changes

It is chosen to make analysis with the daily frequency because the data set of retail prices is unique, the length of the data set is enough to obtain a statistically significant results. Overall inflation in the country may depend largely on the exchange rate change, increase in the money supply, increase in the local costs of distribution. Thus, because of the lack of variables measuring inflation due to local factors it can be appropriate to add dummy variables because of unavailability of corresponding variables with required time series frequency.

The daily data allows for measuring the short responses to shocks and estimation of short run effects even after 1 day is possible. It is not expected that exchange rate shocks should have a fast impact on the prices as the nature of the products requires time to distribute them to consumers.

However, as it can be seen from Figure 3 exchange rate changes may lead to very fast effects on the prices of imported cheese and imported butter.

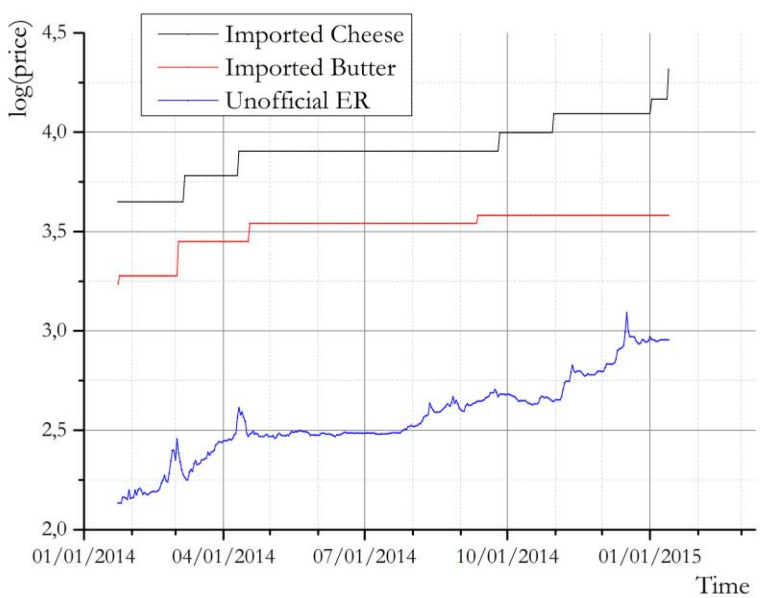

Figure 3. Comparison of price changes of goods with exchange rate changes

Thus, it can be concluded that measuring quick responses of prices is important. Also, from Figure 3 the typical graph of price changes of goods can be seen. It is expected that goods that have price changes should be integrated of order 1 as well as exchange rate and crude oil price.

Chapter 4

METHODOLOGY

In the literature there is a clear distinction in the ways of modelling exchange rate pass-through. First stage pass-through is measured as a relationship between consumer prices and exchange rate. Second stage pass-through is measured as a two-stage process: pass-through from exchange rate to import prices and from import prices to consumer prices. The estimates of the first-stage exchange pass-through can be obtained from different models such as autoregressive distributed-lag models, error-correction models assuming cointegrating relationship between variables.

In the current work specific ERPT coefficient is estimated to every good and obtained ERPT coefficients of local goods compared with those of imported goods. The value of coefficient for local goods is expected to depend on the share of imported components in production. However, the share of imported components in the production is difficult to identify.

First of all, variables should be checked for the order of integration in order to make a selection of the model. From the data it is expected that exchange rate, individual prices of goods should contain the time trend. Augmented Dicky-Fuller test with the time trend was estimated for prices of individual goods, exchange rates and prices of oil:

$$\Delta x_t = \alpha_t + \gamma x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta x_{1t-i} + \varepsilon_t \qquad (1)$$

As expected almost all prices of individual goods are integrated of order 1, only 10,6% of prices of goods reject null hypothesis of unit root but it doesn't causes a problems for further estimation. Exchange rates and oil prices are integrated of order 1. On obtaining the most variables are I(1) there is a need to check for cointegrating relationships between variables. Variables are cointegrated if they have the same order of integration and there is a stationary linear combination between time series. If cointegrating relationship is found then there is a long run relationship between variables and deviations from such relationship will be corrected in the long-run. In the presence of cointegration there is a need to avoid the "spurious regression" problem.

For all goods a test for cointegration was made for the logarithms of three variables in the basic model: the price of the good, the unofficial market exchange rate and the daily price of oil. The test for cointegration was Engle-Granger two-step method. It was found that there is no cointegrating relationships between each two variables but there is a cointegrating relationship between all three variables for the majority of goods. That means that the residual obtained from the following OLS is stationary:

$$p_t = \beta_0 + \beta_1 e_t + \beta_2 oil_t + \varepsilon_{t\,,} \qquad (2)$$

where $p_t -$ log of the price of good in the period t, $e_t -$ log of the exchange rate in the period t, $oil_t -$ log of the oil price in the period t.

However, about third of equations don't reject the null hypothesis of no-stationarity. Given the nature of the variables to capture the short-run dynamics of the relationship between three variables it is appropriate to use single equation error-correction model (ECM). According to Keele and De Boef (2004) single equation ECM can be used to model not only cointegrated data but also stationary data as they provide an evidence of equivalence between autoregressive distributed lag model and error-correction model. As the present data supposed to have short run and long run effects it is appropriate to use error-correction approach to model different effects of shocks.

According to Wooldridge (2004) the single equation ECM can be written as:

$$\Delta p_t = \beta_0 + \beta_1 \Delta e_t + \beta_2 \Delta oil_t + \beta_3 (p_{t-1} - \beta_5 e_{t-1} - \beta_6 oil_{t-1}), \qquad (3)$$

The variables included in the equation (3) are defined as

Δp_t – change in the log of the prices of goods between the periods t and t-1.
Δe_t – change between the log of exchange rates between the periods t and t-1.
Δoil_t – change between the log of prices of oil between the periods t and t-1.
p_{t-1} – log of the price of good in the period t-1.
e_{t-1} – log of the exchange rate in the period t-1.
oil_{t-1} – log of the oil price in the period t-1.
ε_t – disturbance term.

From the equation, coefficients β_1 and β_2 capture immediate effects of changes in exchange rate and oil price on the price of good. It is expected that there should be no immediate effect because of the time required to import, distribute and sell good, ascertain the costs changes, and because of "menu" costs. Coefficients β_5 and β_6 present an equilibrium effect of exchange rate and price of oil on price of good. Coefficient β_3 determines the speed of return to the equilibrium after a deviation. If the error-correction model is appropriate then it should be that $-1 < \beta_3 < 0$ (Keele and De Boef, 2004).

However, from the above model it is difficult to obtain the short-run and long-run estimates and standard errors for them. The short-run coefficients can be directly obtained from the model while to obtain the long-run coefficients and standard errors there is a need to make linear transformations. In order to make it easier to calculate the long-run effects the following model known as a Bardsen ECM was estimated (De Boef and Keele, 2005):

$$\Delta p_t = \beta_0 + \beta_1 \Delta e_t + \beta_2 \Delta oil_t + \beta_3 p_{t-1} + \beta_4 e_{t-1} + \beta_5 oil_{t-1} + \varepsilon_t \qquad (4)$$

The short-run estimates and disequilibrium parameter are directly estimated from the above model with theirs standard errors. The coefficient β_3 represents a rate of return to equilibrium after deviations of exchange rates and oil prices occured and is used to calculate the short-run effects. As an example of interpretation from the obtained estimates price of good will respond by a total amount of long-run change with the spread effect over future periods at a rate of β_3% per period. Coefficients β_1 and β_2 again represent the immediate effect of the changes in an exchange rate and oil price on retail prices. Coefficients β_4 and β_5 are used to calculate the long-run estimates using equation provided below. According to Anindya Banerjee et al. (2003) the long-term relationship between the variables is determined from the equation:

$$p = \frac{\beta_0}{\beta_3} + \frac{\beta_4}{\beta_3} e + \frac{\beta_5}{\beta_3} oil \qquad (5)$$

After obtaining the long-run coefficients there is a need to estimate standard errors for those coefficients.

Again, Keele and De Boef (2005) provided a convenient equation that can be used to obtain standard errors for long-run estimates from the Bardsen ECM:

$$Var\left(\frac{a}{b}\right) = \left(\frac{1}{b^2}\right)Var(a) + \left(\frac{a^2}{b^4}\right)Var(b) - 2\left(\frac{a}{b^3}\right)Cov(a,b) \qquad (6)$$

The above equation was used to calculate the standard errors for obtained long-run estimates.

In order to test for autocorrelation Breusch-Godfrey test for autocorrelation was made. For the model without dummies with inclusion of 1 lag, only 7,85% of goods rejected the hypothesis of no autocorrelation, with inclusion of 10 lags only 15% of goods rejected the hypothesis of no autocorrelation. As the proportion of goods is low autocorrelation is not considered to be a problem.

Single equation ECM allows to clearly distinguish between dependent and independent variables fitting the evidence that exchange rate and oil price changes are exogenous to price changes of goods. Also, it provides an opportunity to specify the short-term and long-term effects of each independent variable on the dependent variable. According to Keele and De Boef, 2004 single equation ECM is appropriate for the case of both long-memoried and stationary data, thus it fit peculiarities of data used.

Chapter 5

RESULTS AND DISCUSSION

Goods were divided on the pure imported goods and local goods. For all goods the estimation was done. For every good the long-run and short-run coefficients and standard errors were obtained. In the following context long-run estimate present an equilibrium relationship that should exist between exchange rate and prices of goods over time obtained from the period of one year starting from January, 2014 to February, 2015. Thus, from the following model the price of the good should fully reflect the estimated pass-through of exchange rate change after one year from shock. The short-run estimate shows a percentage of long-run exchange rate change that is reflected in the prices of goods, thus showing a rate at which exchange rate change is reflected in prices.

In the Table 3 the descriptive statistics of the results of estimated model (4) are given as it is hardly possible to present results of estimation for every good. The coefficients of immediate effect (the effect within one day) were insignificant almost for every good corresponding to expectations that there should be no effect of exchange rate changes within one day. The coefficient of lagged price was significant almost for every good and confirmed that ECM is an appropriate approach because of the satisfaction of the requirement $-1 < \beta_3 < 0$. Coefficient of lagged exchange rate was higher for imported goods and appeared significant more times than for local goods. For every good the long-run coefficients and standard errors were obtained according to formulas (2 - 6).

Table 3. Descriptive statistics of the results for estimation of model without dummies

	Local goods			Imported goods		
Variable	Mean	StDev	Median	Mean	StDev	Median
$\Delta exchange\,rate_t$	0,0038	0,0585	0,0023	0,0003	0,0573	0,0023
Δoil_t	0,0764	0,1835	0,0290	0,0471	0,2598	0,0121
$price_{t-1}$	-0,0456	0,0525	-0,0304	-0,0371	0,0378	-0,0262
$exchange\,rate_{t-1}$	0,0174	0,0265	0,0109	0,0242	0,0295	0,0172
oil_{t-1}	0,0061	0,0202	0,0048	0,0079	0,0218	0,0059
$constant$	0,0556	0,1905	0,0241	0,0344	0,1485	0,0120
$p-val(\Delta ER_t)$	0,6587	0,2789	0,7340	0,6372	0,3284	0,7501
$p-val(\Delta oil_t)$	0,3644	0,3334	0,3231	0,3423	0,3408	0,2337
$p-val(price_{t-1})$	0,0557	0,0876	0,0187	0,0511	0,0784	0,0137
$p-val(ER_{t-1})$	0,2282	0,2432	0,1453	0,1959	0,2314	0,1106
$p-val(oil_{t-1})$	0,3421	0,2955	0,2493	0,3398	0,2946	0,2793
$p-val(cons)$	0,3683	0,3116	0,3064	0,3853	0,3092	0,3501
R^2	0,0476	0,0387	0,0356	0,0420	0,0372	0,0299

For the imported goods the distribution of long-run ERPT coefficients that appeared significant is depicted in the Figure 4. The median is equal to 64,6% and the average of the distribution is 72,3%. However, there are goods that have coefficient larger than 1 and goods that have a very small coefficient. From the Figure 4 it can be seen that a percentage of goods with a small coefficient is almost the same as the number of goods with too high coefficient, thus it is expected that they compensate each other.

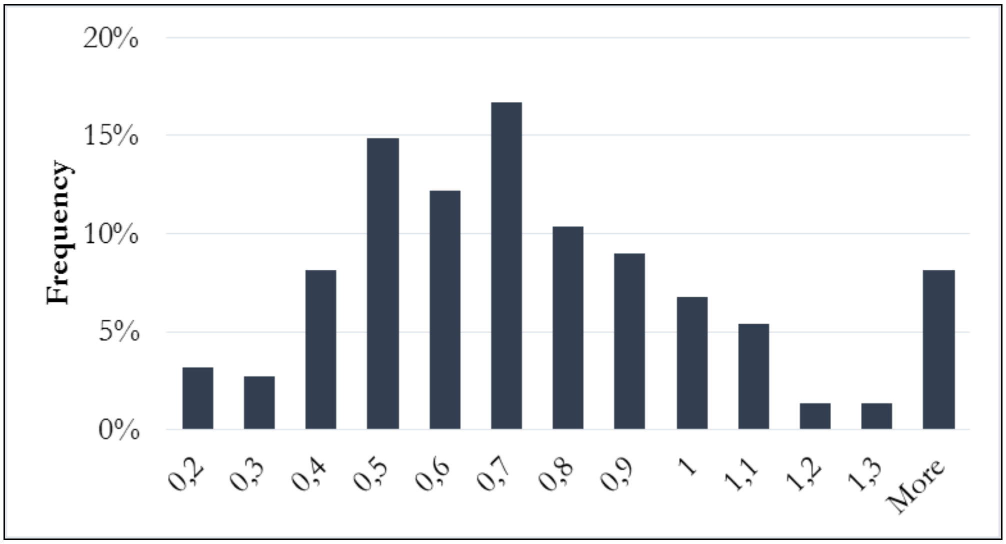

Figure 4. Distribution of ERPT coefficients for imported goods

Calculating long-run effect for local goods produce much lower ERPT coefficients. However, from the theoretic perspective the price of local goods should be influenced directly by the changes in the costs of imported components in production and indirectly by increased demand for local goods that are substitute for becoming more expensive imported goods. Also, because of the increase in the demand for local substitutes, wages should rise pushing consumer prices to further growth. On the other hand, non-traded local costs like the transporation costs, storage costs, advertising costs, tariffs, taxes and other distribution costs should make local prices less vulnerable to exchange rate changes.

On the Figure 5 the distribution of ERPT coefficients that appeared significant for locally produced goods is depicted. The average of the distribution equal to 46,7% and the median is 41,9%. As expected the results are lower for locally produced goods.

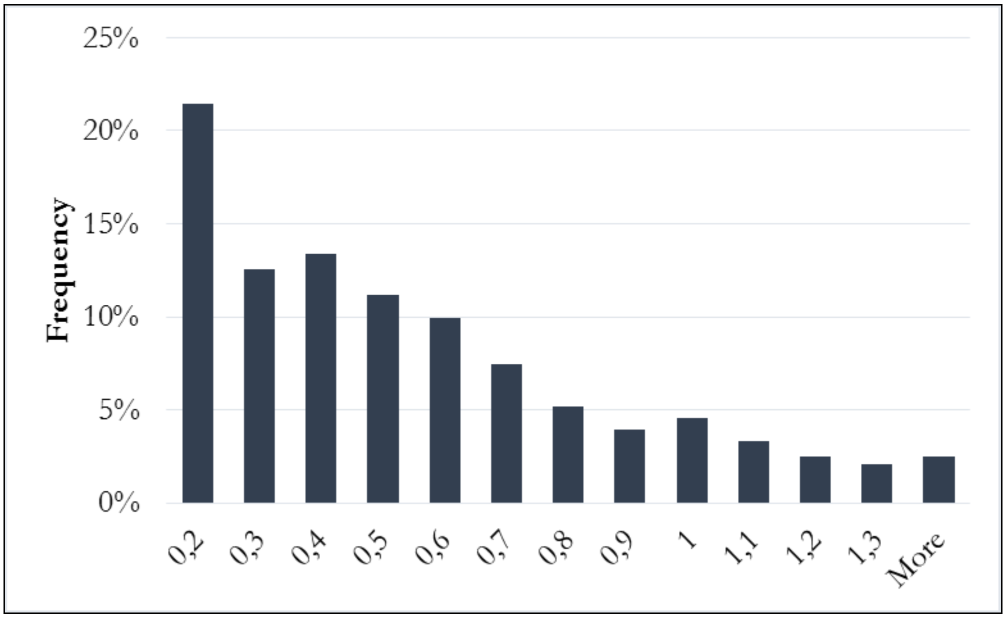

Figure 5. Distribution of ERPT coeffiients for locally produced goods

The results presented above don't account for large number of independent factors, i.e. the variable measuring the income changes in the economy as a proxy for demand changes for goods, the variable measuring the increase in the money supply during given period and the variable measuring the changes in the non-tradable costs. In order to capture all other factors that may influence price changes of goods monthly and quarterly dummy variables were introduced into the model.

The descriptive statistics of the results of estimation for the model with quarterly dummies and monthly dummies is presented in the Table A1 and Table A2 in Appendix correspondingly. By estimating variance inflation factors (VIF) for each regression it was found that with introduction of monthly dummy variables the multicollinearity problem arises as the average maximum individual VIF is found to be equal 61,7 which is unacceptable with rule-of-thumb value of 10. Thus, the results obtained from model with monthly dummies may not give precise estimates for coefficients of lagged exchange rate and lagged price, and therefore for the long-run coefficients of exchange rate pass-through. However, the model with quarterly dummy variables shows a value of average maximum individual VIF across goods equal to 15,1 that also indicates a problem but it not as severe as before and can be accepted because with the presence of multicollinearity OLS estimates are still unbiased but standard errors are larger.

On Figure 6 the distribution of pass-through coefficients for locally produced goods for model with quarterly dummy variables is presented. The average of distribution is 34% and the median is 26%. In comparison with estimation without dummies the average ERPT falls by 12,7%. From the graph it can be seen that there are also outliers with too high pass-through coefficients.

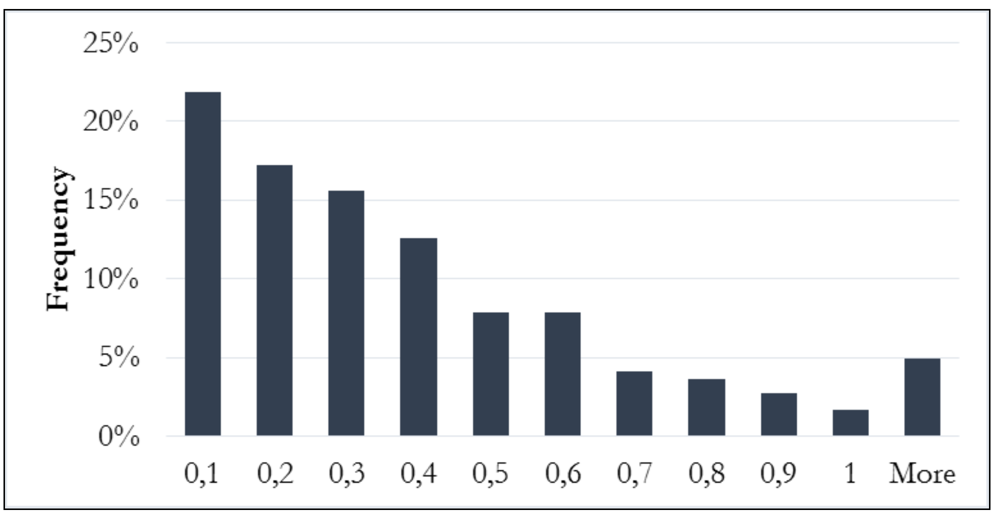

Figure 6. Distribution of ERPT estimates for locally produced goods with quarterly dummies

On the Figure 7 distribution of pass-through estimates for imported goods for the model with quarterly dummies is depicted. The average pass-through from the distribution is 55,4% and the median is 50,9%. In comparison with the estimation without dummies currently presented result gives average pass-through 16,9% lower.

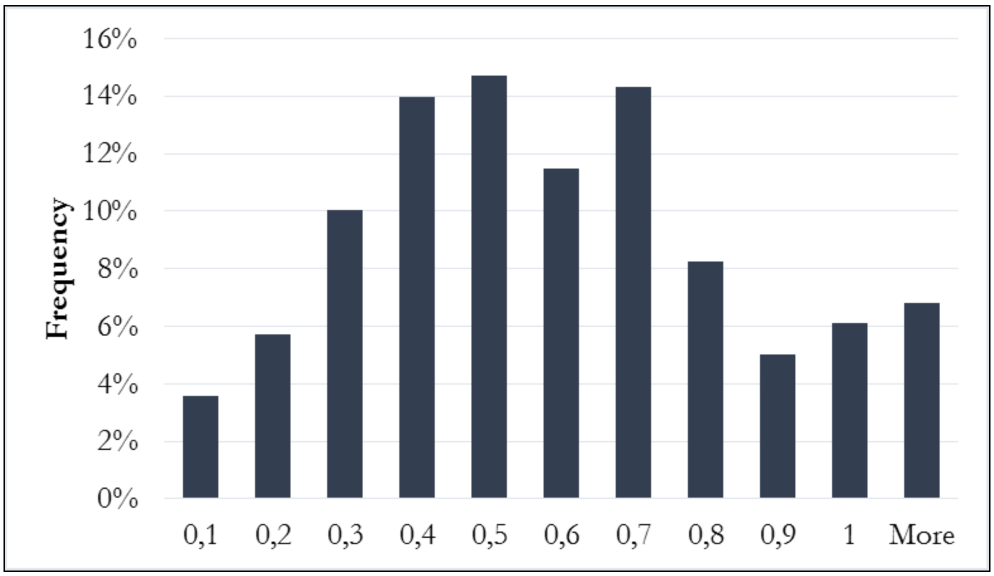

Figure 7. Distribution of ERPT coefficients for imported goods with inclusion of quarterly dummies

Those distributions for locally produced goods and imported goods have different proportions of product categories used to build histograms. Resulting weights for product categories are given in Appendix.

In order to make results more comparable goods were divided on categories: dairy products (butter, cheese, creams and yogurts), bakery products (crisps, biscuits, pasta, and pizzas), candies, alcoholic drinks, vegetables and fruits, sauces, spices and oils. Calculated average pass-through coefficients for categories of imported and local products are shown in Table 4 and Table 5 correspondingly for the model with quarterly dummies and model without dummies.

Table 4. Pass-trough coefficients for different categories of imported goods

Category	No-dummies model	Quarterly dummies model	Category	No-dummies model	Quarterly dummies model
Creams	52%	53%	Butter	74%	77%
Bakery	56%	53%	Candy	76%	42%
Alcohol	61%	53%	Meat&Fish	79%	63%
Cheese	62%	62%	Vegetables	80%	56%
Coffee&Tea	68%	43%	Oils	82%	56%
Spices	120%	53%			

Table 5. Pass-through coefficients for different categories of locally produced goods

Category	No-dummies model	Quarterly dummies model	Category	No-dummies model	Quarterly dummies model
Dairy	22%	16%	Non-alcohol	31%	17%
Bakery	46%	32%	Meat&Fish	58%	40%
Candies	59%	35%	Crisps	39%	18%
Alcohol	46%	21%	Spices	81%	59%
Vegetables	28%	27%			

There are some significant differences between results of these models. Differences between models can be explained by the different composition of products with significant pass-through coefficients, for example with introduction of dummy variables the average pass-through for imported spices fell from 120% to 53% because many of products from the category become insignificant.

For model without dummies and with quarterly dummies short-run estimates of pass-through effect were obtained for the time of 15 days after shock occurred. It was found that there is no difference between local and imported goods in the rate of adjustment to shock for both models. In the current thesis short-run estimates are calculated as the percentage of the long-run estimate that is predicted to occur during specific time period. For the model without dummies after 15 days on average across goods 54% of the long-run estimate passed to the prices, for the model with quarterly dummies on average across goods 71% of the long-run estimate passed to the prices after 15 days.

Chapter 6

CONCLUSION

This work analyzed the effect of exchange rate changes on the retail prices of particular imported goods in supermarkets. The analysis were made using a daily data from several supermarkets in Ukraine for the period from January, 2014 to February, 2015. The estimation was done using single-equation error correction model allowing to calculate the short-run and long-run effects.

It was found that there is an incomplete pass-through to the prices of imported goods. The distribution of the extents of the pass-through to different goods were obtained with the average pass-through coefficient to the prices of goods equal to 72,3% for model without dummies and 55,4% for the model with quarterly dummies. For locally produced goods results are 46,7% and 34% correspondingly. Present results can be compared to the results from the literature. As the degree of pass-through depend on the type of products it is important to compare it with the same products. For South Africa for import prices of food products after 2 years pass-through was estimated to be 46% (Aron et al., 2014); Parsley et al. (2012) found for the set of countries ERPT to imported goods prices to be slightly larger than 40% and for local substitutes equal to 40%. Thus, the present results quite similar to those in the literature.

The short-run effect was calculated for every good giving a result that on average 54% of the shock from exchange rate change occurred after the 15 days of the shock for the model without dummies and 71% for the model with quarterly dummies.

The main shortcoming of the estimation is the low number of factors taken into account in the estimation, i.e. the absence of the control for factors measuring the amount of money supply changes, economic activity in Ukraine and others.

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APPENDIX

Table A1. Descriptive statistics of the results of model with quarterly dummy variables

	Local goods			Imported goods		
Variable	**Mean**	**StDev**	**Median**	**Mean**	**StDev**	**Median**
$\Delta exchange\ rate_t$	0,0027	0,0573	0,0015	0,0011	0,0571	0,0018
Δoil_t	0,0739	0,1816	0,0264	0,0451	0,2590	0,0108
$price_{t-1}$	-0,0741	0,0714	-0,0551	-0,0546	0,0708	-0,0442
$exchange\ rate_{t-1}$	0,0129	0,0288	0,0055	0,0202	0,0318	0,0118
oil_{t-1}	0,0001	0,0257	0,0003	-0,0001	0,0262	0,0000
$qdum_2$	0,0044	0,0101	0,0022	0,0055	0,0124	0,0037
$qdum_3$	0,0066	0,0142	0,0038	0,0062	0,0171	0,0043
$qdum_4$	0,0047	0,0157	0,0023	0,0036	0,0244	0,0017
$constant$	0,1802	0,2860	0,1160	0,1370	0,2773	0,1018
$p - val(\Delta ER_t)$	0,6457	0,2838	0,7215	0,6275	0,3240	0,7529
$p - val(\Delta oil_t)$	0,3624	0,3351	0,3131	0,3431	0,3423	0,2303
$p - val(price_{t-1})$	0,0272	0,0706	0,0015	0,0535	0,1092	0,0041
$p - val(ER_{t-1})$	0,4254	0,3429	0,4105	0,3714	0,3588	0,2247
$p - val(oil_{t-1})$	0,4252	0,3211	0,4014	0,4113	0,3110	0,3868
$p - val(qdum_2)$	0,2655	0,2777	0,1651	0,3216	0,3002	0,2483
$p - val(qdum_3)$	0,3640	0,3448	0,2473	0,3424	0,3612	0,1512
$p - val(qdum_4)$	0,2655	0,2777	0,1651	0,3216	0,3002	0,2483
$p - val(cons)$	0,2204	0,2840	0,0790	0,2776	0,2988	0,1498
R^2	0,0718	0,0547	0,0602	0,0594	0,0542	0,0452

Table A2. Descriptive statistics of the results of model with monthly dummy variables

	Local goods			Imported goods		
Variable	Mean	StDev	Median	Mean	StDev	Median
$\Delta exchange\,rate_t$	0,0039	0,0529	0,0019	0,0014	0,0565	0,0004
Δoil_t	0,0837	0,1915	0,0345	0,0546	0,2916	0,0283
$price_{t-1}$	-0,1318	0,0954	-0,1069	-0,1169	0,0871	-0,0933
$exchange\,rate_{t-1}$	0,0127	0,0349	0,0072	0,0141	0,0352	0,0097
oil_{t-1}	0,0108	0,0535	0,0113	0,0057	0,0767	0,0105
$mdum_3$	0,0021	0,0116	0,0002	0,0045	0,0141	0,0010
$mdum_4$	0,0040	0,0175	0,0011	0,0095	0,0180	0,0046
$mdum_5$	0,0085	0,0188	0,0047	0,0153	0,0230	0,0101
$mdum_6$	0,0109	0,0212	0,0066	0,0203	0,0236	0,0157
$mdum_7$	0,0135	0,0226	0,0093	0,0224	0,0247	0,0183
$mdum_8$	0,0151	0,0256	0,0103	0,0234	0,0289	0,0184
$mdum_9$	0,0184	0,0282	0,0126	0,0270	0,0301	0,0220
$mdum_{10}$	0,0217	0,0316	0,0160	0,0303	0,0346	0,0246
$mdum_{11}$	0,0207	0,0324	0,0153	0,0295	0,0394	0,0235
$mdum_{12}$	0,0213	0,0341	0,0162	0,0298	0,0539	0,0238
$mdum_{13}$	0,0255	0,0417	0,0187	0,0351	0,0625	0,0286
$constant$	0,2927	0,4510	0,2039	0,3278	0,4841	0,2672
$p-val(\Delta ER_t)$	0,6547	0,2786	0,7319	0,6661	0,2876	0,7772
$p-val(\Delta oil_t)$	0,3654	0,3375	0,3175	0,3619	0,3494	0,2409
$p-val(price_{t-1})$	0,0182	0,0574	0,0001	0,0338	0,0796	0,0003
$p-val(ER_{t-1})$	0,4961	0,3087	0,5174	0,5163	0,2946	0,5472
$p-val(oil_{t-1})$	0,3950	0,3137	0,3293	0,4006	0,3179	0,3559
$p-val(mdum_3)$	0,5599	0,3160	0,6456	0,5515	0,3274	0,6544
$p-val(mdum_4)$	0,4864	0,3247	0,5123	0,4185	0,3344	0,4007
$p-val(mdum_5)$	0,3649	0,3245	0,2870	0,3260	0,3164	0,1971
$p-val(mdum_6)$	0,3102	0,3078	0,2016	0,2357	0,2689	0,1319
$p-val(mdum_7)$	0,2460	0,2891	0,1147	0,1979	0,2604	0,0669
$p-val(mdum_8)$	0,2476	0,2827	0,1257	0,2262	0,2644	0,1292
$p-val(mdum_9)$	0,2224	0,2708	0,1004	0,2069	0,2449	0,0983
$p-val(mdum_{10})$	0,1650	0,2402	0,0420	0,1765	0,2451	0,0626

Table A2. Continued

	Local goods			Imported goods		
Variable	Mean	StDev	Median	Mean	StDev	Median
$p-val(mdum_{11})$	0,2242	0,2699	0,0983	0,2448	0,2804	0,1555
$p-val(mdum_{12})$	0,2779	0,2920	0,1510	0,2997	0,2993	0,2161
$p-val(mdum_{13})$	0,2898	0,2997	0,1704	0,3091	0,3059	0,2114
$p-val(cons)$	0,2694	0,3031	0,1359	0,3117	0,3330	0,1686
R^2	0,1169	0,0685	0,1050	0,1121	0,0710	0,0959

Table A3. Descriptive statistics of ADF test for stationarity

p-value of test

Variable	Mean	StDev	Median
$ln(price)$	0,52768	0,31668	0,562
$d.ln(price)$	0,01568	0,12356	0,000

Variable	p-value of test
$ln(exchange\,rate)$	0,1584
$ln(oil\,price)$	1,0000
$d.ln(exchange\,rate)$	0,0000
$d.ln(oil\,price)$	0,0000

Table A4. Weights of products in the distributions of pass-through coefficients for imported goods

Category	Percentage	Category	Percentage
Vegetables	13%	Oil	4%
Butter	3%	Spices	4%
Cheese	27%	Sauce	7%
Creams	4%	Bakery	6%
Meat and Fish	13%	Candies	7%
Alcohol	4%	Other	8%

Table A5. Weights of products in the distributions of pass-through coefficients for local goods

Category	Percentage	Category	Percentage
Dairy	13%	Non alcohol	6%
Bakery	8%	Fish&Meat	21%
Candies	5%	Crisps	1%
Alcohol	2%	Oil	2%
Vegetables	4%	Spices	6%
Other	32%		