THE WILLIAM DAVIDSON INSTITUTE
AT THE UNIVERSITY OF MICHIGAN BUSINESS SCHOOL

Equilibrium Exchange Rates in Southeastern Europe, Russia, Ukraine and Turkey:
Healthy or (Dutch) Diseased?

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William Davidson Institute Working Paper Number 770
May 2005

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Abstract

This paper investigates the equilibrium exchange rates of three Southeastern European countries (Bulgaria, Croatia and Romania), of two CIS economies (Russia and Ukraine) and of Turkey. A systematic approach in terms of different time horizons at which the equilibrium exchange rate is assessed is conducted, combined with a careful analysis of country-specific factors. For Russia, a first look is taken at the Dutch Disease phenomenon as a possible driving force behind equilibrium exchange rates. A unified framework including productivity and net foreign assets completed with a set control variables such as openness, public debt and public expenditures is used to compute total real misalignment bands.

JEL: E31, O11, P17

Keywords: Balassa-Samuelson, Dutch Disease, Bulgaria, Croatia, Romania, Russia, Ukraine, Turkey

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Forthcoming in Economic Systems, 2005, 29(2).

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1. Introduction

The ambition of this paper is to look at equilibrium exchange rates of three Southeastern European countries, namely Bulgaria, Croatia and Romania, of two CIS economies, namely Russia and Ukraine, and of Turkey. The choice of these countries may appear surprising at the first sight. But it is not. The prospect of joining the EU and the actual accession of eight countries from Central and Eastern Europe to the European Union in May 2004 have crowded out attention from equilibrium exchange rates of the rest of the former soviet block. This paper makes a, hopefully not futile, attempt to cover countries of the former soviet block so-badly treated in the literature, for which data are readily available to conduct a more than narrative country-by-country analysis. They are Bulgaria, Croatia, Romania, Russia and Ukraine. Bulgaria, Romania, and probably Croatia will join the EU in the foreseeable future, and questions related to entering ERM-II and adoption the euro for the new EU member states will pop up soon. But perhaps more important is this question, which also apply to Russia and Ukraine: Do these countries have their exchange rates "right" and are they not misaligned after having implemented reform measures with diverging speed and success to turn their economies to a market economy? The reason for Turkey being involved in this investigation is the accession negotiations opening in October 2005 with this country, and in this context, the equilibrium exchange rate of Turkey may not be confined solely to the Turkish central bank and the IMF any more but may be of interest also for European policy makers in the future.

Although a considerable number of the papers on this topic deal with these countries in a panel context such as Halpern and Wyplosz (1997, 2001), Krajnyák and Zettelmeyer (1998), Begg et al. (1999), DeBroeck and Sløk (2001), Dobrinsky (2003) and Fischer (2004), only very few studies focus on the countries in Southeastern Europe and the CIS individually. Chobanov and Sorsa (2004) analyze Bulgaria and Stapafora and Stavlev (2003), Sosunov and Zamulin (2004), and Rautava (2004) study the case of Russia. Crespo-Cuaresma et al. (2004) apply the monetary model to Bulgaria, Croatia, Romania and Russia. For Turkey, Doroodian et al. (2002 and Atasoy and Saxena (2004) investigate the equilibrium real exchange rate. Civcir (2004) and Crespo-Cuaresma et al. (2004) analyze the monetary model for Turkey.

This paper offers to fill this gap. We propose a systematic approach in terms of different time horizons at which the equilibrium exchange rate is assessed. First, we take a look at the deviation from absolute PPP. Subsequently, we investigate whether the real exchange rates in levels

correspond to the underlying productivity levels. In a next step, factors behind real exchange rate movements are studied. First, the simple Balassa-Samuelson effect and the Dutch Disease are put under the microscope and are then incorporated in a more unified framework, namely the stock-flow approach, which also includes other channels explaining real exchange rate developments. Both time series and panel data are used to study deviations from the equilibrium exchange rate.

The remainder of the paper is structured as follows: Section 2 describe the theoretical underpinnings. Section 3 deals with data and econometric issues. Section 4 provides some stylized facts regarding the real exchange rate of the countries under study, followed by Section 5 with the estimation results. Section 6 finally presents some concluding remarks.

2. Theoretical Background

2.1. The Real Exchange Rate in Level

In this paper, we follow a bottom-up approach in that we start looking at approaches to the equilibrium exchange rate which are assumed to hold in the long run and then move forward systematically toward shorter time horizons.

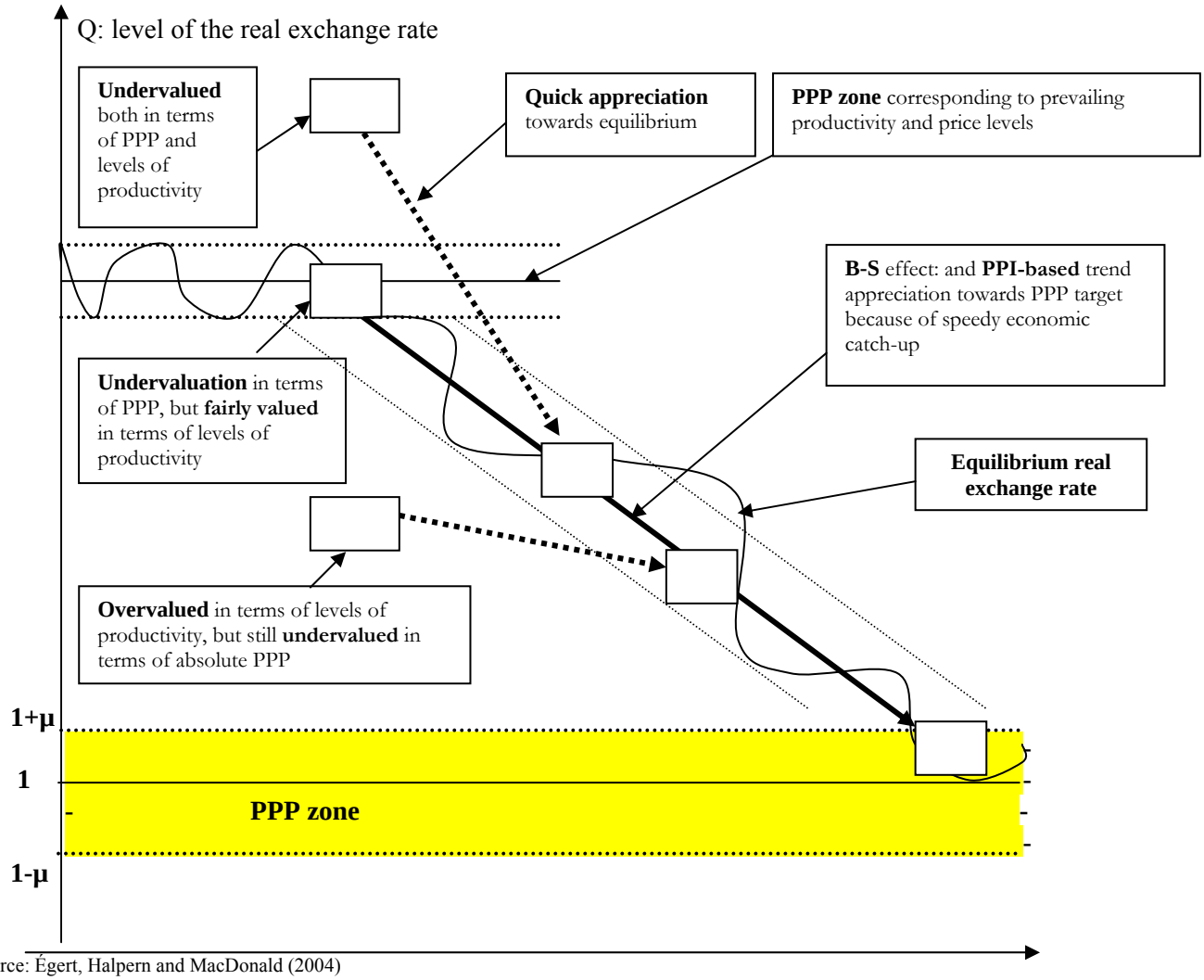
Let us now begin with the concept of purchasing power parity (PPP), which can be thought of as a very long-term approach for countries in the catching-up process. It is a well-understood fact that purchasing power parity is a poor tool, even in the long run, for measuring equilibrium exchange rates for transitional and developing countries because these countries' currencies are undervalued in terms of PPP. According to PPP, the exchange rate given by the ratio of domestic and foreign absolute price levels should be equal to the nominal exchange rate which can be observed on the foreign exchange market. In other words, the real exchange rate, which is given as $E /(P / P^*) = EP^* / P$, should equal 1. With the exchange rate being defined as domestic currency units expressed in terms of one unit of foreign currency,[2] a real exchange rate higher than one implies undervaluation.

Nonetheless, it has been long recognized that PPP is misguiding for transition economies. This is when the Balassa-Samuelson argument comes into the picture, which says that the less developed country is usually less productive in producing tradable goods. The price level in the open sector is given by the PPP condition. At the same time, the level of productivity in the open sector, usually lower in the less developed country, determines the price level in the closed sector through intersectoral wage linkages. Hence, the price level in the sheltered sector, and subsequently the overall price level, will be below that prevailing in the more developed country. As a result, the observed nominal exchange rate in the open sector appears to be weaker (higher) than the exchange rate given by PPP.

This undervaluation in PPP terms is an equilibrium undervaluation if it reflects a difference between productivity levels. By contrast, it may be the case that the price level does not fully reflect productivity levels. If prices are higher than what productivity levels would predict, the exchange rate can be viewed as overvalued in terms of productivity levels (although still undervalued in PPP terms). If prices are lower than what productivity levels would predict, the

currency can be though of as undervalued (not only in PPP terms). This is depicted in Figure 1 hereafter.

Figure 1. Trend Appreciation of the Equilibrium Exchange Rate



Source: Égert, Halpern and MacDonald (2004)

2.2. The Dynamics of the Real Exchange Rate

The equilibrium undervaluation in PPP terms is corrected with the catching-up process going on, if it is associated with a trend appreciation of the real exchange rate. Égert et al. (2004a) argue that such an appreciation may have three sources in transition economies: (1) the Balassa-Samuelson effect in dynamics (market-based services), (2) the appreciation of the real exchange

[2] In the rest of the paper, an increase (decrease) in the (real) exchange rate implies a depreciation (appreciation).

rate of the open sector, and (3) a trend increase of regulated prices. Such an appreciation can be viewed as an equilibrium phenomenon and is demonstrated in Figure when moving from point A to point D. Of course, initial undervaluation can also explain large real exchange rate appreciation, merely reflecting adjustment to equilibrium.

Let us now review quickly these channels. According to the relative version of the Balassa-Samuelson effect, an increase in productivity of the open sector exceeding that in the closed sector (dual productivity henceforth) may go in tandem with increases in real wages in the open sector without any loss in competitiveness given that relative PPP holds in the open sector ($E \cdot P^* / P$ is stable over time). Assuming wage equalization between the open and the market-based sheltered sectors, prices in the closed sector will increase. This productivity-driven inflation in market-based nontradables then results in higher overall inflation and a positive inflation differential, which in turn causes the real exchange rate to appreciate. Recent empirical results indicate, however, that at best half of the real appreciation is accounted for by the B-S effect in transition economies.

A large part of non-tradables is either administered or regulated. Non-market non-tradables behave markedly differently than market non-tradables for two reasons. The relative price of non-market services relative to other goods in the economy was much lower at the outset of transition than in a typical market economy at the same level of development would have been. Prices of non-market non-tradables, mainly transportation, telecommunication and public utilities (water, electricity and gas) were left unchanged or their increase were considerable lower than the rest of the consumer basket at the beginning of price liberalization. But because these sectors are very capital intensive, capital maintenance costs and then the replacement of the capital stock at market prices were to be included in prices, which may generate much larger price changes and this in the longer run, than for any other sectors. MacDonald and Wójcik (2004) and Égert and Lommatzsch (2004) studied the effects of regulated prices. On the basis of 4 CEECs, MacDonald and Wójcik (2004) found that regulated price developments dominated even productivity induced price movements. By contrast, Égert and Lommatzsch (2004) found that although increases in regulated prices play an important role in the real appreciation of some transition economies, they did not fade out the effect of productivity increases.

Finally, turning to the third channel of trend real appreciation, it has to be stressed that even the level of tradable prices of the transition economies is still lower than on average in the old EU member states. Correspondingly, price level convergence and real appreciation is not only linked to non-tradables but also to the prices of tradables. With economic restructuring, transition economies are able to increase their capacity to produce goods of better quality. First of all, old goods disappeared from the goods basket whereas new ones, with better quality, entered it. At the same time, better marketing and the resulting shift in consumer preferences towards goods produced in the domestic economy made it possible to market better and at higher prices the domestic goods. All this leads to an increase in tradable prices, too, the subsequent consequence of which is a trend appreciation of the tradable price-deflated real exchange rate. Égert and Lommatzsch (2004) develop a formal model that describes this phenomenon. This non-price competitiveness effect can be best captured with productivity in industry that reflects a huge increase in quality improvements triggered by large FDI inflows. An empirical implication of this is that an increase in productivity in the open sector is associated with an appreciation of the real exchange rate of the open sector (tradable goods). This is in contrast with what the class of New Open Economy Macroeconomics (NOEM) models suggests. NOEM models such as developed in Beningo and Thoenissen (2003), MacDonald and Ricci (2002) or Világi (2004) predict that although an increase in the open sector's productivity will lead to a B-S induced appreciation of the internal real exchange rate, such productivity improvements would cause tradable prices to decrease leading to a depreciation of the open sector's real exchange rate.

Besides the three aforementioned channels of real exchange rate appreciation, countries rich in natural resources and especially the ones with economic structures relying heavily on oil production and exports are usually good candidates for the Dutch Disease (D-D) phenomenon.

According to the D-D phenomenon, an increase in the price of the exported commodity on the world markets encourages more investment in the given sector, which in turn increases sectoral output. The need for more labor to produce more output in the commodity sector causes wages to increase, which, if wages tend to equalize across sectors, leads to an increase in wages in other sectors of the economy. As a result, the competitiveness of the non-oil open sector drops, implying a slowdown in exports and, as a consequence, in overall sectoral output. At the same time, because of wage increases, the relative price of nontradables and the production of this sector rise. Another implication of increasing commodity prices is the appreciation of the real

exchange rate triggered by the inflow of export revenues. Simultaneously, the overall trade balance remains balanced or even in surplus. The symptoms of the Dutch Disease can be summarized in the following propositions:

1. The real exchange rate appreciates;
2. The output and exports of the non-oil (nonbooming) open sector decline;
3. The production of the nontradable sector increases; and
4. The trade balance is not in the red.

In the flagship paper of the proponents of the D-D phenomenon, Sachs and Werner (1995) find strong empirical evidence in favor of the D-D effect especially in emerging Asian economies and in Sub-Saharan Africa. Nevertheless, in the second half of the 1990s, an increasing number of papers put into question the general validity of the D-D phenomenon and showed that it holds under specific conditions, thus diminishing the policy implication of the findings of Sachs and Warner (1995), according to which countries with abundant natural resources should not exploit their natural resources because this puts at risk their long-term growth. Spilimbergo (1999), for instance, shows that the D-D phenomenon does not seem to work for the cases of Chile and South Africa, countries with abundant natural resources. Gylfason (2002) argues that abundant natural resources may lead to sluggish long-term growth because of (1) ill-defined property rights, imperfect or missing markets and lax legal structures in many developing countries and emerging market economies; (2) the fight for resource rents and the concentration of economic and political power hampering democracy and growth, and (3) too many people getting stuck in low-skill-intensive, natural-resource-based industries. Kronenberg (2004) argues that one of the main reasons for the D-D phenomenon in transition economies is corruption. Papyrakis and Gerlagh (2004) suggest that, when controlling for e.g. corruption, investment, openness and education, abundant natural resources do not decrease (as predicted by the D-D phenomenon) but foster economic growth in the long run.

2.3. A Unified Framework for Modeling Real Exchange Rates

In this section, the different channels of real exchange rate dynamics are incorporated into a more general framework, namely the stock-flow approach to the real exchange rate, which has been used recently for industrialized countries (Faruqee, 1995; Aglietta et al.; 1998; and Alberola

et al., 2002) as well as for transition economies (Alberola, 2003; Rahn, 2003; Burgess et al., 2004; and Égert et al. 2004b), according to which the real exchange rate based on the CPI (Q^{CPI}) can be linked to the dual productivity differential (PROD) and to net foreign assets (NFA). The reduced-form equation commonly used is the following:

$$Q^{CPI} = f(\overset{+/-}{PROD}, \overset{+/-}{NFA}) \qquad (1)$$

In general, the sign on the productivity variable is not straightforward. NOEM models predict that an increase in productivity in the open sector leads to a depreciation of the real exchange rate of the open sector (positive sign). However, the overall impact depends also on whether this effect is counterbalanced by the traditional B-S effect. A specificity of transition economies is the productivity variable of the open sector can also reflect nonprice competitiveness in the open sector and thus lead to a real appreciation as argued in Égert et al. (2004b).

The sign on net foreign assets is not unambiguous either. Égert et al. (2004b) put forth that for well-established economies, an increase in the net foreign assets position is usually associated with an appreciation of the real exchange rate because of capital inflows related to increasing payments received on net foreign assets (positive sign). However, in transition economies, domestic savings may be insufficient to finance the high growth potential. Thus, foreign savings are needed, the inflows of which reduce (increase) net foreign assets (net foreign liabilities) and cause the real exchange rate to appreciate. This implies a negative sign. However, there is a threshold for the net foreign assets position beyond which the sign is likely to switch because the domestic economy has to start servicing its foreign liabilities. Any additional increase in net foreign liabilities would lead to an appreciation of the real exchange rate.

The mechanism causing the real exchange rate to appreciate in case the D-D phenomenon takes effect can be associated with increasing revenues from oil exports. Therefore, for Russia, equation (1) is augmented with the corresponding variable, which is given as the product of the price of Ural crude oil and crude oil production volume ($REV\_OIL = P^{OIL} \cdot \overline{Production}^{OIL}$):

$$Q^{CPI} = f(\overset{+/-}{PROD}, \overset{+/-}{NFA}, \overset{-}{REV\_OIL}) \qquad (1a)$$

To check for the robustness of our results, we include a set of control variables. Bergstrand (1991) argues that an increase in the relative price of nontradables may also be caused by

demand-side pressures leading to a real appreciation. Private and public consumption as a share of GDP have been widely used in the literature to account for these demand-side factors.[3] Because of data availability, we only use public expenditures as a share of GDP (EXP). Openness ($OPEN$) is also often included in empirical estimations. If openness were to reflect trade liberalization, an increase in openness should lead to a deterioration of the current account position. This is usually assumed to lead to a real depreciation. MacDonald (1998) and Clark and MacDonald (1999) use government debt ($PDEBT$) to approximate the risk premium. An increase in government debt implies higher risk, and this causes the real exchange rate to depreciate. MacDonald (1998) also includes real oil prices ($ROIL$), which is to reflect changes in the terms of trade. For non-oil producing countries, a rise in real oil prices implies a worsening of the terms of trade, which calls for a depreciation of the real exchange rate. Equations (1b) to (1e) show equation (1) augmented with the control variables:

$$Q^{CPI} = f(\overset{+/-}{PROD}, \overset{+/-}{NFA}, \overset{-}{EXP}) \tag{1b}$$

$$Q^{CPI} = f(\overset{+/-}{PROD}, \overset{+/-}{NFA}, \overset{+}{OPEN}) \tag{1c}$$

$$Q^{CPI} = f(\overset{+/-}{PROD}, \overset{+/-}{NFA}, \overset{+}{PDEBT}) \tag{1d}$$

$$Q^{CPI} = f(\overset{+/-}{PROD}, \overset{+/-}{NFA}, \overset{+}{ROIL}) \tag{1e}$$

For Russia, the equations tested are equations (1a) – (1e) augmented with the variable $P^{OIL} \cdot \overset{-}{Production}^{OIL}$. Equations (1) to (1e) are also estimated using PPI-based real effective exchange rates.

3. Data and Econometric Issues

Average labor productivity in industry, based on industrial production, is used for the productivity variable. Net foreign assets are approximated with cumulated monthly current account balances relative to GDP.[4] Openness is obtained as the average of exports and imports of

[3] See, for instance, Avallone and Lahrèche-Révil (1999), Beguna (2002), Bitans (2002), Coricelli and Jazbec (2004), Dobrinsky (2003), Fischer (2004), Halpern and Wyplosz (1997), Kim and Korhonen (2002) and MacDonald and Wójcik (2004) for transition economies.

[4] For Russia, official current account figures do not reflect the flight of capital from the country and hence may overstate net foreign assets.

goods relative to GDP. Similarly to MacDonald (1998), government debt is proxied by cumulated monthly deficits of the central or the consolidated general government. Government expenditures as a share of GDP are obtained as the share of expenditures of the central or the consolidated general government in GDP. For more details on data sources, see appendix 2.[5] Finally, it should be noted that dummy variables are included for Bulgaria to capture the financial crisis in 1997 and for Russia and Ukraine covering 1998 to capture the Russian crisis. For Turkey, two dummies are employed. The first is meant to capture the Mexican crisis in 1994, and the second intends to control for the effect of the Russian, Brazilian and Turkish crises in 1998, 1999 and 2001, respectively. A cautionary note should be made about the quality of the data, which in some cases may be of real concern. For want of anything better, we go ahead with these data, and interpret the result with corresponding cautiousness.

Equations (1)-(1e) are estimated based on both time series and panel cointegration techniques. For time series, the dynamic ordinary least squares (DOLS) of Stock and Watson (1993) and the auto-regressive distributed lag (ARDL) of Pesaran et al. (2001) are used. DOLS incorporates lags and leads of the regressors in first differences and thus accounts for the endogeneity of the regressors and for the serial correlation in the residuals:

$$Y_t = \beta_0 + \sum_{i=1}^{n} \beta_i X_{i,t} + \sum_{i=1}^{n} \sum_{j=-k_1}^{k_2} \gamma_{i,j} \Delta X_{i,t-j} + \varepsilon_t \qquad (2)$$

where k_1 and k_2 denote, respectively, leads and lags. The presence of cointegration is assessed upon stationarity of the residuals ε_t obtained from the long-term relationship, in the vein of the Engle-Granger approach by testing for unit roots in the residuals of the long-run relationship derived using DOLS as in equation (3). The critical values derived by MacKinnon(1991) for this purpose are used:[6]

[5] Data from national sources is preferred except if longer time series were available from the OECD or the IMF databases. The time span differs in function of the data availability of the different time series. The longest possible time span is always used.
[6] For the unit root tests, the lag length is determined using the Schwarz information criterion.

$$Y_t = \beta_0 + \sum_{i=1}^{n} \beta_i X_{i,t} + \varepsilon_t \qquad (3)$$

The ARDL approach uses the error correction form of the ARDL model is given by equation (4); where the dependent variable in first differences is regressed on the lagged values of the dependent and independent variables in levels and first differences.

$$\Delta Y_t = \beta_0 + \rho(Y_{t-1} + \sum_{i=1}^{n} \beta_i X_{i,t-1}) + \sum_{j=1}^{l_1} \eta_j \Delta Y_{t-j} + \sum_{i=1}^{n} \sum_{j=0}^{l_2} \gamma_{i,j} \Delta X_{i,t-j} + \varepsilon_t \qquad (4)$$

The lag structure of both the DOLS and the ARDL are determined primarily on the basis of the Schwarz information criterion with the maximum lag length being 4, but the Akaike and Hannan-Quinn information criteria are also employed complementarily.

To detect the presence of cointegrating relationships, Pesaran et al. (2001) employ the so-called bounds testing approach. Using conventional F-tests, the null of $H_0 : \rho = \beta_1 = ... = \beta_n = 0$ is tested against the alternative hypothesis of $H_1 : \rho \neq 0, \beta_1 \neq 0, ..., \beta_n \neq 0$. Pesaran et al. (2001) tabulate two sets of critical values, one for the case when all variables are I(1), i.e. upper bound critical values and another one when all variables are I(0), i.e. lower bound critical values. Critical values are provided for five different models, of which model (3) with unrestricted intercept and no trend will be used in our study. If the test statistic is higher than the upper bound critical value, the null of no cointegration is rejected in favour of the presence of cointegration. On the other hand, an F-statistic lower than the lower bound critical value implies the absence of cointegration. In the event that the calculated F-statistic lies between the two critical values, there is no clear indication of the absence or existence of a cointegrating relationship.

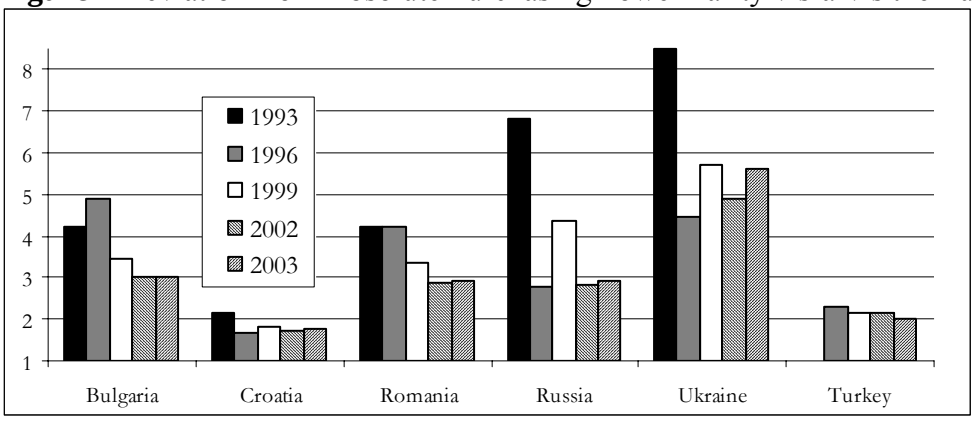
Because of possible heterogeneity across the countries, we employ the mean group DOLS, FMOLS and ARDL estimators that are able to account for cross-country heterogeneity in the slope coefficients in a panel context. A negative and statistically significant error correction term for the mean group ARDL is interpreted as evidence for cointegration.

4. Stylized Facts

Figure 2 indicates an undervaluation of the real exchange rate in level vis-à-vis the euro for all countries under study. The largest undervaluation has been found in Ukraine, whereas the

Croatian currency appears to be the least undervalued one among the countries. There are evident signs of a decrease in undervaluation for Bulgaria, Romania and perhaps for Russia. By contrast, the undervaluation appears pretty stable for Croatia and Turkey, and it fluctuates strongly for Ukraine.[7]

Figure 2 Deviation from Absolute Purchasing Power Parity vis-à-vis the Euro



Source: Calculations based on data obtained from the WIIW's annual database. The data for Turkey were obtained from NewCronos/Eurostat.

Note: The charts are obtained as EP*/P, where E is the actual nominal exchange rate, and P and P* are the absolute domestic and foreign price levels.

We now set out to analyze whether the exchange rate of the countries under consideration were undervalued or overvalued in terms of productivity levels. Put in another way, we are interested in whether a given country is at point A, A' or A'' in Figure 1. This is an important issue because if there is initial undervaluation or overvaluation, both the estimated long-term coefficients and the constant term obtained from the time series and in-sample panel estimates may be biased and thus would also bias the derived real misalignment (see Maeso-Fernandez et al. (2004).

Such an analysis is best conducted using cross-sectional data.[8] We make use of five regressions reported in Čihák and Holub (2003), Coudert and Couharde (2003) and Maeso-Fernandez et al. (2004). The fitted values of the real exchange rates in level (relative price levels or the exchange rate gap) of the countries under study obtained from these equations are then compared to the actual real exchange rates for each country against the EU-15.

[7] For Russia and Ukraine, some of the fluctuations may be due to changes in the euro-dollar exchange rate.

[8] In such a framework, the real exchange rate in levels (the relative price level or the exchange rate gap) of the home country vis-à-vis a benchmark economy (the reciprocal of the real exchange rate in levels) is regressed on the relative productivity level of the home country to that in the foreign benchmark. In practice, however, GDP per capita or GDP per employment expressed in PPP terms, a broad proxy for productivity, is employed because of data (un)availability.

Table 3 Cross-Sectional Regressions, Against the EU-15

	Countries	β_1	Year
Maeso-Fernandez et al. (2004)	25 (OECD)	0.50	2002
Coudert and Couharde (2003)	120 developing economies	0.25	2000
Čihák and Holub (2003)	30 EU+CEEC	0.90	1999
Čihák and Holub (2003)	22 EU+CEEC	0.86	2000
Čihák and Holub (2003)	30 EU+CEEC	0.94	1999

Notes: The coefficient is the slope coefficient from the regression. $Q^{level} = \beta_0 + \beta_1 PROD$; R2 stands for the goodness-of-fit of the regression. MFOS regress the log level of the exchange rate gap on the log level of relative GDP per capita, whereas CH regress relative price levels on relative per capita GDP levels (to the EU-15).

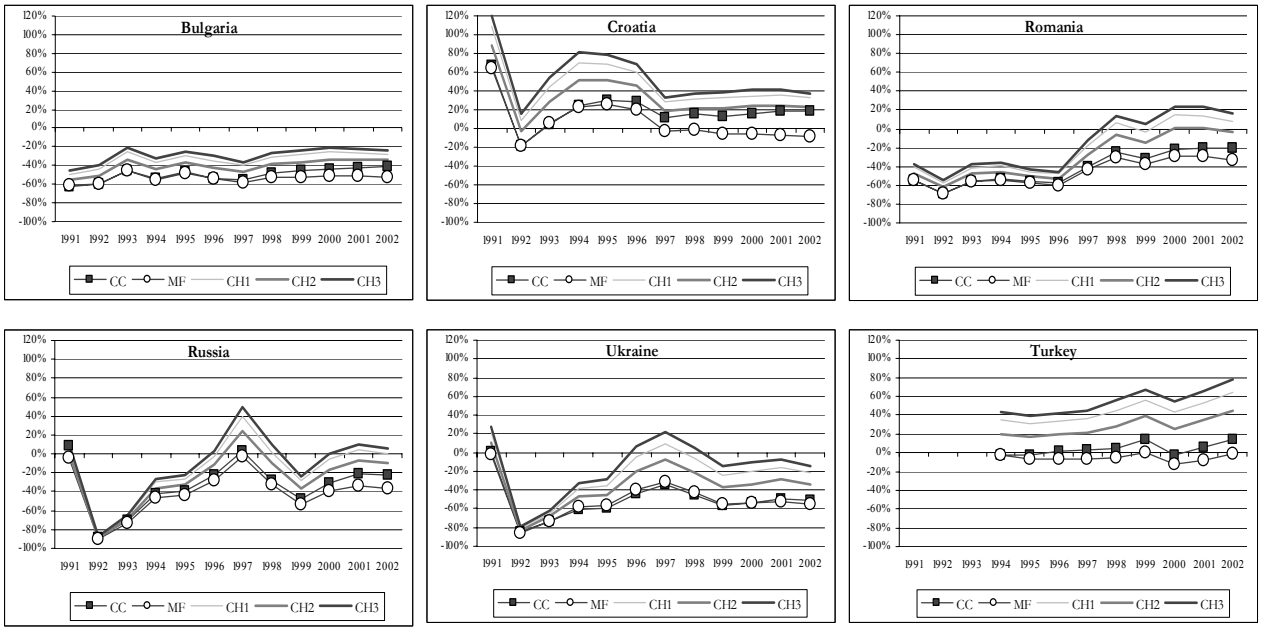
The three papers offer an interesting combination of country coverage. Coudert and Couharde (2003) include 120 developing and emerging economies, whose GDP per capita expressed using the purchasing power standard did not exceed the corresponding figure of the euro area. The sample also included all transition economies with a few exceptions. By contrast, the sample used in Maeso-Fernandez et al. (2004) is composed of 25 industrialized OECD countries, excluding all transition economies.[9] Čihák and Holub (2003) use a number of EU-15 countries and transition economies together.

These observations have interesting implications. First, the regression based on a large number of developing and emerging countries can be viewed as reflecting how the real exchange rate and per capita GDP may be linked, on average, for emerging and developing economies. Second, using a narrow sample of industrialized countries offers some perspectives regarding what this relationship looks like for higher GDP per capita levels. For the countries under study, such a relationship could be thought of as applying in the longer run (because the developing and emerging economies are expected to catch up with the industrialized economies in the long run). Third, taking a group of European transition and developed EU economies may tackle some heterogeneity problems in Coudert and Couharde (2003) and, at the same time, is able to anticipate long-term behavior given by the regression results in Maeso-Fernandez et al. (2004). However, the problem of initial undervaluation can potentially undermine cross-sectional regression if the dataset on which they are based contains countries with initially undervalued currencies. This is clearly the case of the Čihák and Holub regressions, and of the Coudert and Couharde regression, though to a lesser extent because the transition countries do not dominate any more.

[9] The panel includes the EU-15 (except for Luxembourg), Australia, Canada, New Zealand, the U.S.A. , Norway, Iceland, Korea, Mexico and Turkey. OECD countries such as the Czech Republic, Hungary, Poland and Slovakia are excluded.

Figure 4 reports under- and overvaluations in terms of productivity levels for the period of 1991–2003.[10] Focusing on the Maeso-Fernandez et al. and the Coudert and Couharde regressions, for Croatia and Turkey, no major initial undervaluation can be observed and, the results, especially those based on Maeso-Fernandez et al. (2004) show remarkable stability over time. For Bulgaria, the currency seems to be undervalued, but this undervaluation is stable over time. This means that the time series estimations for Bulgaria as for Croatia and Turkey may be viewed as unbiased in the sense of initial undervaluation. For Romania, Russia and Ukraine, the initial undervalutions are large, but over time, the real exchange rates, though still undervalued in 2003, have closed the gap to the level that would be in line with GDP per capita. For these countries, there might be scope for a bias for the entire period. But we may be on the safe side if time series estimations are carried out only for a more recent period, beginning in 1994 – 1996, after which period the undervaluation turns out to be stable.

Figure 4 Under- and Overvaluations in Terms of Productivity Levels



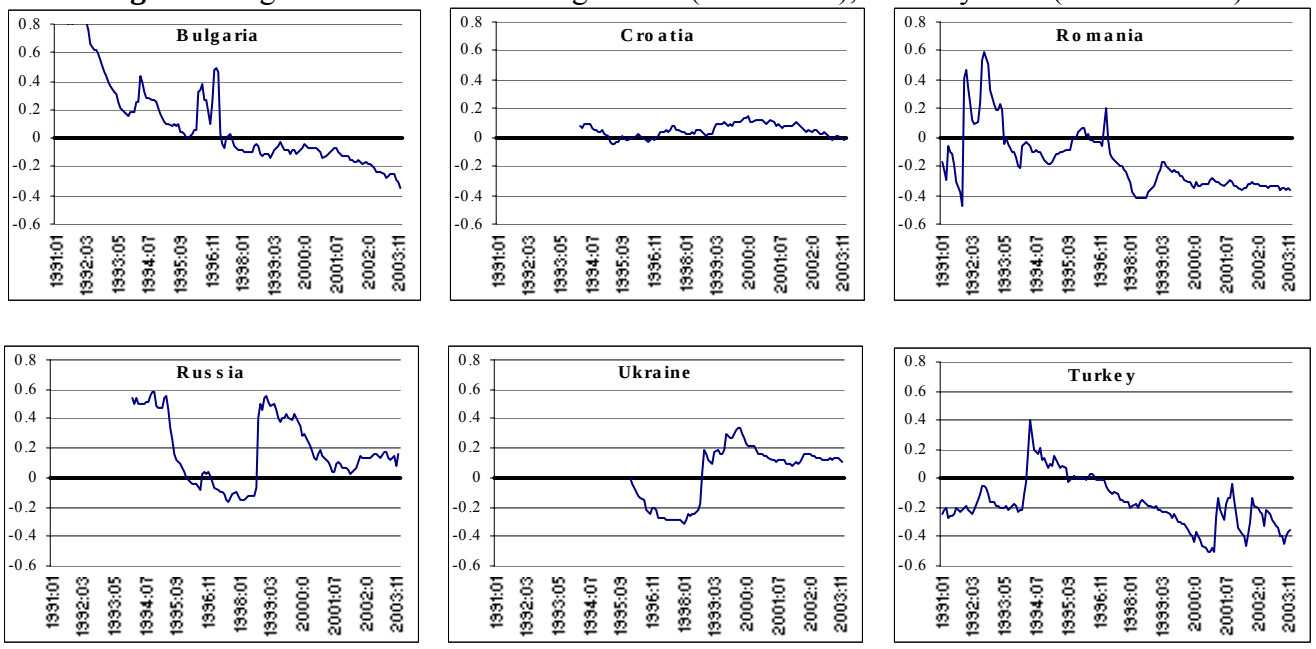
Note: A positive (negative) figure stands for overvaluation (undervaluation). CC denotes Coudert and Couharde (2003), MF is Maeso-Fernandez, Osbat and Schnatz (2004), and CH1, CH2 and CH3 are the three regressions taken from Cihak and Holub (2003).

[10] Čihák and Holub (2003) note that one should interpret the temporal development of data based on the International Price Comparison (IPC) program, i.e. level real exchange rates, with care. The annual data are based on interpolation/extrapolation of actual price observations taken once every three years. The error margin of such an interpolation/extrapolation may be as high as 6%. Notice also, however, that the data here are not used to derive precise misalignment figures but rather to provide some broader trends.

4.1 Potential Sources of Real Appreciation

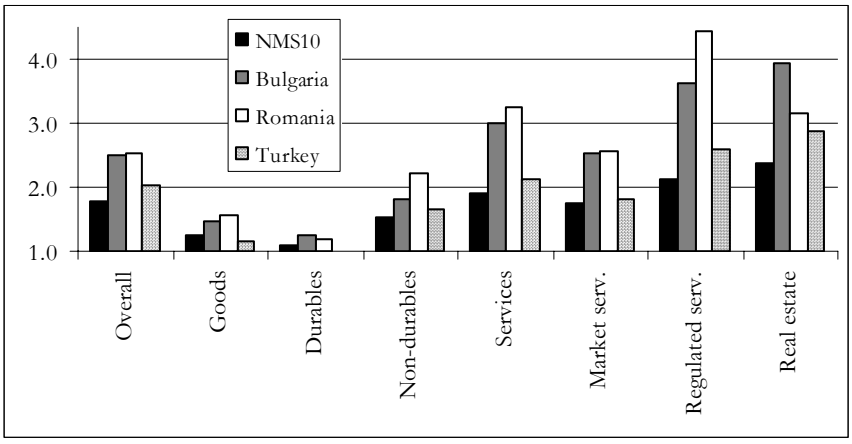
As shown earlier, the currencies of the countries under study are all undervalued in terms of PPP. At the same time, Figure 2 and Figure 5, plotting the real effective exchange rates of the countries on the basis of monthly data, reveal that the real exchange rate of some of the countries studied underwent, to a varying extent, an appreciation during the last 10 years or so.

Figure 5 Log Real Effective Exchange Rates (CPI-Based), Monthly Data (1996:01=100)



Looking at the extent of the undervaluation of the level real exchange rate of different groups of goods and services for Bulgaria, Romania and Turkey may give us an idea regarding the potential sources of the real appreciation. The largest undervaluation can be observed for nontradable goods. The undervaluation of the real exchange rate of regulated services is considerably larger than that of market-based services. Also, goods, especially nondurable (mostly domestically produced and consumed) goods turn out to be undervalued, though to a lesser extent (see Figure 6).

Figure 6. The Real Exchange Rate in Levels for Different Groups of Goods and Services,2002



Note: NMS10 denotes the ten new EU member states
Source: Author's calculations based on data drawn from NewCronos/Eurostat.

4.2 The Balassa-Samuelson Hypothesis

The large undervaluation of market services reported in Figure 4 may be explained by the absolute version of the Balassa-Samuelson (B-S) effect, which is generally thought to be a source of real appreciation in a successful catching-up process. To analyze the size of the inflation to be attributed to the B-S effect ($P^{B\text{-}S}$), let us consider the following equation used in Égert (2005):

$$P^{B\text{-}S} = (1-\alpha)\beta_1(PROD^T - PROD^{NT}) \qquad (5)$$

where $(1-\alpha)$ is the share of nontradables in the consumer basket, β_1 conceptually corresponds to the estimated coefficient, which connects the relative price of nontradables to productivity, and which, ideally, should be 1. PROD is the average labor productivity in the tradable (T) and nontradable (NT) sectors.

Average annual growth rates of the different measures of dual productivity are computed for the countries under consideration using annual data from national accounts for two periods, 1991–2001/2003 and 1996–2001/2003. For Turkey, the series start in 1970. This is why two subperiods are considered additionally for this country, namely 1970–2003 and 1970–1990.[11] The open sector is constructed using manufacturing, or if not available, industry, and for which

[11] It should be mentioned that the productivity figures may be biased downward for Russia and Ukraine because from 1995 to 1998, huge numbers of employees were forced to take unpaid leaves. Hence, they are included in the statistics even if they did not contribute to output.

the closed sector includes the rest except for health, education, public administration and other community services (non-market closed sectors). Agriculture once is part of the closed sector (DIFF2), and is excluded from the analysis once (DIFF1).[12] The coefficient β_1 is restricted to 1.[13]

In addition, average annual growth rates are computed using monthly industrial production-based productivity measures.[14] Using industrial production data, it is assumed that productivity changes in the closed sector is zero.

When comparing growth rates of productivity based on industrial production to growth rates in productivity based on national accounts, it appears that the two measures are broadly in line with data based on national accounts for Croatia, Russia and Turkey and to a lesser extent for Ukraine. By contrast, for Bulgaria and Romania, the reported figures based on industrial production are considerably higher than national accounts-based data when only manufacturing or industry is taken as the open sector. The reason for this is that in these two countries, productivity increased substantially in the closed sectors.

The basic assumptions, which would ensure the B-S effect to be at work were analyzed both graphically using annual data and econometrically for monthly data. It turns out that with the exception of Croatia and Russia, the pass-through from productivity changes in the open sector to the relative price of nontradables is not proportionate but it is lower than one for Bulgaria, Romania and Ukraine (attenuation of the B-S effect) and is higher than one for Turkey (amplification of the B-S effect). Regarding the stability of the real exchange rate in the open sector, the only country, for which stationarity could be detected is Turkey. This means that for

[12] A twofold rule for separating sectors into open and closed sectors in that we consider a sector to belonging to the open sector if (1) goods in this sector are potentially subject to good arbitrage leading to price equalization across countries, and if (2) it is governed by market forces. This yields a classification which is in contrast with, for instance, MacDonald and Wójcik (2004) and Mihaljek and Klau (2004), who argued that tourism, trade and transportation can also be considered open sector. To check the sensitivity of the data to classification issues, we proceeded to calculating alternative measures for open and closed sectors. Overall, how the sectors are classified into open and closed sectors might have a large impact. An example is Bulgaria, where dual productivity is negative when transport and telecommunications are taken as a closed sector, but it becomes highly positive when the same sector is considered an open sector. The opposite is true for Ukraine. However, some countries such as Croatia and Russia are less influenced by the choice of sectoral classification. Another data related issue is that whether average labor productivity is calculated on the basis of sectoral employment or employee data may matter. This is especially the case for Bulgaria and Romania.

[13] This relationship is estimated using monthly data, according to which a coefficient equal to 1 seems to be a reasonable assumption for Bulgaria and Russia. Because this coefficient is lower than 1 for the remaining countries, the reported figures could be viewed as upper-bound estimates. The results are available upon request from the author.

[14] The same periods were considered here as for the national accounts-based data. For Croatia, Romania and Russia, data for 2003 (not available from national accounts) are also shown for comparison purposes.

the remaining countries, the B-S effect can be at best a partial explanation for movements in the real exchange rate.

The inflation rate that can be associated with the B-S effect is quantified relying on equation 5. Table 2 reports the composition of the harmonized CPI for Bulgaria and Romania. It turns out that the share of services is slightly above 30% whereas the share of market-based services is about 15%. The general experience of the new EU member states of Central and Eastern Europe shows that the corresponding shares in the national CPIs are slightly higher than in the HICP. Hence, a share of 20% can be thought of as a reasonable measure for market services for Bulgaria and Romania. Going one step further, because the countries studied here are comparable with the same level of development, 20% can be viewed as a reasonable estimate for the share of market-based nontradables for all of the countries covered in this study.

Table 2 The Share of Different Groups of Items in the HICP (in percent) in 2002

	NMS10	Bulgaria	Romania
Goods, of which	28.1	21.1	20.8
Durable	7.9	2.2	1.5
Semi-durable	10.5	6.6	9.0
Non-durable	9.7	12.4	10.2
Energy	4.7	4.2	4.7
Food, of which	29.9	43.4	46.3
Alcohol&tobacco	6.7	4.5	5.2
Services	48.9	34.0	32.0
of which regulated	15.3	18.0	16.8

Source: Calculations based on disaggregated HICP data drawn from NewCronos/Eurostat. NMS10 stands for the ten new EU member states.

Results in Table 3 indicate that the B-S effect may be negative for Bulgaria irrespective of the period considered and for Croatia for 1991–2002 when using data based on national accounts. However, industrial production-based figures indicate a positive effect. This is mainly because such figures do not take account of productivity increases in services. However, if considering productivity increases in services, as is the case for the other countries, results based on national accounts and on industrial production are fairly similar. Nevertheless, the effect rises to about 0.8 percentage point in Croatia for the period of 1996–2002. Table 3 also indicates a 1.1 percentage point average annual contribution to inflation of the B-S effect in Russia and Ukraine. The effect fluctuates around 0.2 percentage point in Turkey. Finally, the effect strengthens pretty much for the second half of the period studied in Romania, as it hovers around 1.9 percentage points. Nevertheless, when comparing these figures to the average inflation rates of the observed period, Croatia is the only country for which the B-S effect has an important effect from 1996–2002, as it explains roughly up to one-fifth of the observed inflation. This is in line with findings in

Nenovsky and Dimitrova (2002) who argue that the B-S effect is not a major player in Bulgaria. Also, the amplitude of the B-S effect is broadly in line with findings for the eight new EU Member States in Central and Eastern Europe.[15]

What remains to be done is to get an estimate for the B-S effect for the foreign benchmark in order to be able to assess the appreciation of the real exchange rate, which could be explained by the dual productivity differential. For this purpose, we use the average of three studies known to us which provide the needed figure for Germany, which is taken as a proxy for the euro area during the 1990s: 0.25%.[16] For the industrial production-based productivity measure, the two figures which can be obtained using equation (1) are 1.2% for 1992–2003 and 1.0% for 1996–2003.[17] When adjusting the figures reported in Table 3 appropriately, the equilibrium exchange rate appreciates in Romania, Russia and Ukraine, while the direction of a change in the equilibrium exchange rate hinges on whether or not national accounts or industrial production-based data are used in Bulgaria, Croatia and Turkey. However, using data obtained from national accounts seems more appropriate for measuring the B-S effect. This would imply an equilibrium depreciation in Bulgaria, an equilibrium appreciation in Croatia and a constant equilibrium exchange rate in Turkey.

[15] See Égert et al. (2004), for a summary of the results.
[16] For Germany, Swagel (1999), Lommatzsch and Tober (2003) and Égert et al. (2003) estimated the size of the B-S effect as 0% (1990–1996), 0.1% (1995–2002) and 0.55% (1995–2000), respectively.
[17] The share of nontradables in the CPI is set to 40%.

Table 3 The Contribution of the B-S Effect to Average Annual CPI in Percentage Points

		DIFF1_Old	DIFF2_Old		IND_PROD	Observed CPI	
						Period average	2003
BULGARIA	1991-2003	-0.96%	-0.79%	1992-2003	1.79%	145.2%	
	1996-2003	-1.48%	-1.42%	1996-2003	1.54%	153.4%	2.3%
CROATIA	1991-2002	-0.02%	-0.06%	1992-2002	0.63%	203.0%	
	1996-2002	0.82%	0.67%	1996-2002	0.60%	4.3%	1.8%
RUSSIA	1991-2001	1.17%	0.67%			292.3%	
	1996-2001	1.00%	0.58%	1996-2001	1.11%	36.4%	13.6%
UKRAINE	1991-2002	0.99%	0.79%			675.9%	
	1996-2002	0.14%	0.95%	1996-2002	1.94%	24.3%	5.2%
		DIFF1_New	**DIFF2_New**				
BULGARIA	1996-2003	-0.27%	-0.21%	1996-2003	1.54%	153.4%	2.3%
ROMANIA	1991-2002	0.19%	0.52%			100.6%	
	1996-2002	1.43%	1.68%	1996-2002	1.84%	57.3%	15.3%
		DIFF1_TK	**DIFF2_TK**				
TURKEY	1970-2003	0.33%	0.27%			50.4%	
	1970-1990	0.22%	0.26%			39.2%	
	1991-2003	0.22%	0.05%	1991-2003	0.50%	68.6%	
	1996-2003	0.36%	0.07%	1996-2003	0.14%	61.9%	
	1994-2001	0.08%	-0.06%	1994-2001	-0.10%	77.4%	25.3%
EURO AREA		**NATIONAL ACCOUNTS**			**IND_PROD**		
	1991-2003	0.25%			1.00%		
	1996-2003				0.80%		

Source: Average annual inflation is computed based on data drawn from WIIW and from the OECD Economic Outlook for Turkey. IND_PROD refers to average labor productivity obtained on the basis of industrial production.
Note: For the industrial production-based figures, the same periods are shown as for the national account-based data mainly for the sake of full comparability. The extension of the period till 2003 for Croatia, Romania and Russia would not change too much. DIFF1 is the measure of dual productivity when agriculture is excluded both from the open and closed sectors, while it is included in the open sector for DIFF2. DIFF_Old refers to data obtained from old SNA national account standards (for Russia and Ukraine, data only on this basis are available), DIFF_New stands for data based on new NACE classifications.

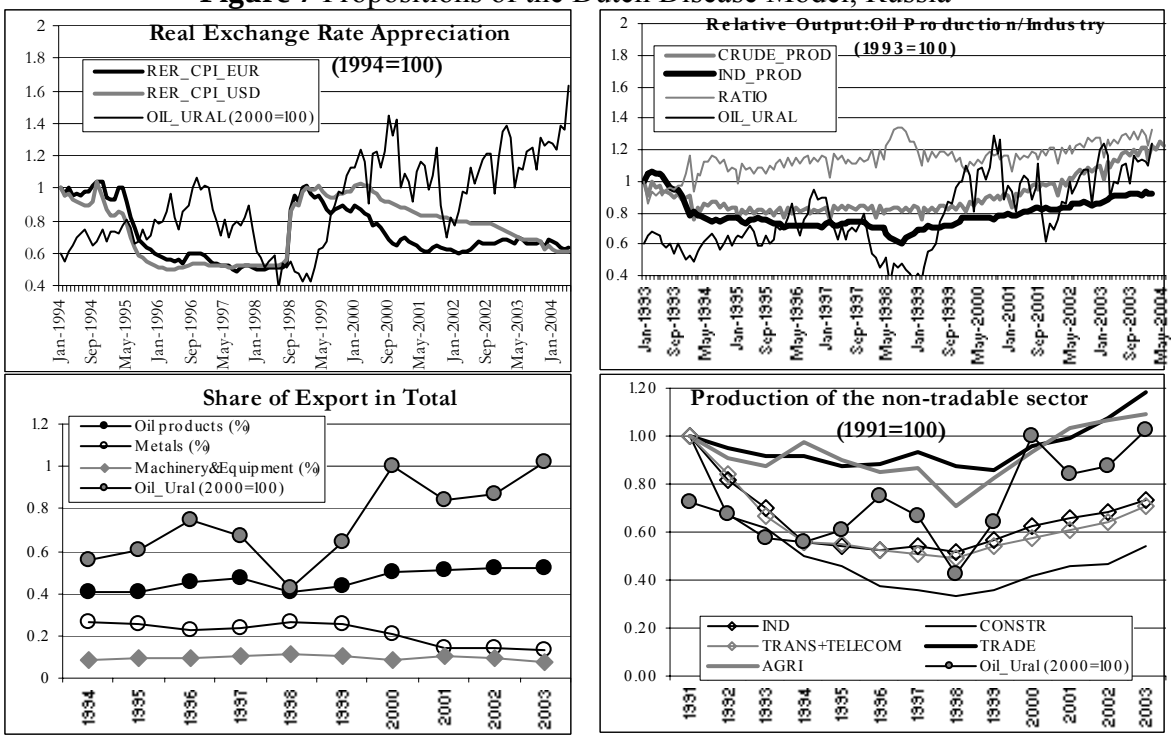
4.3. The Dutch Disease in Russia

Regarding the basic proposition number 1 of the D-D hypothesis for the case of Russia, wage equalization, as already discussed earlier, does not appear to be too heroic an assumption. Analyzing the symptoms of the Dutch Disease in Russia, Figure 7 shows that the real exchange rate of the Russian ruble vis-à-vis both the euro and the U.S. dollar underwent some appreciation episodes. The most notable is the steady appreciation from 1999 onward.

With regard to proposition number 2, Figure 7 also plots the ratio of monthly crude oil production to industrial production in volume. The relative share of crude oil, fuel and natural gas in total exports grew from 40% in 1994 to above 50% in 2003. At the same time, the share of metal exports dropped considerably, whereas the share of machinery and equipment exports remained fairly stable. This indicates that only the commodity exporting sectors are crowded out. The graph also indicates that the value added at constant prices in some of the nontradable sectors, namely trade and agriculture, grew faster than that in industry. By contrast, transport and telecommunications move broadly in line with industry. Finally, the Russian trade balance has exhibited large surpluses since the early 1990s. Overall, it seems that some of the symptoms of

the D-D phenomenon are present in Russia and that there may therefore be some scope for the D-D effect in Russia. This analysis holds true especially for the period after 1999.

Figure 7 Propositions of the Dutch Disease Model, Russia



Sources: WIIW, European Intelligence Unit, Datastream.

5. Estimation Results

5.1. Time Series Results

As shown earlier, the B-S effect may play only a limited role in the countries under study. This is why a unified framework is changes in productivity may affect the exchange rate via channels different than the B-S effect, and which also incorporate the effect of net foreign assets, public expenditures, public debt and openness for all of the countries and the Dutch Disease for Russia and Ukraine.

Tables 4 to 9 below show the estimation results based on alternative time series cointegration techniques.[18] As a rule of thumb, the lag structure given by the Schwarz criterion is retained.

[18] The time periods used are given by data availability. The period starts in 1985 for Turkey, and in 1993 or later for the rest of the sample. As we have shown earlier, a large part of the initial undervaluation had been corrected by the mid-1990s. Therefore

However, when lag structures provided by the alternative information criteria (Akaike and Hannan-Quinn) yield better results, they are preferred and are reported in Tables 4 to 9.

For Bulgaria, using a dummy capturing the 1996 and 1997 financial crisis[19], only DOLS estimates show the presence of cointegration and yield statistically significant coefficient estimates for the CPI-based real exchange rate, while for the PPI-deflated real exchange rate, both the DOLS and ARDL approaches indicate cointegration. Note that no cointegration could be found when public expenditures as a share of GDP are employed. If significant, the productivity variable has always a negative sign[20]. Net foreign assets become significant mostly only with the inclusion of the control variables. In those cases, they have a positive sign, implying that a decrease in net foreign assets is associated with an appreciation of the real exchange rate. If significant, the control variables are correctly signed: an increase in real oil prices and in cumulated public deficits (as a proxy for public debt) causes the real exchange rate to depreciate, and a rise in openness also yields a real depreciation.

Regarding Croatia, it is rather difficult to establish cointegration relationships using the residual-based tests and the bounds testing approach. Weak evidence for cointegration is, however, provided by the error correction terms, which are often significant with a negative sign. Of these cases, the productivity variable has an unambiguous negative sign. Contrary to Bulgaria, the sign on net foreign assets is always negative: a decrease in this variable is linked to a real depreciation. Real oil prices and openness are found significant only with DOLS, but then they are correctly signed. The public deficit is always significant but has a positive sign (an increase leads to a real appreciation). At the same time, the productivity variable becomes insignificant and switches signs, pointing to possible multicollinearity among the two variables. Results are most robust when public expenditures in GDP are included, given that all two estimation techniques both for the CPI-based and the PPI-based real exchange rate yield similar results in terms of both signs and significance. Public expenditures seem to capture demand-side effects, as an increase in this variable is reflected in a real appreciation of the Croatian kuna.

Turning now to Romania, when it is found statistically significant, the productivity variable enters all equations with a positive sign for the whole period, with the exception when the PPI-

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the criticism by Maeso-Fernandez et al. (2004) that the long-term coefficients will be biased because of initial undervaluation applies to our case only to a limited extent.

[19] It takes the value of 1 from 1996:3 to 1997:6, and is zero otherwise

deflated real exchange rate and public expenditures are estimated using DOLS. Splitting the sample in 1998 allowed us to uncover that the productivity variable becomes negative in the baseline specification.[21] However, the use of the control variable reverses the sign once again. Also, while mostly positive for the whole period, the sign on net foreign assets becomes negative for the second half of the period studied.

For Russia, it is also difficult to detect cointegration in an unambiguous way even using a dummy that captures the post-1998 period (1999:01 to 2003:12). For the cases with a significant and negatively singed error correction term, productivity appears to be mostly linked negatively to the real exchange rate, especially for the baseline scenario. The sign on net foreign assets is found to be negative for the baseline scenario. This result changes when the control variables are included, and the sign becomes systematically positive. It should be mentioned that the oil revenue variable becomes significant only if another control variable (OPEN, PDEBT or EXP) is used, and in particular when using the real exchange rate deflated by PPI.[22] In these cases, it bears a negative sign, implying that an increase in oil revenues causes the real exchange rate to appreciate. Note also that for cases when the oil revenue variable becomes significant, the productivity variable tends to be insignificant.

As far as Ukraine is concerned, the results appear more robust than previous results.[23] Productivity and net foreign assets are mostly significant irrespective of the specifications. Like for Russia, NFA are linked to the real exchange rate through a positive sign. Of the control variables, the share of public expenditures in GDP is highly significant and has a negative sign confirming the demand-side channel. The real oil price variable has a negative sign. At first sight, this is surprising because Ukraine is not a net oil-exporting country. However, this finding

[20] Recall that a negative sign means that an increase in productivity leads to an appreciation of the real exchange rate.
[21] Results for the period 1998 to 2003 are not reported here.
[22] Sosunov and Zamulin (2004) use a general equilibrium model to investigate the appreciation of the real exchange rate in Russia. After calibrating their model, they come to the conclusion that the real exchange rate can be modeled as a function of the oil price with an elasticity of about 0.3. We try to match this finding with the data and perform cointegration tests between the real exchange rate and the real oil price for the whole period and for the post-1998 period. Strapafora and Stavrev (2003) also analyze the real exchange rate of the Russian ruble. Using quarterly data and the Phillips and Loretan (1991) cointregration technique, they find that the productivity variable, the oil price and a 1998 dummy significantly enter the real exchange rate equation. We also take a look at this specification. We estimated these specifications and the oil variable (real and nominal oil prices and oil revenue) turned out to be statistically insignificant. There may be several reasons why oil revenues variables are often found to be insignificant: First, oil prices may be too volatile on a monthly frequency to be cointegrated with the other, more stable variables. Second, changes in oil prices may impact on the real exchange rate not instantaneously but with a given lag. So, it would be expedient to use smoothed values for the oil revenue variable (e.g. moving averages) and to include them in the long-term relationship with some lag.
[23] Data for openness are available starting only in November 1999, which is a hindrance for the specification including openness to be estimated for Ukraine.

may be the outcome of a spillover effect from Russian oil revenues: the transit of oil through Ukraine may generate revenues in function of changes in oil prices.

Turning to Turkey, several interesting things emerge from the estimation results obtained for the period of 1985–2003. Although productivity is usually found to be cointegrated with the real exchange rate with the expected negative sign, the sign on net foreign assets depends largely on the inclusion of control variables and whether or not CPI- or PPI-based real exchange rates are used. On the one hand, . In the baseline specification and when using openness or real oil prices, the sign of the net foreign assets variable is positive. However, when the estimations are performed using public debt or public expenditures, the sign becomes negative. Note that the public debt and expenditure variables are significant and have the expected sign. Like in Ukraine, the real oil price variable is negatively signed, although Turkey is a net oil-importing country.

Table 4. Time Series Estimation Results, Bulgaria

	CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI	
	1993:01 – 2003:12				1993:01 – 2003:12				1994:01 – 2003:12				1993:01 – 2003:12				1997:12 – 2003:12			
	DOLS (0,2)	ARDL (4,2)	DOLS (0,2)	ARDL (4,2)	DOLS (0,2)	ARDL (3,0)	DOLS (0,2)	ARDL (4,0)	DOLS (1,2)	ARDL (4,1)	DOLS (0,2)	ARDL (4,1)	DOLS (0,2) AIC	ARDL (4,0)	DOLS (1,4) AIC	ARDL (4,0)	DOLS (0,0)	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)
COINT	-5.93** (1)	4.034a	-5.733** (1)	6.826**	-5.969*** (1)	1.697	-5.763*** (1)	5.227**	-5.731*** (1)	1.551	-5.589*** (1)	2.223	-5.908*** (1)	5.185**	-5.773*** (1)	10.204**	-1.229 (2)	-0.856	-1.531 (0)	-0.52
ECT	-0.195***	-0.109	-0.339***	-0.25***	-0.191***	-0.209**	-0.339***	-0.329***	-0.208***	-0.152	-0.364***	-0.334**	-0.256***	-0.238***	-0.358***	-0.386***	-0.031	-0.051	-0.02	-0.023
CONST	-0.492***	-0.632	0.244***	0.222**	-0.73***	-0.611	0.112	0.236	-0.251	-1.065	0.692***	0.281	-0.717***	-1.177***	0.219**	-0.269**	-0.552***	-0.318	0.091	0.309
PROD	-0.99***	-0.951	-0.819***	-0.911***	-1.062***	-0.968**	-0.859***	-0.877***	-0.934***	-0.619	-0.887***	-0.766**	-0.545***	0.256	-0.772***	0.11	-0.584***	-1.231	-0.362**	-1.037
NFA	0.143	0.03	0.454***	0.242	0.511**	0.04	0.657***	0.169	0.465***	0.573	0.579***	0.504	0.37**	0.529	0.432***	0.732**	0.897***	0.799	0.982***	1.082
ROIL					0.123**	0.027	0.069	-0.005												
OPEN									0.173	-0.277	0.299***	0.062								
PDEBT													-0.357**	-1.098***	-0.062	-0.881***				
EXP																	0.041***	0.012	0.025**	0.018
DUMMY	0.048*	0.3*	0.073***	0.181**	0.016	0.095	0.055**	0.13*	-0.023	0.213	-0.007	0.105	0.102***	0.284***	0.083***	0.254***				

Notes: The shadowed columns indicate that the given equation is used for the derivation of real misalignments. CPI and PPI refer to the estimation results for the CPI-based and the PPI-based real exchange rates, respectively. a) indicates ambiguity in the sense that the tests statistic lies in a range where there is no clear indication of the absence or existence of a cointegrating relationship)(Pesaran, Shin and Smith, 2001). The periods indicated in the header of the table show the longest period available for all the variables. ECT is the error correction term, COINT is the residual-based cointegration test (DOLS) and the F-test based cointegration test (ARDL). LAG indicates the lag structure. If not indicated otherwise, the lag structure is based on the Schwarz information criterion. AIC and HQ meands that the lag structure is determined using the Akaike and the Hannan-Quinn information criterion, respectively. FIX indicates that lags (and leads) correspond to the maximum lag length (=4). CONST, PROD, NFA, ROIL, OPEN, DEF and EXP are the constant term, the dual productivity differential, net foreign assets to GDP, real oil prices, the openness ration, public debt and public expenditures as share of GDP. DUMMY is a dummy term capturing the financial crisis occurred in 1996 and 1997. It takes the value of 1 from 1996:3 to 1997:6, and is zero otherwise.

Table 5. Time Series Estimation Results, Croatia

	CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI	
	1993:01 – 2003:12				1993:01 – 2003:12				1994:01 – 2003:12				1995:01 – 2003:12				1995:12 – 2003:12			
	DOLS (0,3)	ARDL (1,0)	DOLS (0,3)	ARDL (1,0)	DOLS (0,3)	ARDL (1,0)	DOLS (0,3)	ARDL (1,0)	DOLS (4,2) HQ	ARDL (1,0)	DOLS (4,2) HQ	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)	DOLS (1,2)	ARDL (1,3) AIC	DOLS (0,0)	ARDL (1,0)
COINT	-1.888 (0)	-1.577	-1.532 (0)	-0.736	-1.877 (0)	-2.322	-1.815 (0)	-2.204	-1.999 (0)	-2.195	-2.103 (1)	-2.824	-3.686 (1)	2.55	-4.309*** (1)	1.552	-1.982 (0)	3.536a	-4.717*** (1)	1.418
ECT	-0.054	-0.082*	-0.017	-0.059	-0.052	-0.082*	-0.038	-0.082**	-0.065*	-0.084*	-0.043	-0.064	-0.146***	-0.175***	-0.127**	-0.174***	-0.146**	-0.357***	-0.23***	-0.308***
CONST	-0.071***	-0.085*	-0.055***	-0.085	-0.078***	0.019	0.026	0.212	0.018	0.247	0.05	0.278	-0.136***	-0.155***	-0.106***	-0.123***	-0.377***	-0.382***	-0.455***	-0.446***
PROD	-0.63***	-0.205	-0.614***	0.373	-0.639***	-0.201	-0.605***	0.111	-0.365***	-0.201	-0.347***	0.352	-0.058	0.144	-0.123	0.157	-0.438***	-0.628***	-0.756***	-0.705***
NFA	-0.066***	-0.06	-0.187***	-0.2	-0.064***	-0.079	-0.202***	-0.244**	-0.097***	-0.055	-0.209***	-0.197	-0.279***	-0.33***	-0.411***	-0.441***	-0.138***	-0.082*	-0.182***	-0.181***
ROIL					0.003	-0.045	-0.035***	-0.123*												
OPEN									0.072**	0.189	0.076**	0.207								
PDEBT													1.144***	1.506***	1.377***	1.595***				
EXP																	-0.172***	-0.197***	-0.271***	-0.265***

Note: As for Table 4.

Table 6. Time Series Estimation Results, Romania

	CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI	
	1994:01 – 2003:12				1994:01 – 2003:12				1994:01 – 2003:12				1994:01 – 2003:12				1994:01 – 2003:12			
	DOLS (3,1)	ARDL (1,1)	DOLS (4,4) FIX	ARDL (1,1)	DOLS (3,1)	ARDL (4,4) FIX	DOLS (2,0)	ARDL (1,1)	DOLS (3,0)	ARDL (1,1)	DOLS (2,0)	ARDL (1,1)	DOLS (3,1)	ARDL (1,1)	DOLS (4,0)	ARDL (1,1)	DOLS (4,4) AIC	ARDL (3,3) AIC	DOLS (4,4) AIC	ARDL (1,1)
COINT	-2.394 (0)	1.59	-2.44 (0)	4.347*	-2.378 (0)	2.643	-3.23 (1)	2.89a	-2.618 (0)	1.471	-2.904 (0)	3.668a	-2.362 (0)	1.014	-2.429 (0)	3.211a	-1.758 (0)	3.511a	-3.219 (1)	4.047*
ECT	-0.102**	-0.134***	-0.125***	-0.186***	-0.105**	-0.164***	-0.136***	-0.185***	-0.125***	-0.142***	-0.171***	-0.205***	-0.102**	-0.118***	-0.132***	-0.168***	-0.11***	-0.15***	-0.132***	-0.214***
CONST	-0.024	0.014	-0.111***	-0.045	-0.097	0.309	-0.148	0.053	-0.448	0.333	-1.26***	-0.093	0.023	-0.091	-0.092**	-0.146	0.638***	-1.306**	0.44	-1.192**
PROD	0.699***	0.412	0.179**	-0.166	0.658***	0.768**	-0.026	-0.081	0.754***	0.156	0.442**	-0.246	0.864***	0.057	0.079	-0.485	0.472***	0.573*	-0.295***	-0.101
NFA	0.751***	0.726***	0.576***	0.579***	0.768***	0.751**	0.629***	0.577**	0.634***	0.775**	0.305***	0.545**	0.632***	0.964***	0.515***	0.782***	0.813***	0.791***	0.693***	0.64***
ROIL					0.035	-0.139	0.045	-0.046												
OPEN									-0.209	0.147	-0.574***	-0.027								
PDEBT													1.539**	-3.196	0.364	-2.885				
EXP																	0.257***	-0.57**	0.172	-0.506**

Note: As for Table 4.

Table 7. Time Series Estimation Results, Russia

	CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI	
	1994:01 – 2003:12				1994:01 – 2003:12				1994:01 – 2003:12				1994:01 – 2003:12				1995:01 – 2003:12			
	DOLS (4,0)	ARDL (1,0)	DOLS (3,1)	ARDL (3,1) AIC	DOLS (3,0)	ARDL (3,1) HQ	DOLS (3,1)	ARDL (1,0)	DOLS (2,0)	ARDL (1,0)	DOLS (2,1)	ARDL (1,2) HQ	DOLS (4,4)	ARDL (1,2) HQ	DOLS (4,4)	ARDL (1,0) HQ	DOLS (2,4) AIC	ARDL (1,4) AIC	DOLS (2,1)	ARDL (1,4) AIC
COINT	-2.615 (1)	2.651	-2.31 (0)	4.52*	-2.65 (1)	5.251**	-2.644 (0)	1.189	-3.187 (1)	3.181a	-3.13 (0)	5.707**	-1.958 (1)	6.269**	-1.806 (0)	2.947a	-2.012 (1)	2.801a	-1.871 (0)	3.219a
ECT	-0.083***	-0.1***	-0.044	-0.143***	-0.085**	-0.128***	-0.066*	-0.078*	-0.218***	-0.178***	-0.246***	-0.351***	-0.132***	-0.28***	-0.094*	-0.176***	-0.238***	-0.374***	-0.258***	-0.444***
CONST	-0.577***	0.051	-1.109***	-0.517	-0.667***	0.071	-0.866***	1.259	0.07	0.89	0.399	1.809	-0.421***	0.397	-0.704***	0.637	-0.755	0.407	-1.11*	0.59
PROD	-0.809***	-2.538***	-0.954***	-2.407**	-0.814***	-1.568*	-0.179	-3.176	-0.573	-0.95	0.251	0.028	-0.142	-1.062**	0.646***	-1.656*	-0.609*	-1.188*	0.319	-0.925
NFA	-0.012	0.181	-0.127**	0.049	-0.049	0.201	-0.042	0.619*	0.107***	0.246**	0.1**	0.402***	0.01	0.342***	-0.027	0.497***	0.156***	0.173*	0.184***	0.239**
REV_OIL					-0.023	-0.083	-0.281***	-0.657	-0.085*	-0.158	-0.299***	-0.451***	-0.065*	-0.300***	-0.287***	-0.565**	-0.032	-0.057	-0.31***	-0.244*
OPEN									0.172	0.37	0.458	0.719								
PDEBT													0.796	-1.729	0.271	-4.373				
EXP																	-0.129	0.106	-0.173	0.152
DUMMY	0.326***	0.067	0.639***	0.411	0.405***	0.012	0.574***	-0.386	0.144*	-0.091	0.249**	-0.271	0.052	-0.074	0.182*	-0.022	0.078	0.133	0.18**	0.208

Note: As for Table 4. DUMMY is a dummy term capturing the post-1998 crisis period. It takes the value of 1 from 1999:01 to 2003:12, and is zero otherwise.

Table 8. Time Series Estimation Results, Ukraine

	CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI	
	1996:01 – 2003:12				1996:01 – 2003:12				1996:01 – 2003:12				1996:01 – 2003:12			
	DOLS (0,0)	ARDL (1,0)	DOLS (4,4) FIX	ARDL (1,1)	DOLS (0,0)	ARDL (4,4) FIX	DOLS (4,4)	ARDL (4,4) FIX	DOLS (4,0)	ARDL (1,1) AIC	DOLS (4,0)	ARDL (1,4) AIC	DOLS (1,0)	ARDL (4,1) HQ	DOLS (4,0)	ARDL (2,4) AIC
COINT	-4.384** (1)	-0.375	-3.36 (1)	-1.155	-4.487*** (1)	2.536	-3.261 (1)	2.55	-4.182*** (1)	3.46a	-4.209*** (1)	6.014**	-4.17*** (1)	5.719**	-3.942	4.649**
ECT	-0.07	-0.133***	-0.047	-0.145***	-0.084*	-0.058	-0.061**	-0.09	-0.138***	-0.222***	-0.149***	-0.305***	-0.292***	-0.286***	-0.233***	-0.253***
CONST	-0.177***	-0.175*	0.032	-0.122*	-0.031	5.617***	0.906***	2.679***	-0.134***	-0.129***	-0.068***	-0.087***	-1.28***	-1.101***	-0.75***	-0.656**
PROD	-0.489***	-0.628*	-0.33***	-0.38*	-0.487***	0.093	-0.228*	-0.479	-0.535***	-0.533***	-0.204***	-0.329***	-0.483***	-0.407***	-0.195***	-0.198***
NFA	0.487*	0.469	1.588***	-0.063	0.644**	5.803*	2.572***	3.036**	0.817***	0.693*	0.44***	0.408	0.371***	0.364**	0.117	0.2
ROIL					-0.056	-2.137***	-0.334***	-1.025***								
PDEBT									0.014	-0.031	-0.042	-0.085				
EXP													-0.468***	-0.387***	-0.285***	-0.248**
DUMMY	0.4***	0.419**	0.173**	0.485***	0.389***	-0.376	0.071	0.118	0.339***	0.33***	0.327***	0.37***	0.023	0.082	0.141***	0.156**

Note: As for Table 4. DUMMY is a dummy term capturing the post-1998 crisis period. It takes the value of 1 from 1999:01 to 2003:12, and is zero otherwise.

Table 9. Time Series Estimation Results, Turkey

	CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI		CPI		PPI	
	1985:01 – 2003:12																			
	DOLS (0,0)	ARDL (1,1)	DOLS (0,0)	ARDL (1,4) AIC	DOLS (0,0)	ARDL (1,0)	DOLS (4,4) AIC	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)	DOLS (0,0)	ARDL (1,0)	DOLS (4,4) AIC	ARDL (1,0)
COINT	-3.663* (0)	3.367a	-3.753* (0)	5.32**	-3.649 (0)	1.081	-4.23*** (1)	1.565	-3.69 (0)	0.982	-4.495*** (1)	1.756	-4.94*** (0)	4.654**	-4.108*** (0)	1.828	-4.39*** (0)	3.089a	-3.905* (1)	1.489
ECT	-0.101***	-0.11***	-0.109***	-0.132***	-0.101***	-0.11***	-0.119***	-0.128***	-0.101***	-0.11***	-0.121***	-0.138***	-0.171***	-0.174***	-0.117***	-0.125***	-0.135***	-0.145***	-0.109***	-0.118***
CONST	0.159***	0.25***	0.066***	0.124**	0.276***	0.109	0.44***	0.335	0.327*	0.314	0.737***	0.649	0.167***	0.201***	0.069***	0.113**	-0.557***	-0.542*	-0.072	0.132
PROD	-0.384***	0.38	-0.414***	0.483	-0.413***	0.22	-0.274**	0.047	-0.325**	0.321	-0.162	0.258	-0.751***	-0.476	-0.557***	-0.152	-0.751***	-0.38	-0.316***	0.096
NFA	0.193**	0.429	-0.212***	-0.523*	0.24***	0.12	-0.168*	-0.229	0.303**	0.194	0.203**	0.029	-0.332***	-0.52*	-0.428***	-0.635*	-0.24**	-0.353	-0.426***	-0.298
ROIL					-0.043	0.034	-0.136***	-0.086												
OPEN									0.077	0.049	0.309***	0.252								
PDEBT													1.086***	1.402***	0.447***	0.667*				
EXP																	-0.283***	-0.283**	-0.06	0.009
DUMMY1	0.129***	0.109	0.158***	0.093	0.12***	0.152	0.104***	0.132	0.117***	0.129	0.121***	0.124	0.182***	0.198**	0.18***	0.179*	0.18***	0.199**	0.133***	0.148
DUMMY2	-0.075**	0.127	-0.083***	-0.051	-0.065*	0.014	-0.027	-0.023	-0.072**	0.029	-0.074***	-0.038	0.094***	0.208**	-0.015	0.066	-0.007	0.03	-0.072**	-0.053

Note: As for Table 4. DUMMY1 and DUMMY2 are dummy terms capturing the 1994 crisis period and the post-2001 crisis period. They take the value of 1 from 1993:06 to 1995:06 and from 2000:11 to 2003:12, respectively, and are zero otherwise.

5.2. Panel Results

The estimation results obtained on the basis of a panel including Bulgaria, Croatia, Romania, Russia, Ukraine and Turkey for the period 1994 to 2004 are very robust compared to the country-by-country time series results. What should be mentioned first is the fact that the error correction term of the ARDL mean group estimator (MGE) is always negative and significant, which implies the presence of cointegration. Second, the productivity and net foreign assets variables are mostly always significant and the signs are also found to be very stable. Productivity is negatively signed, whereas net foreign assets have a positive sign. The use of control variables changes this picture only slightly. Regarding the control variables themselves, real oil prices appear to be negatively signed. This is somewhat surprising, given that Russia is the only net oil-exporting country. The openness ratio is significant and is correctly signed. However, the sign on the public debt and the public expenditures ratios differ for the CPI-based real exchange rate and the PPI-based real exchange rate.

Table 10. Panel Estimation Results

		ECT	PROD	NFA	ROIL	OPEN	PDEBT	EXP
CPI	DOLS		-0.353***	0.743***				
	MGE	-0.172***	-0.610*	0.641***				
PPI			-0.356***	0.603***				
		-0.124***	-1.244***	0.78***				
CPI	DOLS		-0.426***	0.165***	-0.061**			
	MGE	-0.100***	-0.400	0.656***	-0.176**			
PPI			-0.375***	0.827***	-0.076***			
		-0.153***	-1.08***	1.032***	-0.368**			
CPI	DOLS		-0.040***	0.317***		0.242***		
	MGE	-0.143***	-0.257	0.482***		0.312*		
PPI			0.004***	0.320		0.372***		
		-0.207***	-0.445*	0.324**		0.299		
CPI	DOLS		-0.236***	0.633***			0.350***	
	MGE	-0.134***	-0.422*	0.570***			-2.784	
PPI			-0.160***	0.501***			-0.275***	
		-0.162***	-0.744**	0.659***			-5.279	
CPI	DOLS		-0.342***	0.317***				-0.220***
	MGE	-0.142***	-0.164***	0.117***				-0.071**
PPI			-0.252***	0.360***				0.349***
		-0.167***	-0.644***	0.036***				0.372***

Note: DOLS and MGE are the panel DOLS and ARDL mean group estimators. ECT is the error correction term. CPI and PPI refer to the estimation results for the CPI-based and the PPI-based real exchange rates, respectively.

5.3. Real Misalignments

As a final step of our analysis, we derive the deviation of the observed real effective exchange rate from the estimated equilibrium real effective exchange rate, i.e. the total real misalignment. For this purpose, both time series and panel estimates are used. Among the estimated time series

equations, those will be used for which at least the error correction terms is significant and negative, and for which the productivity and net foreign asset variables are statistically significant with productivity having a negative sign. in which all estimated coefficients are statistically significant and are correctly signed. From the panel equations, only the ones for the CPI-based real exchange rate are used. The retained equations are shaded in Tables 4 to 10. As real misalignments obtained from different equations may differ, the mean with the confidence intervals is useful for summarizing the pieces of information contained in each equation. This key measure of total real misalignments is displayed in Figure 6.

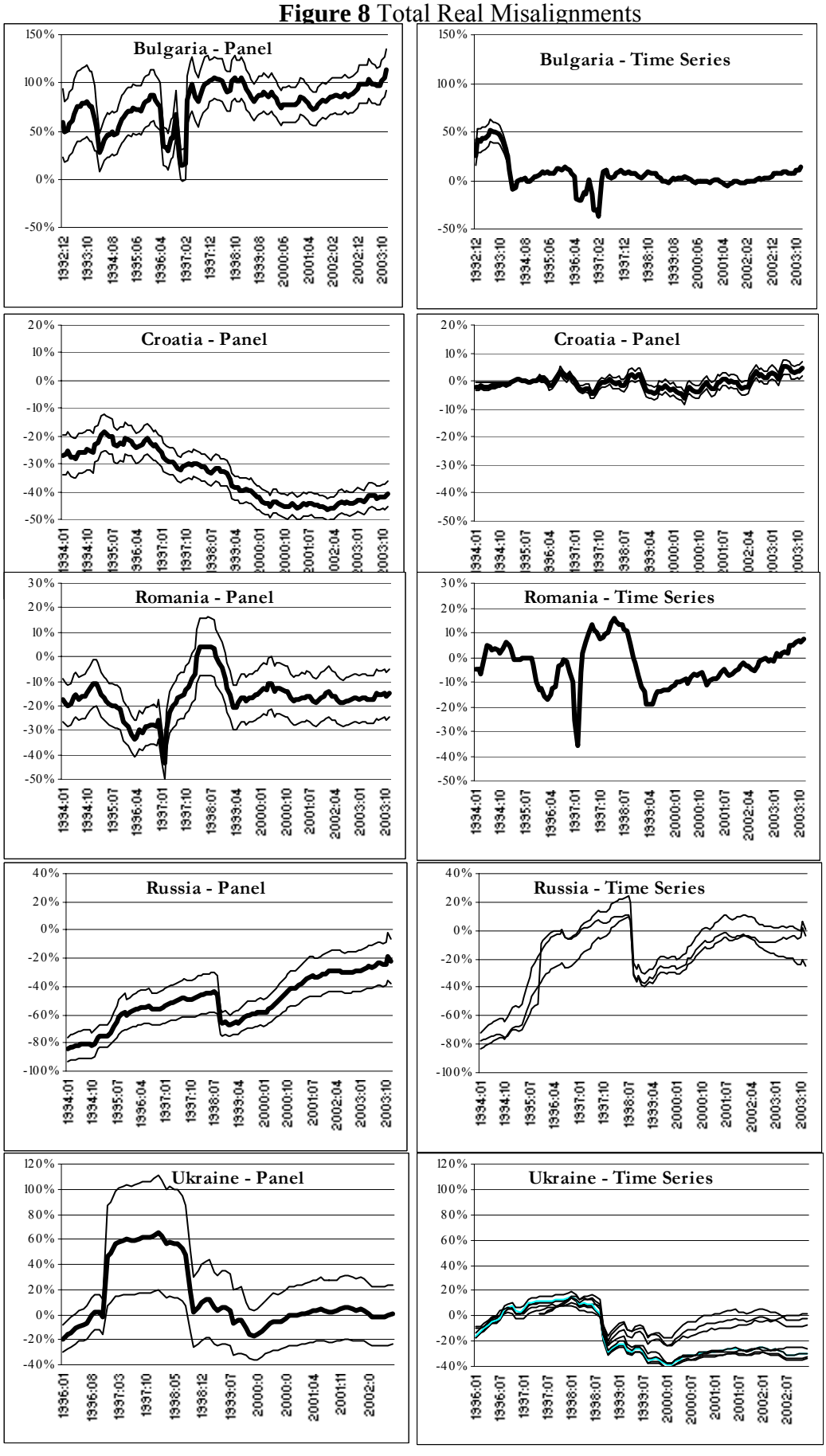
A couple of issues attract attention here. Panel and time series results are broadly in line with each other in terms of broad movements. However, the precise size of the derived misalignments may be rather different between the time series and panel case. It can be observed that misalignments based on panel estimates may indicate prolonged periods of under- or overvaluations, while over- and undervaluations given by time series estimates cancel each other out over the period under study. This seems natural, given that the presence of cointegration implies for the time series case that the residuals, i.e. real misalignments, should be stationary.

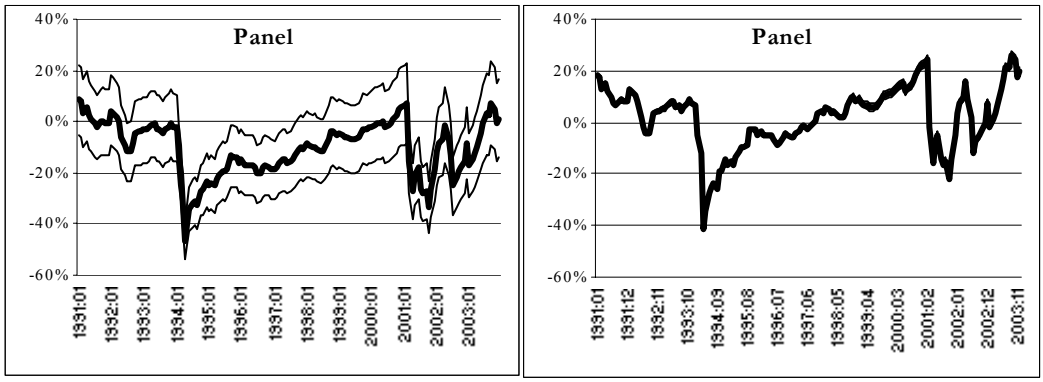
One reason for the conflicting results is the strong heterogeneity in the panel, which is also confirmed by the time series results. Thus, the size and the sign of the estimated coefficients reflect the sample average and not individual country behavior. Consequently, the derived misalignments should be viewed as a result of country heterogeneity and not as a consequence of the real exchange rate not matching the fundamentals. This is the reason why the real misalignments obtained using panel estimates will not be interpreted in the event that they are not in line with the time series misalignments. Another key difference between panel and time series data is this: Misalignments based on panel estimates are not necessarily based on the same set of equations as compared to that obtained from time series. For instance, the number of equations issued from the time series analysis is one for Romania.

Let us now take a look at the derived total real misalignments. For Bulgaria, the time series results reveal that the Bulgarian lev was slightly overvalued just before the financial crisis occurred in 1996 and 1997. During and after the crisis, the currency became heavily undervalued, followed by a swift adjustment to equilibrium. Fairly valued toward the turn of the century, the Bulgarian real exchange rate appears to have been moving away from equilibrium in

the past two years and has become overvalued. For Croatia, the over- and undervaluation of the real exchange rate remained in a narrow corridor of roughly ±5% from 1994 to 2003. As far as Romania is concerned, the lei tends to be slightly overvalued by the end of the period. Regarding Russia, a substantial overvaluation prior to the 1998 crisis, followed by an undershooting reaching an undervaluation of roughly 20% in 1999, can be observed. Since then, the real exchange rate converged toward its equilibrium. In 2003, the ruble can be viewed as fairly valued or slightly overvalued. Similar to the ruble, the Ukrainian hryvnia appeared to be overvalued before the Russian crisis. The subsequent large adjustment resulted in an undervaluation, which was followed by a slow convergence toward equilibrium. For time series, individual results for the selected equations are depicted because the misalignments seem to form two classes. According to one class of measures, the hryvnia was considerably undervalued in 2003, while the second group of misalignments suggests that undervaluation was corrected for by 2003. Turning now to Turkey, the results indicate that the real exchange rate was overvalued prior to 1993 and then became strongly undervalued. After a progressive rapprochement to equilibrium, the real exchange rate appears to have become increasingly overvalued in the crawling peg system. This overvaluation was sharply corrected for in 2001. Since mid-2002, the Turkish currency became increasingly overvalued once again.

Figure 8 Total Real Misalignments





Note: Positive (negative) values denote an overvaluation (undervaluation).

6. Concluding Remarks

This paper investigated the equilibrium exchange rate of two EU accession countries (Bulgaria and Romania), of two EU candidate countries (Croatia and Turkey) and of Russia and Ukraine. The analysis was carried out at three time horizons. We have shown that the currencies of these countries are largely undervalued in terms of absolute PPP. At the same time, some of them have undergone an appreciation implying a long-term convergence toward absolute PPP. Cross-sectional regressions reported in the literature were employed to see whether the currencies are fairly valued in terms of relative productivity levels on the road to PPP. The results indicated an initial undervaluation for Bulgaria, Romania, Russia and Ukraine, which were corrected for to s diverging extent by the mid-1990s. From the late 1990s onward, the real exchange rates in levels were broadly in line with relative productivity levels in Bulgaria, Croatia and Turkey, and slightly undervalued in Romania, Russia and Ukraine and to a lesser extent in Romania.

In a next step, we analyzed the extent to which the B-S effect and the D-D phenomenon may be driving the real exchange rate. It turned out that the basic hypotheses of the B-S effect are oftentimes violated in a number of countries. This implies that either productivity gains cannot translate into relative price increases or that this transmission is either amplified or attenuated. A simple accounting framework has revealed that, similarly to other CEECs, the B-S effect has a fairly moderate role in the countries under study. Furthermore, we have also shown how sensitive the results are to the use of data based on employment and employee data and to the classification of sectors into open and closed sectors. For Russia, it seems that some of the symptoms of the D-D phenomenon are present.

Finally, we studied short- to medium-term deviations of the real exchange rates from their equilibrium. For this purpose, the stock-flow approach to the real exchange rate was employed, which was extended with demand-side and other control variables. The estimates revealed some common features across countries. First, increases in productivity were found to cause the real exchange rate to appreciate, perhaps with the exception of Romania. This suggests that the scope for the mechanism described in NOEM models is not really at work in this set of countries. Second, net foreign assets usually entered the equation. Time series estimates also indicate a great deal of heterogeneity across countries. While positive for most countries, the sign on net foreign assets was negative in Croatia. This may imply that Croatia has already reached an accumulated net foreign liabilities position where it has to start servicing its debt, whereas the others are still on their way to the steady state. It should also be noted that the control variables (openness, government debt and public expenditures to GDP) turned out to be significant and correctly signed and not to alter results for productivity and net foreign assets across the six economies under study. The real oil price appears to have a different impact on the real exchange rate. We found limited evidence for an overwhelming role of oil prices and oil revenues in real exchange rate determination in Russia.

When interpreting the time series results, it should be stressed, however, that they are not particularly robust, to say the least. For some countries, like Croatia and Russia, it is most difficult to establish the presence of cointegration. Whether cointegration is found and whether the coefficient estimates are statistically significant hinges oftentimes on the estimation technique and on the information criterion used for determining the lag structure and may also depend on the definition of the dummy variables aimed at capturing crisis periods. Contrary to the time series results, heterogeneous panel techniques yielded fairly significant and stable coefficient estimates for the panel composed of the six countries under study.

The estimation results uncovered that panel and time series estimates can yield conflicting results regarding the deviations from equilibrium. Although the heterogeneous panel econometric estimates turned out to be very robust, they proved to do a poor job when deriving real misalignments simply because they reflect average behavior of a heterogeneous set of countries. We have argued that for such small heterogeneous panels, time series estimates should be used for the calculation of real misalignments. When using these figures, it should be borne in mind that they reflect rather short-term deviations from equilibrium. In fact, the size of the deviations

depends on how good real exchange rates can be modeled using fundamentals. Put in another way, the real exchange rate can be viewed as misaligned in the event the real exchange rate does not move in tandem with the underlying fundamentals. Our results have revealed that at the end of 2003, the Bulgarian lev, the Romanian lei and the Turkish lira became increasingly overvalued. At the same time, the real exchange rates in Croatia, Ukraine and probably also in Russia can be thought of as fairly valued.

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Data Appendix

Annual Data

Sectoral Value Added, Constant Prices

Bulgaria, Croatia, Romania, Russia, Ukraine: wiiw Annual Database (via WIFO Database)

Turkey: OECD National Accounts Database (via WIFO Database)

Sectoral Empoyment/Employees

Bulgaria, Croatia, Romania, Russia, Ukraine: wiiw Annual Database (via WIFO Database)

Turkey: Türkiye Cumhyriet Merkez Bankasi (central bank)

Monthly Data

CPI, PPI

Bulgaria, Croatia, Romania, Russia, Ukraine: wiiw Monthly Database

Turkey: CPI: IFS/IMF (TKI64..F), WPI: State Institute of Statistics, Turkey (TKPROPRCF)

Euro area: Eurostat (EMCONPRCF, EMESPPIIF); U.S.A.: Bureau of Labor Statistics (USOCP009E), Main Economic Indicators, OECD (USOPP019F)

Nominal Exchange Rate against the Euro and the U.S. Dollar

Bulgaria, Croatia, Romania, Russia, Ukraine: wiiw Monthly Database

Turkey: Datastream (U.S. dollar: TKUSDSP, euro: TKEUROS, Deutsche mark: TKDEMSP)

Industrial Production

Bulgaria, Croatia, Romania, Ukraine: wiiw Monthly Database; for Bulgaria and Ukraine, the index series were obtained using two series of industrial production (real, same month previous year=100 and previous month=100)

Russia: Main Economic Indicators, OECD (Datastream, RSOPRX35G)

Turkey (Manufacturing): State Institute of Statistics, Turkey(TKOPR038G)

Euro area: Eurostat (Datastream, EMESINPRG)

U.S.A.: Main Economic Indicators, OECD (Datastream, USOPR038F)

Employment in Industry

Bulgaria, Croatia, Romania, Ukraine: wiiw Monthly Database

Russia: IFS/IMF (Datastream, RSI67…F)

Turkey: Türkiye Cumhyriet Merkez Bankasi (central bank)

Euro area: Eurostat (Datastream, EMEBEMQ6%)

U.S.A.: Bureau of Labor Statistics (Datastream: USEMPMAN)

Current Account

Bulgaria, Croatia, Romania, Russia, Ukraine: wiiw Monthly Database

Turkey: Main Economic Indicators, OECD (via Datastream, code: TKOBP$15B)

Data for Bulgaria (before 1996), Croatia, Russia, Turkey, Ukraine are linearly interpolated from quarterly to monthly frequency.

Consolidated General (G) or Central (C) Government Balance

Bulgaria (C), Croatia (C), Romania (C), Russia (C), Ukraine (G): wiiw Monthly Database

Turkey (G): Ministry of Finance, Turkey (via Datastream, code: TKGOVBALA)

Consolidated General or Central Government Expenditures

Bulgaria (C), Croatia (C), Romania (C), Russia (C), Ukraine (G): wiiw Monthly Database

Turkey: Ministry of Finance, Turkey (via Datastream, code: TKCBEXPNA)

Monthly expenditures are added up for 12 months on a rolling basis.

Exports and Imports

Bulgaria, Croatia, Romania, Russia, Ukraine: wiiw Monthly Database

Turkey: OECD (via Datastream, TKOEXPU$A, TKOIMPU$A)

Monthly exports and imports data are added up for 12 months on a rolling basis.

Nominal GDP

Bulgaria, Croatia, Romania, Russia, Ukraine: European Intelligence Unit (via Datastream, codes: BLGDPD, CTGDPD, RMGDPD,RSGDGD, URGDPD)

Turkey: Türkiye Cumhyriet Merkez Bankasi (central bank)

Interpolated linearly from yearly to monthly frequency.

Price of Crude Oil – Ural, U.S. Dollars

Datastream (code: OILURAL(P))

Industrial Production – Crude Petroleum

VOLN, Russia: Datastream (code: RSOPR005P)

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