MEASUREMENT OF THE REAL EFFECTIVE EXCHANGE RATE AND THE OBSERVED J-CURVE: CASE OF UKRAINE

by

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Abstract

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The real effective exchange rate is an important economic indicator. It is not directly observable and must be constructed as an index. The construction of such indices requires a number of decisions – which price indices and weighting schemes to use, what currencies to include. These decisions alter the results.

The thesis examines the concepts of the real effective exchange rate and a number of methodological issues relating to the construction of the index. It develops several measures of the real effective exchange rate for Ukraine based on different weighting systems and relative price indices, such as CPI and PPI. In addition, the thesis compares selected measures of the real effective exchange rate in terms of their ability to explain movements in Ukrainian trade balance. The statistical results indicate that changes in the REER index can serve as a determinant of trade balance fluctuations in Ukraine. In addition, simulations suggest the J-curve pattern of trade balance response to the real depreciation as the theory predicts.

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GLOSSARY

Appreciation corresponds to a decrease (or downward movement) in the exchange rate indices in domestic-currency terms.

Consumer Price Index (CPI) is a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services.

Currency weights - the weights that represent the structure of currencies used in trade transactions

Depreciation corresponds to an increase (or upward movement) in the exchange rate indices in domestic-currency terms.

Export and Import Price Indices - are designed to show how prices of a "market basket" of goods or services in country's trade have changed from one period to the next.

GDP Deflator is one way of measuring the price level. It is defined as the ratio of nominal to real GDP.

Nominal effective exchange rate (NEER) - is an index defined as a weighted average of nominal exchange rates.

Price Index is a tool that simplifies the measurement of movements in a numerical series. Movements are measured with respect to the base period, when the index is set to 100.

Producer Price Index (PPI) - a family of indices that measures the average change over time in selling prices received by domestic producers of goods and services. PPIs measure price change from the perspective of the seller.

Real bilateral exchange rate index (RBER) is an index defined in relation to one trading partner.

Real effective exchange rate index (REER) is an index defined in relation to an average for country's all main trading partners, is calculated as a weighted average of country's RBERs.

Trade weights - the weights that correspond to shares of foreign trade partners in the amount of total trade in Ukraine

Unit labor costs are calculated by dividing total labor compensation by real output or, equivalently, by dividing hourly compensation by productivity.

Wholesale Price Index (WPI) measures the average price of goods at the wholesale stage.

Chapter 1

INTRODUCTION

Real effective exchange rate (REER) is a useful summary indicator of essential economic information. It has occupied a major place in theoretical discussion between economists. REER is commonly used as a measure of competitiveness of the traded goods sector and a measure of the standards of living in one country relative to another. Added to that, changes in the real exchange rate are seen as an important part of the adjustment process to real shocks. Movements in the real effective exchange rate may significantly affect inflation and output in transition economies. They can also signal currency crises.

In addition, there is a strong relationship between the real effective exchange rate indices and the current account. Empirically it appears that current account immediately worsens after real depreciation, and then gradually improves within several months period (Krugman. 2000. p.467). This time path of current account is called J-curve. Therefore, the REER can be a good indicator for monetary and exchange rate policies, as policy makers may use it to forecast current account and trade balance in the country.

Considering the importance of the real effective exchange rate, there is a little agreement about forms of the real exchange rate, ways of its measuring and interpretation of its movements. The concept of the REER derives originally from the purchasing power parity (PPP) (Hinkle, 1998, p.43). The real exchange rate is evolved from the theoretical model of dependent economy and is based on the ratio of domestic prices of non-tradables to tradables (Dwyer, 1993, p.1). Hinkle (1998, p.44) states that the real exchange rate for home country can be

defined either in the relation to one trading partner or to an average for its main trading partners. In the first case, it is called real bilateral exchange rate (RBER), and in the second multicountry case, it is called real effective exchange rate (REER), and is calculated as a weighted average. REER index measures how nominal exchange rate adjusted for price differences between a country and its trading partners, moves over a period of time (Lafrance, 1998, p.1).

As some empirical researches indicate, a number of transition countries have experienced real exchange rate appreciation as the initial transformational recession has given way to a recovery (De Broeck, 2001). According to Mark and Broeck and Torsten Sloc (2001), in transition economies this appreciation reflects the progress in their becoming the full-fledged market economies. In addition, authors suggest that as countries of former Soviet Union embark on path of sustained growth, they will also experience the real exchange rate appreciation.

For years of 2000 and 2001, one of the most important achievements of monetary policy in Ukraine is the stabilization of the exchange rate of hryvnia. This factor has had a positive impact on the economic development, and financial stability. However, according to the theory, rather real effective exchange rate than nominal exchange rate matters.

Consequently, the concept of the REER index is becoming more popular now among Ukrainian economists. Generated by different authors REER index series are very similar in their dynamics, and the proposed methodologies are designed rather for scientific than for practical reasons (Kyyak, 2001, Ivanchyk, 2000, and Kryuchkova, 2000). Typically, constructed REER indices are based on CPI taken for price index. Many methodologies take into account weights for many trading partners, up to 20 countries, which is not relevant for practical usage of index. Therefore, the primary target of the research is to develop the methodology for

the construction of the REER index, which coincides with theoretical background, on the one hand; and is workable in practice, on the other.

Therefore, this thesis concentrates on the estimation of the REER index for Ukraine, which can be used as an indicator for monetary policy. The estimation presents such empirical problems as the choice of weighting system appropriate for Ukraine, price indices, and currencies, which should be included in the construction of the REER indices. In the research, we try to develop a methodology, which could be carried out relatively quickly with the limited amount and periodicity of data. This makes it available for usage by policymakers.

The applying of various foreign and domestic price indices and different weighting systems results in differences among the measures of the REER. Hinkle (1998) states that similar types of price indices should be used for both the home country and its trading partners, with the type of index depending upon the theoretical concept being used. In addition, Ellis (2001, p.2) argues that an index weighted by import shares might be most appropriate when investigating the effects of real effective exchange rate movements on the domestic prices of imported goods. An index weighted by export shares might be more appropriate for investigating the effect on competitiveness of domestic export.

In order to construct the real effective exchange rate we use similar price indices for all countries, since they cover a representative basket of goods and services that are comparable between countries (Lafrance, 1998, p.4). For the estimation of the REER indices for Ukraine, we use such indices as PPI, CPI, due to the limitation in availability of data for other price indices.

In order to construct the REER for Ukraine, we use three currencies: Euro, US dollar, and Russian rouble. We include Euro and Russian rouble, since European Union and Russia are main trading partners of Ukraine, and U.S. dollar, since

most of trade contracts are sighed in USD. We construct REER indices based on export, import, and total turnover weights, equal weights for all three currencies, and currency weights.

In addition, we argue that the change of the REER significantly influences the competitiveness of Ukraine on the world market. It is one of the key variables that determine trade balance dynamics and it is the essential indicator of economic development of Ukraine.

The structure of the thesis is as follows. In the next chapter we review relevant literature on the measurement of the REER and develop its definition. In Chapter 3 the institutional arrangements are considered. The methodology for the construction of REER indices for Ukraine is discussed in Chapter 4. Chapter 5 provides alternative REER indices and explores the impact of the changes in REER on the trade balance. Finally, in Chapter 6 we draw conclusions.

Chapter 2

LITERATURE REVIEW

The concepts of the real exchange rate

Real exchange rate is a useful summary indicator of essential economic information. It has occupied a major place in theoretical discussion between economists of different countries. However, among all those works there is no clear agreement on how real exchange rate should be measured. This fact has led to the existence of many alternative models, theories and indices that could be used for the construction of real effective exchange rate.

The concept of the real exchange rate initially comes from purchasing power (PPP) theory. According to Rogoff (1996, p.647), real exchange rate tends toward PPP in the long run, however, the speed of the convergence is extremely slow. Krugman (2000. p. 429) argues, that deviations from the relative PPP can be reviewed in a country's real exchange rate, the price of a typical foreign expenditure basket in terms of the typical domestic expenditure basket. However, the history of the real exchange rate and its analysis during last years confirm that real exchange rates are nonstationary and assessment from the PPP point of view is not highly acceptable (Frait, 2001. p.3).

Mark De Broeck and Torsten Slok (2001, pp.10) construct the real exchange rate from the relative prices of tradables and nontradables. They used the following real exchange rate decomposition (MacDonald, 1997, pp.6): $q_t \equiv s_t - p_t^* + p_t$ (1), where q_t denotes real exchange rate, s_t is the nominal exchange rate (the foreign currency price per unit of national currency), and p_t^* and p_t are the foreign and

domestic price levels, respectively (with all variables in the logs). As this equation shows, the rise (fall) in the q_t indicates appreciation (depreciation) of the real exchange rate.

The same type of equation can be formulated using the prices of tradable goods:

$$q_t^T \equiv s_t - p_t^{T*} + p_t^T \quad (2)$$

Also, as we know from the theory, the general prices can be decomposed into prices of tradable (p^T) and nontradable (p^{NT}) goods:

$$p_t = (1-\alpha_t)p_t^T + \alpha_t p_t^{NT} \quad (3) \qquad p_t^* = (1-\alpha_t^*)p_t^{T*} + \alpha_t^* p_t^{NT*} \quad (4)$$

If we make several transformations (substituting equations (2), (3), and (4), into (1)) we will arrive to the equilibrium real exchange rate: $\bar{q}_t \equiv q_t^T + \alpha_t^*(p_t^{T*} - p_t^{NT*}) - \alpha_t(p_t^T - p_t^{NT})$

This equation highlights three important sources of the long-term real exchange rate variability: unstable real exchange rate for the tradables; movements in the relative domestic prices of tradable and nontradable goods; changes in the weights that were used for constructing the overall price levels in countries (MacDonald, 1997, p.7).

Considering the last productivity-based equation, it is important to state that it will not have an empirical importance if PPP does not hold for tradables or international capital is not mobile. Nevertheless, if all assumptions work, then it is possible to use the last equation for empirical investigations. This was done by Mark De Broeck and Torsten Slok (2001, pp.12). Running the corresponding regressions, they checked for the Balassa-Samuelson effect, which implies that countries with a relatively low ratio of tradables to nontradables productivity will

have a depreciated real exchange rate (a relatively low domestic price level). However, due to the limitation in availability of data for price indices for tradables and nontradables, this approach is often difficult to use for in some transition economies.

In our research, we consider two forms of real exchange rate indices defined by Hinkle (2000): real bilateral exchange rate index and real effective exchange rate index.

The real bilateral exchange rate (RBER) is defined in the relation to one trading partner or currency area (Hinkle, 2000, p.45). It is the easiest way of calculating the real exchange rate index. It compares the value of consumption or production basket of the domestic country with the representative basket of a foreign country measured in the same currency, either domestic or foreign. Therefore, RBER indicates the relative value of the domestic and foreign consumption or relative baskets.

The RBER in foreign-currency term can be calculated as:

$$RBER = \frac{EP^*}{P}$$

where E is the nominal exchange rate, defined as the unit of domestic currency per one unit of foreign currency. P and P* are domestic and foreign price indices, respectively. A decline in the RBER corresponds to a real exchange rate appreciation and reflects an increase in the prices of domestic goods and services relative to the foreign goods and services.

Real Effective Exchange Rate (REER) is defined in the relation to the average of the country's main trading partners (Hinkle, 2000, p.49). It is weighted real exchange rate index:

$$REER = \prod_{i=1}^{m} \left[E_i P_i^* \right]^{w_i} \frac{1}{P}, \quad 0 < w_i < 1, \qquad i = \overline{1..m}$$

where m is the number of trading partners or number of currencies included; w_i is the appropriate weight of each foreign country i (i=1,..,m), and $\sum_{i=1}^{m} w_i = 1$. A geometric averaging technique is typically used, since a geometric index has certain properties of symmetry and consistency that an arithmetic index does not have (Hinkle, 2000, p.50). First of all, the percentage movements in the arithmetic index differ in magnitudes depending in which currency the index is constructed (Ellis, 2001, p.4). In addition, the index based on the arithmetic averages can be distorted when the base period is changed. The geometric index solves these problems. It treats depreciating and appreciating currencies in a symmetric manner, while arithmetic index gives larger weights to currencies that have appreciated (depreciated) in real terms more than domestic currency (Hinkle, 2000, p.50). The geometric average is also more advantageous in using, since the logarithm of a geometric average is the arithmetic average of the logs of bilateral rates.

In the following equation, it is easy to see the link between BRER and REER (for details see Appendix A):

$$REER = \prod_{i-1}^{m} RBER^{w_i}$$

Weighting schemes

There are different methods of calculating the appropriate weights for constructing the real effective exchange rate index. As Ellis states, the choice of weighting scheme depends on the purpose (2001, p.14). Import-weighted indices are generally the most appropriate when assessing the effect of exchange rate

movements on import prices. Export weights are typically used in order to characterize competitiveness of the country.

The simplest and most transparent way to determine country's weights is to use shares of *total direct trade* (exports and imports) (Hinkle, 2000, p.61). In fact, the IMF uses bilateral trade flows for constructing real effective exchange rate indices. Computing import weights is straightforward and is based on *bilateral imports* (Lafrance, 1998, p.3). Assessing the effect of exchange rate movements on the competitiveness is not an easy task. In the *bilateral export weighting system*, the weights are derived based on bilateral trade patterns. But this method of calculating weighs takes into account only the competitiveness between domestic country and direct trade partners and does not consider the possible indirect competition on the third markets. An alternative approach could be the calculation of the *multilateral export weights*, which measure country's share in the world trade (Ellis, 2001, p.15). These weights should better capture the importance of other countries in determining the competitive pressure faced by domestic country, but ignores the competitive effects of the importing country's domestic producers (Ellis, 2001, p.15). The problem of availability the accurate data is an additional disadvantage of this method. Another weighting system is the *double export* one. Under this approach, the export weights are derived as a combination of two elements: a bilateral export weight; and a third-market export weight, which capture competition between exporters from two different countries in a third market (Lafrance, 1998, p.3). Also, when countries have different patterns of trade for import and export, then it is preferable to calculate separate real effective exchange rate indices for import and export rather than averaging them together (Hinkle, 2000, p.61).

Furthermore, trade is sometimes denominated in a major currency rather than in the currency of a trade partner (in Ukraine, trade is priced in USD), so, currency

weights may need to be adjusted to reflect the currency composition of trade (Hinkle, 2000, p.60). It seems reasonable to include all currencies with significant weights in the index. Moreover, RBERs influence patterns of trade. Therefore, fixed weights become less representative as RBERs and patterns of trade change, thus changing trade weights of trading partners. Thus, it is necessary to change country's weights periodically. Recent weights should be used for constructing the real effective exchange rate indices in order to reflect the trade changes reasonably. According to Hinkle (2000, p.61), using current weights also mitigates the problem of changing trade structure but increases the complexity of the calculations required.

If weights are allowed to vary, the index must be spliced together at every period that the weights are changed (Ellis, 2001, p.5). Otherwise, movements in the REER index will be misleading. Ellis describes the possible modification of the equation for constructing REER in order to adjust it to the changing weights (Ellis, 2001, pp.6-7) (for details see Appendix B).

Price Indices

According to Sebastian Edwards (1989, p.24) four alternative price indices are suggested as possible candidates for estimation the real effective exchange rate. However, as he states, most of them relate to the PPP definition. The following price indices were suggested:

- Consumer Price Indices, domestic and foreign - CPI;
- Wholesale Price Indices, domestic and foreign – WPI;
- GDP Deflators – GD;
- Wage rate indexes – WR.

In addition to those indices there are several more that can be used for the constructing the real effective exchange rate. For example, available measures can

include export and import unit values, producer price indices (PPI) and unit labor costs (ULC) (Lafrance, 1998, p.4). Each of the proposed indices has its strengths and weaknesses. Therefore, below there is a discussion of main characteristics of each index, based on the papers of Sebastian Edwards (1989, pp.25-30), Anthony G. Turner (1997, pp.6-8), Lawrence Hinkle (2000, pp.74-96), and Robert Lafrance (1998, pp.4-5).

The CPI is among the most commonly used indices for the constructing the real effective exchange rate. The main advantage of the CPI over other price indices is that it is available monthly in most developing countries. However, it has several disadvantages. It includes a broad group of goods and services, and, thus, it is arguable whether it is a good index for the constructing the real effective exchange rate, since it includes nontradable goods. Therefore, if prices of tradables and nontradable will diverge over time, the CPI could be very misleading indicator. The same problem occurs with the WPI and the GDP deflator. CPI may be distorted by price controls and excise taxes, and, thus, diverges from the underlying costs of production. In addition, the CPI may not accurately reflect the prices of the intermediate goods. Additionally, CPIs for different countries are based on the different baskets of goods, and they reflect consumption patterns that can differ from one country to another. These differences limit the usefulness of real effective exchange rate for comparing standards of living.

The WPI contains mainly tradable goods, and due to this fact, the real effective exchange rate, calculated on its basis, will vary less, than indices calculated on the basis of CPI. Unfortunately, the WPI is not available for many developing countries. Therefore, sometimes the ratio of the domestic CPI or GDP deflator to the foreign WPI can be used. However, this ratio gives a mixed indicator, since we compare foreign prices of foreign goods with domestic prices or

production prices of all goods. The PPI, in its turn, covers more of the tradable goods sector, but its coverage and method of construction vary substantially from country to country. If we compare GDP deflator with the other indices, it is a price index of aggregate production, while CPI and WPI are indices of consumption prices. In addition, GDP deflator is comparable between countries. However, it includes price developments in the nontradables and services such as construction and the government sector. Also, GDP deflator includes export prices but excludes the prices of imports of final goods, whereas CPI does the opposite, including import prices and excluding export prices.

Relative export and/or import unit values have the advantage of excluding nontradables. However, export and import prices may be influenced by short-term pricing to market. In addition, they are not available for many countries.

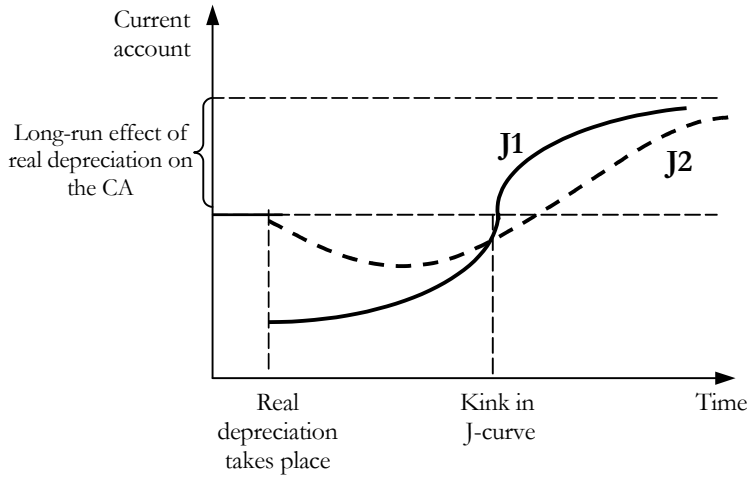
Another price index, often used for constructing the real effective exchange rate, is relative unit labor costs indices, which are considered more stable than other indices. They provide a broad indication of domestic costs of production. However, labor costs are likely to diverge more across countries than other costs of production, and they can be sensitive to cyclical changes in productivity caused by labor hoarding. However, due to the difficulties with obtaining data on unit labor costs in most developing countries, the real effective exchange rate computed on the basis of unit labor cost is less used. Some economists simplify the calculation of real effective exchange rate for developing countries by assuming that productivity differentials are constant. In this restated version, the real effective exchange rate depends on the relative nominal wage rate expressed in foreign exchange terms. Wage data has such advantage as it is available and can be easily compared with other indicators such as GDP per capita.

The concept of J-curve

According to the theory of REER, there is an important linkage between the REER and current account of a country. Empirically it appears that real depreciation (an increase in the REER) immediately worsens the current account, and then improves it several months later (Krugman. 2000. p.467). This time path of changing current account is called J-curve (Figure 1, curve J1). Empirical evidence indicates a J-curve lasting more than 6 months but less than a year for most industrialized countries.

The sharp deterioration of the current account after the depreciation exists due to the fact that most of trade contracts are signed in advance. Therefore, the depreciation rises the value of pre-contracted level of import in terms of domestic product, while the value of exports in terms of domestic product remains the same. Therefore, initially, the current account worsens. As time passes, the gradual adjustment to relative prices change takes place, and current account begins improving.

Figure 1. J-curve.



However, if it takes time before exchange rate depreciation passes through to domestic prices of import, the initial worsening of the current account is not immediate, but also gradual (Figure 1, curve J2).

Chapter 3

AGENTS AND INSTITUTIONS

It is natural for every world economy to possess some level of historical inertia. This refers to a path-dependency argument of institutional economics. Therefore, we need better understand the features of external sector functioning in Ukraine, in particular the relationship between the REER and the trade balance.

We start this Chapter from considering the definitions of Markets, Agents and Institutions. According to the World Development Report 2002 (2001, pp.3-20), markets allow people to use their skills and resources and to engage in higher-productivity activities if there are institutions to support those markets. Institutions are rules, enforcement mechanisms, and organizations supporting markets. We may suggest that as distinct from policies, which are the goals and desired outcomes, institutions are the rules according to which agents interact and the organizations that implement rules and codes of conduct to achieve desired outcomes. Policies affect which institutions evolve, but institutions also affect which policies are adopted. Institutions have to support effective markets, and make people wish to use them.

From the earlier section of the Literature Review, we know that one of the parameters that influences pattern of the REER indices is the nominal exchange rate of Ukrainian Hryvnia against currencies of its trading partners. Therefore, we consider the determinants of the nominal exchange rate of Hryvnia. The exchange rate, in turn, depends on the imports and exports, as well as capital inflows and outflows. Therefore, we examine Ukrainian external sector of the economy and foreign exchange market. The major participants in the foreign

exchange market are the NBU, commercial banks, exporters and importers. Individuals may also participate in the foreign exchange market, but they do not really influence the exchange rate.

Before independence, the external sector of Ukraine was characterized by the fact that international activity was completely monopolized by the government. Volumes of exports and imports were defined by the central plan, and any international activity required special approval from central government. In addition, trade with the Soviet Union countries was characterized by high level of intra-industry trade due to vertical production links and significant portion of industrial products. Therefore, when Ukraine became independent, its main trading partners were countries of former Soviet Union. This situation is changing now, as Ukraine starts 'turning west'.

In addition, we may state that during the early years of transition (1995-1996) the volumes of exports and imports increased substantially with a negative merchandized trade balance throughout the period. In the later period, the volumes of trade, both export and import gradually decreased, while maintaining the negative trade balance till 1999. Nevertheless, the share of exports in GDP of Ukraine was increasing during all of the transition period (see Table 1).

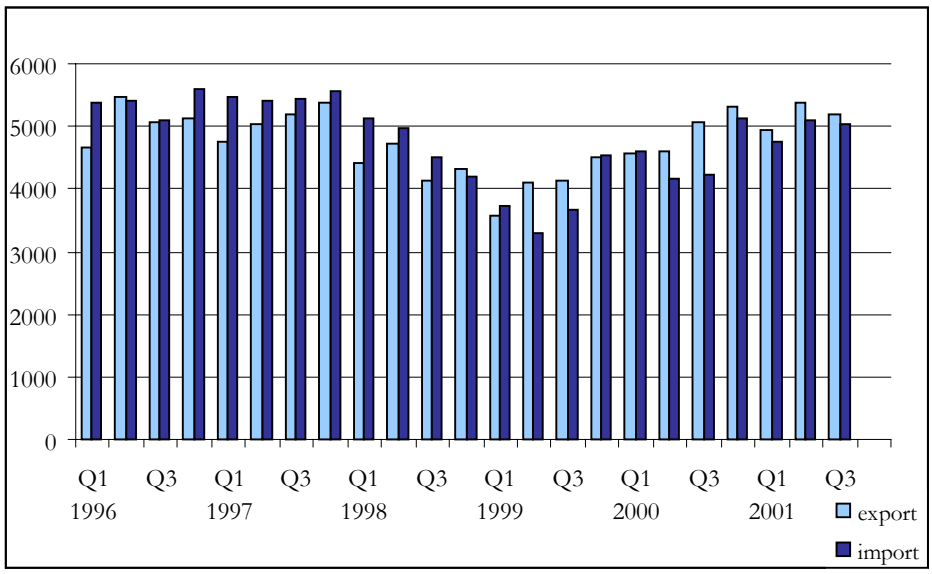
Table 1. Ukrainian exports-to-GDP ratio dynamics.

Year	**Share of export volume in GDP**
1996	45.7%
1997	40.6%
1998	42.1%
1999	51.7%
2000	61.6%
2001	56.2%

Source: NBU, Main Macroeconomic indicators; own calculations

The pattern of trade balance had changed over time from deficit to surplus (Figure 2). In 1999, for the first time, trade balance surplus arose. However, the structure of exports for all these years is characterized by the predominance of raw materials, semi-finished goods and prepared raw materials. The import structure is prevailed by large percentage of transactions involving give-and-take raw material, existence of barter schemes.

Figure 2: Volumes of imports and exports in Ukraine (USD mln)



Source: NBU, Balance of Payment

Today, a majority of exporters (mainly from metallurgic sector) views devaluation as the Ukraine's only competitive advantage on world market (Kyyak, p.2). However, exports volumes depend on imports to a great extend (share of imports in the Ukrainian exports is over 60%), and therefore, exporters might loose from devaluation (Galchynska, p.32). Thus, slow appreciation will not necessarily be a obstacle on the way of economic development of country.

Different Laws of the Verchovna Rada, resolutions and decrees of the Cabinet of Ministers and other government institutions regulate imports and exports in

Ukraine. There are different non-tariff and tariffs barriers, which behave as restrictions to trade. However, there are some privileged industries. For example, the ferrous metal industry has many tax privileges in comparison with other industries. It exports almost 90% of its total production, which is 43% of total Ukrainian export[1]. In addition, there are special trade zones in Ukraine, where enterprises have tax and tariff privileges. The zones are intended to increase investment inflows, and, therefore, to push the development of those regions.

At the foreign exchange market of Ukraine, NBU and commercial banks are main actors. NBU establishes the official exchange rate of Hryvnia against other foreign currencies (Appendix C). In addition, NBU gives individual and general licenses on fulfillment of foreign exchange operations. The general licenses are given to commercial banks and other credit-financial institutions of Ukraine for the accomplishment of on-going foreign exchange operations that do not require individual licenses. Individual licenses are given to residents and nonresidents for fulfillment once-only exchange operation for the period that is necessary for its fulfillment. For providing foreign currency to individuals, authorized banks and other credit-financial institutions (which have the license or temporary permission of NBU for fulfilling the operations of selling/buying cash foreign currency) have a right to open their own currency exchange kiosks (NBU, Resolution #129, 1994). Appendix D provides further details on the subject of exchange rate regulation in Ukraine.

Therefore, when we talk about exchange rate, we have to define the type of the exchange rate. First, the official exchange rate established by NBU serves as an orientation for other kinds of exchange rate. Another one is the banks' exchange rate. The third one is the kiosks' exchange rate, which is established by authorized banks. The last two kinds of exchange rates are more volatile and typically higher

[1] Derzhkomstat, monthly data, October 2001

than the official exchange rate. The latter is relatively stable since NBU conducts the policy oriented on preserving low inflation and a predictable and stable exchange rate (see Appendix E). And, finally, there is a parallel exchange rate that exists in the shadow economy.

Appendix F presents the changes in the exchange rate policy of Ukraine. In 1999, the Hryvnia exchange rate demonstrated relative stability at the beginning of the year, then it depreciated slightly as a result of increased fuel imports for spring planting. Then, a slow depreciation process began. The Hryvnia went beyond the currency corridor during the summer gasoline shortage. The presidential election was an additional substantial destabilizing factor. In contrast to 1997-1999, when the government followed the policy of currency corridor, the National Bank of Ukraine and the Cabinet of Ministers promulgated their joint statements about declaration of floating-exchange-rate regime for 2000 (NBU, Decree, 2000). However, it is not free floating. NBU constantly intervenes to the Interbank Foreign Exchange Market in order to stabilize exchange rate, thus increasing its foreign reserves.

Given the specifics of the Ukrainian economy, the main source of demand and supply of foreign currency at the foreign exchange market are exporters and importers. According to Derzhkomstat, exports and imports of goods grew by 11.6% and 13.0%, respectively, in 2001, still maintaining trade surplus. However, the faster imports growth led to a loss in the merchandise trade balance. Since 50% of inflow of foreign currency of the 1st group of Classifier to the accounts of residents, legal entities, has to be sold through the authorized banks at the Interbank Foreign Exchange Market of Ukraine, trade surplus creates excess USD supply at the Foreign Exchange market (NBU, Resolution, 1998). This in turn causes an appreciation of the nominal exchange rate of Hryvnia. In order to prevent further appreciation, NBU began a policy of 'supporting' the USD, by

buying excess surplus of dollar on the Foreign Exchange market, and, thus, increasing, its reserves (Table 2).

Table 2. Dynamics of the Foreign Exchange Reserves of NBU.

Year	**Foreign Exchange reserves of NBU** ***(mln USD)***	**Foreign Exchange reserves of NBU,** ***weeks of imports***	**Monetary base** ***(mln USD)***
1997	2341.1	5.6	3791,159
1998	941.1	2.2	3521,127
1999	753.5	3.7	2902,382
2000	1628.0	4.3	3083,894
2001	3240.0	7.8	4291,618

Source: Bereslavska, Visnyk NBU, 2002, p.35; NBU Macroeconomic statistics; Derzhkomstat

According to the Main tasks of monetary policy of NBU (NBU. 2002. P.7), the exchange rate policy is aimed to keep stable exchange rate of Hryvnia, and graduate (slight) devaluation of Ukrainian currency. Such policy is aimed to provide financial stability, low inflation and creation of the favorable conditions in external sector activities. In addition, the increase in the international reserves of the NBU and the reaching by them of the international standards is defined as important criteria of the supporting long-term stability of the national currency.

The current level of foreign exchange reserves of NBU is insignificant to deal with the prolonged negative shock. In the January, 2002, NBU used near 4% of its reserves (115 mln. USD) in order to stabilize minor exchange rate imbalances. Therefore, foreign exchange reserves are very sensible to the exchange rate volatility. Thus, NBU should continue its strategy of increasing its reserves.

According to the international standards, international reserves of the Central Bank should cover up to three months of imports. However, as we can see from the Table 2, even now, foreign exchange reserves cover only 7.8 weeks of Ukrainian imports. The Appendix G presents the statistics for CEEC. Another

target for the size of international reserves is that they should cover monetary base of country (actually, this is a requirement for the country that wants to change its exchange rate policy to the currency board). In Ukraine, even now, when NBU significantly increased its reserves, they cover only 75% of monetary base.

Chapter 4

METHODOLOGY OF MEASUREMENT OF THE REAL EFFECTIVE EXCHNAGE RATE

In an idealized world of perfect information, freely and promptly available, REER would be a weighting of bilateral real exchange rate of a given country against the rest of the world, treated as a single country (Wright, 1993. p.2). In practice, the availability and quality of data and, in particular, the price data required for the construction of the real effective exchange rate, is limited. Long-term reliable data is available only for developed countries. Hence, any real-world real effective exchange rate must restrict the sample of currencies and countries included.

For constructing the real effective exchange rate indices for Ukraine, we ought to choose the relevant price indices and decide what countries we should include in the final estimation equation. In principle, it is desirable to include all countries whose firms compete with domestic producers. In practice, we tend to restrict the number of countries considered. In this research, we construct several measures of the real effective exchange rate. Then by applying econometric model we try to find the appropriate index that can be used as an indicator for monetary policy.

In the thesis, we use geometric-average real effective exchange rate, due to advantages discussed in the Literature Review. Therefore, we use the following equation for the construction of REER indices for Ukraine:

$$REER = \prod_{i=1}^{m} \left[E_i P_i^* \right]^{w_i} \frac{1}{P}, \quad 0 < w_i < 1, \qquad i = 1,..., m$$

where E_i is the nominal exchange rate, defined in units of Hryvnia per one unit of foreign currency. P and P* are Ukrainian and foreign price indices, respectively; m is the number of currencies included; w_i devotes to appropriate weight of each foreign country i (i=1,..,m).

In the thesis, for measurement of the REER indices we use PPI and CPI, due to limitations in the availability of other price indices for Ukraine. Both price indices have strengths and weaknesses. PPI has some advantages against CPI as it reflects the prices of intermediate goods more accurately. This argument is important since intermediate products (or primary products) are very significant in the Ukrainian trade structure. However, PPI does not cover agricultural sector, which accounts for 8% of total Ukrainian export. The main advantage of the CPI is that it has better coverage, but it involves the prices of nontradables. Moreover, the consumer prices are the subject of more severe regulations by the Ukrainian government and, thus, do not accurately reflect true market tendencies.

The decision on an appropriate weighing system is more complicated.

Weighting systems

There are two methods available for the determination of weights. In one method, the weights represent the structure of currencies used in trade transactions (currency weights); in another, the weights represent the structure of foreign trade (trade weights). According to these approaches of defining weights, we develop several measures of weights.

In general, theory suggests including currencies of all trading partners of Ukraine that take a significant share in the country's trade flows. However, we should take into account that near 70% of trade is denominated in USD (even though USA stands only for 3.5% of total exports and 2.9% in imports). Moreover, Ukrainian

trade is reported in USD. Nevertheless, we cannot ignore the movements of currencies of Ukraine's major trading partners (European Union and Russia), since rather fluctuations in the value of their currency influence the bilateral trade. Thus, currency denomination in contracts is not the main factor that determines the foreign demand for Ukrainian goods, and Ukrainian demand for foreign goods. Real demand for our export depends rather on real income measured in the domestic currencies of Ukrainian trading partners.

In addition, since the target is to provide the indicator, which is easily measured and workable in practice, involving the large set of currencies is not convenient for this purpose. Therefore, we consider main features of Ukrainian trade in order to construct relatively simplified weights. Moreover, some trading partners (for instance Turkey) have experienced high inflation and prolonged nominal depreciation of their currencies. According to Buldorini (2002. p.10) it tends to decouple the REER. Therefore, it is not relevant to include those currencies into the measured index.

During 1998-2000, the panel of the major trading partners did not changed, including Russia, Turkey, Germany, China, Italy, Belarus, Poland, Hungary, Bulgaria, Turkmenistan, the USA, and Kazakhstan. Therefore, we use constant weights for whole period of research. While constructing the index for our country, we divide these main trading partners and all other Ukrainian trading partners by regions. As we conclude from exports and imports data, our main trading partners are countries of former Soviet Union (Table 3). They account for near 30% of Ukrainian exports and 57% of its imports (Table 3). The European region follows, and then there is Asia and all other regions.

Table 3: Main trading partners (2001)

	Export % from total export	**Import** % from total import	**Total turnover** % from total turnover
Total	100	100	100
Rest of CIS (*including Russia)*	30.27	57.04	43.75
Russia	22.6	36.9	30
Europe	35.05	31.38	33.27
Asia	23.36	5.34	14.62
Africa	4.90	1.26	3.13
America (*including USA)*	6.36	4.61	5.50
USA	3.5	2.9	3.20
Australia and other Ocean Counties	0.05	0.37	0.20

Source: Derzhkomstat, monthly Trade Balance data

Therefore, before constructing weights, we divide all trading partners to three regions: CIS (including Russia), Europe (EU, and EU candidates), other trading partners (America, Asia, Australia). According to those regions, we use following currencies for the construction the REER indices for Ukraine:

- We use *Russian Rouble* for the CIS countries, since exchange rate of Rouble largely defines the position of other currencies in the region, and thus determines the trade development between the countries. In addition, significant part of trade with CIS belongs to Russia.

- We use *ECU* till 1999 and *Euro* after for the European countries, since the Euro exchange rate captures the fluctuations in most European currencies;

- For all other trading partners (rest of the world), we use US Dollar, since USD is quite significant currency for determining Ukraine's trade with the other world countries. Moreover, none of the remaining regions has a currency that would be more significant than USD. There is a possible criticism that then we could lose the effect of currency crisis in those

countries. Nevertheless, we may defend our decision by considering the fact that the biggest trading partner among Asian countries (China) did not have a devaluation during Asian crisis in 1997. Besides, we include USD since nearly 70% of trade is denominated in this particular currency and it is the main currency for Ukrainian economy. In addition, Ukrainian economy is considered to be highly dollarized. Dollariazation arose from high inflation, currency crisis and the significance of the shadow economy (Curtis, et al. 2001. p.14)

Moreover, Ukrainian trade is mainly denominated in these three currencies. According to NBU data, in 2001 currency structure of trade was following: near 70% in USD, 20% - Russian Rouble, 3.5% - Euro, 0.4% - Hryvnia (Appendix H).

Therefore, we include Russian Rouble, Euro and USD in the construction of REER indices. In table 4 we present weights for each currency. First three models are based on trade weights. The construction of separate REER indices based on the exports and imports weights is necessary, since the patterns of export and import are rather different. Another scheme is based on the combined export-import method. The simplest technique is to calculate the total turnover as $w_i = \frac{w_i^x + w_i^m}{w^x + w^m}$, where w_i^x are export weights, and w_i^m are import weights. As we see, model 2 yields a rather high weight on the Russian Rouble and a low on the USD. Therefore, we develop the fourth model with equal weights for each of three currencies (Mankovska, 2002. p.4). As we see, those weights are very close to weights from model 1. In addition, we build model 5, based on currency weights, that is weights in which trade is denominated.

Table 4: Weights for calculating REER indices.

	Trade weights			Model 4 Equal weights	Model 5 Currency weights
	Model 1 Export	Model 2 Import	Model 3 Total turnover		
Rouble	0.30	0.57	0.44	1/3	0.20
USD	0.35	0.12	0.23	1/3	0.70
Euro	0.35	0.31	0.33	1/3	0.10

Linkage between REER indices and Trade Balance

Recent empirical works support a strong linkage between REER and trade balance (TB), and show the pattern of dynamics of the trade balance in response to changes in the REER. For example, Shirvani and Willbratte (1997) provided empirical results of evidence of a reversed L-curve effect of real depreciation on the U.S. trade balance (under this effect, the short-term adjustment is negligible). On the other hand, Boyd et al (2001) show the evidence of J-effect in Canada, Italy, Japan, and the UK.

Therefore, as the second part of the research we check for the significant impact of REER fluctuations on trade balance dynamics and the evidence of such effects for the Ukrainian economy. If there is such relationship, then constructed REER indices can be used as indicators for monetary policy.

There have been several attempts to explain Ukraine's trade dynamics by fluctuations of nominal or real effective exchange rate. Most of them considered the influence of a change in the index on import and export flows separately (see Ivanchyk, 2000, Galchynska et al., 2001, and Piontkivsky, 2000). Their studies conclude that exchange rate fluctuations do influence the export and import dynamics.

Nevertheless, in the general picture of import and export growth, we consider the trade balance as the more important parameter for Ukraine's economy. Therefore, after the construction of the REER indices, we investigate the pattern, of the influence of the REER deviations onto the trade balance of Ukraine.

In order to check whether REER determines dynamics of trade balance, we can run following regression:

$$TB_t = c_0 + \sum c_i REER_{t-i} + \varepsilon_t ,$$

where TB_t – current account at the time t

c_i – coefficients, i=1,…n; i – necessary amount of lags.

$REER_{t-i}$ – lagged real effective exchange rate indices

The equation is rather simplified, however, it can serve to its main purpose of checking whether REER can be used as an indicator for policymakers. We expect that coefficients near the REER are significant and are negative near lower lagged indices and positive near higher lagged indices, due to the existence of J-Curve effect.

Chapter 4

EMPIRICS

Data

The period analyzed in the thesis covers the time-interval 1996 – 2001. We start the investigation from 1996 due to the changes in the methodology of calculation trade variables, which had changed starting from 1996, making trade data more reliable. The sample includes 24 observations of quarterly data.

Our empirical investigation begins with the calculation of the NEER indices and is carried out with quarterly data on exchange rate of Hryvnia against Russian Rouble, US Dollar, and the relevant European estimated currency - the ECU before 1999 and Euro after that period. We use official exchange rates, established by NBU. For the construction of REER indices, we use quarterly data for the price indices for the trade partners of Ukraine. Since we use three currencies for construction the REER indices (RUR, UAD, and Euro), we use the data of CPI and PPI for USA, Russia, and EU as proxies for price levels of trade partners. For Ukraine we take data on price indices from Derzhkomstat. For USA and Russia data is taken from the IMF's International Financial Statistics (IFS) CD-ROM'2001, and for the EU it is taken from the official site of the European Central Bank (http://www.ecb.int).

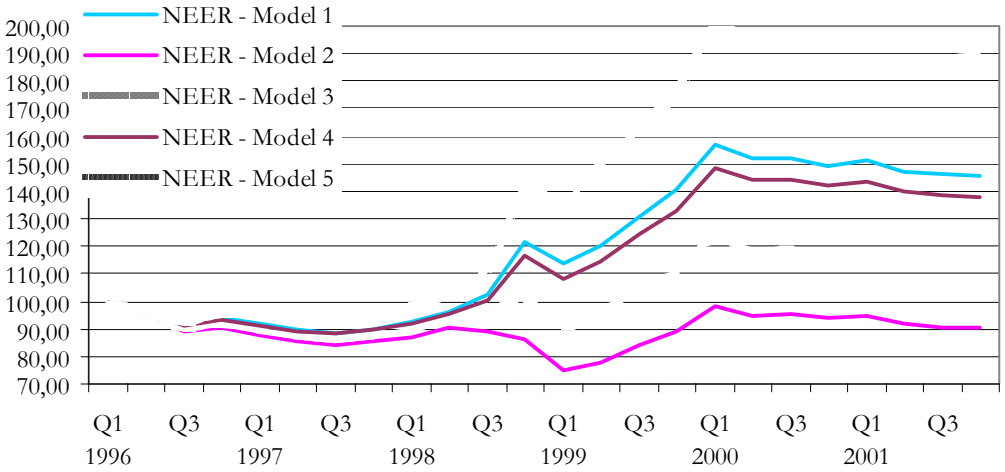
Our further investigation is based on the data for trade balance of Ukraine. During the year, the Derzhkomstat provides only cumulative data for those variables. Thus, if we calculate the monthly data by subtracting method we receive systematic error, which is difficult to eliminate. Hence, we use the quarterly data from NBU, which is more reliable. Therefore, in the model we use

quarterly data on trade balance, deflated by the U.S. GDP deflator, since it is reported in terms of USD. In addition, we seasonally adjust trade balance using dummy variables.

Nominal Effective exchange rates (NEER)

NEER is the weighted-average exchange rate. It constitutes a summary measure of the external value of a country's currency vis-a-vis the currencies of its main trading partners (Buldorini, p.7). We calculate it as $NEER = \prod_{i=1}^{3} [E_i]^{w_i}$, where E_i is the index of the nominal exchange rate, defined as units Hryvnia per one unit of foreign currency; w_i devotes to appropriate weight of each foreign country *i*. As described in the methodological part, we use five models of assigning weights, and three currencies (Table 4). Therefore, we receive five different time series for NEER (Figure 3).

Figure 3: Nominal effective exchange rates of Hryvnia



Source: own calculations based on the NBU data for official exchange rates.

An upward trend indicates a depreciation of Hryvnia, and a downward trend means an appreciation. Therefore, as we see from the graph there was a sharp depreciation of the nominal effective exchange rate of Hryvnia starting from the end 1998. The appreciation began from the February 2000. Moreover, as we see from the graph, the trends are similar for five models. The main difference is in magnitudes of depreciation and appreciation, depending on the weight of Russian Rouble and USD (since weight of Euro is similar in all models, except of Model 5). The models with higher weight of Russian Rouble yield appreciation in 1998, due to the sharp depreciation of Russian Rouble against Ukrainian Hryvnia. On the contrary, models with higher weight of USD (such as model 5) indicate very high nominal effective depreciation of Hryvnia, starting in 1998 and continuing till 2000. In the extreme case (Model 5) it shows 100% depreciation.

Real Effective exchange rates (REER)

We calculate the REER according to the weights derived in the methodological part of the thesis. The Table 5 presents calculated quarterly REER indices. There are two estimates for each model: one based on the PPI, and another based on CPI.

The graphs for the constructed REER are presented in Appendix I. An upward trend on the graphs means a real depreciation, while downward trend indicates a real appreciation. As we may conclude from graphs, all models show similar pattern of REER dynamics over the investigated period. We can group models according to their weights and trends:

Group 1: Model 1 and Model 4;

Group2: Model 2 and Model 3;

Group3: Model 5.

Models of group 1 indicate similar trends and magnitudes of changes in the REER indices, since they have similar weights of each currency. Group 2, which has relatively high weight of Russian Rouble, yields relatively higher appreciation in the 1998, due to the appreciation of Hryvnia against Russian Rouble. On the contrary, Model 5 shows only slight real appreciation, while high level of real depreciation that started in the end of 1998, and continued till year 2000.

Table 5: Resulting REER

		Model 1 (Exports)		Model 2 (Imports)		Model 3 (Total Turnover)		Model 4 (equal weights)		Model 5 (currency weights)	
		REER PPI	REER CPI	REER PPI	REER CPI	REER PPI	REER CPI	REER PPI	REER CPI	REER PPI	REER CPI
1996	Q1	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00
	Q2	94,24	92,28	94,49	92,58	94,37	92,43	94,32	92,34	95,06	92,85
	Q3	88,96	83,85	88,87	83,16	88,91	83,51	88,97	83,79	89,56	84,51
	Q4	91,05	82,20	91,24	81,18	91,14	81,69	91,11	82,11	91,71	83,28
1997	Q1	90,52	78,86	92,88	78,43	91,69	78,64	90,90	78,91	91,937	81,09
	Q2	85,51	76,72	86,42	76,60	85,97	76,66	85,75	76,84	87,81	79,48
	Q3	84,14	75,67	85,27	75,78	84,70	75,72	84,44	75,85	87,24	79,23
	Q4	84,83	75,20	85,59	74,97	85,20	75,09	85,06	75,33	87,48	78,36
1998	Q1	85,05	75,96	86,07	75,93	85,56	75,94	85,33	76,14	88,01	79,74
	Q2	87,03	78,44	87,56	78,22	87,29	78,33	87,25	78,59	90,11	82,25
	Q3	88,13	86,98	82,31	83,49	85,17	85,21	87,58	86,74	93,38	92,07
	Q4	89,23	101,69	71,30	87,54	79,77	94,35	87,05	100,10	99,06	110,84
1999	Q1	83,21	95,84	64,47	80,72	73,25	87,95	80,94	94,17	94,71	106,78
	Q2	89,37	99,75	69,92	84,21	79,05	91,65	87,10	98,12	103,20	112,90
	Q3	97,10	109,66	77,76	93,61	86,90	101,32	94,92	108,02	111,64	123,96
	Q4	105,32	112,94	86,05	95,85	95,20	104,05	103,20	111,20	120,43	128,46
2000	Q1	114,23	115,16	94,05	97,15	103,65	105,77	112,09	113,38	131,85	133,07
	Q2	108,49	106,15	90,31	90,06	98,99	97,77	106,68	104,66	126,74	124,37
	Q3	108,57	104,23	92,41	90,06	100,17	96,89	107,06	103,02	126,59	122,22
	Q4	105,83	100,54	91,17	87,93	98,23	94,03	104,56	99,57	124,13	118,61
2001	Q1	106,35	100,99	91,58	88,92	98,69	94,76	105,01	100,02	123,25	117,10
	Q2	104,30	98,22	90,71	87,33	97,27	92,62	103,16	97,45	121,64	115,05
	Q3	103,05	99,25	90,25	88,30	96,44	93,62	101,95	98,45	118,86	115,64
	Q4	101,79	100,27	89,79	89,28	95,61	94,62	100,75	99,45	116,08	116,24

Although each model has specific characteristics, the REER index constructed according to different models reveals three distinctive phases in the index dynamics during the observed period. In the first phase, which continued till the first quarter of 1999 inclusively, Ukraine experienced real effective appreciation of the hryvnia. The main reason of such trend was higher (comparatively with trading partners) inflation rates in the Ukrainian economy. This corresponds to a common real effective appreciation tendency observed in most transition economies (see Halpern and Wyplosz, 1995). This trend is mainly explained by improvement of terms of trade and Balassa-Samuelson effect (Frait, 2001. p. 6). However, this mode of REER index behavior did not hold during the second phase, which started at the second quarter of 1999 and continued till the first quarter of 2000 inclusively. It was caused by nominal exchange rate depreciation and comparatively higher weighted inflation in trading partners (mainly in Russia). The second quarter of 2000 reverted the tendency toward appreciation of the real effective value of Hryvnia and started the third phase that continues to the end of investigated period. The key reason for such trend is a nominal appreciation, caused by higher relative growth of exports versus imports. Moreover, as Frait argues (2001. p. 29), if transformation processes in transition countries are successful, the REER would move toward appreciation. Therefore, current real appreciation in Ukraine can partially be explained by successful transformation, for example, by financial stabilization.

As can be seen from graphs (Appendix I), the REER based on CPI and PPI show the similar dynamics, but different magnitudes of change. However, the indices based on PPI do not really show the real depreciation in the second half of 1998 (contrary to indices based on CPI). The main reason for this is that in Ukraine there was a higher inflation in the tradable sector, than in nontradables. Therefore, the increase in Ukrainian PPI was comparatively higher than in CPI (from the equation for the REER, it follows, that the increase in domestic price

level causes the reduction in the REER, that is real appreciation). CPI was kept more stable in accordance with the Decree of the President and Cabinet of Ministers in the mid 1998. Actually, contrary to the common view of real depreciation in the last quarter of 1998, the REER indices based on both PPI and CPI indicate a real appreciation due to high real appreciation of Hryvnia against Russian Rouble. The indices based on PPI yield higher level of real appreciation. This can be explained primarily by the high inflation in PPI (during fourth quarter there was a change equal to 17.9%, while annual change in PPI was 35.4%).

Econometric estimation

All data we use for empirical estimation are time series. These are often found to be nonstationary, containing unit roots. Thus, if series contain a unit root, ignoring this fact may result in incorrect statistical inference. Our time series for seasonally adjusted trade balance and calculated REER indices were tested for the existence of a unit root using the Augmented Dickey-Fuller (ADF) test. A unit root cannot be rejected in levels for all time series. However, the first differenced series are stationary. Thus, the trade balance and the REER indices are integrated of order one.

Therefore, since time series are nonstationary and integrated of order one, we should test for cointegration relationship. We use Engle-Granger procedure for testing (Johnston, 1997. p.263). We fit a linear regression of trade balance on a constant and REER index:

(*) $TB_t = c_1 + c_2 REER_{t,i,j} + \sum_{l=1}^{3} a_l d_l + \varepsilon_t$ where i=1…5, j stands for PPI and CPI; and d_l stand for the seasonal dummies.

In order to check for cointegration relationship, we test residuals from each relation for staionarity, applying ADF test. Residuals from the relation of trade balance and REER indices based on PPI are nonstationary and integrated of order one, while residuals from the relation of trade balance and REER indices based on CPI are stationary. Therefore, we conclude that there is no cointegration relationship between trade balance and the REER indices based on PPI contrary to indices based on CPI. Thus, for estimation of the impact of the REER indices based on PPI and CPI on trade balance we apply different econometric procedures.

Estimation of the impact of the REER indices based on PPI on trade balance

Since there is no cointegration relationship between trade balance and REER indices based on PPI (that is residuals obtained from the cointegration equation are of the same order of integration), we simply run regressions in the first differences:

$D(TB_t) = \sum_1 c_i D(REER_{n,t-i}) + \sum_{j=1}^{3} a_j d_j + u_t$, where $REER_n$ are real effective exchange rate indices based on PPI and constructed according to the weights of different models; and d_j stand for the seasonal dummies.

This model was estimated for constructed REER indices based on PPI. The results are presented in Appendix K. As shown, REER helps to identify turning points in trade balance pattern several quarters ahead. All equations indicate the significance of the same order of lags for all calculated REER. The first lag of the differenced REER has a negative sign, while the second lag has a positive sign.

Estimation of the impact of the REER indices based on PPI on trade balance

Since, trade balance and the REER indices based on CPI are cointegrated, we have to use different from the previously described econometric procedure.

According to the Johansen cointegration test, there is one cointegration vector. In addition, we applied Granger Causality test. Since it is often sensitive to the number of lags included in the equation, we performed test up to four lags. Appendix L presents the results of the test. Granger causality test allows us to reject the hypothesis that REER based on CPI does not Granger cause trade balance, while we cannot reject the opposite hypothesis. The exception is only the model 2. We cannot reject the above hypothesis up to three lags (inclusive). However, we can reject the hypothesis that REER based on CPI and constructed according to this model does not Granger cause trade balance taking four lags.

Therefore, for analyzing the impact of REER based on CPI on trade balance, we use error correction model (ECM), since there is a cointegration relationship between trade balance and REER indices based on CPI (Johnston, 1997. p.305). In addition, ECM takes into account both long-term and short-term relationships. Thus, we run following regression:

$$D(TB_t) = \sum_1 b_i D(REER_{n,t-i}) + \sum_1 c_i D(TB_{t-i}) + \sum_{j=1}^{3} a_j d_j + g_l \,\mathrm{Re}s\_k + u_t,$$

where a, b, c, g – are constants, $REER_n$ are real effective exchange rate indices based on CPI and constructed according to weights of different models; d_j stand for the seasonal dummies; Res_k are residuals obtained from the cointegration equations (*), that is this is the deviations of trade balance from long run relationship with fundamentals, k=1…5.

The results are presented in the Appendix M (we consider ECM with three lags according to the Akaike information criteria). As we see, the lagged differenced trade balance does not significantly influence the current one. However, the REER indices have a significant impact on trade balance. The coefficients near first lagged, the third lagged, and in some models near second lagged differences of the REER indices are significant, having negative sign near the first lag, and positive signs near higher lags. In addition, the ECM term is significant, having negative sign and is less than one, implying that the system is stable and converging to the equilibrium.

After estimating the extended version of ECM, we eliminate lagged differences with insignificant coefficients to make model more parsimonious (Appendix N). As can be seen, signs of coefficients near the REER indices do not change. The coefficient near first lag of differenced REER is positive and near second lag is significant and negative (the third lag is not included, since in this specification it is highly insignificant).

Discussion of results

As can be seen from the Appendices K and N, the coefficients near differenced REER indices of the same order of lag are significant and coefficients have positive sign near first lagged variable and negative near the second lag. In addition, in all models the tests of serial correlation, heteroscedasticity and normality of residuals work out favorably (Appendix O).

The significance of our estimation in the range of 44-62 % for adjusted R-squared makes conclusions strong enough to say that constructed REER indices can be used as an indicator for monetary policy (in particular for trade balance

dynamics). Since we have several models, it would be appropriate to identify the REER index with relatively better explanatory power.

Akaike info criterion (AIC) and Schwarz criterion (SC) are typically used as a model selection guide. We are to select the model with the smallest value of information criterion. In addition, we use the adjusted R-squared (the higher is its value, the better is model) and Prob(F-statistics) (the lower it is, the better is model). Therefore, we use four criteria as a model selection guide.

From the Appendix K, we can conclude that REER based on PPI and estimated according to the model 1 yields the relatively better results (it has the highest adjusted R-squared and lowest values of all other statistics). According to Appendix N, REER based on the base of CPI and estimated according to model 4 yields relatively better results (however, the results of this model are very similar to one with export weights). If we compare those two models, we may conclude that according to specified above criteria the REER indices based on CPI and equal weights for all three currencies have relatively higher explanatory power of trade balance dynamics.

As results indicate, the first lag of the differenced REER has a negative sign, while the second lag has a positive sign. Therefore, coefficients have expected signs. However, from the results of the regression, we cannot conclude that they indicate the evidence of J-curve in Ukraine, since variables are in first differences. Therefore, in order to analyze patterns of the trade balance time path after real depreciation, we use simulations. As results indicate (Appendix P) after real depreciation there is an initial worsening of trade balance and then it improves. The trend is similar to the curve J2 at the Figure 1. Thus, even being in the process of transition, Ukrainian external sector displays the properties of J-curve, typical for market economies.

Chapter 6

CONCLUSIONS

In the thesis, we formulated general methodological principles upon which the measurement of Ukrainian REER indices should be based. While it is preferable to include in the construction of REER as many trading partners as possible, it is important to remember about trade-off between country coverage and timeliness. The REER indices that include a large number of countries are typically dated, and often, due to this reason, are not particular useful for monitoring purposes. The methodology developed in the thesis is aimed to construct an index, which is workable in practice. Therefore, we construct REER indices with using weights that include three currencies: USD, Russian Rouble, and Euro. Ukrainian trade is mainly denominated in these three currencies. In addition, as it was argued, these currencies determine the position of currencies of other trading partners of Ukraine. Trade weights were defined according to the shares of exports, imports and total turnover for Ukrainian trading partners. In addition the fourth model with equal weights for all three currencies was defined (its weights are close to export weights). The fifth model uses currency weights. We use PPI and CPI for the estimation of the REER indices. The Hryvnia real effective exchange rates obtained through implementation of the developed models yield similar results. Moreover, they indicate trends similar to models, which include more trading partners (e.g. Stelmah, 2001. p.4; Kyyak, 2001. p.3).

In addition to providing the methodology for the calculation of the REER indices in Ukraine, the thesis tests for effects of change in REER index on trade balance and determines whether the adjustment is characterized by so-called J-curve.

According to the estimation results, indices based on either CPI or PPI have a similar effect on the dynamics of trade balance. However, if we use specified criteria (adj.R-squared, Akaike-criteria, Schwarz-criteria), we may conclude that the Model 1 (based on export weights and PPI) and Model 4 (with equal weights and CPI) construct REER indices which have relatively higher explanatory power. Therefore, these indices can be used as indicators for monetary and exchange rate policy of NBU. However, it is important to note, that we should not diminish the role of indices constructed on the basis of other weighting schemes. All indices are important, and all have to be taken into account while analyzing trade balance.

Moreover, simulations provide the evidence of a J-curve effect of real depreciation on the Ukrainian trade balance. The implications of findings are rather clear. They suggest that given some time real devaluation can improve the trade balance in Ukraine. Therefore, even being in the process of transition and suffering from the inherited distortions from the planned system, Ukrainian economy displays the properties of the J-curve that are typically observed in market economies. The significance of our estimations of 50-60% for adjusted R-squared makes our conclusions strong enough to suggest using the REER index as the indicator for a country's foreign economic position.

The implication of this research may be as follows. As it was discussed in the Chapter 3, NBU currently has insufficient foreign exchange reserves. Therefore, it should continue the policy aimed at reserve accumulation. Due to the specifics of Ukrainian foreign exchange market, one of the sources for that accumulation is trade balance surplus. Thus, we suggest that the REER index should play a role in the NBU's monetary and/or exchange rate strategies. However, sharp real appreciation can negatively effect real economic activity and also create exchange

rate crisis. Therefore, a prudent policy of maintaining real effective smoothness of Hryvnia should be incorporated as a part of any strategy of the NBU.

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APPENDIX A

Linkage between REER and RBER

Real effective exchange rate: $REER = \prod_{i=1}^{m} \left[EP_i^*\right]^{w_i} \frac{1}{P},\ 0 < w_i < 1,\ i = \overline{1..m}$

Knowing $\sum_{i=1}^{m} w_i = 1$, we may rewrite the equation for REER as:

$$REER = \prod_{i=1}^{m} \left[EP_i^*\right]^{w_i} \frac{1}{P} = \prod_{i=1}^{m} \left(\left[EP_i^*\right]^{w_i}\right)\left(\frac{1}{P}\right)^{\sum w_i} = \prod_{i=1}^{m} \left[\frac{EP_i^*}{P}\right]^{w_i} \qquad (1)$$

Since, real bilateral exchange rate: $RBER = \frac{EP^*}{P}$, we may substitute its value into the equation (1). Therefore, we arrive to the equation, which links bilateral and effective real exchanged rates:

$$REER = \prod_{i-1}^{m} RBER^{w_i}$$

APPENDIX B

Possible modification of the equation for constructing REER in order to adjust it to the changing weights

(Ellis, 2001, pp.6-7)

Assume that at time $t=\tau$, weights change from their previous value $w(i,\tau\text{-}s)$ at time τ-s, to the new value $w(i,\tau)$. Then:

$$REER_t = \prod_{i=1}^{m} RBER_{it}^{w(i,\tau)} \times Q_\tau$$

where Q_τ is a splicing adjustment calculated as:

$$Q_\tau = \frac{REER_{\tau-s}}{\prod_{i=1}^{m} RBER_{i,\tau-s}^{w(i,\tau)}}$$

Ellis characterized this method of calculation as a splices Laspeyres index.

Therefore, new real effective exchange rate index is the product of previous real effective exchange rate index, and a Paasche index of bilateral real effective exchange rate indices in that base period and in the current period. Thus, we have a following equation:

$$REER_t = REER_{\tau-s} \times \frac{\prod_{i=1}^{m} RBER_{it}^{w(i,\tau)}}{\prod_{i=1}^{m} RBER_{i,\tau-s}^{w(i,\tau)}}$$

By splicing together the series in this way, weighting schemes can be updated to reflect changing trade partners (Ellis, 2001, p.7).

APPENDIX C

Establishment of the official exchange rate of Hryvnia with respect to other foreign currencies

NBU establishes the official exchange rate of Hryvnia with respect to other currencies on different base[2]:

- everyday – for free convertible currencies (the 1st group of Classifier of foreign currencies) and for foreign currencies of countries that are main external economic partners of Ukraine:
  - with respect to USD – on the basis of analysis about average exchange rate that was established from non-cash transfers of selling-buying of USD by commercial banks on the Interbank Foreign Exchange Market, and also the exchange rate according to which NBU fulfilled operations of selling-buying of USD on the Interbank Foreign Exchange Market;
  - with respect to other free convertible currencies that are used for payments in international operations and are sold on the main world foreign exchange markets – on the basis of official exchange rate of hryvna with respect to USD, everyday fixing of European Central Bank of current cross exchange rates with respect to Euro, current cross exchange rates with respect to USD on the International Foreign Exchange Markets;

[2] Resolution of NBU from March 6th, 2001, #98, Regulation on the establishing and usage of official exchange rate of Hryvnia with respect to foreign currencies

- with respect to other free convertible currencies that are not widely used for payments in international operations and are sold on the main world foreign exchange markets – on the basis of official exchange rate of hryvna with respect to USD, exchange rates of national currencies with respect to USD that are established by central banks of countries of NIS and Baltics, current cross exchange rates with respect to USD on the International Foreign Exchange Markets;

- once a month – for other foreign currencies,

- twice a month – for special right of borrowing.

APPENDIX D

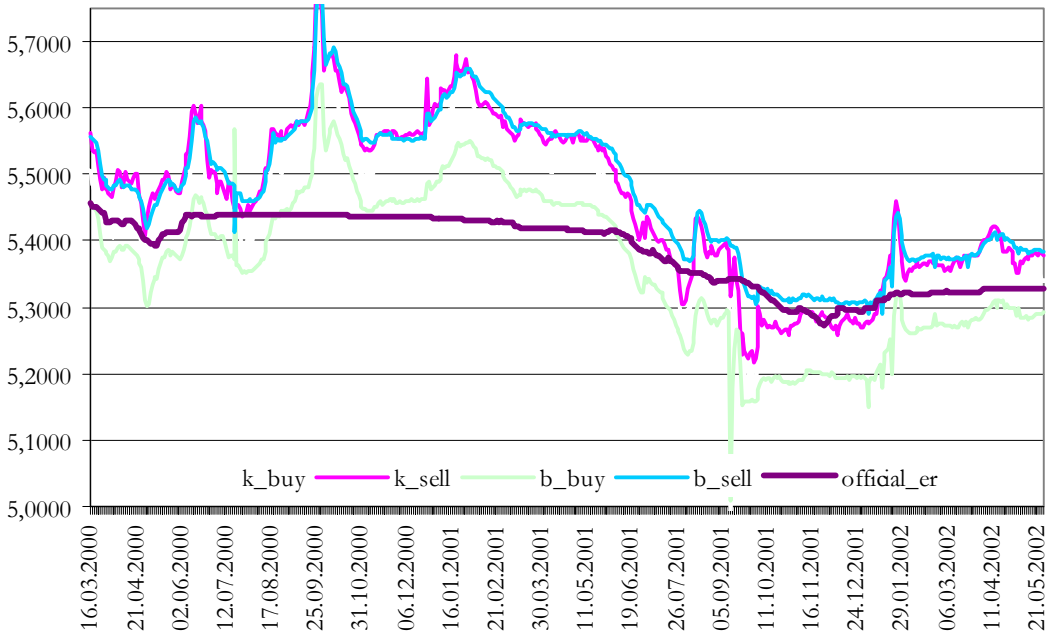
More on the regulation of exchange rate of Hryvnia

Authorized banks can buy foreign currency at the Interbank Foreign Exchange Market of Ukraine in order to fulfill own obligation connected with organization and serving of payments that use charge cards of international payment system (NBU, Resolution#127, 1999). Foreign currency bought through authorized banks and financial institutions at the Interbank Foreign Exchange Market of Ukraine has to be used by resident during the 5 workdays from the day of receiving them on the resident's current account. Money has to be used for the purposes written in the request for the buying of foreign currency.

For the providing of foreign currency to individuals, authorized banks and other credit-financial institutions, which have the license or temporary permission of NBU for fulfilling the operations of selling/buying cash foreign currency, have a right to open own currency exchange kiosks (NBU, Resolution #129, 1994). The currency exchange kiosk of authorized bank is a component of operation hall of the bank, where bank fulfils the operations from selling/buying foreign currency for individuals either residents or non-residents. Also, other legal entities – residents can open currency exchange kiosks on the basis of agent agreement with the authorized bank. Authorized banks, that signed the agent agreement for opening of currency exchange kiosks, have to register them at regional department of NBU. They are also supposed to control the observance of requirements of legislation and NBU by these agent-kiosks. In turn, agents pay certain amount of money to the authorized bank. In addition, authorized banks are establishing the exchange rates for kiosks that belong to the bank or have an agent agreement with this bank.

APPENDIX E

Exchange rate trends in 2000-2002



Source: NBU data, and data from the web-site http://www.finance.com.ua

office_exchange_rate – official exchange rate of Hryvnia with respect to USD

k_buy – buying price of the dollar in kiosks

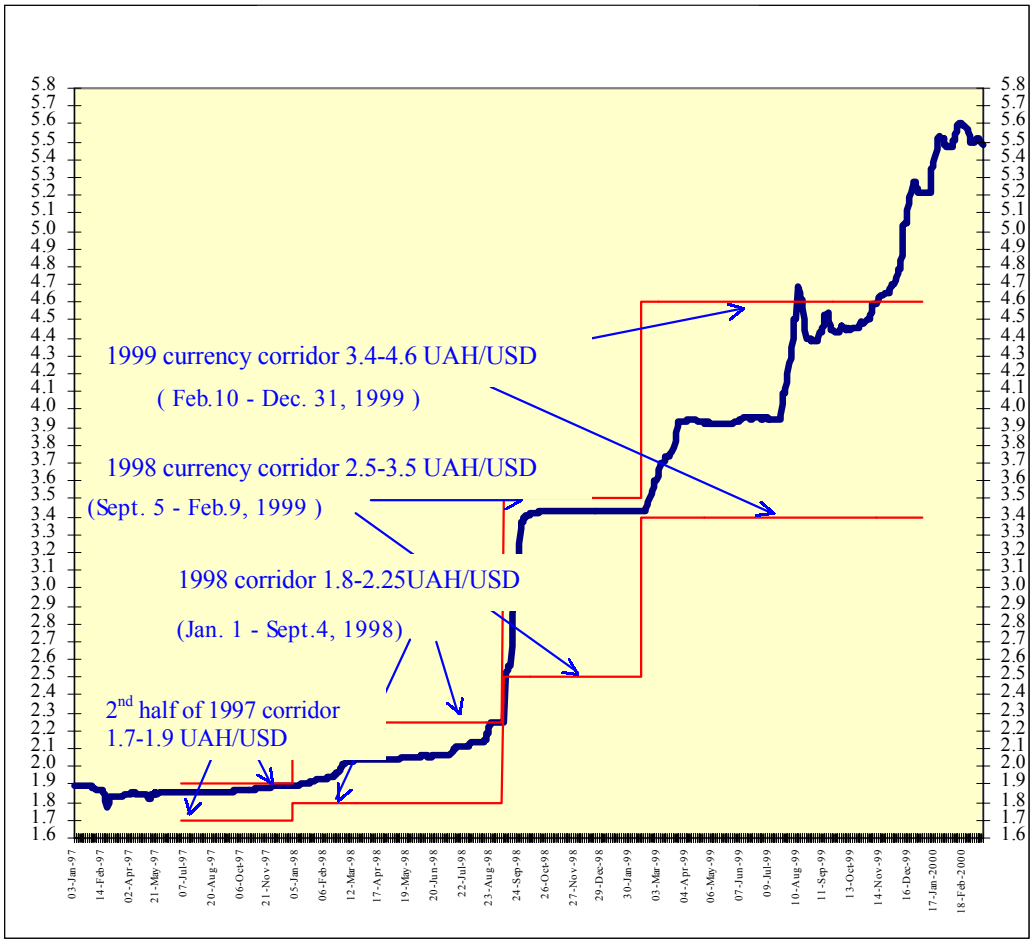
k_sell – selling price of the dollar in kiosks

b_buy – buying price of the dollar in banks

b_sell – selling price of the dollar in banks

APPENDIX F

Exchange rate policy, 1996-2000



Source: Research of the Kinto Investment and Securities, March 2000

APPENDIX E

International reserves, months of imports

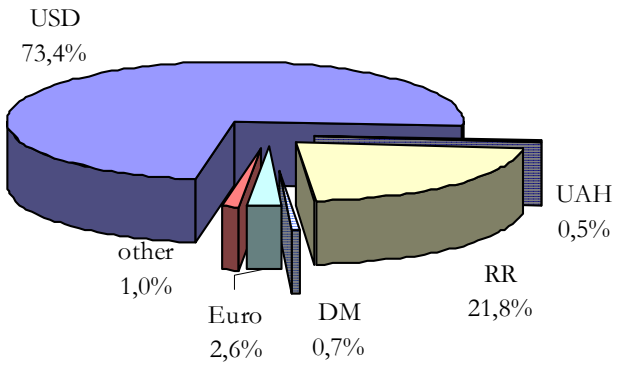
	1996	1997	1998	1999	2000
Belarus	0.6	0.5	0.5	0.6	0.5
Bulgaria	1.0	4.4	5.4	5.3	5.4
Croatia	2.8	2.7	3.2	3.7	4.4
Czech Republic	4.4	3.6	4.4	4.6	4.5
Estonia	2.5	2.4	2.2	2.7	2.4
Hungary	5.7	4.0	4.1	4.6	4.2
Latvia	2.5	2.5	2.2	2.8	2.6
Lithuania	1.9	1.9	2.7	2.7	2.7
Moldova	3.0	3.1	1.4	2.9	2.6
Poland	6.0	5.8	6.6	6.4	6.5
Romania	0.5	2.0	1.3	1.6	2.1
Russia	1.6	1.7	1.3	1.9	4.7
Slovak Republic	3.1	2.8	2.3	3.1	3.4
Ukraine	1.1	1.3	0.5	0.9	1.0

Source: IER. 2002. *Ukraine and the world economy*. p. 51.

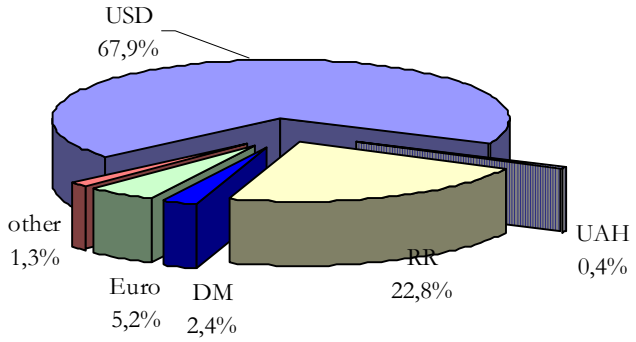
APPENDIX H

Structure of the currencies used in trade transactions

The currency structure of Ukrainian exports



The currency structure of Ukrainian imports

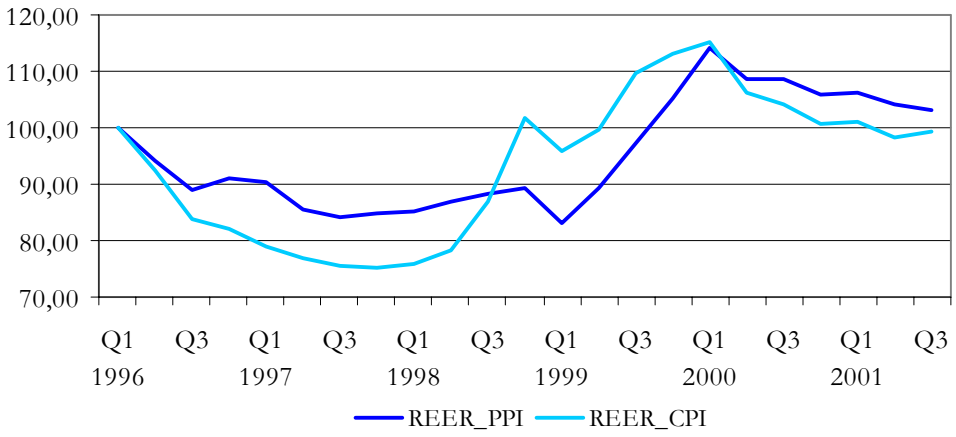


Source: NBU data

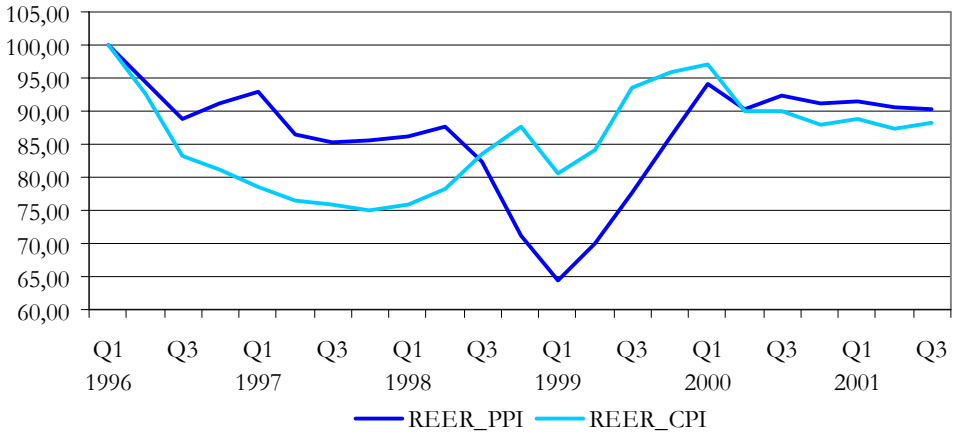
APPENDIX I

Graphs of the constructed REER

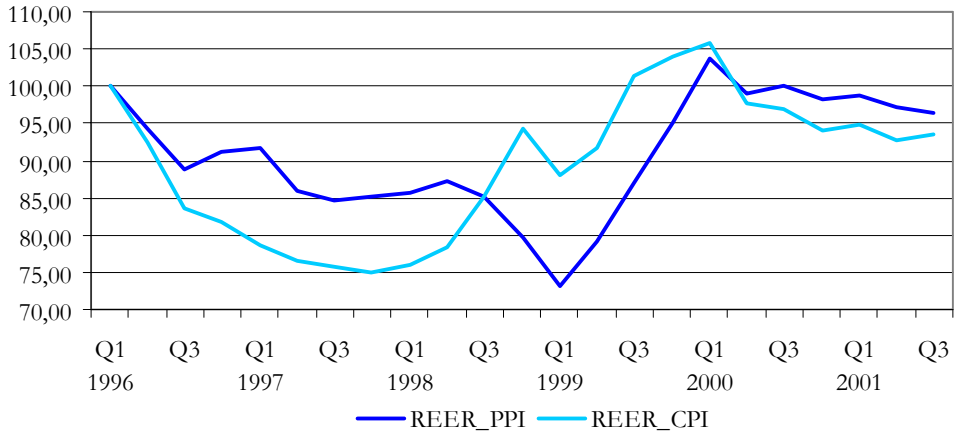
Model 1 (export weights)



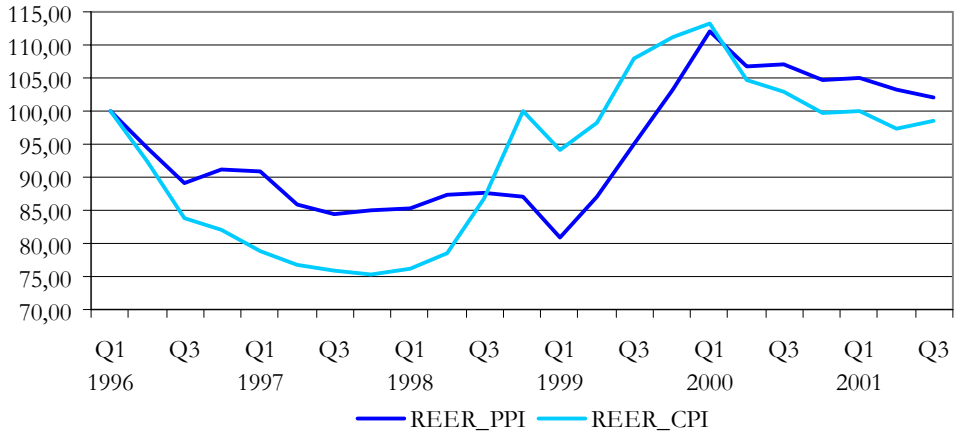
Model 2 (import weights)



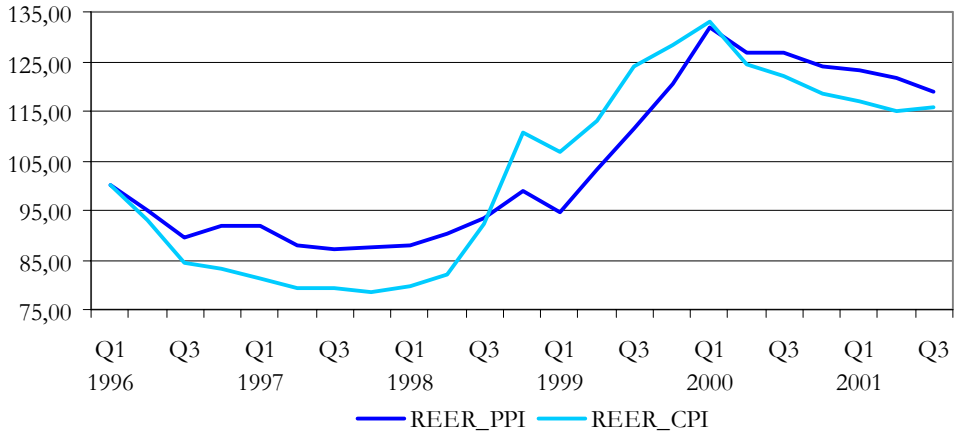
Model 3 (total turnover weights)



Model 4 (equal weights)



Model 5 (currency weights)



APPENDIX K

Estimation output of regressions based on PPI

TB is a dependent variable.

	Model 1 (exp. weights)	*Model 2* (imp. weights)	*Model 3* (avg. weights)	*Model 4* (equal weights)	*Model 5* (cur-cy weights)
D(REER(-1))	-34.02* *(-2.3038)*	-32.31* *(-2.1563)*	-36.93* *(-2.4003)*	-35.35* *(-2.3493)*	-26.07** *(-1.7475)*
D(REER(-2))	-40.18* *(2.8376)*	24.84** *(1.7082)*	33.86* *(2.2899)*	38.91* *(2.6950)*	36.72* *(2.5042)*
Adjusted R-squared	0.56	0.44	0.51	0.54	0.49
Prob(F-statistic)	0.002	0.011	0.0047	0.002	0.0050
Akaike info criterion	14.259	14.485	14.362	14.286	14.478
Schwarz criterion	14.507	14.733	14.611	14.535	14.727

* significant at 1% significance level
** significant at 5% significance level

APPENDIX L

Significance levels of granger causality test for trade balance and REER indices based on CPI

Lags included	Hypothesis (H_0)	Model 1	Model 2	Model 3	Model 4	Model 5
1	$REER_i$ doesn't Granger Cause TB	0.01396	0.12742	0.03499	0.01590	0.00550
	TB does not Granger Cause	0.25532	0.04715	0.10990	0.21799	0.47123
2	$REER_i$ doesn't Granger Cause TB	0.02503	0.42410	0.10506	0.03243	0.00625
	TB does not Granger Cause	0.41594	0.06067	0.20444	0.37091	0.63158
3	$REER_i$ doesn't Granger Cause TB	0.01313	0.17321	0.04497	0.01664	0.00332
	TB does not Granger Cause	0.46348	0.17767	0.31544	0.43017	0.64431
4	$REER_i$ doesn't Granger Cause TB	0.01926	0.06134	0.02818	0.02039	0.01834
	TB does not Granger Cause	0.34806	0.26504	0.33647	0.34412	0.43841

$REER_i$ devotes to the REER based on CPI, i=1,…,5, and stands for the # of model.
TB – trade balance
Probabilities (prob.) are given in the columns

Decision rule:
If prob.<0.1, we reject the null hypothesis that one variable does not Granger cause another one.

APPENDIX M

Estimation output of ECM for trade balance (dependent variable) and REER indices based on CPI: with lagged TB

	Model 1	Model 2	Model 3	Model 4	Model 5
CointEq1	-0.383408**	-0.387884*	-0.396145*	-0.388651*	-0.389492**
	(-1.98818)	(-2.13686)	(-2.15080)	(-2.03762)	(-1.84251)
D(D_TB(-1))	-0.254795	-0.227322	-0.240279	-0.251127	-0.258830
	(-0.91392)	(-0.89416)	(-0.90583)	(-0.91366)	(-0.93015)
D(D_TB(-2))	-0.094772	0.131476	0.019527	-0.068839	-0.175601
	(-0.51168)	(0.67795)	(0.10517)	(-0.37184)	(-0.89413)
D(D_TB(-3))	-0.209836	0.007115	-0.108673	-0.188015	-0.260157
	(-0.85033)	(0.02990)	(-0.45775)	(-0.77131)	(-1.01381)
D(REER_i(-1))	-22.13236**	-35.44585*	-28.05683*	-23.43668**	-19.09392**
	(-1.84490)	(-2.21707)	(-2.04437)	(-1.89554)	(-1.71008)
D(REER_i(-2))	22.11366***	21.79071	22.11837	22.21138***	22.42905**
	(1.63198)	(1.24310)	(1.42058)	(1.58741)	(1.87824)
D(REER_i(-3))	24.61303***	30.50667**	29.08921**	25.79312***	20.41314
	(1.56491)	(1.71106)	(1.71223)	(1.61039)	(1.43851)
R-squared	0.834131	0.841025	0.840484	0.835722	0.818411
Adj. R-squared	0.668263	0.682050	0.680968	0.671443	0.636821
F-statistic	5.028869	5.290295	5.268970	5.087230	4.506931
Log likelihood	-124.2537	-123.8504	-123.8827	-124.1621	-125.1139
Akaike AIC	14.13196	14.08951	14.09291	14.12233	14.22252
Schwarz SC	14.62904	14.58659	14.58998	14.61940	14.71959
Mean dependent	33.57895	33.57895	33.57895	33.57895	33.57895
S.D. dependent	422.4372	422.4372	422.4372	422.4372	422.4372

t-statistics in parentheses

* significant at 1% significance level
** significant at 5% significance level
*** significant at 10% significance level

Presented output considers only lagged REER based on CPI and residuals, although regression included seasonal dummies.

REER_i devotes to the REER based on CPI, i=1,…,5, and stands for the # of model.
TB – trade balance

APPENDIX N

Estimation output of ECM for trade balance (dependent variable) and REER indices based on CPI

	Model 1	Model 2	Model 3	Model 4	Model 5
Error Correction:	D(D_TB)	D(D_TB)	D(D_TB)	D(D_TB)	D(D_TB)
D(REER_i(-1))	-11.11150	-25.87736***	-17.15454	-12.11464	-7.147396
	(-0.859467)	(-1.569901)	(-1.163036)	(-0.907980)	(-0.619431)
D(REER_i(-2))	32.64712*	39.69032*	37.16703*	33.63458*	24.87031*
	(2.837945)	(2.549191)	(2.787226)	(2.824049)	(2.246451)
RES_ECM	-0.448185***	-0.270787	-0.381885	-0.445297***	-0.593117**
	(1.501910)	(1.170736)	(1.405670)	(1.515151)	(1.821138)
R-squared	0.718103	0.688630	0.713929	0.718834	0.695247
Adj. R-squared	0.617426	0.577426	0.611760	0.618418	0.599978
Akaike AIC	14.22287	14.32231	14.23757	14.22027	14.26747
Schwarz SC	14.52159	14.62103	14.53629	14.51899	14.56619
Prob(F-statistics)	0.0016	0.0013	0.0022	0.0016	0.0023

t-statistics in parentheses

* significant at 1% significance level
** significant at 5% significance level
*** significant at 10% significance level

Presented output considers lagged REER based on CPI and residuals, although regression included seasonal dummies.

REER_i devotes to the REER based on CPI, i=1,…,5, and stands for the # of model.

TB – trade balance

APPENDIX O

Tests for residuals

Tests for the regressions presented in the Appendix N:

	Model 1	Model 2	Model 3	Model 4	Model 5
Breusch-Godfrey serial Correation LM test	0.8877	0.5908	0.7620	0.8687	0.9581
White Heteroscedasticity test	0.1685	0.2679	0.2217	0.1775	0.1236
Jarque-Bera normality test	0.8707	0.7877	0.7955	0.8582	0.8765

Tests for the regressions presented in the Appendix K:

	Model 1	Model 2	Model 3	Model 4	Model 5
Breusch-Godfrey serial Correation LM test	0.5294	0.2111	0.3590	0.4939	0.5742
White Heteroscedasticity test	0.1912	0.1256	0.1125	0.1345	0.1115
Jarque-Bera normality test	0.8463	0.7850	0.6878	0.7700	0.8244

Breusch-Godfrey serial Correation LM test:

H_0: residuals are not autocorrelated

H_1: residuals are autocorrelated

White Heteroscedasticity test:

H_0: residuals are homoscedastic

H_1: residuals are heteroscedastic

Jarque-Bera normality test:

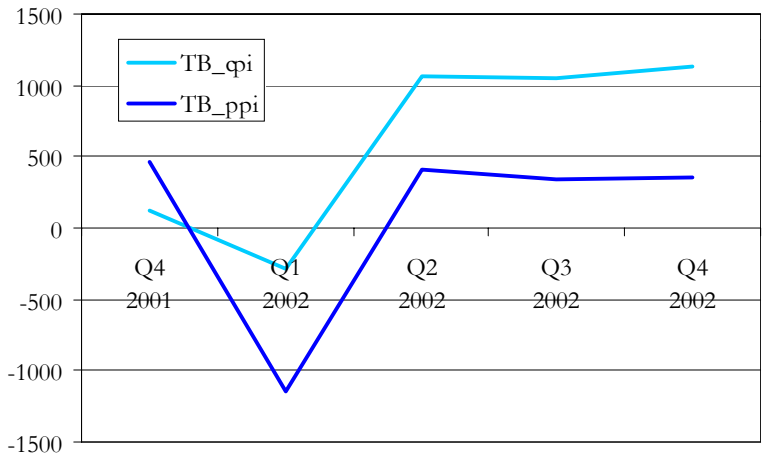
H_0: residuals are normally distributed

H_1: residuals are not normally distributed

Decision rule for each test: reject if p-value is less that 0.1

APPENDIX P

Simulations of trade balance dynamics after 30% real depreciation



TB_cpi – simulations based on the model 4 with the REER based on CPI

TB_ppi – simulations based on the model 1 with the REER based on PPI