MEASURING THE INFLUENCE OF REAL EXCHANGE RATE ON VOLUMES OF EXPORTS IN UKRAINE

by

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Abstract

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This paper investigates the relationship between real exchange rates (RER) and volumes of exports from Ukraine to the 25 countries, which are the major Ukraine trading partners, using annual panel data for the period from 1997 to 2000. The study revealed that for the most countries common RER measures, which are based on CPI and PPI, are significant in explaining volumes of Ukrainian exports. Moreover, it was estimated that on average 10% increase in RER leads to 12.7% rise in volume of exports, if RER was calculated using CPI, and to 11.7% rise in volume of exports, if RER was calculated using PPI. And, finally, the RER measure based on CPI has higher explanation power for explaining Ukraine export compared to the one based on PPI.

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GLOSSARY

CIS countries – Commonwealth of Independent States: Azerbaijan, Armenia, Belarus, Georgia, Kazakstan, Kyrgyz, Moldova, Russia, Tajikistan, Uzbekistan and Ukraine

CPI – consumer price index: measures the cost of buying a fixed basket of goods and services representative of the purchases of urban consumers.

EU countries – countries of European Union: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden, United Kingdom

PPP – purchasing power parity. Two countries are at purchasing power parity when a unit of domestic currency can buy the same basket of goods at home or abroad.

RER – real exchange rate: is the ratio of foreign to domestic prices, measured in the same currency. It measures a country's competitiveness in international trade.

WPI – wholesale price index: measures the cost of large-scale buying a fixed basket of goods and services representative of the purchases of average wholesale consumer.

C h a p t e r 1

INTRODUCTION

In most of developed countries foreign trade accounts for a significant part of GDP, for less developed – trade is the gateway to higher rate of economic development. Foreign trade is like an access to superior technology, since it allows one good to be "transformed" into another at a lower opportunity cost then under autarky. The trade stimulates economic activity, and its lack results in an economic slowdown. Its importance for Ukraine economy can be especially seen following Russian financial crisis 1998, which led to the sharp fall in economic activity through out the country.

One of the major determinants of foreign trade is real exchange rate (RER). In this research it will be the central issue. RER measures a country's competitiveness in the international market and equals to the ratio of prices of tradable goods to non-tradable goods, measured in the same currency. Since direct measures of those prices are difficult to obtain, the most commonly used measures of RER are based on consumer price indices (CPI) or producer price indices (PPI) in different countries. Though these common RER measures are not very accurate, since CPI and PPI include both tradable and non-tradable goods, but they are most easily to obtain and calculate, comparing with those more direct measures of RER, based on direct prices of tradables and non-tradables.

In this sense I would like to raise the following questions answering which might help to understand major factors influencing trade pattern in Ukraine:

- is RER significant as an explanatory factor in determining volumes of exports in Ukraine for the period from 1997 to 2000,;

- how big is the influence of RER changes on volumes of exports in Ukraine?

- which method of measuring RER (CPI or PPI) is most appropriate for exports movements explanation?

Answering these questions will have the following economic applications:

- can commonly used RER measures be useful policy instruments to influence volumes of exports in Ukraine?

- what is relationship between RER and volumes of exports?

- exports to which countries can be perfectly explained by RER?

To attain these goals the structure of the paper is as following. Chapter 2 is devoted to a literature overview of different RER measures and econometric models of export, which are based on RER. Chapter 3 describes historical trends in Ukrainian foreign trade, patterns of export by goods and countries. Theoretical background of the model of Ukrainian export and theoretical predictions are given in Chapter 4. The most valuable part of the paper – empirical evidence and the results of predictions are presented in Chapter 5. And the last Chapter 6 contains discussion of the results, policy recommendations and scope of further research.

C h a p t e r 2

LITERATURE REVIEW

Before examining the relationship between real exchange rate (RER) and volume of exports let us make a review of RER measures, which are most widely used in research.

The RER is defined as the ratio of price of tradable goods (P_T) to the price of non-tradable goods (P_N) measured in the same currency:

$$RER = P_T / P_N \quad . \quad (2.1)$$

The problem is that direct data on P_T and P_N is difficult to find since officials seldom record it. As a result, indirect measures of P_T and P_N are used. There is a great deal of literature on RER measurements. For example, Maciejewski (1983) discusses 17 different combinations of CPIs, PPIs, import and export prices, etc., which could be used to approximate P_T and P_N.

From practical point of view, since all country publish their CPI and PPI (or WPI) indices, the most widely used approximations for RER measures is weighted average of the trading partners CPI or PPI divided by the domestic CPI:

$$RER_{CPI/CPI} = \sum w_i \cdot \frac{E_i \cdot CPI_i}{CPI_d} \quad \text{or} \quad RER_{PPI/CPI} = \sum w_i \cdot \frac{E_i \cdot PPI_i}{CPI_d}, \quad (2.2)$$

where E_i - nominal exchange rate of the home country with country i, w_i - is the portion of the home country's trade that takes place with country i.

However, CPIs and PPIs tend to contain both tradable and non-tradable goods, and, thus, they are not very accurate estimations of both tradable and non-tradable prices. Moreover, because basket of goods and shares of tradables and non-tradables in CPIs-PPIs diverge widely across countries this may cause additional deviation from real value of RER.

To increase accuracy some authors use other more direct methods of obtaining tradable and non-tradable prices. Good example of such measures and the methodology of using RER for investigating the trade performance of a single country is given in Radelet's article (1996). However, those measures are rather complicated and data for them is not always exists for the country's trading partners. These are the main reasons why I will employ only commonly used measures of RER based only on CPI and PPI.

And now let us consider how RER can be employed in explaining trends of volumes of exports.

In his research Radelet (1996) had examined which of seven RER measures is most applicable to explain export trends in Indonesia. He assumed that non-oil export supply function take the form:

$$X_t = \alpha_0 + \alpha_1 RER_t + \alpha_2 DD_t + \alpha_3 K_t + \varepsilon_t . \quad (2.3)$$

All variables are expressed in logs. X_t is the quantity of non-oil exports.

DD_t - is a measure of domestic demand pressure, calculated as the actual value of domestic credit outstanding divided by the trend value. This variable picks up the impacts of changes in domestic demand pressures on exports. K_t - is the stock of capital for the economy, which captures changes in total

productive capacity that may result from changes in factor supplies, skills, infrastructure, technology, or total factor productivity.

Radelet found that for Indonesia "trading partners' CPIs and WPIs did not accurately represent trends in traded prices. RER measures based on these indices gave misleading signals in both the magnitude and direction of changes in relative prices … Trading partners' export and import prices (or unit values) appear to be better choices, but these indices should be supported with available domestic price series, and when possible, wages and productivity data".

Wider investigation of trade performance for Indonesia, but with no emphasis on RER was given by Rodgers (1994). This article is especially valuable for this research since it considered the same country – Indonesia, - but with different approach and point of view. So, the results of the two approaches can be compared.

The Rodgers' paper examines the impact of exchange rate devaluation and income growth on both Indonesian aggregate import and non-oil export performance. Here, the supply equation for Indonesian non-oil export X_t^s in period t has a form (all terms are in logs):

$$X_t^s = \beta_0 + \beta_1 \frac{e_t \cdot PX_t}{PD_t} + \beta_2 Y_t + \upsilon_t, \quad (2.4)$$

where PX_t - dollar price of non-oil export; Y_t - real domestic income (real GDP). Real GDP is not divided into cyclical and trend components in order to avoid simultaneity bias and to maintain some comparability with Ariza (1990).

The actual export level may respond with a lag to desired demand due to transactions costs, contracts, and delivery delays (also, use of quarterly data makes it more likely that adjustment within period will not hold):

$$\Delta X_t = \lambda\left(X_t^s - X_{t-1}\right), \quad 0 \le \lambda \le 1 . \quad (2.5)$$

Substituting equation (4) into (5) and solving for X_t^s gives:

$$X_t = \lambda\beta_0 + \lambda\beta_1 \frac{e_t \cdot PX_t}{PD_t} + \lambda\beta_2 Y_t + (1-\lambda)X_{t-1} + \lambda\nu_t . \quad (2.6)$$

To construct the structural coefficients β_1 and β_2 he divided the estimated coefficients by λ, calculated from the coefficient on lagged exports. The standard errors were calculated following the method in Kendall and Stuart (1977).

Rodgers found that devaluation is "a highly affective policy instrument to provide domestic producers with the incentive to boost non-oil exports" and that these equations are "extremely useful tool to forecast Indonesian non-oil export responses to future changes in exchange rate policy".

Another important issue concerning RER and trade performance was raised by Mark De Broeck in his research "Interpreting Real Exchange Rate Movements in Transition Countries". He noted that for last decade several transition countries have experienced strong exchange rate appreciation in the course of the transition process. The paper tests the Balassa-Samuelso "productivity hypothesis" [Balasa, 1964, and Samuelson, 1964] , which states that these RER appreciations reflect underlying productivity gains in the tradable sector.

According to this hypothesis, productivity gains in the tradable sector (in relative terms, compared with developments in competitor countries) allow real wages to increase commensurately. Since wages are assumed to be linked between the tradable and the nontradable sectors, wages and prices will also increase in the nontradable sector. This will lead to an increase in the overall

price level in the economy which will in turn result in an appreciation of the real exchange rate.

To control for broad macroeconomic developments that affect real exchange rate movements, the author built econometric equation with a wide range of explanatory variables included in the regression:

$$
\begin{aligned}
&\text{Log(REER)} = \\
&\alpha_{0,i} + \\
&\alpha_1 * \text{Log(an index for the productivity level in the agricultural sector)} + \\
&\alpha_2 * \text{Log(an index for the productivity level in the industrial sector)} + \\
&\alpha_3 * \text{Log(an index for the productivity level in the service sector)} + \\
&\alpha_4 * \text{Log(broad money divided be GDP)} + \\
&\alpha_5 * \text{Log(openness of the economy)} + \\
&\alpha_6 * \text{Log(government balance)} + \\
&\alpha_7 * \text{Log(terms og trade)} + \\
&\alpha_8 * \text{Log(index for fuel prices)} + \\
&\alpha_9 * \text{Log(index for nonfuel prices)} \qquad (2.7)
\end{aligned}
$$

where all variable are in relative terms to the same variable for the OECDcountry, $\alpha_{0,I}$ – fixed effect to reflect differences between countries.

Using panel data over the period 1993-1998 for a range of transition countries, the results show clear evidence of productivity–driven exchange rate movements in the central and eastern European and Baltic countries, but the evidence is more tentative in the other transition countries, Russia and others countries of the former Soviet Union (including Ukraine in particular).

These results have important policy implications. Real exchange rate appreciations that reflect productivity gains in the tradable sector are an equilibrium phenomenon and do not erode competitiveness. In transition economies, these appreciations reflect progress in their becoming full-fledged market economies, and they do not require a policy response. The author concludes that transition countries, particularly the EU accession countries that have begun to catch up, can expect to experience further productivity–driven real exchange rate appreciations.

Chapter 3

UKRAINIAN FOREIGN TRADE: MARKET, AGENTS AND INSTITUTIONS

A certain change in the directions of trade flows along with diversification of the Ukrainian export has taken place during the latest years. There has been a significant reduction of the CIS countries' share in Ukrainian export. During a number of years, volumes of Ukrainian goods shipments to China, Turkey, Germany and Italy have increased. At the same time, the Ukrainian economy is still greatly dependent on Russian import, its share making up almost 50% [Onischuk, 2001].

However, the countries, which were the major Ukrainian's trading partners, are remained the same for over past several years, they are: Russian, China, Turkey, Germany, Italy, USA, Belarus, and Poland.

For Ukraine the growing volume of foreign trade is hindered by a number of factors [Onischuk, 2001]:

- low competitiveness of national goods and services on the EU countries' market;
- slow restructuring of industry;
- conservation of high costs for most types of export products;
- high European standards and technical standing orders (certification, sanitary and phytosanitary norms, ecological requirements);
- quantity restrictions for trading in certain types of goods;
- use of the "non-market economy country' status for anti-dumping investigations against the goods originating from Ukraine.

Another point of view on situation in Ukrainian foreign trade is given by Jacques Sapir. The author argued that slow development of Ukrainian foreign trade had its root s in:

- collapse of trade between former Soviet countries, exacerbated by Russia's 1998 financial crisis impact;
- low on non-FSU markets preventing a switch in commercial orientations;
- rigid demand for given goods (energy, oil and gas);
- over-valued currency till mid-1999.

The author states that to a large extent revitalizing trade with FSU countries is one of most obvious solutions to Ukrainian's problems.

Though, the balance of payments situation has improved substantially following the devaluation of the hryvnia in the wake of the 1998 financial crisis. Exports grew by 26% and imports by 15% in 2000. Exports grew another 20% in the first quarter of 2001, while imports fell by 5.8%. The current account balance, which was minus $1.2 billion in 1998, grew to $800 million in 1999 and leaped to $1.4 billion in the year 2000. Russia remains Ukraine's major trading partner [Ukrainian Economic Trends].

As regards the pattern of Ukrainian export to Russia, 90% are devoted to deep or rather deep processing products (services – 44.3%, goods – 55.7%, including: metal industry products – 16.3%, engineering industry products – 13.8%, food products – 8.8%, chemical industry products – 9.3.%, mineral products and metal ores – 1.7%, wood, paper and cellulose – 1.6%, stone, gypsum and cement articles – 1.2%)[Ukrainian Economic Trends].

EU countries are responsible for about 20% of foreign trade activities in Ukraine. Though, the EU is Ukraine's main trading partner outside the New Independent States, for the EU trade flows with Ukraine are marginal (0.3% EC trade). A Partnership and Co-operation Agreement (PCA) between UE,

on the one hand, and Ukraine, on the other, was signed on 14 June 1994, and entered into force on 1 Mach 1998. The agreement provided a framework for wide ranging co-operation in the commercial, industrial, scientific and administrative fields and became an important instrument in bringing Ukraine in line with the legal frameworks of the single European market and the GATT/WTO system [EU-Ukraine partnership].

In 1999, EU-Ukraine trade suffered a step decline due to the repercussion of the Russian financial crisis of August 1998 on the Ukrainian economy? With EU exports dropping by 26%. Positive trends in the Ukrainian economy have lead to a renewed increase in EU-Ukraine trade in 2000, which was the first year of positive growth in Ukraine since 1989.

Among EU the largest volume of trade in goods is with Germany (almost 39% of import and 30% of export). Leading export positions of Ukraine in the trading pattern with the EU (totally over 74%) are: base metals and articles – 31.94 (including ferrous metals – 17.7%); textile and textile articles – 15.6% (including clothes and textile clothes articles – 12.9%); mineral products – 11.22%; chemical industry products – 9.76%; machines, equipment and appliances – 5.5% [Ukrainian Economic Trends].

And finally let's observe the general tendencies in Ukraine's trade by economy branches. Over the period of 1996-2000 (the period of relative currency stability) Ukraine has diversified its exports of machinery products, metallurgy products, mineral products, pulp and paper products, wood products and slightly of chemicals. Diversity of these industries' exports has been increasing during the whole period, except 1998 when whole external sector was affected be Russian financial crisis. Ukrainian trade and its diversification mostly lies on raw materials and primary goods, except for machinery products which trade recovery might be explained by increased demand from FSU that uses the same technologies and re-establishes old soviet links with Ukrainian enterprises. At the same time diversity of food and light industry

has declined which is surprising as product diversity in these branches was underdeveloped in soviet economy and these branches do not require significant investments in order to expand at shortage market. Also these branches are competitive at EU market takin into consideration relatively cheap labor force in Ukraine [Goloven, 2001].

Chapter 4

THEORY

4.1. RER: Description & Determinants

Theoretical background for relation between foreign trade and RER can be taken from major books on International Trade or Macroeconomics. In this chapter I will use the following sources: "International Economics" of P.Krugman and M.Obstfeld, "Foundation of International Macroeconomics" of Obstfeld, Maurice and Kenneth Rogoff, , and "The World Economy: Trade and Finance" of Yarbrough B. and Yarbrough R. These sources sufficiently deep and comprehensively examine notion of RER and its relation to foreign trade performance.

So, the theory states that the real exchange rate (RER) between two countries' currencies is a broad summary measure of the prices of one country's goods and services relative to the other's.

$$RER_{12} = \frac{E_{12} \cdot P_2}{P_1}$$

where E_{12} - nominal exchange rate between Country 1 and Country 2. P_1 and P_2 - prices in Country 1 and Country 2 respectively.

A rise in the RER_{12} is called a real depreciation of currency 1 against currency 2. Respectively, a real appreciation of the dollar against the euro is a fall in RER_{12}. There are several factors that affect RER, but, since, a RER reflects changes in the relative prices of two countries' expenditures baskets, then, conditions in both countries matters (see Table 4.1).

Table 4.1. Factors that affect a RER between Country 1 and Country 2.

Change of Factor	Effect on RER_{12}
Increase in Country 1 money supply level	↑
Increase in Country 2 money supply level	↓
Increase in Country 1 money supply growth rate	↑
Increase in Country 2 money supply growth rate	↓
Increase in Nominal Ex. Rate: E_{12} ↑	↑
Inflation in Country 1: P_1 ↑	↓
Inflation in Country 2: P_2 ↑	↑
Increase in demand for Country's 1 output	↓
Increase in demand for Country's 2 output	↑
Output supply increase in Country 1	↑
Output supply increase in Country 2	↓

It is to be mentioned that some of the factors in the table have effect on a RER only in the long-run, while the others in both short- and long-run.

4.2. Major Determinants of Foreign Trade

P.Krugman & M.Obstfeld expressed a country's current account balance as a function of its currency's real exchange rate $RER=EP^*/P$, and of domestic disposable income, Y^d:

$$CA=EX-IM=CA(EP^*/P, Y^d),$$

where E – the nominal exchange rate, P* - is the foreign price level, P is the home price level. Here Y^d is written as output Y, less taxes, T:

$$Y^d=Y-T$$

RER will be used here as a measure of relative prices of domestic products against foreign ones. For instance, a rise in the price of the foreign basket in terms of domestic baskets will be associated with a rise in the relative price of

foreign output relative to domestic. Moreover, if RER rises then "foreign products have become more expansive relative to domestic products: Each unit of domestic output now purchases fewer units of foreign output. Foreign consumers will respond to this price shift be demanding more of our exports. This response by foreigners will therefore raise EX and will tend to improve the domestic country's current account.

The effect of the same RER increase on IM is more complicated. Domestic consumers respond to the price shift by purchasing fewer units of the more expensive foreign products. Their response does not imply, however, that IM must fall. IM denotes the value of imports measured in terms of domestic output, and not the volume of foreign products imported: Because a rise in RER tends to raise the value of each unit of imports in terms of domestic output units, import measured in domestic output units may rise as a result of a rise in RER even if import decline when measured in foreign output units. IM can therefore rise or fall when RER rises, so the effect of a RER change on the current account is ambiguous." [P.Krugman & M.Obstfeld, 2000]

But, for simplicity, the authors assumed, that the volume effect of a RER change outweighs the value effect, so that, other things equal, a real depreciation of the currency improves current account and a real appreciation of the currency worsens current account.

The second factor influencing the current account is domestic disposable income. Since a rise in Y^d causes domestic consumers to increase their spending on all goods, including imports and potential export from abroad, an increase in disposable income have ambiguous effect on the current account. But, again, for simplicity we may assume that Y^d has no effect on volume of exports.

Table 4.2. Factors determining trade performance.

Change	EX	IM	CA
RER ↑	↑	↓	↑
RER ↓	↓	↑	↓
Y^d ↑	0	↑	↓
Y^d ↓	0	↓	↑

All possible outcomes of RER and Y^d changes on current account , EX, and IM are summarized in the table below (see Table 4.2.).

Chapter 5

EMPIRICAL EVIDANCE FROM UKRAINE TRADE PERFORMANCE

5.1. Data Description

In this research I used the sets of annual panel data for 25 countries for the period from 1997 to 2000 (see Table below). The full list of 25 countries, which are the major trading partners of Ukraine is given in Appendix A.

Table 5.1. Data description.

Variable	Description	Sample Coverage	Source
X_{it}	Export from Ukraine to i-th country at time t.	1997-2000	*UEPLAC*
E_{it}	Nominal exchange rate (foreign currency per hryvna) for i-th country's currency at time t.	1997-2000	*IMF Financial Statistics*
CPI_{it}	Consumer Price Index of the i-th country at time t.	1997-2000	*IMF Financial Statistics*
PPI_{it}	Producer Price Index of the i-th country at time t.	1997-2000	*IMF Financial Statistics*
GDP_{it}	GDP of the i-th country at time t.	1997-2000	*IMF Financial Statistics*

where i – stands for country, t – stands for year.

Here E_{it} is calculated as a division: $E_{it} = \frac{E(hrv/\$)}{E(i-th\ foreign\ currency/\$)}$,

where *E(hrn/$)* – hryvnya to USD exchange rate; *E(i-th foreign currency/$)* – i-th country foreign curency to USD exchange rate.

For some countries data on GDP where divided by CPI to obtain relative and correct data for all countries.

Then data for *E, CPI* and *PPI* where used to calculate *RER* between Ukraine and every country (total 25 different RER) using two formulas.

$$RER_{it} = \frac{E_{it} \cdot CPI_{it}}{CPIUkr_t}, \qquad RER_{it} = \frac{E_{it} \cdot PPI_{it}}{PPIUkr_t}, \tag{5.1}$$

Here the first formula present RER based on CPI, and the second – RER based on PPI.

Before running regressions panel data for all 25 countries were:

- normalized such that their values for all countries in 1997 equal 100;
- after normalization all values of variables were transformed to logs.

5.2. The Model and Testable Hypothesis

The goal of this research is to test whether RER is playing an important role in determining a value of exports from Ukraine to its major trade partners (25 countries – see Appendix 1). Using panel data for 25 countries we will run a regression to test whether coefficients before RER are significant.

The equation is the following (all variables are in logs):

$$Ex_{it} = A_{0i} + \alpha_1 Y98 + \alpha_2 Y99 + \alpha_3 Y00 + \alpha_4 RER_{it} + \alpha_5 GDP_{it} + \varepsilon_{it}, \tag{5.2}$$

where Ex_{it} - export from Ukraine to the i-th country at time t, A_{0i} - fixed effect of the i-th country (or cross section effect), $Y98$ - dummy variable for year 1998 ($Y98 = 1$, if t=1998 and $Y98 = 0$, $t \neq 1998$), $Y99$ and $Y00$ - dummy variables for years 1999 and 2000 respectively, RER_{it} - real exchange rate between Ukraine and the i-th country at time t, GDP_{it} - GDP of i-th country at time t.

Here a question arise: is it enough to run only simple OLS or it requires fixed or random effects procedures? If OLS is not consistent then which procedure we have to use: fixed effect or random effect? To answer these questions we have, firstly, run Breusch and Pagan Lagrangian multiplier test for random effects. The null hypothesis here is H_0: $Var(A_{0i})=0$. If we reject H_0 then OLS is not consistent [Johnston & DiNardo, 1997].

After rejecting OLS we have decide between fixed and random effects. From one side if A_{0i} is uncorrelated with the other variables then random effect procedure is appropriate estimation strategy which gives consistent and efficient estimators, while fixed effect procedure will give consistent but inefficient results. Though if over hypothesis that A_{0i} is uncorrelated with the other variables failed than random effect procedure will give us inconsistent estimators and only fixed effect procedure can be applied. To test the null hypothesis H_0: "A_{0i} is uncorrelated with the other variables" we will apply Hausman specification test, and it will be the final step of our procedure [Verbeek., 2000].

Though export from Ukraine depends on Ukrainian GDP, however Ukrainian GDP is not included in the model, since it is implicitly presented in year-dummy variables $Y98$, $Y99$ and $Y00$.

We will run regressions with commonly used RER measures using CPI and PPI of the countries:

$$RER_{it} = \frac{E_{it} \cdot CPI_{it}}{CPIUkr_t}, \quad (5.3) \qquad RER_{it} = \frac{E_{it} \cdot PPI_{it}}{PPIUkr_t}, \quad (5.4)$$

where E_{it} – nominal exchange rate between Ukraine and the i-th country at time t, CPI_{it}, PPI_{it} - CPI and PPI of the i-th country at time t, $CPIUkr_t$, $PPIUkr_t$ - CPI and PPI of Ukraine at time t.

Having different RER measures will also compare which one has a higher explanatory power for Ukrainian export. Moreover, coefficients before RER (and other variables) also will tell us how big is the influence of RER (and other variables) on volumes of exports in Ukraine.

5.3. Discussion of Results

Before running regressions let us make a qualitative analysis on the base of graph, which reflect trends in export, GDP and RER (see Appendix B). Sign of the coefficient before RER is not clear for a while, since on average most countries, with rare exception, show a decline in export from Ukraine in 1999 and then export rise in 2000, while RER was rising all this time. However, this leads to a conclusion that sign of the coefficient before dummy variable for year 1999 tend to be negative, while sign of the coefficient before dummy variable for year 2000 can be both negative and positive (it depends whether rise in RER is high/low enough to reflect rise in export). And, finally, sign of the coefficient before country's GDP is also not clear, since while GDP almost for all countries was constantly rising, export had different trends in different years and for different countries. Thus coefficient before GDP tends to be insignificant. For feather analysis we have to run regressions.

Quantitative (econometric) part of analysis has the following steps:

1. **Random effect regression:** We run random effect regressions on the base of equation (5.2) in the software "Intercooled Stata 7" (see Appendix C.1. and Appendix D.1. for Stata commands). The results are presented in the table below. (more extended results of the regression are given in Appendix C.2 for RER based on CPI and in Appendix D.2 for RER based on PPI).

Table 5.2. The results of regressions for the two types of RER measures based on CPI and PPI.

RER	Coefficient	Prob.	R-squared
RER cpi	1.255795	0.000	0.2285
RER ppi	1.168671	0.002	0.1906

2. **Breusch and Pagan Lagrangian multiplier test:** Before analyzing these results we perform Breusch and Pagan Lagrangian multiplier test (see Appendix C.3. for RERcpi and Appendix D.3. for RERppi). The results in both tests showed that null hypothesis is rejected and, thus, OLS is inconsistent and cannot be applied.

3. **Hausman specification test:** The objective of the final step - Hausman specification test, - is to determine whether we have to use random or fixed effect procedure. Results of the test (see Appendix C.4. for RERcpi and Appendix D.4. for RERppi) showed that null hypothesis is rejected and only random effect procedure will give us both consistent and efficient estimators.

So, after we have checked that random effect econometric model is consistent and efficient let's analyze its outcomes.

As we see coefficients before both RER measures (based on CPI and PPI) have p-value less then 0.01% , which means that they both are significant (see Table 5.1. above).

The table also shows that RERcpi compared to RERppi is more significant and has higher predictive power, since it has lower p-value and higher R-squared value.

Since all variables in equation (5.2.) are in logs, it means that 10% increase in RERcpi will lead to $1.1^{1.255795} = 1.127147435 \approx 12.7\%$ rise in export

compared to 10% increase in RERppi which will lead to $1.1^{1.168671} = 1.117826576 \approx 11.7\%$ rise in export.

When we look at coefficients before the other variables, we will note that our qualitative analysis was correct, and coefficient before Y99 has really negative sign, while coefficient before GDP is insignificant for both RER measures.

Table 5.3. Results of the regression where RER measured using CPI.

Variable	Coefficient	Prob.
Y98?	-.2344204	0.015
Y99?	-.6360686	0.000
Y00?	-.3552648	0.019
GDP?	.5159282	0.463

Table 5.4. Results of the regression where RER measured using PPI.

Variable	Coefficient	Prob.
Y98?	-.1557207	0.095
Y99?	-.421115	0.001
Y00?	-.2115974	0.133
GDP?	-.0024554	0.998

In both cases coefficient before Y99 has higher value negative compared to the other dummy variables for the years. It means that year 1999 was most unfavourable year for export from Ukraine. Moreover, all dummy variables for the years (in both cases) has significant coefficients which reflects the fact that institutional changes in this years had significant effect on volumes of exports to major trading partners.

Chapter 6

CONCLUSIONS AND POLICY IMPLICATIONS

6.1. Conclusions

This paper investigates influence of real exchange rate on volumes of exports in Ukraine. For this purpose annual panel data for 25 countries, which are the major Ukrainian trading partners, for the period from 1997 to 2000 were used. Two most widely used methods of RER measuring were used: based on CPI and based on PPI. The research revealed:

1. In both cases RER is significant as an explanatory factor in determining volumes of exports in Ukraine for the given period from 1997 to 2000.

2. 10% increase in RER based on CPI leads to 12.7% rise in volumes of exports and 10% increase in RER based on PPI leads to 11.7% rise in volumes of exports.

3. RER based on CPI has more explanatory power compared with RER based on PPI.

4. GDP of foreign countries played on average insignificant role in determining volumes of Ukrainian export, since the share of that export was insignificant compared with total world export to that countries (except for the former Soviet Union countries).

5. Each year Ukrainian institutional and macroeconomic changes had negative effects on volumes of exports. Moreover, year 1999 was most unfavorable year for Ukrainian export since it was exacerbated by Russia's 1998 financial crisis impact.

6.2. Policy Implications

Results discussed above can have the following policy implications:

1. RER can be efficient policy instrument to influence volumes of exports in Ukraine.

2. When government increase RER by 10% the estimated average increase of volumes of exports from Ukraine to foreign countries will be approximately 12% (it means that every from 25 trading countries will export from Ukraine by 12% more).

3. Export almost to all countries except Belarus, Belgium, Luxemburg, and Israel can be perfectly explained by real exchange rate.

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Appendix A

LIST OF 25 MAJOR TRADING PARTNERS OF UKRAINE

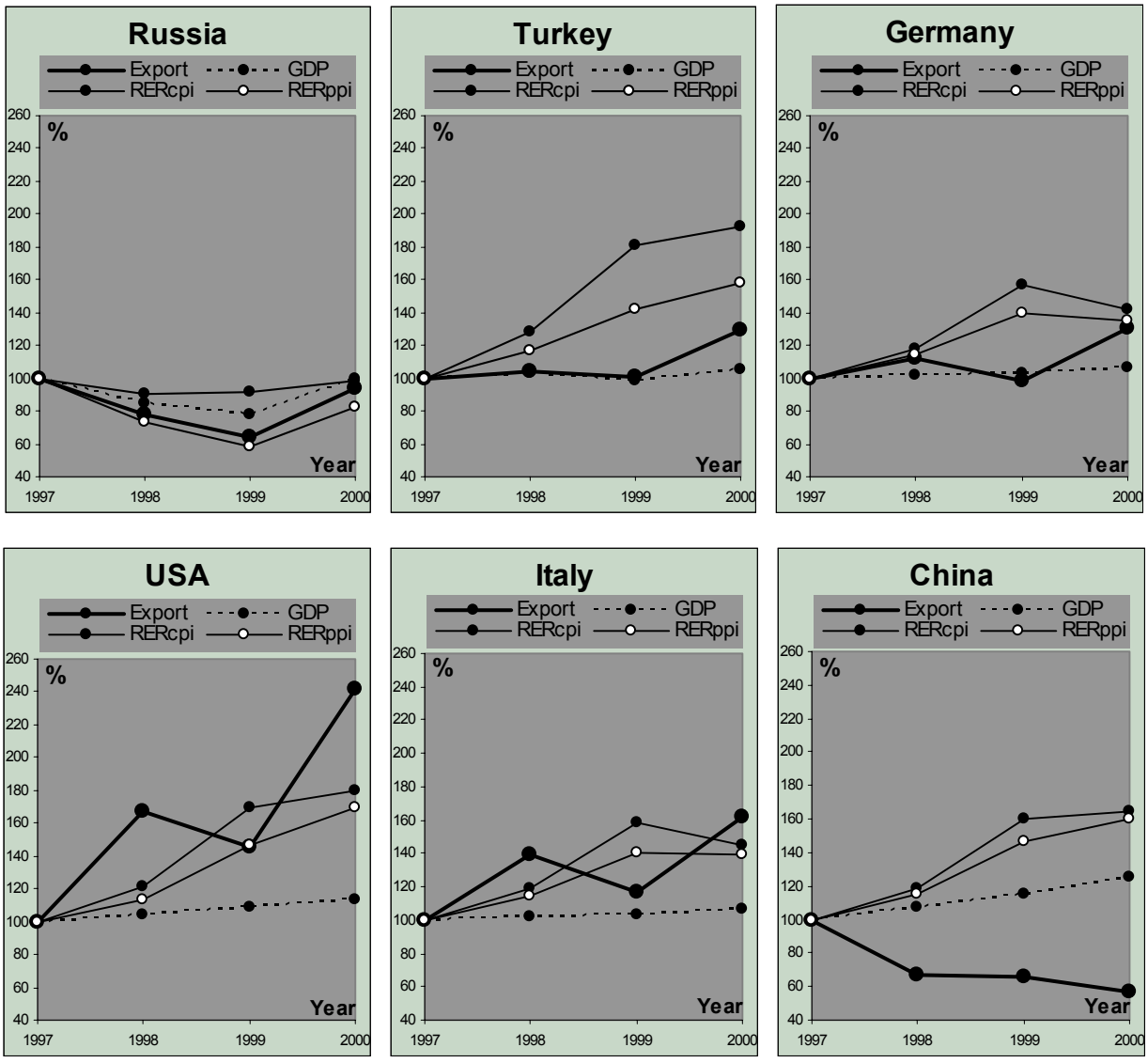
Table A.1. The major 25 trading partners of Ukraine (sorted in descending order by the volume of export in 2000)

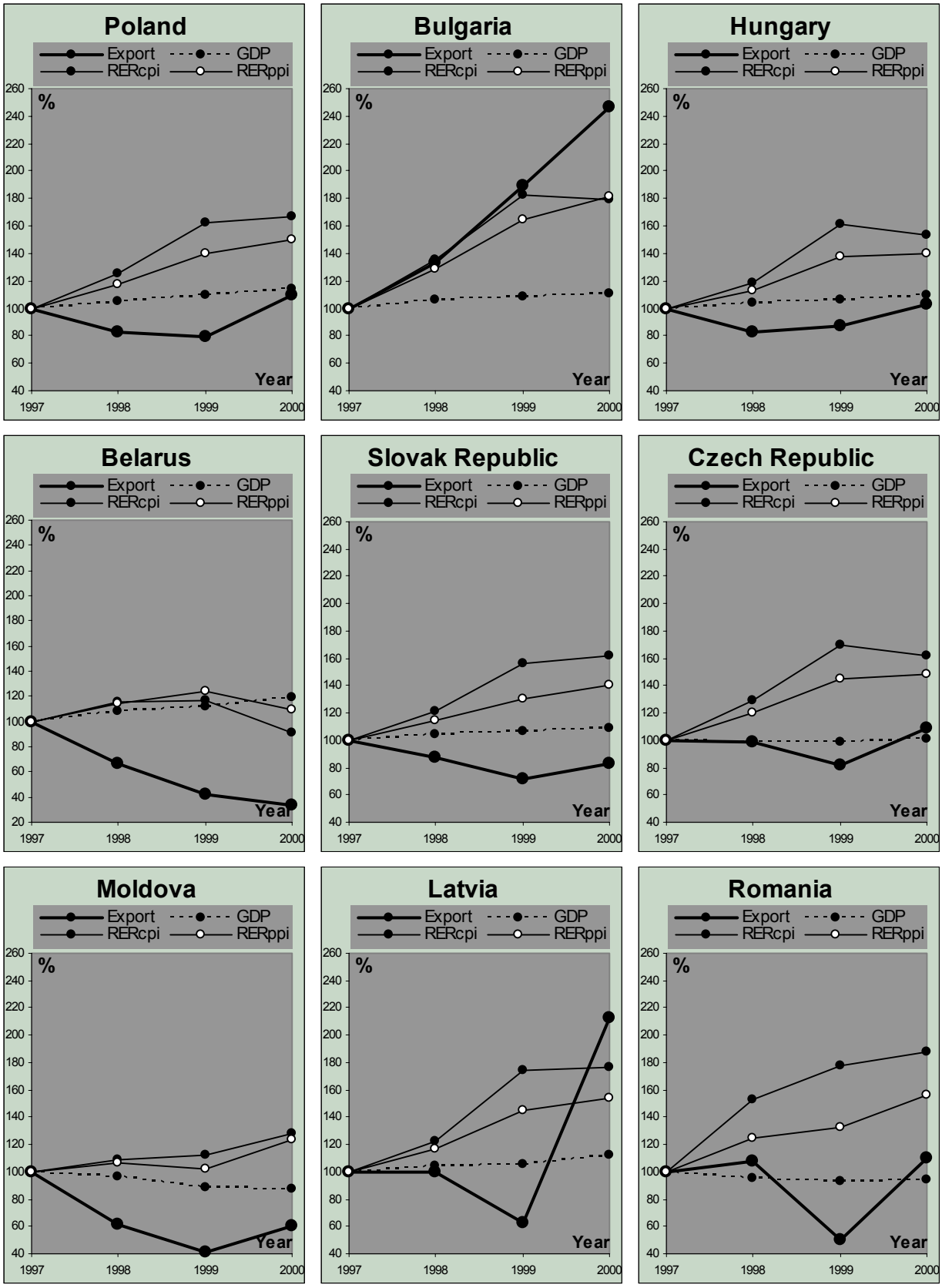
1.	Russia
2.	Turkey
3.	Germany
4.	USA
5.	Italy
6.	China
7.	Poland
8.	Bulgaria
9.	Hungary
10.	Belarus
11.	Slovak Republic
12.	Czech Republic
13.	Moldova
14.	Latvia
15.	Romania
16.	Austria
17.	Spain
18.	Switzerland
19.	Korea Republic
20.	Netherlands
21.	United Kingdom
22.	France
23.	Belgium, Luxemburg
24.	Israel
25.	Thailand

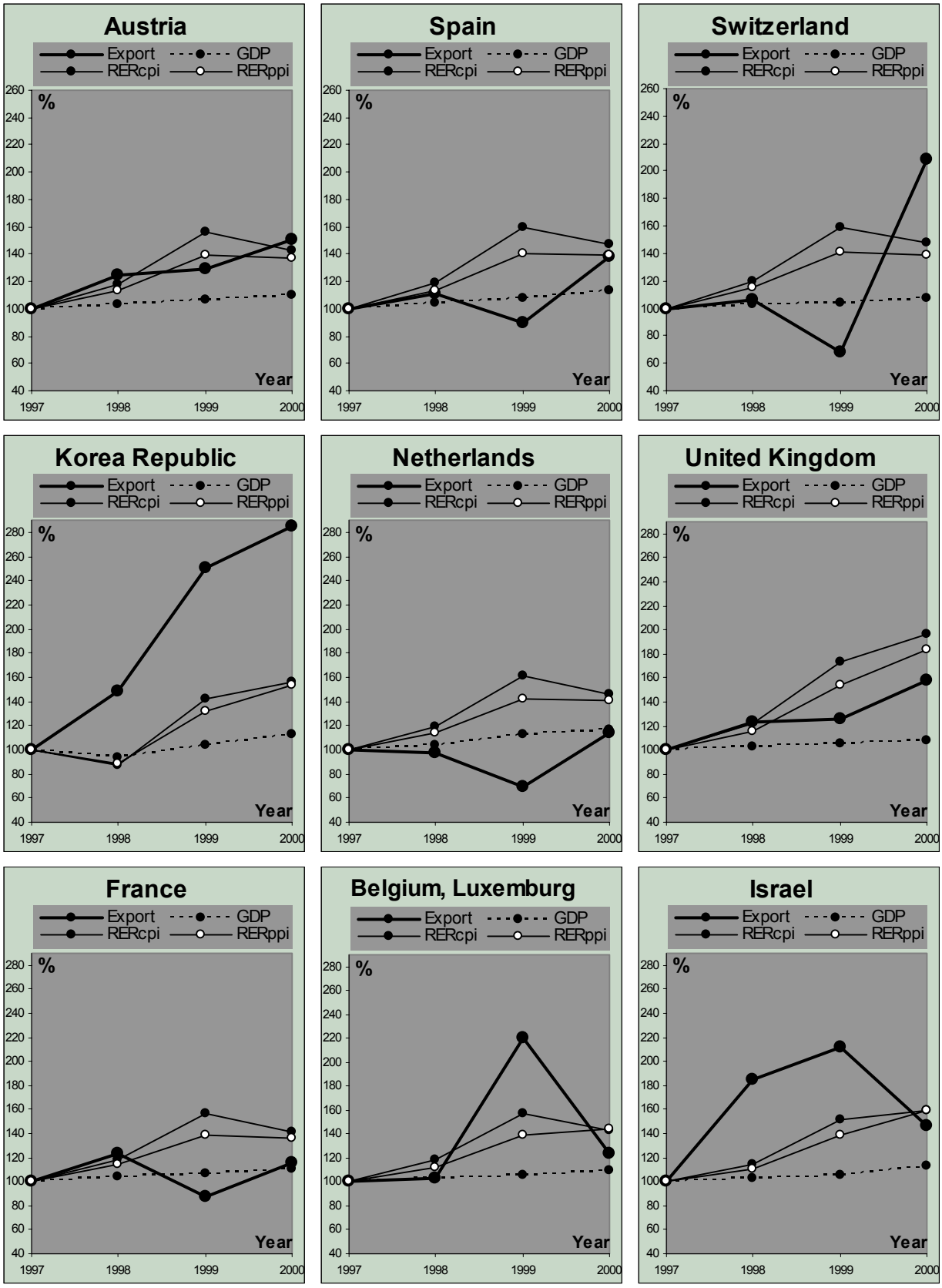
Appendix B

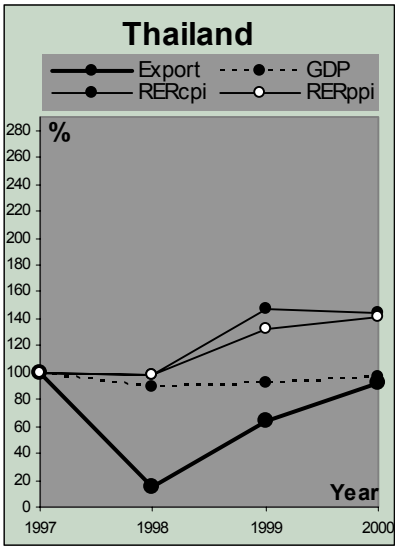
GRAPHICAL COMPARISON OF TRENDS OF EXPORT , GDP AND RER FOR 25 COUNTRIES FOR 1997-2000.

The graphs below represent trends of export, GDP and two RER measures (all of them are normalized such that their value for year 1997 equals 100). Data represent the period from 1997 to 2000. RERcpi, RERppi are calculated using countries' CPIs and PPIs respectively.




Poland
Bulgaria
Hungary
Belarus
Slovak Republic
Czech Republic
Moldova
Latvia
Romania
Export
GDP
RERcpi
RERppi
%
Year
1997
1998
1999
2000


Austria
Spain
Switzerland
Korea Republic
Netherlands
United Kingdom
France
Belgium, Luxemburg
Israel
Export
GDP
RERcpi
RERppi
%
Year
1997
1998
1999
2000


Thailand
Export
GDP
RERcpi
RERppi
%
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
Year
1997
1998
1999
2000

APPENDIX C.

ESTIMATED ECONOMETRIC MODELS OF UKRAINIAN EXPORTS (RER CALCULATED ON THE BASE OF CPI)

Appendix C.1. "Stata Software" comands

```
iis country
tis year
sum

xtreg ex y98 y99 y00 rer_cpi gdp, re
xttest0
xthausman
```

Appendix C.2. Random effects model of exports (RER calculated on the base of CPI).

Random-effects GLS regression Group variable (i) : country	Number of obs = 100 Number of groups = 25
R-sq: within = 0.2895 between = 0.1725 overall = 0.2285	Obs per group: min = 4 avg = 4 max = 4
Random effects u_i ~ Gaussian corr(u_i, X) = 0 (assumed)	Wald chi2(5) = 33.77 Prob > chi2 = 0.0000

ex	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
y98	-.2344204	.0968333	-2.42	0.015	-.4242101	-.0446307
y99	-.6360686	.1578965	-4.03	0.000	-.9455401	-.3265972
y00	-.3552648	.1510082	-2.35	0.019	-.6512354	-.0592942
rer_cpi	1.255795	.3249526	3.86	0.000	.6188992	1.89269
gdp	.5159282	.7034355	0.73	0.463	-.86278	1.894636
_cons	-3.557642	3.049507	-1.17	0.243	-9.534567	2.419282

Appendix C.3. Breusch and Pagan Lagrangian multiplier test for random effects.

```
    ex[country,t] = Xb + u[country] + e[country,t]

                 |     Var       sd = sqrt(Var)
        ---------+-----------------------------
              ex |   .1838505       .4287779
               e |   .0891781        .298627
               u |   .0657453       .2564084

Test:   Var(u) = 0
                    chi2(1) = 24.55

Prob > chi2 = 0.0000
```

Appendix C.4. Hausman specification test

```
         |     Fixed       Random
      ex |    Effects      Effects       Difference
---------+-----------------------------------------
     y98 |  -.2446794    -.2344204        -.010259
     y99 |  -.6638292    -.6360686       -.0277605
     y00 |  -.3744642    -.3552648       -.0191994
 rer_cpi |   1.329452     1.255795        .0736576
     gdp |   .3616272     .5159282        -.154301

Test:  Ho: difference in coefficients not systematic
chi2(5)  =  (b-B)'[S^(-1)](b-B)  =  0.18,  S  =  (S_fe  -
S_re)

Prob>chi2 = 0.9993
```

APPENDIX D.

ESTIMATED ECONOMETRIC MODELS OF UKRAINIAN EXPORT (RER CALCULATED ON THE BASE OF PPI)

Appendix D.1. "Stata Software" comands

```
iis country
tis year
sum

xtreg ex y98 y99 y00 rer_ppi gdp, re
xttest0
xthausman
```

Appendix D.2. Estimation of export equation (variables are in logs) using RER calculated on the base of PPI.

Random-effects GLS regression Group variable (i) : country	Number of obs = 100 Number of groups = 25
R-sq: within = 0.2484 between = 0.1375 overall = 0.1906	Obs per group: min = 4 avg = 4 max = 4
Random effects u_i ~ Gaussian corr(u_i, X) = 0 (assumed)	Wald chi2(5) = 27.16 Prob > chi2 = 0.0001

ex	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
y98	-.1557207	.0932557	-1.67	0.095	-.3384986	.0270571
y99	-.421115	.1313121	-3.21	0.001	-.6784819	-.1637481
y00	-.2115974	.1407754	-1.50	0.133	-.4875121	.0643172
rer_ppi	1.168671	.3825951	3.05	0.002	.4187989	1.918544
gdp	-.0024554	.8321381	-0.00	0.998	-1.633416	1.628505
_cons	-.7662561	3.147096	-0.24	0.808	-6.93445	5.401938

Appendix D.3. Breusch and Pagan Lagrangian multiplier test for random effects.

```
    ex[country,t] = Xb + u[country] + e[country,t]

                 |     Var       sd = sqrt(Var)
        ---------+-----------------------------
              ex |   .1838505       .4287779
               e |   .0943505       .3071652
               u |   .0682284       .2612056

Test:   Var(u) = 0
                    chi2(1) = 23.98

Prob > chi2 = 0.0000
```

Appendix D.4. Hausman specification test

```
         |      Fixed       Random
      ex |    Effects      Effects       Difference
---------+-----------------------------------------
     y98 |  -.1635236    -.1557207        -.0078028
     y99 |  -.4422788     -.421115        -.0211638
     y00 |  -.2296004    -.2115974        -.0180029
 rer_ppi |   1.258569     1.168671         .0898979
     gdp |  -.1917576    -.0024554        -.1893023

Test:  Ho: difference in coefficients not systematic

chi2( 5) = (b-B)'[S^(-1)](b-B), S = (S_fe - S_re)
         = 0.16

Prob>chi2 = 0.9995
```