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

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This paper investigates the equilibrium exchange rates of three Southeastern European countries, namely Bulgaria, Croatia and Romania, of two CIS economies, namely 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. The deviation from absolute purchasing power parity (PPP) and from the real exchange rate, which is given by relative productivity levels, is investigated. For Russia, a first look is taken at the Dutch disease phenomenon as a possible driving force behind equilibrium exchange rates. As a next step, a Behavioral Equilibrium Exchange Rate (BEER) model including productivity and net foreign assets is estimated using both time series and panel techniques. Control variables such as openness, public debt and public expenditures are also used to check for the robustness of the results. In a final stage, total real misalignment bands are computed for the countries under study.

1 Introduction

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 drawn much attention to these countries' equilibrium exchange rates. By contrast, equilibrium exchange rates of countries in Southeastern Europe and of the CIS have been less in focus and only a few papers have investigated this issue. A considerable number of the papers on this topic deal with these countries in a panel context, which may be insufficient for accounting for country-specific features.[2] Only very few studies analyze Bulgaria, Croatia, Romania and Russia.[3]

In this paper, we seek to fill this gap by investigating the equilibrium exchange rates of three Southeastern European countries, namely Bulgaria, Croatia and Romania, of two CIS economies, namely Russia and Ukraine, and of Turkey. These countries are of interest because Bulgaria, Romania and probably Croatia will join the EU in the foreseeable future, and Russia, Ukraine and Turkey are of utmost economic interest for the EU in the (South)eastern part of Europe. For this purpose we have proposed a systematic approach in terms of different time horizons at which the equilibrium exchange rate is assessed, combined with a careful analysis of country-specific factors. Questions related to equilibrium exchange rates in these countries as compared to those in the new Member States in Central and Eastern Europe can either be raised differently or are sometimes truly different. For instance, the issue of current account and foreign debt sustainability is of utmost importance for Croatia. Also, the real exchange rate in Russia may be driven not only by traditional channels but also by the Dutch disease phenomenon.

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[2] *E.g. Halpern and Wyplosz (1997, 2001), Krajnyák and Zettelmeyer (1998), Begg et al. (1999), De Broeck and Sløk (2001), Dobrinsky (2003) and Fischer (2004).*

[3] *Chobanov and Sorsa (2004) analyze Bulgaria. 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.*

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, the factors of real exchange rate movements are studied. First, the simple Balassa-Samuelson effect and the Dutch disease are put under the microscope. In a next step, the stock-flow approach is used to widen the horizon. 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 briefly addresses the deviation from absolute PPP. Section 3 investigates the relationship between the level real exchange rates and relative productivities. Section 4 analyzes factors behind a possible trend appreciation of the currencies. The Balassa-Samuelson effect is studied in great detail, and a first look is taken at the Dutch disease in Russia. A Behavioral Equilibrium Exchange Rate (BEER) model including productivity and net foreign assets is estimated using both time series and panel techniques. Control variables such as openness, public debt and public expenditures are also used to check for the robustness of our results. Finally, total real misalignment bands are computed for the countries under study. Section 5 presents some concluding remarks.

2 Undervaluation in Terms of Purchasing Power Parity

In the 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. We then move forward systematically toward shorter time horizons.

Let us now begin with the concept of 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 PPP is a poor tool, even in the long run, for measuring equilibrium exchange rates for transitional and developing economies because their 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,[4] a real exchange rate higher than 1 implies undervaluation, which can be clearly observed vis-à-vis the euro for all countries under study (see table 1). 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 steady 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.[5]

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

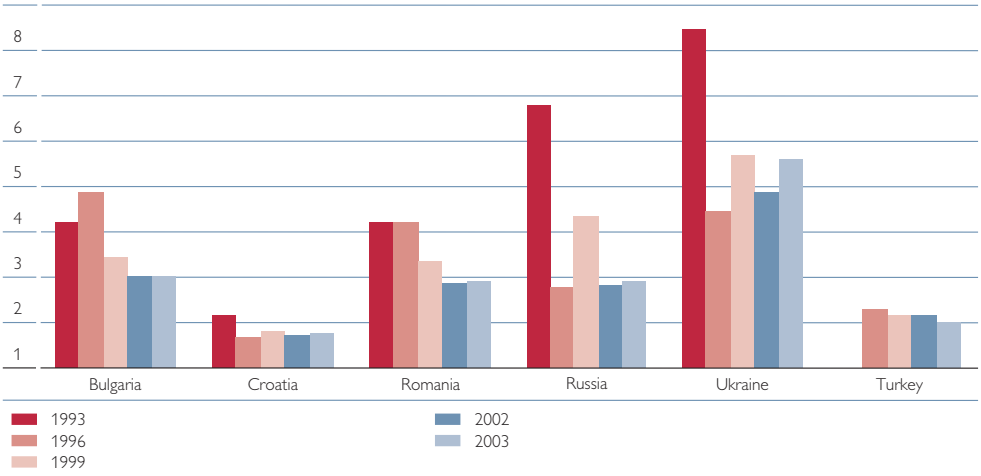
[5] *For Russia and Ukraine, some of the fluctuations may be due to changes in the euro/U.S. dollar exchange rate.*

Chart 1

Deviation from Absolute Purchasing Power Parity

vis-à-vis the Euro

Real exchange rate level



Source: Author's 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 prices.*

3 The Role of Productivity: A Cross-Sectional Perspective

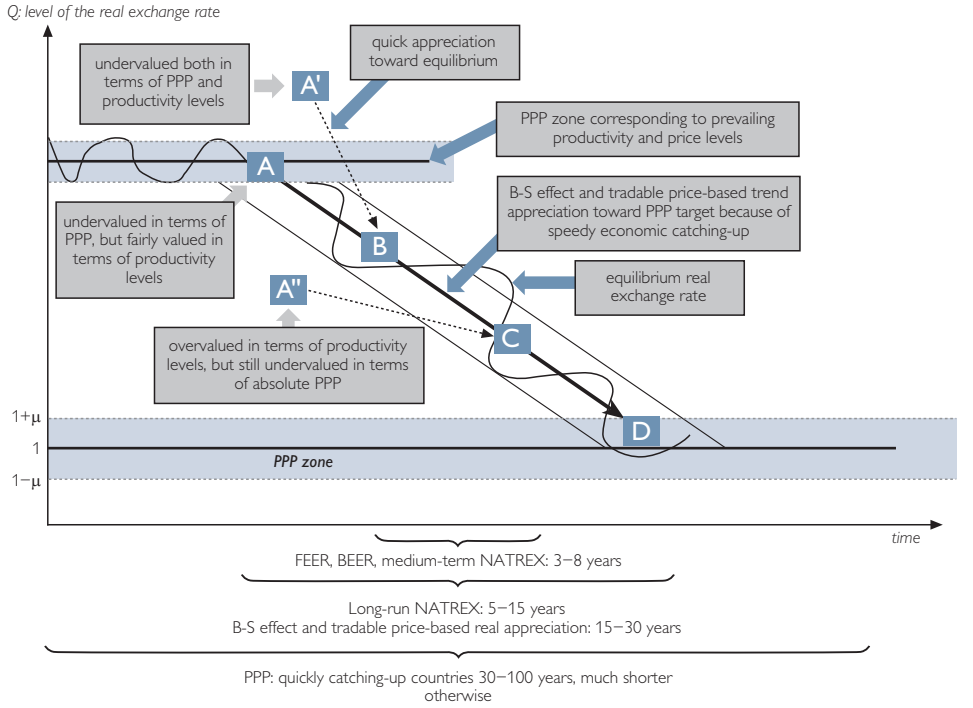
According to the traditional Balassa-Samuelson argument, the less developed country is usually less productive in producing tradable goods. The price level in the open sector is given by the PPP condition. At the same time, the level of productivity in the open sector, which is usually lower in the less 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 given by PPP in the open sector appears to be weaker (higher) than the exchange rate given by PPP.

Notice, however, that 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 thought of as undervalued (not only in PPP terms). This is depicted in chart 1.

We now set out to analyze whether the exchange rates of the countries under consideration were undervalued or overvalued in terms of productivity levels. Put differently, we are interested in whether a given country is at point A, A' or A" in chart 2. Such an analysis is best conducted using cross-sectional data. In such a framework, the real exchange rate in levels or the relative price level 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

Chart 2

Trend Appreciation of the Equilibrium Real Exchange Rate



Source: Égert, Halpern and MacDonald (2005), Égert (2003).

the home country to that in the foreign benchmark. In practice, however, GDP per capita or GDP per employment expressed in PPP terms, which is a broad proxy for productivity, is employed based on data (un)availability.

A number of studies have already investigated this relationship extensively. We make use of the regression results reported in these studies. We have selected all the equations which use the EU-15 as the foreign benchmark. The five retained equations from three papers, namely Čihák and Holub (2003), Coudert and Couharde (2003) and Maeso-Fernandez et al. (2004) are reported in table 1. The fitted values of the real exchange rates in level or relative price levels of the countries under study obtained from these equations are then compared to the actual real exchange rates or relative price levels for each country against 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.[6] Čihák and Holub (2003) keep to

[6] *The panel includes the EU-15 (without 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.*

Table 1

Cross-Sectional Regressions

	Countries		Year	Benchmark	R2
Maeso-Fernandez et al. (2004)	25 (OECD)	0.50	2002	EU-15	0.65
Coudert and Couharde (2003)	120 developing economies	0.25	2000	EU-15	0.24
Čihák and Holub (2003)	30 EU+CEE	0.90	1999	EU-15	0.90
Čihák and Holub (2003)	22 EU+CEE	0.86	2000	EU-15	0.86
Čihák and Holub (2003)	30 EU+CEE	0.94	1999	EU-15	0.89

Source: Maeso-Fernandez et al. (2004), Coudert and Couharde (2003), Čihák and Holub (2003).
Note: The coefficient is the slope coefficient from the regression. R2 stands for the goodness-of-fit of the regression. Coudert and Couharde as well as Maeso-Fernandez et al. regress the log level of the real exchange rate on the log level of relative GDP per capita, whereas Čihák and Holub regress relative price levels on relative per capita GDP levels.

the golden mean in that a number of EU-15 countries and transition economies are used together for their estimations.

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, in 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, helps anticipate the long-term behavior given by the regression results in Maeso-Fernandez et al. (2004).

Chart 3 reports under- and overvaluations in terms of productivity levels for the period of 1991 to 2003.[7] For Bulgaria and Romania, the real exchange rates seem to have been undervalued at the beginning of the 1990s. This is something which is labeled initial undervaluation by Halpern and Wyplosz (1997), and Krajnyák and Zettelmeyer (1998).[8] Over time, the real exchange rate of Bulgaria has approached the level that would be in line with GDP per capita. For Romania, the adjustment process turns out to be slightly overshooting, and from the mid-1990s onward, the real exchange rate has even become overvalued. For Russia and Ukraine, the initial undervaluations, which were considerably larger than for Bulgaria and Romania, were corrected much more quickly, leading to an overvaluation in 1997 in Russia, which was corrected during the crisis in 1998. Regarding Croatia and Turkey, the level exchange rates are found to be steadily overvalued.

[7] *Čihák and Holub (2003) note that one should interpret the temporal development of data based on the International Price Comparison (IPC) program with care. The annual data are based on interpolation/extrapolation of actual price observations carried out 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.*

[8] *Halpern and Wyplosz (1997) and Krajnyák and Zettelmeyer (1998) use additional variables besides productivity to investigate initial undervaluations.*

Chart 3

Under- and Overvaluations in Terms of Productivity Levels

Source: Author's calculations.

Note: Positive/negative values stand for overvaluation/undervaluation. CC denotes Coudert and Couharde (2003), MFOS is Maeso-Fernandez et al. (2004), and CH1, CH2 and CH3 are the three regressions taken from Čihák and Holub (2003).

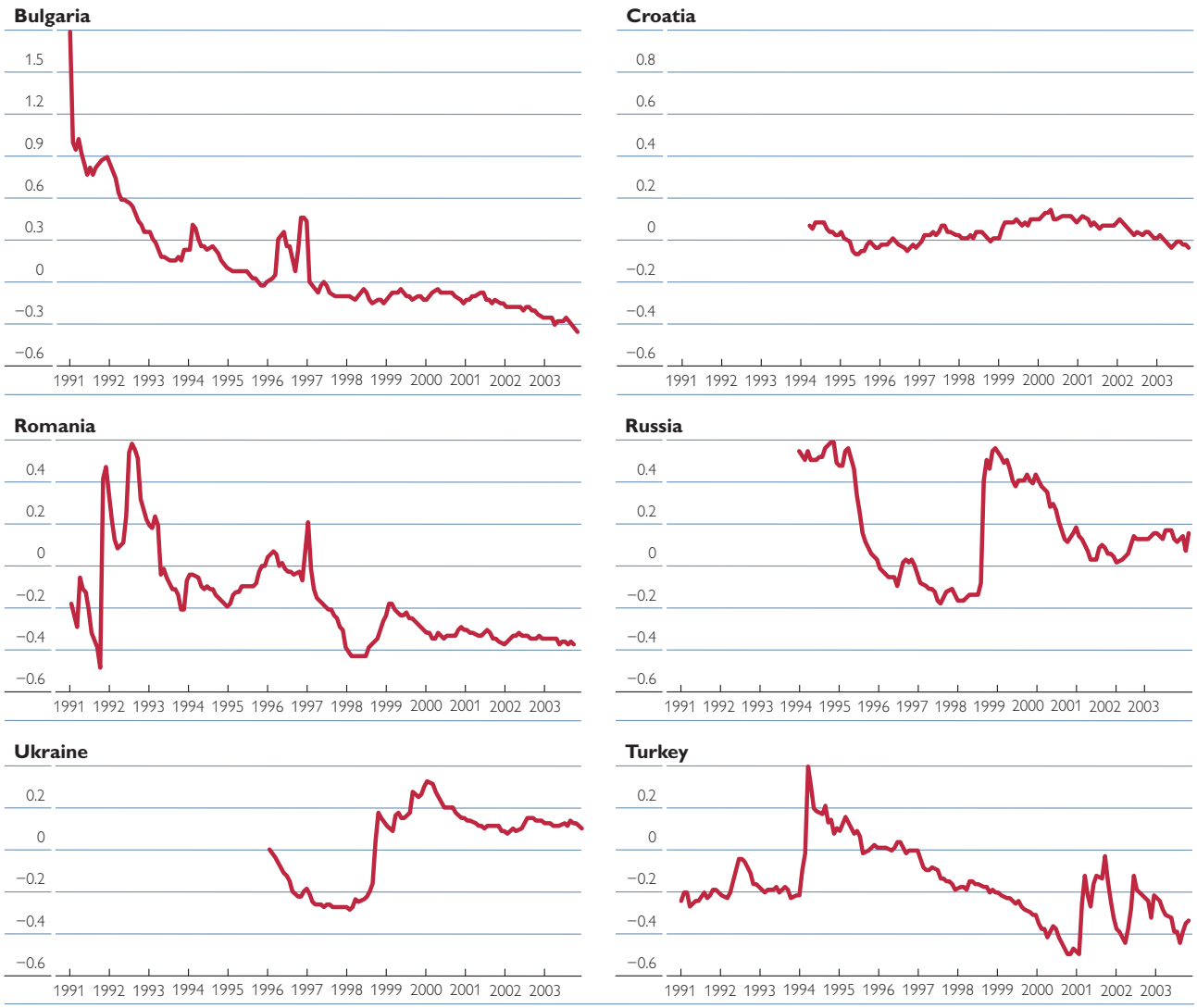
4 Potential Sources of Real Appreciation

As shown earlier, the currencies of the countries under review are all undervalued in terms of PPP. At the same time, chart 1 and chart 4, 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 has, to a varying extent, undergone an appreciation during the last ten years.

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 undervalued, though to a lesser extent (see chart 5). This is in line with Égert, Halpern and MacDonald (2004), who

Chart 4

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

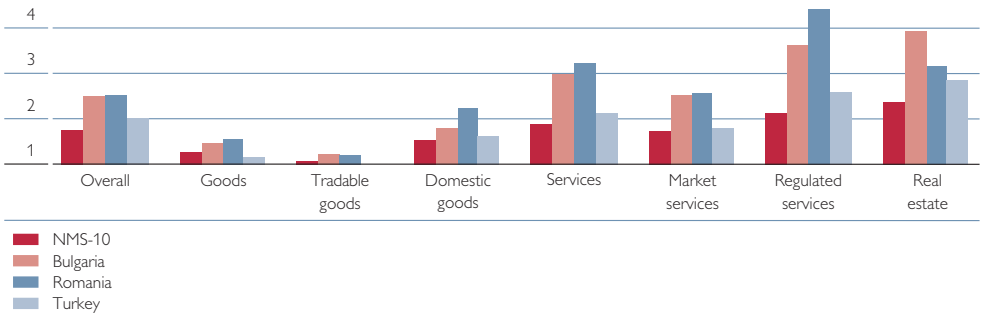


Source: Author's calculations based on data presented in the appendix.

argue that an appreciation of the real exchange rate of transition economies has three sources: (1) the standard Balassa-Samuelson effect (market-based services), (2) the appreciation of the real exchange rate of the open sector, and (3) a trend increase of regulated prices. Such an appreciation can be viewed as an equilibrium phenomenon, as demonstrated in chart 2 by a movement from point A to point D. Of course, initial undervaluation can also explain large real exchange rate appreciation, merely reflecting adjustment to equilibrium.

Chart 5

The Real Exchange Rate in Levels for Different Groups of Goods and Services in 2002



Source: Author's calculations based on data drawn from NewCronos/Eurostat.
Note: NMS-10 denotes the ten new EU Member States.

4.1 The Balassa-Samuelson Hypothesis

The large undervaluation of market services reported in chart 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. According to the relative version of the B-S 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 ($\Delta(E \cdot P^*/P)$ 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.

4.1.1 Basic Assumptions: First Glance Evidence from Yearly Data

We now proceed to evaluate the extent to which the B-S effect has contributed to the appreciation of the equilibrium exchange rate from the early 1990s. The first step is to investigate whether or not the four basic assumptions which are needed for the B-S effect to hold are verified:

1. Real wages are linked to productivity in the open sector.
2. Nominal wages tend to equalize across sectors.
3. Dual productivity is linked to the relative price of market-based nontradable goods.
4. PPP holds for the open sector.

The first three assumptions are first judged by applying ocular econometrics to annual data obtained from national accounts.[9] For instance, Égert (2004) and Égert and Halpern (2004) have shown recently that how sectors are classified into open and closed sectors does affect the results. We follow a twofold rule for separating sectors into open and closed sectors in that we consider a sector open 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 MacDonald and Wójcik (2004) and Mihaljek and Klau (2004), who argued that tourism, trade and transportation can also be considered to belong to the open sector.[10] This is the reason why we also check how sensitive the results are when classifying those sectors as open sectors.

Data available until the mid-1990s are usually based on old national accounts standards. From the mid-1990s on, national accounts data are available in the new NACE format. To cover the whole period, the NACE sectors are grouped so as to match sectors to the old standard. Exceptions are Romania and Russia. For Romania, NACE data are available for the entire period,[11] while for Russia, only data based on old national accounts standards are available.[12]

For the old SNA classification,[13] three classifications for the open sector are used including (1) industry, (2) agriculture and industry, and (3) agriculture, industry, transport and telecommunications. The rest is considered as belonging to the closed sector, except for agriculture, which, if not included in the open sector, is once used as part of the open sector and once excluded because of the potential highly distorting effects of agricultural subsidies. This yields a total of six combinations of open and closed sectors (see appendix table 1).

For the new NACE classification,[14] the following five measures are used for the open sector: (a) manufacturing, (b) industry, (c) industry and agriculture, (d) industry, transport and telecommunications, and hotels and restaurants, and finally (e) agriculture, industry, transport and telecommunications, and hotels and restaurants. Regarding the closed sector, five alternative measures are considered: (1) the remaining market-based sectors, (2) the remaining market-based sectors plus real estate, (1) and (2) augmented by agriculture if not used in the open sector, (3) market-based sectors and non-market-based sectors

[9] *Data are obtained from the annual database of the Vienna Institute for Comparative Economic Studies (wiiw). The database contains data broken down into five sectors for Bulgaria, Croatia, Russia and Ukraine from 1991 onward. For Bulgaria and Croatia, a 15-sector disaggregation is available from 1996, in accordance with the NACE classification. Such disaggregated data are available for Romania and Turkey for the whole period. For a detailed description of the data, see appendix 2.*

[10] *However, these sectors cannot be viewed as open sectors because, notwithstanding the relatively high share of exports, prices are determined by domestic factors in these sectors.*

[11] *It should be noted that some doubt arises regarding the reliability of such data starting in 1991.*

[12] *For Romania, data in NACE format cover the period from 1991 to 2003. For Russia, data are available only in the old format, from 1991 to 2003. Data for Bulgaria, Croatia and Ukraine are available both in the old format and in NACE format: Bulgaria (old: 1991–96, NACE: 1996–2003); Croatia (old: 1991–95, NACE: 1995–2003); Ukraine (old: 1991–2000, NACE: 2001–03).*

[13] *The old classification provides data on six sectors: (1) agriculture, (2) industry, (3) construction, (4) transport and telecommunications, (5) trade, (6) others.*

[14] *The NACE classification contains the following sectoral breakdown: (1) agriculture (including hunting, forestry and fishing), (2) mining and quarrying, (3) manufacturing, (4) electricity, gas and water supply, (5) construction, (6) wholesale and retail trade, (7) hotels and restaurants, (8) transport, storage and telecommunications, (9) financial intermediation, (10) real estate, renting and business activities, (11) public administration and defense and compulsory social security, (12) education, (13) health and social work, and (14) other community, social and personal services activities.*

Chart 6

Real Wages and Productivity Growth in the Open Sector

Source: Author's calculations.
Note: RW1_PPI and RW1_CPI are the PPI- and CPI-deflated nominal wages in the open sector. PROD_M and PROD_E denote average labor productivity in the open sector using data on employment (M) and on employees (E). The open sector includes industry (PROD1) or industry and agriculture (PROD2).

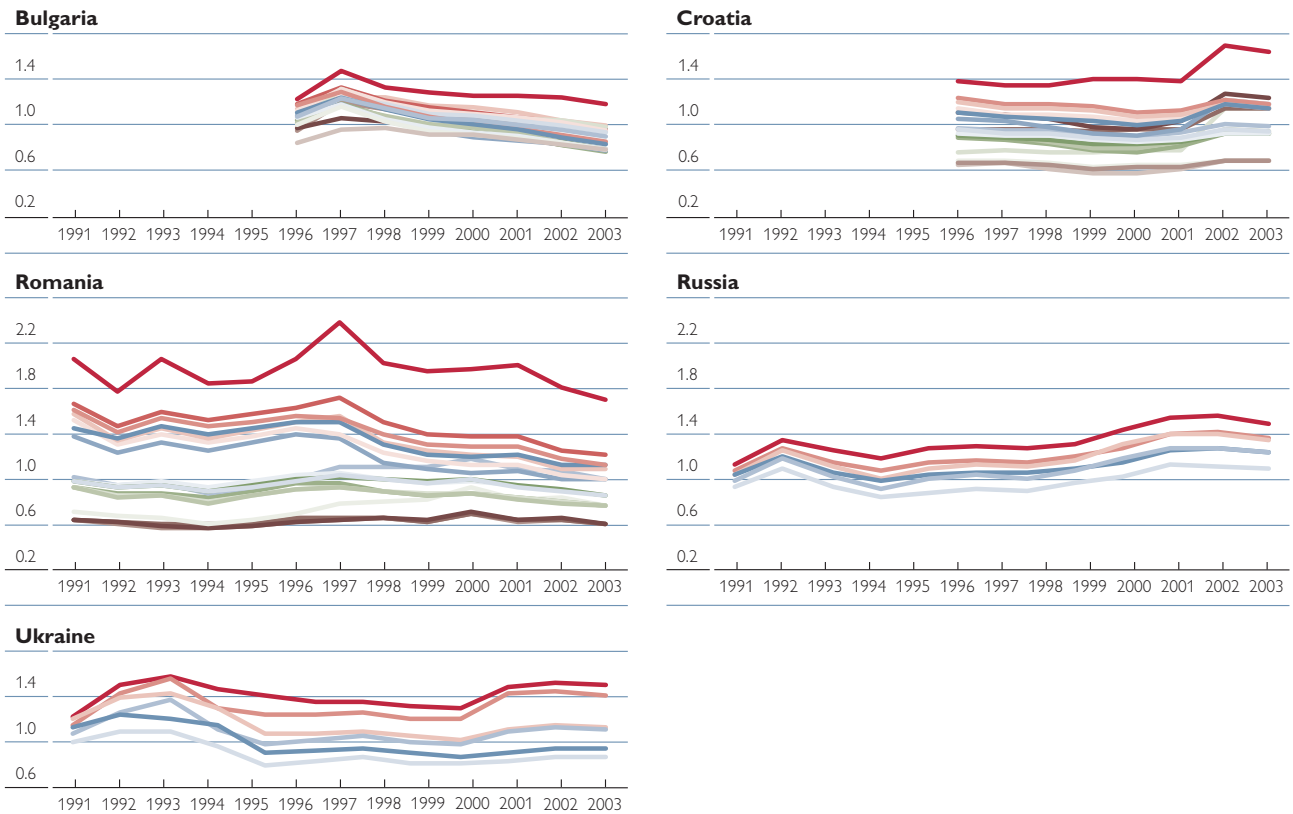
(education, health, public administration and other communal services) and (4) a measure of (3) completed with agriculture. This yields a total of 18 combinations of open and closed sectors (see appendix table 2).

Growth rates of average labor productivity and real wages in the open sector are depicted in chart 6 above.[15] Average labor productivity is obtained as sectoral real value added divided by employment (PROD_E) or the number of employees (PROD_M). Real wages are calculated as the nominal wage in the open sector divided by the producer price index (PPI). As the PPI is highly distorted by oil prices in the case of Russia, the consumer price index (CPI) is used additionally for this country. Generally speaking, productivity and real wages broadly grew hand in hand, perhaps with the exception of Romania. However, in Croatia wages rose more slowly than productivity from 2000 to 2002. In Bulgaria, Russia and Ukraine, we can observe periods during which productivity increased faster than real wages followed by periods when the opposite happened.

As far as wage equalization is concerned, the ratio of the nominal wage in the open sector to the nominal wage in the closed sector corresponding to the dual productivity differentials described above is shown in chart 7. For Bulgaria, the ratio decreased steadily over the period under study, which implies that nominal wages grew faster in the closed sector than in the open sector (amplification

Chart 7

Wage Equalization across Sectors



Source: Author's calculations.

[15] Note that wage data based on national accounts are not available for Turkey.

of the B-S effect). The opposite can be observed for Russia where the ratio is on the rise (attenuation of the B-S effect). Regarding Croatia and Ukraine, jump-like changes can be observed in chart 6. Finally, the ratio is fairly stable for Romania, provided agriculture is excluded from the analysis.

4.1.2 Basic Assumptions: Econometric Evidence from Monthly Data

Using monthly data instead of annual data allows a more rigorous examination of the assumptions underlying the B-S model, which can be formulated econometrically as follows:

1. Productivity in the open sector is cointegrated with real wages in the open sector, with the estimated long-term coefficient being equal to 1.
2. The sectoral wage ratio is difference stationary.
3. Dual productivity is cointegrated with the relative price of market-based nontradable goods, with the estimated long-term coefficient being equal to 1.
4. The tradable price-based real exchange rate is difference stationary.

Average labor productivity is now based on industrial production and employment in industry. Real wages are obtained as gross or net monthly wages (depending on data availability) divided by the PPI (and by the CPI for Russia). Long-term cointegration relationships are estimated using three alternative cointegration techniques: the Engle and Granger (EG) method (Engle and Granger, 1987), the Dynamic OLS (DOLS) by Stock and Watson (1993) and the error correction representation of the Autoregressive Distributed Lags (ARDL) model of Pesaran et al. (2001).[16] For the EG and DOLS techniques, residual-based cointegration tests are conducted, whereas the bounds-testing approach proposed by Pesaran et al. (2001) is used for the ARDL model. As an additional check to the standard cointegration tests, error correction terms are also reported for the EG and ARDL estimates. Note that we stick to this systematic assessment throughout the whole paper in order to check for the sensitivity of the results regarding different econometric specifications.

The results reported in table 2 show the existence of a long-run relationship between gross monthly real wages and productivity in the open sector for Bulgaria from 1991 to 2004. Notice that the coefficient estimates are very low, at 0.09 (EG and DOLS), and insignificant when using the ARDL approach. The estimated coefficients are somewhat higher (about 0.45), but still considerably below unity for the period following the financial crisis in 1997. For Croatia and Romania, both gross and net monthly wages are available for the period from 1994 to 2004. For Croatia, cointegration can be detected unambiguously only when the bounds-testing approach is used. For both gross and net wages, the estimated long-run coefficient is slightly higher than 1. As for Romania, the relationship between productivity and real wages is fairly weak because, notwithstanding the presence of a long-term relationship, the coefficient is near zero or insignificant for gross wages. For net wages, the estimated coefficient turns out to be negative, which is in sharp contrast with our expectations. Turning to Turkey, all three estimation techniques indicate the presence of cointegration. Except for ARDL, where the coefficient is not significant, the estimated coeffi-

[16] *These techniques were used in e.g. Égert (2004), where a more detailed description of the techniques can be found.*

Table 2

Cointegration Tests between Productivity and Real Wages, Monthly Data

Cointegrating vector X = [RWAGE,PROD]; $\beta' = [1, \beta 1]$; expected sign = [1,+]

	EG	DOLS	ARDL	EG	DOLS	ARDL
	Gross wages 1991 to 2004			*Net wages 1998 to 2004*		
Bulgaria						
LAG		(0.0), S, A, H	(7.1), H		(6.1), A, H	(6.6), A
COINT	3.60** (7), A	3.67** (7), A, H	12.547**	3.3* (6), H, A	3.247* (0), S, A, H	4.951*
ECT	0.11***		0.149***	0.102*		0.144**
CONST	0.204***	0.201***	0.256***	0.108**	0.121**	0.163
$\beta 1$	0.091***	0.090***	0.008	0.444***	0.464***	0.551*
	Gross wages 1994 to 2004			*Net wages 1994 to 2004*		
Croatia						
LAG			(4.0), S, H			(5.0), A
COINT	NO	NO	9.896**	NO	NO	9.003**
ECT	1.36***		0.108***	0.107***		0.076**
CONST	0.199***		0.502***	0.271***		0.741***
$\beta 1$	2.064***		1.16*	2.636***		1.242
	Gross wages 1994 to 2004			*Net wages 1994 to 2004*		
Romania						
LAG		(0.0), S	(3.3), S, A, H		(6.0), S, H	(4.0), A, H
COINT	3.756** (3), A	3.767** (3), A, H	7.861**	3.626** (3), H	3.654** (4), A	10.426**
ECT	0.139**		0.185***	0.128**		0.208***
CONST	0.023	0.035	0.07	0.042	0.17***	0.176*
$\beta 1$	0.043*	0.050*	0.023	0.038	0.128***	0.129*
	Gross wages 1993 to 2004					
Russia						
LAG		(1.2), S, A, H	(6.6)			
COINT	(12), 3.698**	(0), 3.288*	8.213**			
ECT	0.059***		0.125***			
CONST	0.33***	0.375***	0.388***			
$\beta 1$	1.058***	1.495***	1.417***			
DUMMY_98–04	0.182***	0.134***	0.087			
	Gross wages 1996 to 2004					
Ukraine						
LAG		(5.6), S, A, H	(1.0), S, A, H			
COINT	NO	(1, all), 3.747**	5.997**			
ECT	0.095***		0.081**			
CONST	0.051***	0.103***	0.107*			
$\beta 1$	0.787***	0.724***	1.315***			
DUMMY_98–04	0.176***	0.117***	0.362***			
	Gross wages 1988 to 2004					
Turkey						
LAG		(0.4)	(4.1)			
COINT	3.421** (1)	3.079* (1)	4.907*			
ECT	0.025*		0.028**			
CONST	0.157***	0.124***	0.183			
$\beta 1$	1.65***	1.953***	0.311			

Source: Author's calculations.

*Note: EG, DOLS and ARDL denote the Engle-Granger, the Dynamic OLS and the Autoregressive Distributed Lags estimations. The raw LAG shows the lag structure of the DOLS and ARDL models. S, A and H indicate that the lag structure was chosen on the basis of the Schwartz, Akaike and Hannan-Quinn information criterion, respectively. The raw COINT contains residual-based cointegration tests for the EG and the DOLS approach (with the lag length in parentheses), and test statistics from the bounds-testing approach for ARDL. The error correction terms for EG and ARDL are reported in the raw ECT. *, ** and *** denote that the null hypothesis is rejected at the 10%, 5% and 1% levels, respectively. CONST is a constant term. NO: No cointegration could be found.*

cients vary from 1.6 to 1.9. Robust cointegration for Russia can be found only when a dummy is used to capture the post-Russian crisis period from December 1998 until the end of the period, and for Ukraine when using DOLS and ARDL. For Russia, the estimated coefficient that links productivity to real wages is positive and is about 1.4. For Ukraine, the coefficient ranges from 0.7 to 1.3.

The sectoral wage ratio is defined as the ratio of nominal gross or net wages in industry to those in the whole economy. According to test results reported in table 3, the Augmented Dickey Fuller (ADF), the Phillips-Perron (PP) and the Elliott-Rothenberg-Stock (ERS) point optimal unit root tests are unable to reject the presence of a unit root, while the Kwiatowski-Phillips-Schmidt-Shin

(KPSS) test mostly rejects stationarity for the whole sample and for a shorter period, i.e. 1996 to 2004, used for the sake of comparability across countries. The only country for which there is some (mixed) evidence for difference stationarity is Russia. Note also that the wage ratios based on both gross and net monthly wages exhibit trend stationarity for the subperiod. In sum, with the exception of Russia, all series either have a unit root or are trend stationary, implying the first and/or second moments to be unstable over time.

Table 3

Unit Root Tests for the Sectoral Wage Ratio, Monthly Data

	Gross monthly wages					Net monthly wages			
	ADF	PP	KPSS	ERS		ADF	PP	KPSS	ERS
Bulgaria									
1991:01 to 2004:03	1.13 (5)	−2.23 (6)	0.39*** (10)	8.39 (5)					
1996:01 to 2004:03	−0.99 (4)	−1.42 (6)	1.13*** (7)	10.50 (4)					
Croatia									
1994:01 to 2004:03	−1.93 (2)	−2.27 (3)	0.71*** (9)	38.50 (2)	1993:01 to 2004:03	−2.65 (2)	−2.35 (6)	0.98*** (9)	5.84 (2)
1996:01 to 2004:03	−1.69 (2)	−2.14 (5)	0.39* (7)	53.30 (2)	1996:01 to 2004:03	−2.06 (3)	−2.52 (6)	0.44* (7)	23.15 (3)
Romania									
1993:01 to 2004:03	−1.72 (1)	−13.05	0.74** (9)	4.26 (1)	1991:04 to 2004:03	−3.01** (1)	−3.57** (4)	0.35* (9)	24.73 (1)
1996:01 to 2004:03	−1.25 (1)	−1.72 (4)	1.14*** (7)	7.13 (1)	1996:01 to 2004:03	−1.26 (1)	−1.93 (4)	1.08*** (7)	6.40 (1)
Russia									
1992:01 to 2004:03	−1.35 (12)	−4.88*** (7)	0.99*** (9)	13.37 (12)					
1996:01 to 2004:03	−5.21*** (2)	−5.17*** (4)	0.64** (7)	17.83 (2)					
Ukraine									
1996:01 to 2004:03	−1.21 (1)	−0.98 (3)	1.04*** (7)	79.59 (1)					

Source: Author's calculations.
*Note: ADF, PP, KPSS and ERS are the Augmented Dickey-Fuller, the Phillips-Perron, the Kwiatowski-Phillips-Schmidt-Shin and the Elliott-Rothenberg-Stock point optimal unit root tests, respectively, for the case including only a constant. In parentheses the lag length chosen using the Schwartz information criterion is given for the ADF and ERS tests, and the Newey West kernel estimator for the PP and KPSS tests. *, ** and *** denote the rejection of the null hypothesis. For the ADF, PP and ERS tests, the null hypothesis is the presence of a unit root, whereas for the KPSS tests, the null hypothesis is stationarity.*

The relationship between dual productivity and the relative price of market nontradables is investigated using monthly data. Dual productivity is proxied by average labor productivity in industry or manufacturing.[17] For the relative price of market nontradables, three measures are employed: (1) the ratio of services in the CPI to goods in the CPI, (2) the ratio of services in the CPI to the PPI, and (3) the CPI-to-PPI ratio. Time series for services and goods in the CPI are obtained from the Main Economic Database of the OECD. As the OECD has ceased to publish these series for Bulgaria, Croatia, Romania and Ukraine, the series for these countries end at the end of 2001 or 2002.

Turning now to the estimation results shown in tables 4a and 4b, we can observe the following pattern. On the one hand, productivity and relative prices based on service prices (SERVGOODS or SERVPPI) appear cointegrated in a reasonably robust manner with coefficients of around 1 for Bulgaria[18] and Russia,

[17] *Productivity changes in the closed sector are set to zero because no data are available on a monthly basis.*

[18] *Overall, our results are a little more encouraging for Bulgaria than those reported in Nenovsky and Dimitrova (2002), who argued that the B-S effect did not work in Bulgaria between 1997 and 2001 because of the nonfulfillment of the underlying assumptions.*

Table 4a

Cointegration Tests between Productivity and Relative Prices,

Monthly Data

Cointegrating vector X = [SERVGOODS/SERVPPI,PROD]; $\beta' = [1, \beta 1]$; expected sign = [1,+]

	SERVGOODS			SERVPPI		
	EG	DOLS	ARDL	EG	DOLS	ARDL
	1995:01 to 2002:09			*1991:12 to 2002:09*		
Bulgaria						
LAG			(5.0)		(1.6)	(4.1)
COINT	NO	NO	24.247**	3.203* (1)	3.325* (1)	6.102**
ECT	0.243***		0.209***	0.09**	2.559	0.159***
CONST	0.12***		0.336***	0.104***	0.061***	0.289***
DUMMY_97	0.451***		2.257***	0.349***	0.73***	0.942***
$\beta 1$	1.155***		0.973**	0.961***	1.033***	0.664**
	1997:01 to 2002:09			*1997:01 to 2002:09*		
Croatia						
LAG			(6.6)			(6.6)
COINT	1.626 (0)	NO	5.705*	3.636** (11)	NO	4.515a)
ECT	0.072**		0.109**	0.063**		0.088**
CONST	0.021***		0.015	0.084***		0.089*
$\beta 1$	0.854***		1.37**	0.845***		1.357*
	1994:01 to 2002:08			*1994:01 to 2002:08*		
Romania						
COINT	0	NO	NO	NO	NO	NO
ECT	0.005					
CONST	0.582***					
$\beta 1$	0.75***					
	1993:01 to 2004:03			*1993:01 to 2004:03*		
Russia						
LAG		(0.0)	(4.3)		(0.0)	(12.12)
COINT	3.523*(1)	3.431** (1)	4.994*	3.32* (0)	3.351* (0)	13.365**
ECT	0.078**		0.129***	0.088**		0.16***
CONST	0.232***	0.234***	0.308***	0.07***	0.07***	0.045
DUMMY_1998	0.292***	0.288***	0.273***	0.469***	0.469***	0.442***
$\beta 1$	1.027***	1.05***	1.049***	0.745***	0.741***	0.839**
	1994:01 to 2004:03			*1994:01 to 2004:03*		
Turkey						
LAG		(0.1)	(6.2)		(6.3)	(6.6)
COINT	2.187 (1)	2.228 (1)	8.863**	1.114 (12)	3.257* (0)	9.422**
ECT	0.156***		0.064	0.099**		0.101**
CONST	0.192***		0.608**	0.121***	0.274***	0.357*
$\beta 1$	0.412		8.378*	0.964**	4.373***	4.075
	1994:01 to 2001:12			*1994:12 to 2001:12*		
Ukraine						
LAG			(5.3)		(0.0)	(3.0)
COINT	3.501** (12)	NO	7.316**	5.475** (1)	5.599** (1)	6.107**
ECT	0.06**		0.073**	0.098***		0.084***
CONST	0.126**		0.679***	0.107**	0.107**	0.621***
DUMMY_1998	0.466***		0.376	0.191**	0.191**	0.357**
$\beta 1$	0.083		0.211	0.231	0.226	0.281

Source: Author's calculations.

*Note: EG, DOLS and ARDL denote the Engle-Granger, the Dynamic OLS and the Autoregressive Distributed Lags estimations. The raw LAG shows the lag structure of the DOLS and ARDL models. The raw COINT contains residual-based cointegration tests for the EG and the DOLS approach (with the lag length in parentheses), and test statistics from the bounds-testing approach for ARDL. The error correction terms for EG and ARDL are reported in the raw ECT. *, ** and *** denote that the null hypothesis is rejected at the 10%, 5% and 1% levels, respectively. CONST is a constant term. 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 et. al., 2001). NO: No cointegration could be found.*

and in a less robust manner with coefficients relatively close to 1 for Croatia. On the other hand, virtually no cointegration can be found for Romania, and the estimated coefficients are not significant for Ukraine. For Turkey, there is either no cointegration or the coefficient is fairly high, i.e. around 4. As for the

Table 4b

Cointegration Tests between Productivity and Relative Prices, Monthly Data

Cointegrating vector X = [CPIPPI,PROD]; $\beta' = [1, \beta 1]$; expected sign = [1,+]

	EG	DOLS	ARDL		EG	DOLS	ARDL
Bulgaria				**Russia**			
1991:12 to 2004:03				1993:01 to 2004:03			
LAG	(0.3)	(1.4)		LAG		(0.0)	(2.4)
COINT	−3.734** (1)	−3.217* (1)	12.978**	COINT	−4.25** (0)	−5.028** (2)	7.895**
ECT	−0.063***		−0.073***	ECT	−0.202***		−0.263***
CONST	−0.187***	−0.206***	−0.032	CONST	−0.117***	−0.118***	−0.132***
DUMMY_97/98	0.208***	0.197**	0.899***	DUMMY_97/98	0.152***	0.154***	0.17***
$\beta 1$	0.49***	0.514***	0.068	$\beta 1$	−0.343***	−0.353***	−0.406***
Croatia				**Ukraine**			
1992:01 to 2004:03				1994:12 to 2004:03			
LAG		(6.6)	(6.0)	LAG		(0.0)	(6.0)
COINT	−3.441** (10)	−3.886** (0)	50.524**	COINT	−3.795*(11)	−3.836** (11)	12.29**
ECT	−0.098**		−0.061*	ECT	−0.044		−0.07**
CONST	0.013***	0.012***	0.063***	CONST	0.037***	0.037***	0.18***
DUMMY_98				DUMMY_98	0.029	0.029	−0.152**
$\beta 1$	0.679***	0.716***	0.445	$\beta 1$	0.132***	0.133***	0.196
Romania				**Turkey**			
1994:01 to 2004:03				1985:03 to 2004:03			
LAG			(10.12)	LAG		(4.0)	(6.6)
COINT	−2.408 (0)	NO	13.11**	COINT	−4.673** (1)	−4.267** (0)	5.084*
ECT	−0.062**		0.006	ECT	−0.131***	11	−0.111***
CONST	0.029		−3.303	CONST	−0.028***	0.004	0.037
DUMMY				DUMMY	0.145***	0.118***	0.101*
$\beta 1$	−0.065***		1.354	$\beta 1$	0.569***	0.676***	0.673**

Source: Author's calculations.
Note: As for table 4a.

CPI-to-PPI ratio (CPIPPI), cointegration with the good sign could be established not only for Bulgaria, but also for Croatia, Turkey and Ukraine, albeit with fairly low coefficients in the latter country.

Finally, unit root tests including a constant are reported in table 5, from which it can be seen that the PPI-based real exchange rate is clearly not difference stationary in levels for Bulgaria, Croatia, Romania and Ukraine. For Russia, the null of a unit root cannot be rejected by the ADF, PP and ERS tests, and the KPSS test is not able to reject the null of stationarity. The opposite happens to be the case for Turkey, where the ADF, PP and ERS tests suggest difference stationarity. However, the KPSS test indicates nonstationarity. Thus, it is fair to say that PPP does not hold for the open sector for most of the countries.

Table 5

Unit Root Tests for the PPI-Based Real Exchange Rates, Monthly Data

		ADF	PP	KPSS	ERS
Bulgaria	1993:01 to 2004:03	−2.084 (0)	−1.992 (2)	0.979*** (9)	−3.104* (3)
Croatia	1993:01 to 2004:03	−1.337 (1)	−1.290 (3)	0.764*** (9)	7.719 (1)
Romania	1994:01 to 2004:03	−1.686 (0)	−1.592 (6)	1.025*** (9)	15.797 (0)
Russia	1994:01 to 2004:03	−1.854 (1)	−2.078 (6)	0.169 (9)	11.840 (1)
Turkey	1985:01 to 2004:03	−3.138** (0)	−3.376** (2)	0.412* (11)	3.750* (0)
Ukraine	1996:01 to 2004:03	−1.088 (2)	−1.052 (2)	0.845** (7)	20.567 (2)

Source: Author's calculations.
*Note: ADF, PP, KPSS and ERS are the Augmented Dickey-Fuller, the Phillips-Perron, the Kwiatowski-Phillips-Schmidt-Shin and the Elliott-Rothenberg-Stock point optimal unit root tests, respectively, for the case including only a constant. In parentheses the lag length chosen using the Schwartz information criterion is given for the ADF and ERS tests, and the Newey West kernel estimator for the PP and KPSS tests. *, ** and *** denote the rejection of the null hypothesis at the 10%, 5% and 1% levels. For the ADF, PP and ERS tests, the null hypothesis is the presence of a unit root, whereas for the KPSS tests, the null hypothesis is stationarity.*

4.1.3 To Sum Up

All in all, there is mixed evidence regarding the functioning of the basic assumptions. First, increases in productivity are connected to increases in real wages in the open sector roughly proportionately only in Croatia, Russia and Ukraine. The effect of productivity on real wages is below 1 in Bulgaria, and the relationship is highly questionable for Romania. By contrast, changes in productivity in the open sector lead to disproportionately large changes in real wages in Turkey. Second, a proportionate wage equalization between the open and closed sectors can be verified to a limited extent only for Russia. Third, notwithstanding the mixed evidence on real wages and nominal wage equalization, the service-based relative price is found to be linked reasonably well to dual productivity with a coefficient in the neighborhood of 1 for Bulgaria, Croatia and Russia. The coefficient is much higher than 1 for Turkey and considerably lower than 1 for Ukraine. No cointegration could be detected for Romania. Overall, this suggests that the B-S effect works reasonably well in Bulgaria, Croatia and Russia, whereas it is attenuated in Ukraine and is amplified in Turkey. For Romania, it does not seem to function. Another question is, however, the influence of the B-S effect on overall inflation, an issue which is addressed in the next section. Fourth, relative PPP is rejected for the real exchange rate of the open sector for all economies, perhaps with the exception of Turkey, which implies that the B-S effect will not be able to explain the entirety of real exchange rate movements.[19]

4.1.4 A Simple Accounting Framework

We now set out to analyze the size of the inflation to be attributed to the B-S effect (P^{B-S}). For this purpose, let us consider the following equation used in Égert (2004):

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

where $(1-\alpha)$ is the share of nontradables in the consumer basket, β_1 conceptually corresponds to the estimated coefficient from tables 4a and 4b, 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 additional periods are considered for this country, namely 1970–2003 and 1970–90.[20] In addition, average annual growth rates are computed using monthly industrial production-based productivity measures.[21]

The results are displayed in tables 6a to 6d. Several observations deserve attention. The first observation is that it may matter whether average labor pro-

[19] *If relative PPP were verified for the open sector, then the B-S effect could explain real exchange rate movements based on the CPI. By contrast, if relative PPP cannot be verified, the B-S effect will provide an explanation for changes in the difference between the (CPI-based) overall real exchange rate and the real exchange rate of the open sector.*

[20] *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.*

[21] *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 comparsion purposes.*

ductivity is calculated on the basis of sectoral employment or employee data. This is especially the case for Bulgaria for DIFF3 to DIFF6 (table 6a) and for Romania for DIFF23, DIFF25 and DIFF31 to DIFF33 (table 6b). The second observation is that how the sectors are classified into open and closed sectors may have a large impact. An example is Bulgaria, where dual productivity is negative when transport and telecommunications are taken as a closed sector, but 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.

Table 6a

Average Growth Rates of Dual Productivity, Old Classification

			DIFF1	DIFF2	DIFF3	DIFF4	DIFF5	DIFF6
			%					
Bulgaria	EMPLOYEE	1991–2003	−4.44	−5.6	0.47	4.11	−3.76	9.66
		1996–2003	−2.62	−4.03	1.73	15.06	0.33	15.8
	EMPLOYMENT	1991–2003	−4.82	−3.94	−5.02	7.51	9.05	5.51
		1996–2003	−7.4	−7.1	−6.87	5.48	4.82	5.58
Croatia	EMPLOYEE	1991–2002	−0.1	−0.29	0.16	0.57	0.14	0.72
		1996–2002	4.11	3.37	3.92	4.87	3.42	4.81
Russia	EMPLOYMENT	1991–2001	5.83	3.36	7.11	5.2	2.21	6.43
		1996–2001	5.00	2.9	5.81	5.46	2.99	6.31
Ukraine	EMPLOYEE	1991–2002	1.4	2.93	−0.06	−2.61	−0.18	−3.18
		1996–2002	−4.11	−3.24	−3.48	−9.68	−7.94	−8.69
	EMPLOYMENT	1991–2002	4.94	3.95	4.01	0.98	0.91	0.78
		1996–2002	0.69	4.77	−3.36	−7.06	2.17	−9.98

Source: Author's calculations.
Note: EMPLOYEE refers to average labor productivity measured by means of the number of employees in the sectors. EMPLOYMENT denotes productivity figures computed on the basis of sectoral employment data.

Table 6b

Average Growth Rates of Dual Productivity, New Classification

	Bulgaria		**Romania**			
	EMPLOYEES	EMPLOYMENT	EMPLOYEES		EMPLOYMENT	
	1996–2003	1996–2003	1991–2002	1996–2002	1991–2002	1996–2002
	%					
DIFF11	−0.86	−1.33	3.40	4.63	3.69	10.8
DIFF12	−2.98	−1.06	−0.63	−1.62	5.66	12.93
DIFF13	−0.86	−1.33	0.60	1.30	0.97	7.15
DIFF14	−2.98	−1.06	−1.29	−1.77	2.62	8.4
DIFF15	−0.86	−1.33	1.06	1.49	1.10	7.27
DIFF16	−2.98	−1.06	−0.77	−1.30	2.44	8.28
DIFF21	−0.57	−1.01	1.63	1.73	−2.88	0.93
DIFF22	−2.73	−0.73	−1.37	−2.31	−2.19	1.05
DIFF23	−0.57	−1.01	5.43	10.52	−0.68	6.09
DIFF24	−2.73	−0.73	0.59	2.23	−0.44	5.25
DIFF25	−0.57	−1.01	5.81	10.64	−0.53	6.28
DIFF26	−2.73	−0.73	1.22	2.94	−0.34	5.56
DIFF31	2.56	−1.02	4.74	6.50	−2.98	0.03
DIFF32	2.56	−1.02	9.64	17.41	−0.81	5.20
DIFF33	2.56	−1.02	10.13	17.7	−0.66	5.39
DIFF41	13.57	10.35	2.49	1.2	−0.90	1.21
DIFF42	1.20	6.30	−2.05	−4.11	0.17	1.74
DIFF5	16.51	9.50	5.15	5.33	−1.27	0.59

Source: Author's calculations.
Note: As for table 6a.

Table 6c

Average Growth Rates of Dual Productivity, New Classification, Turkey

	DIFF11	DIFF12	DIFF13	DIFF21	DIFF22	DIFF31	DIFF32	DIFF33	DIFF41
	EMPLOYMENT								
1970–2003	1.66	1.36	1.56	1.47	1.47	3.53	1.10	1.10	3.55
1970–1990	1.09	1.28	1.59	0.44	0.44	2.31	1.75	1.75	1.93
1991–2003	1.12	0.25	0.28	2.11	2.11	2.70	−0.80	−0.80	3.46
1996–2003	1.81	0.35	0.44	3.70	3.70	0.94	−2.36	−2.36	2.05
1994–2001	0.40	−0.29	−0.40	1.52	1.52	0.01	−1.71	−1.71	0.67

Source: Author's calculations.
Note: As for table 6a.

The productivity growth rates reported in table 6d 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 are taken as the open sector. Nevertheless, they are comparable with the figures obtained when some service sectors are also included in the open sector (DIFF32 and DIFF33 for Romania and DIFF41 and DIFF5 for Bulgaria).

Table 6d

Average Growth Rates of Dual Productivity, Industrial Production

		%			%
Bulgaria	1992–2003	9.00	**Russia**	1996–2001	5.50
	1996–2003	7.70		1996–2003	6.80
Croatia	1993–2002	3.20			
	1993–2003	3.20	**Ukraine**	1996–2002	9.70
	1996–2002	3.00			
	1996–2003	3.00	**Turkey**	1991–2003	2.50
Romania	1996–2002	9.20		1996–2003	0.70
	1996–2003	9.30		1994–2001	−0.50

Source: Author's calculations.
Note: One-year average yearly growth rates are derived from monthly series according to the practice of Eurostat. The average cumulated series for year t (average of 12 months) is divided by the average cumulated series for year t-1.

The inflation rate that can be associated with the B-S effect is quantified relying on equation (1). Table 7 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% to 20%. As the countries studied here are comparable with the same level of development, 20% can be thought of as a reasonable estimate for the share of market-based nontradables for all countries. Of the calculated dual productivity measures, we select those for which the open sector is constructed using manufacturing or, if not available, industry, and for which the closed sector includes the rest except for health, education, public administration and other community services. Agriculture is once part of the closed sector (DIFF2, DIFF14, DIFF12), and is once excluded from the analysis (DIFF1, DIFF13, DIFF11). The coefficient β_1 is restricted to 1, which seems reasonable 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.

Results in table 8 indicate that the B-S effect may be negative for Bulgaria irrespective of the period considered and for Croatia for 1991 to 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 productivity grows in services, as is the case for the other countries, results based on national accounts and industrial production are fairly similar. Nevertheless, the effect rises to about 0.8 percentage point in Croatia for the period of 1996 to 2002. Table 8 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 impact from 1996 to 2002, as it explains roughly up to one-fifth of the observed inflation. 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 (see Égert, Halpern and MacDonald, 2004, for a summary of the results).

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 which provide the needed figure for Germany, which is taken as a proxy for the euro area during the 1990s: 0.25%.[22] For the industrial production-based productivity measure, the two figures which can be obtained using equation (1) are 1.2% for 1992 to 2003 and 1.0% for 1996 to 2003.[23] When adjusting the figures reported in table 8 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.

Table 7

The Share of Different Groups of Items in the HICP in 2002

	NMS-10	Bulgaria	Romania
	%		
Goods	28.1	21.1	20.8
of which: durable	*7.9*	*2.2*	*1.5*
semidurable	*10.5*	*6.6*	*9.0*
nondurable	*9.7*	*12.4*	*10.2*
Energy	4.7	4.2	4.7
Food	29.9	43.4	46.3
of which: alcohol and tobacco	*6.7*	*4.5*	*5.2*
Services	48.9	34.0	32.0
of which: regulated	*15.3*	*18.0*	*16.8*

Source: Author's own calculations based on disaggregated HICP data drawn from NewCronos/Eurostat.
Note: NMS-10 stands for the ten new EU Member States.

[22] *For Germany, Swagel (1999), Lommatzsch and Tober (2003) and Égert et al. (2003) estimated the size of the B-S effect as 0% (1990–96), 0.1% (1995–2002) and 0.55% (1995–2000), respectively.*

[23] *The share of nontradabeles in the CPI is set to 40%.*

Table 8

The Contribution of the Balassa-Samuelson 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	145.20	
	1996–2003	−1.48	−1.42	1996–2003	1.54	153.40	2.30
Croatia	1991–2002	−0.02	−0.06	1992–2002	0.63	203.00	
	1996–2002	0.82	0.67	1996–2002	0.60	4.30	1.80
Russia	1991–2001	1.17	0.67			292.30	
	1996–2001	1.00	0.58	1996–2001	1.11	36.40	13.60
Ukraine	1991–2002	0.99	0.79			675.90	
	1996–2002	0.14	0.95	1996–2002	1.94	24.30	5.20
		DIFF13_New	DIFF14_New				
Bulgaria	1996–2003	−0.27	−0.21	1996–2003	1.54	153.40	
Romania	1991–2002	0.19	0.52			100.60	
	1996–2002	1.43	1.68	1996–2002	1.84	57.30	15.30
		DIFF11_TK	DIFF12_TK				
Turkey	1970–2003	0.33	0.27			50.40	
	1970–1990	0.22	0.26			39.20	
	1991–2003	0.22	0.05	1991–2003	0.50	68.60	
	1996–2003	0.36	0.07	1996–2003	0.14	61.90	
	1994–2001	0.08	−0.06	1994–2001	−0.1	77.40	25.30
		NATIONAL ACCOUNTS			IND_PROD		
Euro area	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.
Note: IND_PROD refers to average labor productivity obtained on the basis of industrial production. 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 until 2003 for Croatia, Romania and Russia will not change the results significantly (see data in table 6d).

4.2 The Dutch Disease in Russia

Besides the classical channels of real exchange rate appreciation, countries rich in natural resources and especially those with economic structures relying heavily on oil production and export are usually good candidates for the Dutch disease (D-D) phenomenon. Of the countries under consideration, Russia is an important oil-producing and exporting country: the share of energy products (crude oil, fuel and gas) in total exports amounted to an impressive 51.6% in 2003 (chart 7).

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.
4. The trade balance is not in the red.

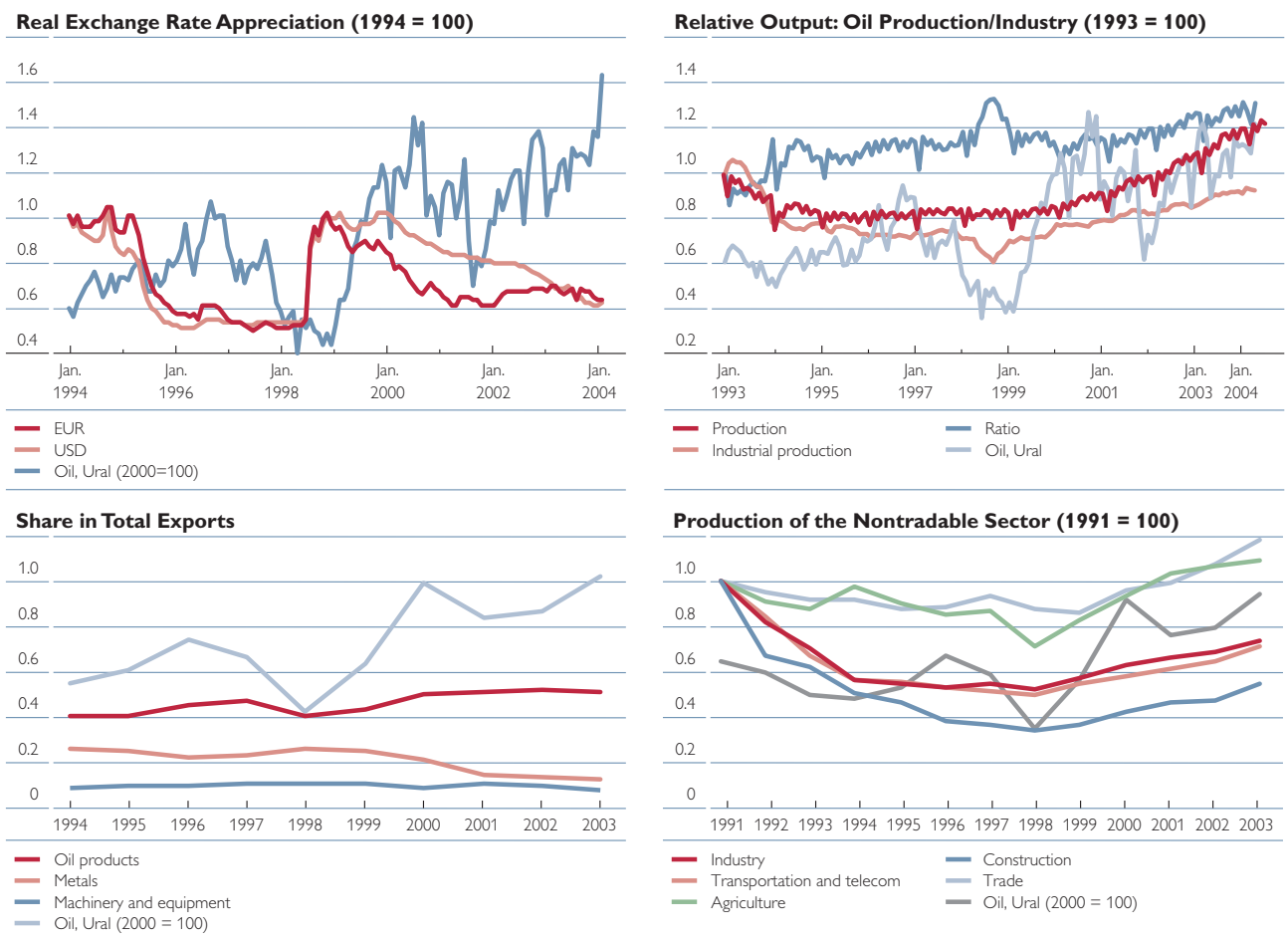
In the flagship paper of the proponents of the D-D phenomenon, Sachs and Warner (1995) find strong empirical evidence in favor of the D-D effect especially in emerging Asian economies and in Sub-Saharan Africa. Nevertheless, in the second half of the 1990s, an increasing number of papers put into question 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. Altamiro (1999) refers to Corden (1984), who suggests that the D-D phenomenon might not even hold for the Netherlands. 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, which hamper 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.

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, chart 8 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, chart 8 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.

Chart 8

Wage Equalization across Sectors



Source: Author's calculations.

4.3 The Role of Net Foreign Assets and Additional Factors

In the previous sections, we investigated in more depth the B-S effect and the D-D phenomenon. In this section, we propose to incorporate them 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; Alberola et al., 2002) as well as for transition economies (Burgess et al., 2004; Rahn, 2003; Alberola, 2003; Égert, Lahrèche-Révil and Lommatzsch, 2004), 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:

$$Q^{CPI} = f(\overset{-}{PROD}, \overset{+/-}{NFA}) \qquad (2)$$

An increase in the productivity variable is expected to lead to an appreciation of the real exchange rate (negative sign). Alberola et al. (1999, 2002) and Rahn (2003) interpret this as the traditional B-S effect. The productivity variable for industry can also reflect nonprice competitiveness in the open sec-

tor and thus lead to a real appreciation as argued in Égert, Lahrèche-Révil and Lommatzsch (2004).

The sign on NFA is not unambiguous. Égert, Lahrèche-Révil and Lommatzsch (2004) put forth that for well-established economies, an increase in the NFA position is usually associated with an appreciation of the real exchange rate because of capital inflows related to increasing payments received on NFA (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 net foreign assets and increase net foreign liabilities and cause the real exchange rate to appreciate. This implies a negative sign. However, there is a threshold for the NFA 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 (2) is augmented with the corresponding variable, which is given as the product of the price of Ural crude oil and crude oil production volume ($REV\_OIL = P^{OIL} \cdot \bar{Production}^{OIL}$):

$$Q^{CPI} = f(\bar{PROD}, \overset{+/-}{NFA}, \bar{REV\_OIL}) \tag{2a}$$

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.

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 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.[24] 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 (DEF) 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

[24] *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.*

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 (2b) to (2e) show equation (2) augmented with the control variables:

$$Q^{CPI} = f(\overset{-}{PROD}, \overset{+/-}{NFA}, \overset{-}{EXP}) \quad (2b)$$

$$Q^{CPI} = f(\overset{-}{PROD}, \overset{+/-}{NFA}, \overset{+}{OPEN}) \quad (2c)$$

$$Q^{CPI} = f(\overset{-}{PROD}, \overset{+/-}{NFA}, \overset{+}{DEF}) \quad (2d)$$

$$Q^{CPI} = f(\overset{-}{PROD}, \overset{+/-}{NFA}, \overset{+}{ROIL}) \quad (2e)$$

These equations are estimated based on both time series and panel cointegration techniques. Because of possible heterogeneity across the countries, we employ the mean group DOLS 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. For Russia, the equations tested are equations (2a) to (2e) augmented with the variable $P^{OIL} \cdot \overline{Production}^{OIL}$.

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.[25] Openness is obtained as the average of exports and imports of goods relative to GDP. Similarly to MacDonald (1997), 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.[26] 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.

4.4 Estimation Results

4.4.1 Time Series Results

Tables 9 to 14 below show the estimation results based on alternative time series cointegration techniques.[27] For Bulgaria, although all econometric techniques detect the presence of cointegrating vectors, only the EG and DOLS estimates yield statistically significant coefficient estimates. For these estimates, the productivity variable is always significant and has the expected sign. Net foreign

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

[26] *Data from national sources are preferred except if longer time series are 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 (see tables 9 to 14 and appendix tables 1 to 3).*

[27] *The time periods used are given by data availability. The period for Turkey starts in 1985 and the period for the rest of the sample in 1994 or later. As we have shown, a large part of the initial undervaluation had been corrected by the mid-1990s. Therefore 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.*

assets become significant only with the inclusion of the control variables. In those cases, they have a positive sign, implying that a decrease in NFA 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. Note that no cointegration could be found when public expenditures as a share of GDP are employed.

Regarding Croatia, both productivity and NFA are significant in the baseline equation when using DOLS. Contrary to Bulgaria, the sign on NFA is negative: a decrease in this variable is linked to a real depreciation. This result does not change with the inclusion of control variables. 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 three estimation techniques 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, the productivity variable enters all equations with the wrong, positive sign for the whole period. Splitting the sample in 1998 allowed us to uncover that the productivity variable becomes negative in the baseline specification. However, the use of the control variable reversed the sign once again. Also, while positive for the whole period, the sign on NFA becomes negative for the second half of the period studied.

For Russia, we first start with the equation including only the oil price. For this purpose, we use three alternative measures: (1) oil revenues, (2) real oil prices and (3) nominal oil prices. As reported in table 12a, it is only by using the ARDL approach that it is possible to show, for the whole period, the presence of a cointegrating vector between the real exchange rate on the one hand and the oil price on the other hand.[28] The estimated coefficient varies from 0.5 to 0.65. However, when only the period after 1998 is considered (table 12b), the null of no cointegration cannot be rejected with any of the techniques. This makes us think that a more elaborate model is needed to model the real exchange rate in Russia than that used by Sosunov and Zamulin (2004). As a next step, we also include the productivity variable as in Strapafora and Stavrev (2003) (table 12a). The productivity variable is significant and has the expected sign. However, contrary to Strapafora and Stavrev (2003), the oil price turns out to be statistically insignificant. Apparently, the results are sensitive to the econometric technique (Phillips and Loretan, 1991, versus DOLS and ARDL) and/or the data frequency (quarterly versus monthly).

We now turn to the results of the baseline equation including productivity and NFA. This relationship turns out to be very robust in terms of statistical

[28] *If the cointegration tests are not able to reject the null of no cointegration, a negative and significant error correction term may be viewed as a weak evidence in favor of cointegration.*

significance and the stability of signs. The sign on NFA is found to be positive. The results remain broadly unchanged when the control variables are included. It should be mentioned that the oil revenue variable becomes significant only if another control variable (OPEN or DEF) is used.[29] In these cases, it bears a negative sign, implying that an increase in oil revenues causes the real exchange rate to appreciate.[30]

As far as Ukraine is concerned, the results appear fairly robust.[31] Productivity and NFA 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 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 to 2003. Although productivity is usually found to be cointegrated with the real exchange rate with the expected negative sign, the sign on NFa depends largely on the inclusion of control variables. In the baseline specification and when using openness or real oil prices, the sign of the NFA 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.

[29] *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.*

[30] *In one of these cases, productivity and NFA become insignificant when using DOLS.*

[31] *Data for openness are available only as of November 1999, which is a hindrance for the specification including openness to be estimated for Ukraine.*

Table 9

Time Series Estimation Results, Bulgaria

	1993:1 to 2003:12			1993:1 to 2003:12		
	EG	DOLS	ARDL	EG	DOLS_AIC	ARDL_SIC
LAG		(0.4)	(4.2)		(1.4)	(3.0)
COINT	−4.481*(1)	−4.872** (0)	3.587a)	−4.583*** (1)	−5.123*** (1)	4.457**
ECT	−0.073		0.014	−0.077		−0.074
CONST	−0.575***	−0.531***	−0.356	−0.725***	−0.705***	−0.965
PROD	−0.829***	−0.885***	−0.828	−0.84***	−0.906***	−0.934
NFA	0.195	0.14	0.057	0.392*	0.346*	0.606
ROIL				0.069	0.08*	0.193
OPEN						
DEF						
DUMMY	0.18***	0.146***	9.301***	0.162***	0.164***	−2.216***
	1994:1 to 2003:12			1993:1 to 2003:12		
	EG	DOLS_SIC	ARDL_SIC	EG	DOLS_SIC	ARDL_SIC
LAG		(1.2)	(4.1)		(0.2)	(3.0)
COINT	−5.83*** (1)	−5.808*** (1)	4.89**	0	−4.528*** (0)	3.978*
ECT	−0.166**		−0.147*	−0.077		−0.06
CONST	−0.046	−0.361***	0.18	−0.656***	−0.63***	−0.714
PROD	−1.005***	−0.909***	−0.924	−0.666***	−0.696***	−0.584
NFA	0.177	0.433***	0.865	0.315*	0.266	0.327
ROIL						
OPEN	0.336***	0.104	0.493			
DEF				−0.195**	−0.184	−0.429
DUMMY	0.072	0.054	−1.015***	0.209***	0.149**	−2.534***

Source: Author's calculations.

*Note: EG, DOLS and ARDL denote the Engle-Granger, the Dynamic OLS and the Autoregressive Distributed Lags estimations. The raw LAG shows the lag structure of the DOLS and ARDL models. S, A and H indicate that the lag structure was chosen on the basis of the Schwartz, Akaike and Hannan-Quinn information criterion, respectively. The raw COINT contains residual-based cointegration tests for the EG and the DOLS approach (with the lag length in parentheses), and test statistics from the bounds-testing approach for ARDL. The error correction terms for EG and ARDL are reported in the raw ECT. *, ** and *** denote that the null hypothesis is rejected at the 10%, 5% and 1% levels, respectively. CONST is a constant term. The shadowed columns indicate that the given equation is used for the derivation of real misalignments in section 4.4.3. 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 et al., 2001). The periods indicated in the header of the table show the longest period available for all the variables.*

Table 10

Time Series Estimation Results, Croatia

	1993:1 to 2003:12			1993:1 to 2003:12		
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(1.3)	(3.3)		(4.4)	(4.4)
COINT	−1.705 (0)	−4.152** (1)	3.955a)	−1.789 (0)	−4.636*** (1)	1.666
ECT	−0.058	0	−0.156**	−0.061		−0.192***
CONST		−0.074***	−0.117***		−0.143***	−0.135*
PROD		−0.613***	−0.184		−0.648***	−0.338
NFA		−0.067***	−0.098**		−0.057***	−0.089**
ROIL					0.028*	0.01
OPEN						
DEF						
EXP						
	1994:1 to 2003:12			1995:1 to 2003:12		
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(4.2)	(1.3)		(4.4)	(0.1)
COINT	−1.943 (0)	−4.205*** (0)	−0.176***	−3.71 (1)	−4.796*** (1)	2.55
ECT	−0.063			−0.148**		−0.175***
CONST		0.018	0.052	−0.127***	−0.175***	−0.155***
PROD		−0.365***	−0.199	−0.114	0.171	0.144
NFA		−0.097***	−0.095**	−0.279***	−0.291***	−0.33***
ROIL						
OPEN		0.072**	0.096			
DEF				1.212***	0.896***	1.506***
EXP						
	1995:12 to 2003:12					
	EG	DOLS	ARDL			
LAG		(2.2)	(1.3)			
COINT	−3.412 (1)	−5.46*** (1)	3.536a			
ECT	−0.179**					
CONST	−0.544***	−0.353***	−0.382***			
PROD	−0.495***	−0.483***	−0.628***			
NFA	−0.12***	−0.128***	−0.082*			
ROIL						
OPEN						
DEF						
EXP	−0.289***	−0.161***	−0.197***			

Source: Author's calculations.
Note: As for table 9.

Table 11

Time Series Estimation Results, Romania

	1994−2003			1998−2003		
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(4.4)	(3.2)		NO	(3.0)
COINT	−2.563 (0)	−5.194** (4)	4.485*	−3.896** (6)		5.47**
ECT	−0.117**		−0.175***	−0.092*		−0.191***
CONST	0.061***	−0.06***	−0.012	−0.408***		−0.364***
PROD	0.524***	0.828***	0.564**	−0.37***		−0.356*
NFA	0.787***	0.739***	0.722***	−0.426***		−0.338

Source: Author's calculations.
Note: As for table 9. NO: No cointegration could be found.

Table 12a

Time Series Estimation Results, Russia

	1994–2003								
	EG	DOLS	ARDL	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(4.4)	(4.4)		(4.4)	(4.4)		(4.4)	1.588
COINT	−2.159 (1)	−2.724 (1)	7.177**	−2.146 (1)	−2.693 (1)	6.861**	−2.559 (1)	−3.01 (0)	(1.0)
ECT	−0.056**		−0.068***	−0.053**		−0.065**	−0.067**		−0.058**
CONST	−0.406***		−0.507***	−0.225		1.008	−0.652***		−0.168
PROD							−1.017***		−3.144**
REV_OIL	−0.055		−0.481**						
ROIL				−0.067		−0.646**	0.111		−0.121
DUMMY	0.162***		0.458***	0.157***		0.372**	0.185***		0.504***

Source: Author's calculations.
Note: As for table 9. REV_OIL refers to the oil revenue variable.

Table 12b

Time Series Estimation Results, Russia

	1994–2003								
	REV_OIL			ROIL			OIL		
	EG	DOLS	ARDL	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(4.4)	−2		(4.4)	(2.0)		(4.4)	(2.0)
COINT	−1.653 (0)	−1.485 (0)	−0.191	−0.844 (0)	−1.005 (0)	−0.397	−1.064 (0)	−1.072 (0)	−0.33
ECT	−0.028		−0.032	−0.021		−0.021	−0.022		−0.023

Source: Author's calculations.
Note: As for table 9. REV_OIL refers to the oil revenue variable.

Table 12c

Time Series Estimation Results, Russia

	1994:1 to 2003:12			1994:1 to 2003:12		
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(4.3)	(3.1)		(6.6)	(2.3)
COINT	−2.457 (1)	−4.463** (0)	7.605**	−2.452 (1)	−4.401*** (0)	2.217
ECT	−0.042		−0.111***	−0.043		−0.107**
CONST	−0.058	−0.14***	0.015	−0.021	−0.108*	−0.154
PROD	−1.608***	−0.58**	−1.58*	−1.508***	−0.718**	−1.422
NFA	0.067***	0.157***	0.209***	0.077***	0.182***	0.178**
REV_OIL				−0.059	0.004	0.061
OPEN						
DEF						
EXP						
DUMMY	−0.266***	−0.035	0.253	−0.288***	0.153**	0.582***

	1994:1 to 2003:12			1994:1 to 2003:12		
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(2.0)	(1.3)		(5.4)	(2.2)
COINT	−5.041** (3)	−5.035** (2)	2.147	−3.516 (1)	−5.672** (0)	7.59**
ECT	−0.148***		−0.222***	−0.153***		−0.252***
CONST	2.811***	0.471	0.141	0.389***	−0.356***	0.286*
PROD	0.499	−0.56*	−1.251	−1.846***	−0.139	−0.971**
NFA	−0.084	0.19***	0.243*	0.253***	0.036	0.329***
REV_OIL	−0.006	−0.156***	−0.133	−0.276***	−0.078**	−0.278**
OPEN	1.747***	0.24	0.008			
DEF				1.99	−0.981	−0.618
EXP						
DUMMY	−0.123**	−0.109**	0.075	−0.261***	0.034	0.169**

	1995:11 to 2003:12		
	EG	DOLS	ARDL
LAG		(6.5)	(1.5)
COINT	−2.699 (0)	−6.659** (1)	3.61*
ECT	−0.139**		−0.41***
CONST	−4.146***	0.416	1.162
PROD	0.191	−1.775***	−1.71***
NFA	0.105**	0.246***	0.276***
REV_OIL	−0.19***	−0.004	−0.073
OPEN			
DEF			
EXP	−0.86***	0.06	0.204
DUMMY	0.038	0.02	0.019

Source: Author's calculations.
Note: As for table 9. REV_OIL refers to the oil revenue variable.

Table 13

Time Series Estimation Results, Ukraine

	1996:1 to 2002:12			1996:1 to 2002:12		
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(3.0)	(1.1)		(4.4)	(1.0)
COINT	−5.031*(1)	−5.908** (1)	−0.231	−5.011*** (1)	−6.506***	−0.575
ECT	−0.063		−0.193***	−0.053		−0.136**
CONST	−0.156***	−0.182***	−0.179**	−0.227*	1.071***	0.333
PROD	−0.435***	−0.635***	−0.627**	−0.451***	−0.585***	−0.502
NFA	0.68***	0.852***	0.724	0.626**	3.405***	1.129
ROIL				0.023	−0.364***	−0.158
DEF						
EXP						
DUMMY	0.35***	0.423***	0.424***	0.356***	0.077	0.328
	1996:1 to 2002:12			1996:12 to 2002:12		
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(4.0)	(2.1)		(1.0)	(4.1)
COINT	−4.699*** (1)	−7.32*** (1)	5.134***	−4.073* (6)	−5.775***	5.126**
ECT	−0.129***		−0.251***	−0.192**		−0.280***
CONST	−0.1***	−0.132***	−0.141***	−1.55***	−1.166***	−1.174***
PROD	−0.451***	−0.562***	−0.537***	−0.523***	−0.465***	−0.428***
NFA	0.404	0.948***	0.788**	0.26***	0.379***	0.448***
ROIL						
DEF	0.222***	0.027	−0.037			
EXP				−0.587***	−0.416***	−0.424***
DUMMY	0.36***	0.336***	0.336***	−0.07***	0.07**	0.034

Source: Author's calculations.
Note: As for table 9.

Table 14

Time Series Estimation Results, Turkey

	1985:1 to 2003:12					
	EG	DOLS	ARDL	EG	DOLS	ARDL
LAG		(5.4)	(1.1)		(0.6)	(1.1)
COINT	−3.918** (0)	−3.953** (0)	4.700*	−3.983* (0)	−4.042* (0)	2.846a)
ECT	−0.125***		−0.131***	−0.123***		−0.131***
CONST	0.179***	0.19***	0.203***	0.431***	0.555***	0.164
PROD	−0.278***	−0.224*	0.132	−0.395***	−0.61***	0.101
NFA	0.225***	0.16*	0.184	0.28***	0.252***	0.202
ROIL				−0.096***	−0.149***	0.014
OPEN						
DEF						
EXP						
DUMMY 1	0.202***	0.128***	0.287**	0.175***	0.168***	0.296**
DUMMY 2	−0.063***	−0.1***	−0.034	−0.089***	−0.132***	−0.029
LAG		(5.4)	(1.1)		(5.4)	(1.0)
COINT	−3.997* (0)	−4.029* (0)	2.55	−5.097*** (0)	−5.481*** (1)	5.327**
ECT	−0.126***		−0.137***	−0.181***		−0.188***
CONST	0.451***	0.398*	0.648	0.163***	0.156***	0.166***
PROD	−0.19*	−0.25*	0.221	−0.657***	−0.583***	−0.452
NFA	0.37***	0.362**	0.465	−0.347***	−0.582***	−0.598**
ROIL						
OPEN	0.127*	0.094	0.206			
DEF				0.803***	0.96***	0.993***
EXP						
DUMMY 1	0.195***	0.094**	0.241*	0.236***	0.226***	0.318***
DUMMY 2	−0.072***	−0.112***	−0.056	−0.052***	−0.113***	−0.031
LAG		(5.6)	(1.0)			
COINT	−4.661*** (0)	−5.848*** (0)	4.883**			
ECT	−0.161***		−0.166***			
CONST	−0.545***	−0.942***	−0.668**			
PROD	−0.505***	−0.402***	−0.207			
NFA	−0.301***	−0.913***	−0.557*			
ROIL						
OPEN						
DEF						
EXP	−0.285***	−0.433***	−0.332***			
DUMMY 1	0.249***	0.244***	0.346***			
DUMMY 2	0.031	0.038	0.079			

Source: Author's calculations.
Note: As for table 9.

4.4.2 Panel Results

The estimation results obtained on the basis of a panel including Bulgaria, Croatia, Romania, Russia, Ukraine and Turkey are very robust compared to the country-by-country time series results (table 15). 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 NFA variables are always significant and the signs are also found to be very stable. Productivity is correctly (negatively) signed, whereas NFA have a positive sign. The use of control variables changes this picture only slightly. Public expenditures as a share of GDP and the openness ratio are significant and correctly signed. Real oil prices appear to be negatively signed. This is somewhat surprising, given that Russia is the only net oil-exporting country.

Table 15

Panel Estimation Results

	ECT	PROD	NFA	ROIL	DEF	EXP	OPEN
DOLS		−0.353***	0.743***				
MGE	−0.172***	−0.610*	0.641***				
DOLS		−0.426***	0.165***	−0.061**			
MGE	−0.100***	−0.4	0.656***	−0.176**			
DOLS		−0.236***	0.633***		0.350***		
MGE	−0.134***	−0.422*	0.570***		−2.784		
DOLS		−0.342***	0.317***			−0.220***	
MGE	−0.142***	−0.164***	0.117***			−0.071**	
DOLS		−0.040***	0.317***				0.242***
MGE	−0.143***	−0.257	0.482***				0.312*

Source: Author's calculations.

Note: DOLS and MGE are the panel DOLS and ARDL mean group estimators. ECT is the error correction term. PROD, NFA, ROIL, DEF, EXP, OPEN are the productivity, net foreign assets, real oil price, and public debt-to-GDP ratios, the public expenditures-to-GDP and the openness-to-GDP ratios.

4.4.3 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, only those will be used in which all estimated coefficients are statistically significant and are correctly signed.[32] 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 chart 9.

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 cases. 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 that

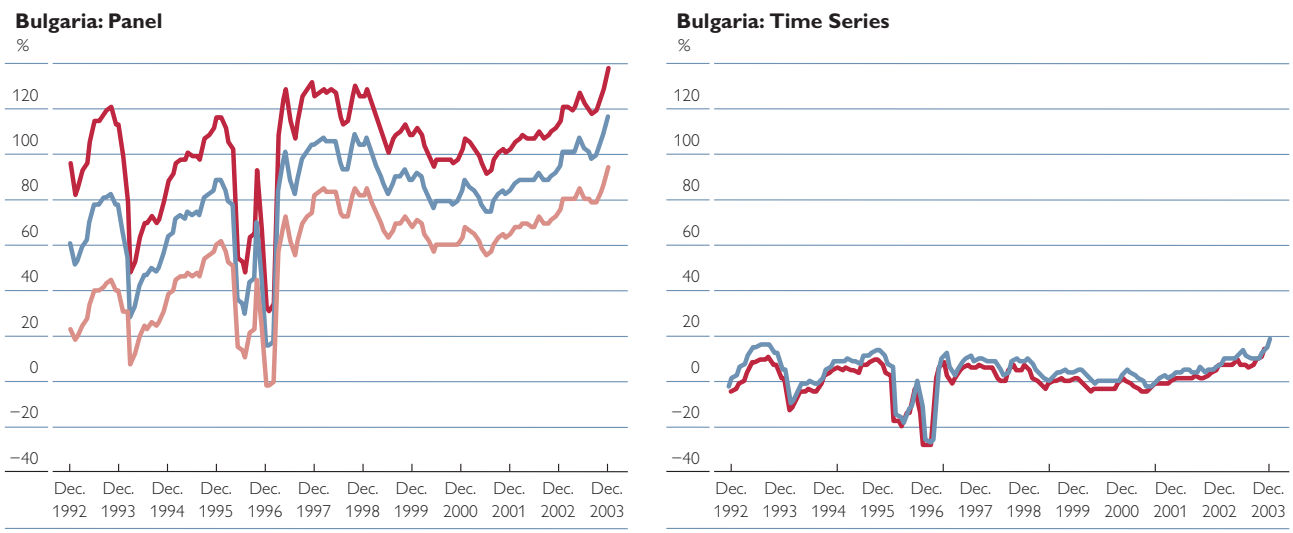
[32] *This leaves us with a single equation for Romania, two equations for Bulgaria, six equations for Croatia, Russia and Ukraine, and nine equations for Turkey. For some of the equations used for Russia, the openness and public deficit variables are not significant, but the others are. This is how we ensured that the oil revenue variable is considered. The retained equations are shaded in tables 9 to 14.*

obtained from time series. For instance, the number of equations issued from the time series analysis is 1 for the case of Romania and 2 for Bulgaria.

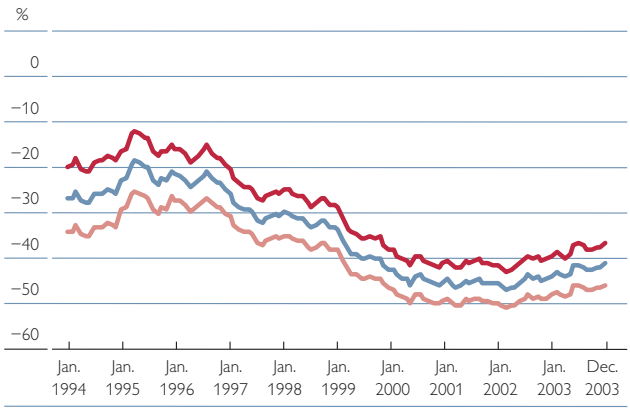
Let us now take a look at the derived total real misalignments. For Bulgaria, the time series results reveal that the Bulgarian lev was slightly overvalued just before the financial crisis occurred in 1996 and 1997. During and after the crisis, the currency became heavily undervalued, followed by a swift adjustment to equilibrium. Fairly valued toward the turn of the millenium, 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 2002. However, since then, the Croatian kuna seems to have been becoming slightly overvalued. As far as Romania is concerned, the lei is found fairly valued for the period of 1998 to 2003. 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 has 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. 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 has become increasingly overvalued once again.

Chart 9

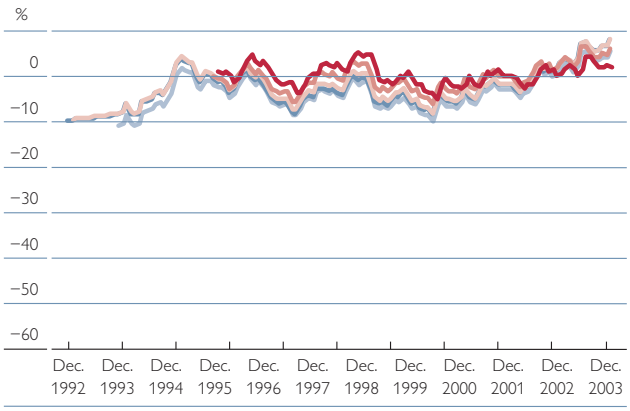
Total Real Misalignments



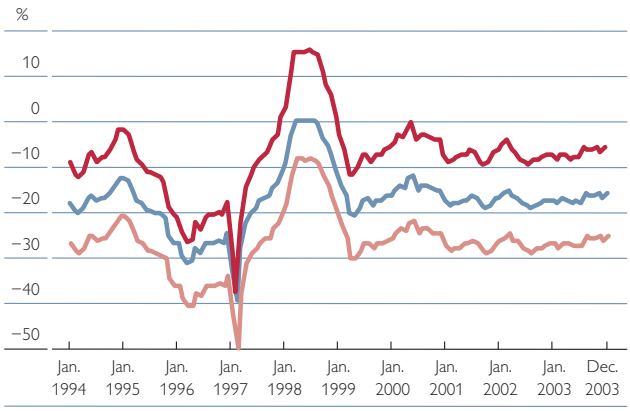
Croatia: Panel



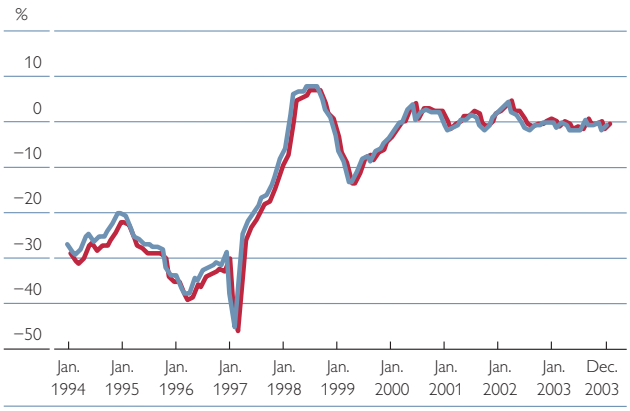
Croatia: Time Series



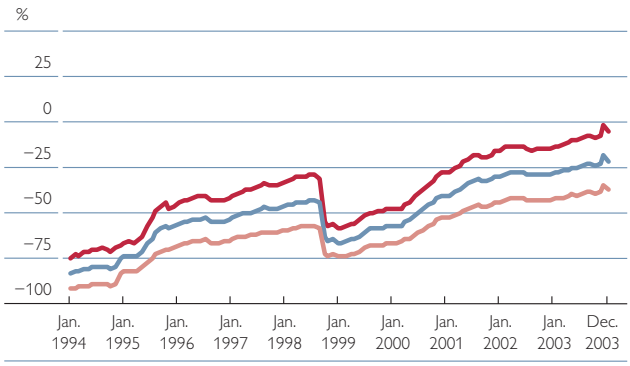
Romania: Panel



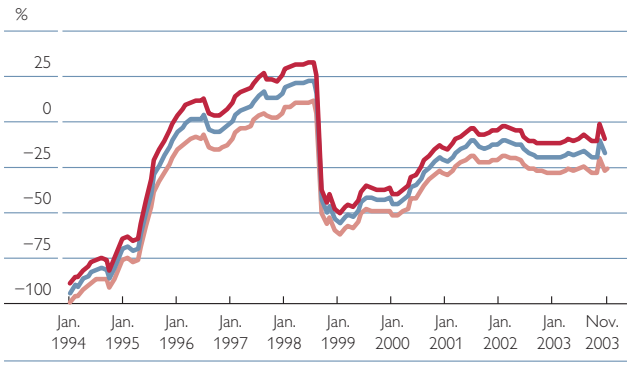
Romania: Time Series

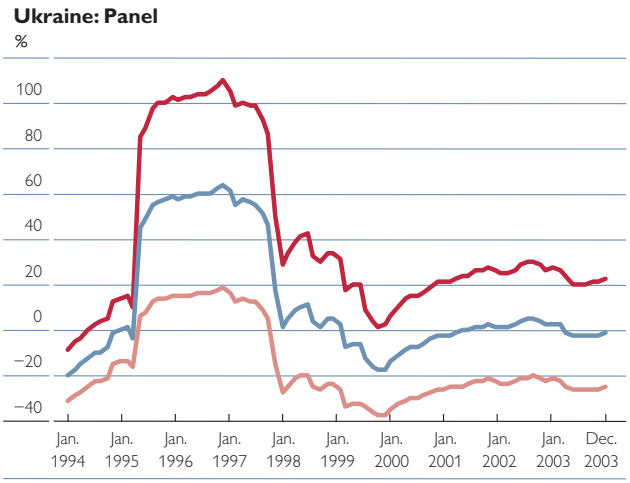


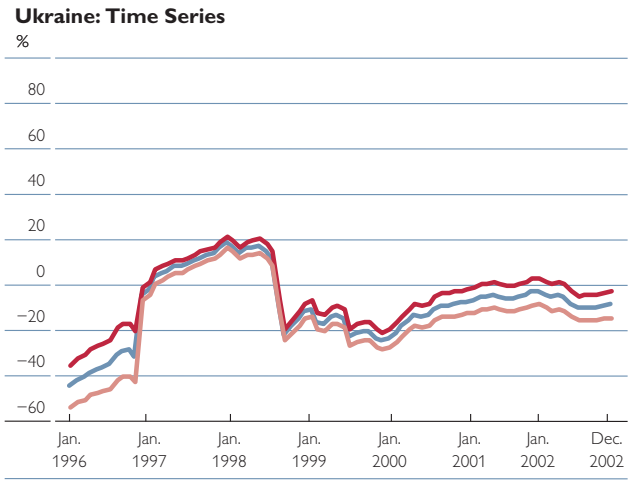
Russia: Panel

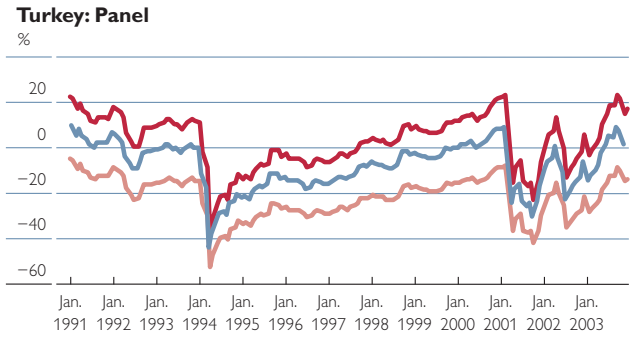


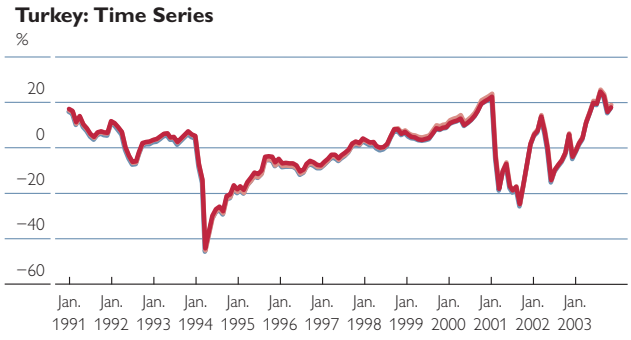
Russia: Time Series











Source: Author's calculations.
Note: Positive/negative values denote an overvaluation/undervaluation.

5 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, however, largely disappeared by the mid-1990s. The real exchange rates in levels were broadly in line with relative productivity levels in Bulgaria, Russia and Ukraine and to a lesser extent in Romania from the late 1990s onward. In Croatia and Turkey, a strong mismatch is found between the level real exchange rate and relative productivity levels.

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 often 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. Second, NFA usually entered the equation. Time series estimates also indicate a great deal of heterogeneity across countries. While positive for most countries, the sign on NFA 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 other countries are still on their way to the steady state. For Romania, the sign is found to be positive for the whole period but it was estimated to be negative for the period after 1998. This may indicate that easier access to financial markets and perceived progress in market reforms may soften external budget constraints. 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 NFA across the six economies under review.

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.

Contrary to the time series results, heterogeneous panel techniques yielded surprisingly 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 Croatian kuna and the Turkish lira became increasingly overvalued. At the same time, the real exchange rates in Romania, Ukraine and probably also in Russia can be thought of as fairly valued.

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Appendix 1: Classification of Sectors

Table A1

Classification of Sectors, Old Standards

	OPEN	CLOSED
DIFF1_O	B	C+D+E
DIFF2_O	B	C+D+E+A
DIFF3_O	B+A	C+D+E
DIFF4_O	B+D	C+E
DIFF5_O	B+D	C+E+A
DIFF6_O	B+D+A	C+E

Source: Author's calculations.
Note: A = agriculture; B = industry; C = construction; D = transport and telecommunications; E = trade.

Table A2

Classification of Sectors, 15-Sector NACE Standards

	OPEN	CLOSED	
DIFF11_N	D	F+G+H+I+J	
DIFF12_N	D	F+G+H+I+J+(A+B)	
DIFF13_N	D	F+G+H+I+J+K (market)	
DIFF14_N	D	F+G+H+I+J+K+(A+B)	
DIFF15_N	D	F+G+H+I+J+K+(L+M+O) (all)	
DIFF16_N	D	F+G+H+I+J+K+(L+M+O)+ (A+B)	
DIFF21_N	C+D+E	F+G+H+I+J	= DIFF1_O
DIFF22_N	C+D+E	F+G+H+I+J+(A+B)	= DIFF2_O
DIFF23_N	C+D+E	F+G+H+I+J+K (market)	
DIFF24_N	C+D+E	F+G+H+I+J+K+(A+B)	
DIFF25_N	C+D+E	F+G+H+I+J+K+(L+M+O) (all)	
DIFF26_N	C+D+E	F+G+H+I+J+K+(L+M+O)+ (A+B)	
DIFF31_N	C+D+E+(A+B)	F+G+H+I+J	= DIFF3_O
DIFF32_N	C+D+E+(A+B)	F+G+H+I+J+K (market)	
DIFF33_N	C+D+E+(A+B)	F+G+H+I+J+K+(L+M+O) (all)	
DIFF41_N	C+D+E+(H+I)	F+G+J	= DIFF4_O
DIFF42_N	C+D+E+(H+I)	F+G+J+(A+B)	= DIFF5_O
DIFF5_N	C+D+E+(H+I)+(A+B)	F+G+J	= DIFF6_O

Source: Author's calculations.
Note: A = agriculture, hunting, forestry; B = fishing; C = mining and quarrying; D = manufacturing; E = electricity, gas and water supply; F = construction; G = wholesale and retail trade; H = hotels and restaurants; I = transport, storage and telecommunications; J = financial intermediation; K = real estate, renting and business activities; L = public administration and defense as well as compulsory social security; M = education; N = health and social work; O = other community, social and personal services activities.

Table A3

Classification of Sectors, 6-Sector NACE Standards, Turkey

	OPEN	CLOSED	
DIFF11_TK	(C+D+E)	F+(G+H+I)+(J+K)	= DIFF21_N
DIFF12_TK	(C+D+E)	F+(G+H+I)+(J+K)+(A+B)	= DIFF22_N
DIFF13_TK	(C+D+E)	F+(G+H+I)+(J+K)+(A+B)+(L+M+O)	= DIFF25_N
DIFF21_TK	(C+D+E)+(A+B)	F+(G+H+I)+(J+K)	= DIFF31_N
DIFF22_TK	(C+D+E)+(A+B)	F+(G+H+I)+(J+K)+(L+M+O)	= DIFF33_N
DIFF31_TK	(C+D+E)+(G+H+I)	F+(J+K)	= DIFF41_N
DIFF32_TK	(C+D+E)+(G+H+I)	F+(J+K)+(A+B)	= DIFF42_N
DIFF33_TK	(C+D+E)+(G+H+I)	F+(J+K)+(A+B)+(L+M+O)	
DIFF4_TK	(C+D+E)+(G+H+I)+(A+B)	F+(J+K)	= DIFF5_N

Source: Author's calculations.
Note: Only 6-sectoral disaggregation is available: (A+B); (C+D+E); F; (G+H+I); (J+K); (L+M+O).

Appendix 2: Data Sources

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 Bankası

Sectoral Nominal Wages

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

Monthly Data

Services in the CPI, Goods in the CPI

Bulgaria, Romania, Russia, Ukraine: Main Economic Indicators, OECD (via Datastream, Bulgaria: BLOCP071F, BLOCCPSVF (services), BLOCP034F (goods); Romania: RMOCP071 (services), RMOCP027 (goods); Russia: RSOCP072F (services), RSOCP034F; Ukraine: UROCP071F (services), UROCP024F (food))

Croatia: Croatian Central Bureau of Statistics (CTCPIS..F (services), CTCPIG..F (goods))

Turkey: State Institute of Statistics, Turkey (via Datastream, TKCPSERVF, TKCPGOODF)

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)

Wages in Industry/in the Whole Economy

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

Turkey: Türkiye Cumhyriet Merkez Bankası

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 Bankası

Euro area: Eurostat (Datastream, EMEBEMQ6%)

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

Wages in Industry/in the Whole Economy

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

Turkey: Türkiye Cumhyriet Merkez Bankası

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 frequencies.

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 (G) or Central (C) Government Expenditures

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

Turkey (G): 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 Bankası

Interpolated linearly from yearly to monthly frequencies.

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

Datastream (code: OILURAL(P))

Industrial Production – Crude Petroleum

VOLN, Russia: Datastream (code: RSOPR005P)