Exchange Rate Regimes, Foreign Exchange Volatility and Export Performance in Central and Eastern Europe

Balázs Égert[1],
Amalia Morales-Zumaquero[2]

This paper attempts to analyze the direct impact of exchange rate volatility on the export performance of ten Central and Eastern European transition economies as well as its indirect impact via changes in exchange rate regimes. Not only aggregate but also bilateral and sectoral export flows are studied. To this end, we first analyze shifts in exchange rate volatility linked to changes in the exchange rate regimes and second, use these changes to construct dummy variables we include in our export function. The results suggest that the size and the direction of the impact of forex volatility and of regime changes on exports vary considerably across sectors and countries and that they may be related to specific periods.

1 Introduction

The relationship between exchange rate volatility and export flows has been studied in a large number of theoretical and empirical papers. From a theoretical point of view, the effect of exchange rate volatility on international trade is not unambiguous. On the one hand, it may be argued that a rise in exchange rate volatility increases the uncertainty of profits on contracts denominated in a foreign currency because this risk leads risk-averse and risk-neutral agents to redirect their activity from higher risk foreign markets to the lower risk home market. On the other hand, higher exchange rate volatility and thus higher risk represent a greater opportunity for profit and might increase trade.[3]

From an empirical point of view, the large body of literature focusing on developed countries generally cannot establish any clear and statistically significant link between exchange rate volatility and aggregate or bilateral export flows. Nonetheless, differentiating between sectors yields more encouraging results even though the evidence from sectoral data suggests that the impact of volatility differs both in magnitude and direction across sectors (Klein, 1990; Bini-Smaghi, 1991; McKenzie, 1998, among others). Interestingly, Fontaigné and Freudenberg (1999) show that exchange rate volatility has a negative impact on intraindustry trade.

More recently, Doroodian (1999), Chou (2000), Achy and Sekkat (2001), Siregar and Rajan (2002), Arize et al. (2004) and Baak (2004) put pen to paper to investigate the case of less developed countries employing multilateral, bilateral and sectoral export data. Generally speaking, these papers unanimously support the hypothesis that exchange rate volatility has a negative effect on exports flows. In other words, an increase in volatility appears to depress exports in less developed countries. Along these lines, a related question very few researchers have investigated is whether changes in exchange rate regimes which can be associated with a shift in the amplitude of volatility cause export flows to decrease (see Fountas and Aristotelous, 1999, for the Exchange Rate

[1] *Oesterreichische Nationalbank (OeNB), Foreign Research Division; MODEM, University of Paris X-Nanterre and William Davidson Institute, balazs.egert@oenb.at and begert@u-paris10.fr.*

[2] *University of Málaga and Centro de Estudios Andaluces, amalia@uma.es.* *We are grateful to Ian Babetskii, Jarko Fidrmuc, Iikka Korhonen, Doris Ritzberger-Grünwald and Julia Wörz for their useful remarks and suggestions. The paper also benefited from discussion at a seminar at BOFIT and the wiiw. We thank Rena Mühldorf for language support. Part of the paper was written when Balázs Égert was visiting BOFIT in 2004 and 2005. The opinions expressed in the paper are those of the authors and do not necessarily represent the views of the Oesterreichische Nationalbank or the European System of Central Banks (ESCB).*

[3] *See McKenzie (1999) for a very complete survey on this topic.*

Mechanism period and Aristotelous, 2001, for Britain and the U.S.A. from 1889 to 1999).[4]

In this paper, we undertake to dissect the relationship between exchange rate volatility, exchange rate regimes and export performance in ten transition economies in Central and Eastern Europe (CEE), namely Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Slovenia and Ukraine. To address this issue, we look not only at yearly and monthly aggregate export data but also analyze export flows to the European Union (EU) and at the sectoral level.

The methodological framework used here marks a departure from the traditional literature on the impact of exchange rate volatility on export flows. We proceed in three stages. First, we identify changes in exchange rate volatility using two procedures, the Iterated Cumulative Sums of Squares (ICSS) algorithm developed by Inclán and Tiao (1994) and Hansen's (1997) approximation to the p-values of the supreme, exponential and average statistics developed by Andrews (1993) and Andrews and Ploberger (1994). Second, we match shifts in exchange rate volatility with changes in the exchange rate regime and construct dummy variables corresponding to changes in exchange rate regimes in line with the detected structural breaks. Third, we include the indirect forex volatility measure (dummies) and, alternatively, a direct measure of exchange rate volatility (as in the previous literature) in export functions using both panel and time series cointegration estimation techniques.

The issue of forex volatility and trade, which to our knowledge has not yet been analyzed for this group of countries, is of particular interest because five countries from our pool joined the EU in May 2004 and the accession to the EU of three others is in all likelihood only a matter of time. Joining the EU entails the prospect of adopting the euro or even the obligation to do so, with the timing of this step having recently been subject to lively academic and policy discussions. If exchange rate volatility were to impede export flows, commonly perceived as the engine of economic growth in those countries, their motivations for adopting the euro and hence for making a greater effort to meet the Maastricht convergence criteria – in particular those applying to public finances – should increase considerably.

The remainder of this paper is structured as follows. Section 2 gives a detailed overview on the tested export equations, including a volatility measure, the econometric techniques for testing structural breaks in exchange rate volatility, and the cointegration techniques used to estimate the export functions. This is followed by the discussion of the shifts in exchange rate regimes in section 3. Section 4 reports the estimation results of the export functions based on panel and time series data and discusses the results. Section 5, finally, provides some concluding remarks.

[4] *Gravity models offer an alternative to aggregate export functions because they analyze all possible bilateral trade relations for a given set of countries (for instance, a panel of ten countries would comprise 120 bilateral trade series). The impact of forex volatility on trade is not less controversial in the gravity context: a negative relationship is found in Rose (2000), Taglioni (2002), Babetskaia-Kukharchuk and Maurel (2004) and Frankel and Rose (2002), no connection between forex volatility and trade is detected in Tenreyro (2003), and the relationship is positive in Babetskii et al. (2003) and in Bussière et al. (2004).*

2 Estimation and Data Issues

2.1 Nominal and Real Export Functions

Although the selection of the correct trade equation in general and that of an export equation in particular is problematic, we follow the approach employed, for instance, in McKenzie (1998), who analyzes the relationship between exchange rate volatility and trade flows in a very meticulous and systematic way. The export functions are estimated both in nominal and real terms, and include domestic and foreign income (Y_t and Y_t^*), relative prices (P_t and P_t^*), usually defined as export prices in the domestic economy to import prices in the foreign economy, the nominal exchange rate (E_t) for nominal exports (X_t^N), the real exchange rate ($Q_t = E_t{\cdot}P_t^*/P_t$) for real exports ($X_t^R$), and a volatility measure of the nominal and the real exchange rates, denoted by VOL_t^E and VOL_t^Q, respectively.

It is a well-established fact in the literature dealing with transition economies that an increase in the transition economies' export flows was substantially influenced by the massive inflow of foreign direct investment (FDI) into the manufacturing sector. FDI, absorbed either by privatization or by the establishment of greenfield projects, built up substantial exports capacities in the transition economies (see Barrell and Holland, 2000; Campos and Kinoshita, 2002; or Benáček et al., 2003). Table 1 shows the dramatic increase in FDI stocks relative to GDP; by 2003, the figures are close to or well over 30% in Bulgaria, Croatia, the Czech Republic, Hungary, Poland and Slovakia. Changes of exports as a share in GDP are reported in table 2; they more than doubled in most of the countries. Hence, we modified equations of the standard specification by taking account of the prominent role of FDI in export performance:

$$X_t^N = f(Y_t^N, Y_t^{N*}, P_t, P_t^*, E_t, FDI_t^N, VOL_t^E) \tag{1}$$

$$X_t^R = f(Y_t^R, Y_t^{R*}, Q_t, FDI_t^R, VOL_t^Q) \tag{2}$$

Economic theory suggests that the impact of nominal and real income should be positive on nominal and real exports, respectively. Moreover, an exchange rate depreciation may increase exports and the impact of domestic (foreign) relative prices on exports should be negative (positive). The volatility measure, VOL_t, is a standard direct measure of volatility, and, alternatively, a dummy variable constructed in accordance with changes in the exchange rate regime and exchange rate volatility. The effect of exchange rate volatility on exports is, from the theoretical viewpoint, ambiguous and may have a positive or negative impact on export flows.

An increase or decrease in exchange rate volatility may impact on exports with a certain delay, given that export contracts may be fixed one or two periods ahead. The same may apply to foreign direct investment, as the fruits of FDI inflows may be felt only with some delay. FDI has been mainly related either to privatization or to greenfield investments. In both cases, some time is needed to restructure the company or to build the plant, which can then produce goods for exports. This is the reason both volatility measures and FDI are used also with a lag of one or two years in equations (1) and (2).

2.2 Testing for Structural Breaks

The methodology used in this study to detect structural breaks in the variance of the exchange rate series is based on two procedures: the Iterated Cumulative Sums of Squares (ICSS) algorithm developed by Inclán and Tiao (1994) and Hansen's (1997) approximation to the p-values of the supreme, exponential and average statistics developed by Andrews (1993) and Andrews and Ploberger (1994).

Inclán and Tiao (1994) propose a cumulative sums of squares algorithm to estimate the number of changes in variance and the point in time of each variance shift. Let

$$C_k = \sum_{t=1}^{k} \epsilon_t^2, \qquad k = 1, ..., n \tag{3}$$

be the cumulative sum of the squared observations from the start to the k^{th} point in time where n is the number of observations and ϵ_t denotes a series of independent observations from a normal distribution with zero mean and with unconditional variance σ_t^2. From equation (5), Inclán and Tiao (1994) propose to use the statistic given by:

$$IT = \sup_k \sqrt{n/2}|D_k| \tag{4}$$

where $D_k = \frac{C_k}{C_n} - \frac{k}{n}$. Under the null hypothesis of constant unconditional variance, asymptotically D_k behaves as a Brownian bridge. The critical value of 1.36 is the 95$^{\text{th}}$ percentile of the asymptotic distribution of $\sup_k \sqrt{n/2}|D_k|$. Thus, upper and lower boundaries can be set at ± 1.36 in the D_k plot. Exceeding these boundaries marks a significant change in the variance of the series. If the series under study has multiple break points, the D_k function alone is not enough because of the masking effects. To avoid this problem, Inclán and Tiao (1994) design an algorithm that is based on a successive evaluation of D_k at different parts of the series, dividing consecutively after a possible change point is found.

Our second procedure to detect structural breaks in volatility is based on univariate autoregressive models for first differences (growth rates) of the series, which we denote as q_t. Following McConnell and Pérez-Quirós (2000) and Camacho (2004), we compute, at any quarter t, the Generalized Method of Moments (GMM) estimates of the specification:

$$q_t = \mu + \phi q_{t-1} + \epsilon_{1s} \tag{5}$$

$$\sqrt{\frac{\pi}{2}}|\hat{\epsilon}_{1s}| = \alpha_1 D_{1s} + \alpha_2 D_{2s} + \epsilon_{2s} \tag{6}$$

where the dummies are $D_{1s} = \begin{cases} 0 \; if \; s \leq T \\ 1 \; if \; s > T \end{cases}$ and $D_{2s} = \begin{cases} 1 \; if \; s \leq T \\ 0 \; if \; s > T \end{cases}$, and

s refers to data of the period from the beginning of the sample to s, the instruments for each period s are a constant, q_t, D_{1s} and D_{2s}, T is the estimated break point and α_1 and α_2 are the estimators of the standard deviation.[5]

Andrews (1993) and Andrews and Ploberger (1994) develop statistics for cases similar to the previous one, where the parameter T appears under the alternative hypothesis but not under the null of constant conditional standard deviation ($\alpha_1 = \alpha_2$). They define the function $F_n(T)$ as the Wald (W), Likelihood Ratio (LR) or Lagrange Multiplier (LM) statistic of the hypothesis that ($\alpha_1 = \alpha_2$) for break date T, where n is the number of observations. They assume that T lies in a range T_1, T_2.[6] Specifically, Andrews (1993) considers the supreme statistic:

$$SupF = \sup_{T_1 \leq T \leq T_2} F_n(T) \tag{7}$$

where $F = W$, LR or LM. Andrews and Ploberger (1994) consider the exponential and average statistics, given by the following expressions:

$$ExpF = \ln\left(\frac{1}{T_2 - T_1 + 1} \sum_{T=T_1}^{T_2} \exp\left(\frac{1}{2} F_n(T)\right)\right) \tag{8}$$

$$AveF = \frac{1}{T_2 - T_1 + 1} \sum_{T=T_1}^{T_2} F_n(T) \tag{9}$$

where $F = W$, LR or LM. The asymptotic distributions of these statistics are nonstandard and have been obtained by Andrews (1993) and Andrews and Ploberger (1994), together with their asymptotic critical values. In this paper we apply these statistics, using the associated p-values obtained following the approximation developed by Hansen (1997). In particular, we use statistics in equations (7), (8) and (9) in a new way: we sequentially apply those tests, compute the p-values associated with the supreme, exponential and average statistics for any date, and obtain a profile of p-values. In doing so, we will have numerical and graphical information that will be used to delimit periods of stability and instability in the variance of the series.

2.3 Estimation Methods

The order of integration of the variables is tested using time series unit root and stationarity statistics such as the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP), the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and the Elliot, Rothenberg, and Stock (ERS) Point Optimal tests. Moreover, the panel unit root test proposed by Im et al. (2003), the Im-Pesaran-Shin (IPS) test, is used for panel data. For the time series data, equations (1) and (2) are estimated using the Dynamic Ordinary Least Squares (DOLS) approach suggested by Stock and Watson (1993) and the Auto-Regressive Distributed Lag (ARDL) approach proposed by Pesaran et al. (2001).

[5] *If ε_t follows a normal distribution, $\sqrt{\frac{\pi}{2}}|\hat{\epsilon}_t|$ is an unbiased estimator of the standard deviation of ε_t.*

[6] *We set $T_1 = .15n$ and $T_2 = .85n$ (see Andrews, 1993, and Andrews and Ploberger, 1994).*

For the panel data, the cointegration tests worked out by Pedroni (1999) are used. Out of the seven panel cointegration statistics developed by Pedroni (1999), we choose those which not only permit heterogeneity in the slope coefficients and the constant term but also allow for heterogeneous autoregressive coefficients in the residuals. These are the nonparametric PP, rho statistics and an ADF-based t-statistic. The coefficients are estimated using fixed effect OLS.

Banerjee et al. (2004) argue that in the presence of cross-unit cointegration relationships, panel cointegration tests tend to overreject the null of no cointegration. In (1) and (2), the foreign income and price variables may be strongly correlated across countries. To diminish the cross-sectional bias, the ratios Y_t^N/Y_t^{N*} and P_t/P_t^* rather than the separate series are used for panel data.

2.4 Data Issues

To carry out our empirical analysis, we use two sets of data. The first set of data consists of yearly data and spans the period from 1990 to 2003. It is obtained from the Economies in Transition 2004 database of the Vienna Institute for International Economic Studies (wiiw). Following our export function specification, the domestic and foreign price indices are producer prices. Some studies use consumer prices, but these indices clearly contain elements which have little to do with the exporting sectors (such as administered or regulated prices, changes in indirect taxes and imported goods). Others use export prices for the domestic economy and import prices for the foreign economy. However, we first face a data constraint here in that export prices are available only for four countries (the Czech Republic, Hungary, Poland and Slovenia). For export prices, one may use export unit values or proper export prices. However, the dynamics of the two types of series may be rather different in practice. Another source of confusion is that the series are commonly expressed in U.S. dollar terms, which implies that the exchange rate is already included in the series, and, perhaps more importantly, that they are of little use when the other variables are expressed in effective terms or against the euro area. For the sake of consistency, we opted for the producer price series. Nominal exports and GDP are expressed in domestic currency units, and real exports are obtained as nominal exports deflated by producer price series. Real GDP is the cumulated series based on yearly real GDP growth rates. Nominal FDI is the cumulated FDI stock, while for the real export equation, it is constructed as the stock of FDI as a share of GDP. GDP and PPI series for the foreign economy are a weighted average of euro area and U.S. series, where the weight for the euro area corresponds to the share of exports to the euro area in total exports and the weight for the U.S. series represents the rest of total exports.

A sectoral decomposition for exports is available for all countries except Russia and Ukraine; according to this decomposition, exports are classified in nine sectors.[7] Table 1 indicates that most of the eight CEE economies' exports concentrate on manufacturing, representing a share of slightly more than 60%

[7] *(1) Food and live animals, (2) beverages and tobacco, (3) crude materials, inedible, except fuels, (4) mineral fuels, lubricants, etc., (5) animal and vegetable oils, fats, waxes, (6) chemicals and related products, (7) manufactured goods classed by materials, (8) machinery and transport equipment, and (9) miscellaneous manufactured articles.*

for Bulgaria and Croatia at the lower end and above 80% for the Czech Republic, Hungary and Slovakia at the higher end. The share of machinery and transport equipment alone reaches 50% in the Czech Republic and Slovakia and 60% in Hungary in 2003.

Table 1

The Share of Exports by Sectors in Total Exports

%, 2003

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S7 S8 S9
Bulgaria	6.7%	2.1%	6.3%	8.4%	0.2%	9.0%	24.7%	13.0%	28.8%	66.5%
Croatia	9.1%	2.6%	5.7%	9.6%	0.2%	9.6%	14.0%	29.4%	19.6%	63.0%
Czech Republic	2.7%	0.6%	2.8%	2.9%	0.1%	5.9%	23.1%	50.1%	11.8%	85.0%
Hungary	6.2%	0.3%	1.8%	1.6%	0.2%	6.9%	10.3%	61.1%	10.6%	82.0%
Poland	7.6%	0.3%	2.6%	4.3%	0.0%	6.5%	23.7%	37.8%	17.1%	78.6%
Romania	2.2%	0.2%	6.2%	6.5%	0.2%	4.8%	19.3%	21.5%	38.9%	79.7%
Slovakia	2.5%	0.4%	2.5%	5.2%	0.1%	5.2%	23.7%	47.4%	13.0%	84.1%
Slovenia	2.1%	1.3%	1.7%	1.4%	0.1%	13.8%	25.6%	36.6%	17.5%	79.7%

Source: Calculated on the basis of the wiiw's Countries in Transition 2004 database.

Notes: S1: Food and live animals, S2: beverages and tobacco, S3: crude materials, inedible, except fuels, S4: mineral fuels, lubricants, etc., S5: animal and vegetable oils, fats, waxes, S6: chemicals and related products, S7: manufactured goods classed by materials, S8: machinery and transport equipment, S9: miscellaneous manufactured articles.

The exchange rate series are defined as units of domestic currency units per one unit of the foreign currency. Hence, a decrease (increase) in the exchange rate indicates an appreciation (depreciation). Furthermore, the real exchange rate is calculated using producer price series rather than consumer price series for reasons developed earlier.

The second set of data contains monthly data drawn mostly from the wiiw monthly database on Eastern Europe. It covers the period from January 1993 to September 2004 for the Czech Republic, Hungary, Poland and Romania, and from January 1994 to September 2004 for Croatia, Russia, Slovakia and Slovenia. For Bulgaria and Ukraine, monthly time series for exports start only in 1999 and 1998, respectively; for this reason, they are excluded from the cointegration analysis. If not indicated otherwise, the construction of the series is the same as for the yearly data. Note that the monthly FDI series are obtained by linear interpolation from yearly data. For the Czech Republic, Croatia, Hungary, Poland, Romania, Slovakia and Slovenia, besides aggregate exports, exports to the euro area are also analyzed. Domestic and foreign incomes are proxied by industrial production, the only variable available at a monthly frequency which can be taken as an approximation of gross domestic product.[8] Wherever the presence of seasonality is detected in the data, the series are seasonally adjusted and are taken as a natural logarithm.[9]

A final and important aspect of the data is the construction of variables capturing the volatility of the real exchange rate. For yearly data, two direct measures are used: (1) the standard deviation of monthly changes in the exchange rate for the 12 months of the year (VOLE), and (2) the average of standard deviations computed for each month of the year based on monthly changes in the

[8] *Alternatively, quarterly GDP series interpolated to monthly frequency could be also used.*

[9] *The U.S. Census Bureau's X12 seasonal adjustment program was used.*

exchange rate for a window of 12 months (VOLA). For monthly data, a standard deviation for a 12-month window is computed for each month. In addition, dummy variables are also used with the aim of capturing changes in the exchange rate regime and forex volatility. More discussion on this issue is provided in the next section.

3 Exchange Rate Regimes and Breaks in Volatility

3.1 Changes in Exchange Rate Regimes

Table 2

Exchange Rate Regimes in Transition Economies from 1990 to 2005

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CEEC-5																
Slovenia	×	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a (6)	3a→5	5
Hungary	1	1	1	1	1	1→2	2	2	2	2	2	2→4→5	5	5	5	5
Poland	1	1	2	2	2	4	4	4	4	4	4→7	7	7	7	7	7
Slovakia	1	1	1	1	1	1	5	5	5→6	6	6	6	6	6	6	6
Czech Republic	1	1	1	1	1	1	5	5→6	6	6	6	6	6	6	6	6
Southeastern Europe																
Bulgaria	1	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0
Croatia			1	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)	5 (6)
Romania	1	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)	3b (6)
CIS																
Russia			6	6	6	6→5	4	4	4→6	6	6	6	6	6	6	6
Ukraine					6	6	6	6→5	5	5	5→6	6	6	6	6	6

Source: Authors.

Notes: 0: formal or de facto currency board; 1: peg to a currency or to a basket with fluctuation margins less than, or equal to, ±2.25%; 2: crawling peg with fluctuation margins of less than, or equal to, ±2.25%; 3a: float with active management by monetary authorities (implicit crawling peg); 3b: float with active management by monetary authorities (implicit crawling band); 4: crawling peg with fluctuation margins of more than ±2.25%; 5: peg to a currency or a basket with fluctuation margins of more than ±2.25%; 6: float with intervention; 7: free float without any intervention. In parentheses are the de jure regimes for Croatia, Romania and Slovenia. Shaded areas denote a regime shift.

Table 2 presents a general overview of how exchange rate regimes change over time in transition economies. For the CEEC-5, a gradual move from a peg toward more flexibility can be observed for all countries with the exception of Slovenia, which has maintained a de facto crawling peg until its entry into ERM II in June 2004. Both Hungary and Poland started transition using pegged regimes with discretionary adjustments and then switched to crawling peg regimes. Poland widened the fluctuation margins up to ±15% in consecutive steps to cope with appreciation pressures, and then opted for a pure floating regime in 2000. Hungary maintained its tight-band crawling peg regime for a longer period and adopted a pegged regime with fluctuation margins as high as ±15% in April 2001.[10] The Czech Republic and Slovakia, which had a common history until 1993, had pegged regimes until 1997 and 1998, respectively, when, after a short-lived widening of bands in the Czech Republic, and with a brusque shift in Slovakia, they moved toward a managed float. More flexible exchange rate regimes may indeed generate more amplified movements in the nominal exchange rate, which, in turn, make these countries prone to being "victims" of nominal exchange rate volatility.

[10] *Note that formally, the crawling peg regime was abandoned in October 2001, when the rate of crawl was set to zero. However, in practice, between April and October 2001 the rate of crawl was very low and remained insignificant in terms of influencing the exchange rate because of the enlarged fluctuation bands.*

An opposite tendency becomes apparent in Southeastern Europe, especially in Bulgaria, which can be best described as an abrupt shift from a managed float toward more rigidity (a currency board). The cases of Croatia and Romania are similar to that of Slovenia, with regimes that have remained unchanged for a long time. Although officially announced as a managed float, the regime Romania has been operating for the past 15 years or so is a de facto crawling peg or band, and Croatia has maintained its nominal exchange rate in a very narrowly managed band from 1994 onward.[11] Russia and Ukraine constitute another group of countries with cyclical changes in the exchange rate regime. Starting with a managed float, Russia pegged the ruble to the dollar in 1995 and introduced a crawling band in 1996, which ended with the return to a managed float in the aftermath of the Russian crisis of 1998. Ukraine also entered the initial phase of transition with a managed float and followed Russia with some delay in pegging its currency to the dollar in 1997. The country let the hryvnia float in 2000 after an uphill struggle against constant depreciation pressures from August 1998 on, which included an increase in the fluctuation band and a shift toward a stronger depreciation of the band.

3.2 Breaks in Volatility

Table 3 reports the breaks in volatility detected when using the ICSS and the Hansen methods for real and nominal exchange rates in effective terms.[12] Note that results are reported only for the effective exchange rates for Russia and Ukraine. A number of general observations can be made: First and perhaps most importantly, the reported results reflect most of the changes in the exchange rate regimes. Nonetheless, there is ample evidence that changes in nominal and real exchange rate volatility also occurred within one and the same exchange rate regime. Second, the two procedures (ICSS and Hansen) may yield different results. The ICSS procedure produces one-off changes in volatility, while the Hansen method shows the periods during which volatility in the exchange rate is different from that in the remaining observations. Generally speaking, the number of reported breaks in volatility is usually higher for the Hansen procedure than for the ICSS procedure. Third, breakpoints in the real exchange rate may or may not coincide with breakpoints in the nominal exchange rate. Finally, the use of effective exchange rate series obtained from different sources for Hungary (Magyar Nemzeti Bank versus wiiw) may lead to different results. This may be partly traced to the different time period over which the time series are available.

[11] Croatia, Romania and Slovenia are the three countries in our sample whose de jure and de facto regimes differ markedly.

[12] Results for the euro exchange rates are not reported because they are mostly in line with the results for the real effective exchange rates.

Table 3

Structural Changes in Exchange Rate Volatility

Country	Method	REER	NEER
Bulgaria	ICSS	1993.9, 1994.4, 1996.3, 1997.5, 1999.7	1994.2, 1996.4, 1997.1, 1998.10
	Hansen	1997.2**, 1997.3*, 1997.4-1998.3**, 1999.5–1999.7**, 1999.9–2000.12**, 2001.1–2004.9*	1995.12–1996.4**, 1997.2–1997.12**, 1998.1-2004.12*
Croatia	ICSS	no breaks	no breaks
	Hansen	no breaks	1995.1–1995.6*
Czech Republic	ICSS	no breaks	1996.4, 1999.2
	Hansen	1997.12–1998.2**, 1998.3*, 1998.4**, 1998.5–2004.9*	1992.1**, 1992.4–1992.5*, 1992.8–1992.10**, 1992.11–1995.2*, 1995.3–1995.5**, 1995.6–2004.9*
Hungary	ICSS	1994.6, 1995.3	1990.11
	Hansen	1992.12**, 1993.3–1993.11*	1991.1*, 1991.2**, 1996.5-1998.10*, 1998.11-1998.12**
		MNB: 2000.11**, 2000.12*, 2001.3–2001.4**	MNB: 1991.1*, 1991.2–19914**, 1991.8**, 1991.11**, 1992.2-1992.3, 1996.8-1996.10**, 1996.11–1998.10*, 1998.11**, 1998.12**, 1999.1–1999.4**, 1999.8–2001.3**, 2001.4*, 2001.5**
Poland	ICSS	1993.5, 1997.9	1993.7, 1997.5
	Hansen	2002.5–2002.9**, 2003.3–2003.10**, 2004.3**1993.12*, 2003.9**	1994.1–1994.2*, 1994.3–1994.4**, 1994.5–1995.2*, 1995.3–1995.4**, 1999.7–2000.3**, 2000.4–2004.9*
Romania	ICSS	1992.10, 1994.4, 1995.9, 1996.11, 1997.2, 1999.5	1992.6, 1993.12, 1997.3
	Hansen	1994.3–1994.8**, 1994.9–1997.2*, 1997.3–1998.6**, 1998.7–2004.8*	1992.3–2004.9*
Slovakia	ICSS	1993.6, 1994.6	1993.7, 1998.8, 2000.10
	Hansen	no breaks	1994.1–1994.2*, 1994.3–1995.2**, 2000.3**, 2000.5–2000.9**, 2000.10–2004.9*
Slovenia	ICSS	1995.3	1995.2
	Hansen	1997.12–1998.8**, 1999.3–2000.5**, 2003.4**, 2004.7–2004.9**	1997.4–1997.8**, 1997.12–1998.6**, 1998.7–1998.8*, 1998.9–1999.8**, 1999.9*, 1999.10**, 1999.12–2000.5**, 2000.8**, 2000.11**, 2001.5–2001.7**, 2001.9–2001.11**, 2002.2–2004.9**
Russia	ICSS	1996.7, 1998.6, 1998.11	1996.7, 1998.7, 1998.11
	Hansen	1995.1–1995.2*, 1995.3**, 1995.4*, 1995.5**, 1996.3–1996.5**, 1996.6*, 1998.1–1998.7**, 2002.1–2002.5**, 2002.6–2003.11*, 2003.12–2004.9**	1998.12**, 2001.11–2002.2**, 2002.3–2004.9*
Ukraine	ICSS	1998.7, 1998.9, 2000.3	1998.7, 1998.9, 1999.12
	Hansen	2003.3**	2001.9–2002.2**, 2002.3–2004.9*

Source: Authors.

Notes: REER and NEER refer to the real effective exchange rate and the nominal effective exchange rate. The exchange rate series are obtained from the wiiw monthly database and PPI-based real exchange rates. MNB refers to the exchange rate series provided by Magyar Nemzeti Bank. * *and* ** *indicate evidence of instability at the 5% and 10% significance levels, respectively.*

3.3 The Construction of Dummy Variables

The dummy variables take the value 0 for the low volatility regime and 1 for the high volatility regime. Table 4 below summarizes the periods for which the dummy variables are constructed along the line of changes in the exchange rate regimes combined with the changes in forex volatility analyzed previously. It shows the periods for which the dummy variables take the value 1. For yearly data, only one high volatility regime is used, mainly because of the difficulty of combining several alternative volatility regimes for given countries.[13] This gap is filled for monthly data, where several alternative periods are considered for the Czech Republic, Hungary, Poland, Slovakia and Russia. For Croatia, Romania and Slovenia, only the direct volatility measures are employed in the absence of changes in the exchange rate regimes. For Croatia, the identified high volatility regime from 1990 to 1993 cannot be tested for monthly data, as they start only in 1994. As noted earlier, estimations are not carried out on a monthly basis for Bulgaria and Ukraine.

Table 4

Dummy Variables and High Volatility Regimes

	Yearly data	Monthly data	
	High		High
Bulgaria	1991–1996		. .
Croatia	1990–1993		. .
Czech Republic	1997–2003	DUM1 DUM2	1997.05 2004.09 1998.05 2004.09
Hungary	1990–1994; 2001–2003	DUM1 DUM2	1995.3 2004.9 2001.4 2004.9
Poland	1990–1991; 1995–2003	DUM1 DUM2	1998.10 2004.09 2000.03 2004.09
Romania	—		—
Slovakia	1998–2003	DUM1 DUM2	1997.01 2004.09 1998.10 2004.09
Slovenia	—		—
Russia	1990–1994; 1998–2003	DUM1 DUM2	1994.1 1997.06 1998.9 2004.09
Ukraine	1990–1996; 1999–2003		. .

Source: Authors.

4 Empirical Results

4.1 Estimation Results for Panel Data

We start by analyzing the impact of exchange rate volatility and changes in exchange rate regimes on export performance in a panel context. The panel unit root tests indicate that most of the variables are I(1). The two direct volatility measures are exceptions. With this as a background, panel cointegration is used for level variables including the dummy variables, and fixed effect OLS is applied to data in first differences. In the first difference specification, the volatility measures are not first-difference, given the fact that they are already stationary in levels.

The Pedroni mean group statistics reported in table 5 show the presence of cointegration for most of the specifications. Table 6 contains the estimation results including the volatility measure and FDI with a lag of one year. When all ten countries are included in the panel (CEEC-10), the indirect dummy vol-

[13] *It should be noted that the period over which yearly data are available is sometimes longer than the one for which monthly data are available. This is the case, for instance, for Croatia, where large devaluations occurred from 1990 to 1993; this is why we constructed a dummy to cover this period.*

atility measure turns out to have a positive sign for the level equations (shaded), indicating that an increase in exchange rate volatility is associated with an increase in exports. For the equations in first differences, all (lagged) volatility measures are mostly insignificant. This result implies that an increase in exchange rate volatility causes exports to decrease with a delay. Nonetheless, results for the CEEC-8 (excluding Russia and Ukraine) indicate that the direct volatility measures (VOLE and VOLA) are statistically significant with a negative sign – for both nominal and real export equations. These results are fairly robust over the time period investigated, as the results for the period from 1993 to 2003 are very similar to those obtained for the periods from 1990 to 2003 and from 1995 to 2003.

For sectoral exports, it appears that the exchange rate volatility measures are not significant for the first five sectors[14] (and are therefore not reported here). By contrast, as shown in table 6, exchange rate volatility is found to hamper manufacturing exports. This does not mean that these sectors were the only ones to be affected. Exports of the chemicals sector are, in fact, also influenced by exchange rate volatility. Although the effect is mostly positive for the cointegration relationships including the dummy variables, the effect switches sign when data in first differences are used: Higher exchange rate volatility appears to dampen export growth in chemicals and manufacturing. These results seem to be most robust for manufactured goods classed by materials and for machinery and transport equipment.

Table 5

Pedroni Panel Cointegration Tests from 1993 to 2003

		Nominal exports			Real exports		
		Rho statistics	PP statistics	ADF statistics	Rho statistics	PP statistics	ADF statistics
CEEC-10	total exports	2.994	–10.012***	–5.267***	3.187	–2.259**	–1.262
CEEC-8	total exports	2.767	–8.698***	–4.003***	2.713	–2.856**	–1.295
	sector 6	3.136	–3.470***	–1.836*	2.165	–5.484***	–3.349***
	sector 7	2.595	–7.989***	–6.501***	1.830	–7.481***	–4.829***
	sector 8	2.879	–7.364***	–3.544***	2.347	–5.326***	–3.504***
	sector 9	2.912	–4.819***	–4.637***	2.786	–0.929	–0.486

Source: Authors.

Notes: PP: nonparametric Phillips-Perron statistics, ADF: Augmented Dickey-Fuller;
, ** and * indicate that the null of no cointegration is rejected at the 10%, 5% and 1% levels, respectively.*

[14] *(1) Food and live animals, (2) beverages and tobacco, (3) crude materials, inedible, except fuels, (4) mineral fuels, lubricants and (5) animal and vegetable oils, fats, waxes.*

Table 6

Coefficient Estimates from 1993 to 2003

	Nominal exports					Real exports			
	Y/Y^*	P/P^*	E	FDI	VOL	Y/Y^*	Q	FDI	VOL
CEEC-10 aggregate exports									
DUM	0.695***	–0.219	0.552***	0.188***	0.118**	1.017***	0.453***	0.222***	0.134**
DUM	0.478**	–0.136	0.686***	–0.125**	0.006	0.865***	0.691***	0.03	–0.005
VOLA	0.436**	–0.003	0.604***	–0.088	–0.009	0.774**	0.636***	0.093*	–0.019
VOLE	0.415**	0.016	0.619***	–0.082	–0.022*	0.801**	0.669***	0.071	–0.022
CEEC-8 aggregate exports									
DUM	0.767**	0.007	0.215	0.186***	0.084	1.423***	0.181	0.196***	0.131**
DUM	0.092	0.355	0.544***	–0.049	–0.014	0.418	0.49**	–0.01	–0.036
VOLA	0.01	0.559*	0.432**	0.006	–0.045**	0.216	0.41**	0.092*	–0.056**
VOLE	–0.01	0.551*	0.465**	–0.01	–0.043***	0.267	0.431**	0.047	–0.048**
CEEC-8 chemicals and related products (sector 6)									
DUM	1.915***	–1.706***	0.919**	–0.008	0.068	1.82***	0.714**	0.052**	0.105*
DUM	0.832*	–0.628	0.862**	–0.035	0.021	1.26**	0.655**	0.024	0.033
VOLA	0.685	–0.349	0.751**	0.019	–0.051	0.86	0.736**	0.147	–0.049
VOLE	0.635	–0.311	0.773**	0.009	–0.058**	0.658	0.683**	0.147	–0.065*
CEEC-8 manufactured goods classed by materials (sector 7)									
DUM	0.902***	–0.374	0.494*	0.115***	0.041	1.16***	0.454**	0.133***	0.081**
DUM	0.107	0.493	0.436**	–0.006	0.018	0.281	0.333*	0.037	0.006
VOLA	–0.024	0.742*	0.337	0.043	–0.046**	–0.026	0.29	0.135**	–0.054*
VOLE	–0.017	0.686	0.386*	0.019	–0.034**	0.084	0.292	0.082	–0.035
CEEC-8 machinery and transport equipment (sector 8)									
DUM	0.899	–0.186	0.143	0.367***	0.113	2.641***	0.35	0.354***	0.226**
DUM	–0.134	0.748	0.314	–0.192*	–0.092*	–0.203	0.219	–0.108	–0.121**
VOLA	–0.166	0.991	0.101	–0.088	–0.073**	–0.296	0.079	0.064	–0.108**
VOLE	–0.193	0.969	0.157	–0.115	–0.067**	–0.432	0.086	0.028	–0.112**
CEEC-8 miscellaneous manufactured articles (sector 9)									
DUM	0.077	1.522***	–0.519*	0.166***	0.075	0.15	–0.831***	0.206***	0.05
DUM	0.067	0.289	0.654***	0.038	–0.043*	0.249	0.634***	0.118**	–0.104***
VOLA	0.102	0.295	0.605***	0.062	–0.012	0.381	0.522**	0.135**	–0.02
VOLE	0.089	0.307	0.609***	0.06	–0.015	0.468	0.584**	0.091	–0.025

Source: Authors.

Notes: The dummy variable DUM (shaded) refers to equations estimated in levels, whereas the nonshaded areas refer to equations estimated in first differences. VOLE is the standard deviation of changes in the exchange rate for twelve months of the year, and VOLA is the average of standard deviations computed for each month of the year for a window of twelve months (see section 2.4). CEEC-8 exclude Russia and Ukraine. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

4.2 Estimation Results for Time Series

Estimation results resting on panel data indicate that exchange rate volatility might impact on both nominal and real exports. Given that panel results provide a general picture of the studied phenomenon, the question of the role of exchange rate volatility in the individual countries remains unanswered. This question, which is of utmost importance for policymakers, can be best answered by drawing on time series analysis, to which we now direct our attention.

With very few exceptions, the time series are difference stationary, i.e. I(1) processes. This finding and the more than 120 monthly observations (141 for the period from January 1993 to September 2004 and 129 for the period from January 1994 to September 2004) motivate us to use cointegration to study to what extent, if at all, exchange rate volatility influences export performance. To check our results, we carry out OLS estimations for variables in year-on-year changes ($dx = ln(x_t) - ln(x_{t-12})$) that turn out to be stationary in levels.

We separate the countries under study into two groups. One group contains countries where no changes in the exchange rate regimes occurred over the time span of the monthly data, namely Croatia, Romania and Slovenia. The other group includes the remaining countries. Results for DOLS and the bounds testing approach are reported for all countries. Coefficient estimates are shown only if cointegration relationships could be established for the export equation. Results for year-on-year changes are reported systematically. Lagged values of both volatility measures and FDI are used for panel data. The outcome of this exercise is included in the paper only if the results are markedly different from the results based on contemporaneous volatility and FDI. The estimation results are displayed in tables 7a to 7c. To save space, these tables only include the coefficient estimates for the volatility measures.[15]

4.2.1 Croatia, Romania and Slovenia

For the three countries without changes in the exchange rate regime we used only the direct volatility measure.[16] The absence of major changes in the exchange rate regime does not necessarily imply that these countries are immune to forex volatility, however. As a matter of fact, they appear to be unevenly affected by it. Slovene exports do not seem to be linked to exchange rate volatility. For all specifications including real and nominal exports both in effective terms and to the euro area, the coefficient of exchange rate volatility is statistically insignificant except for the case of lagged volatility and FDI for nominal exports to the euro area. Moreover, the coefficient estimates for the rest of the variables in the model generally bear the expected signs when they are significant (except for the domestic relative price). For Romania, it is difficult to establish cointegration in half of the cases. When cointegration is found, and if the coefficient estimate is significant at any standard significance level, volatility is negatively correlated to exports. However, this only holds for nominal exports. For year-on-year changes, a statistically significant negative relationship is found between exports and lagged forex volatility. The biggest impact of forex volatility on exports could be established for Croatia. Although mostly unimportant when volatility is used in a contemporaneous manner, volatility with a lag of 12 months is associated negatively with exports, and this relationship appears to be particularly robust: not only are the results very similar for nominal and real exports but they are also very comparable regardless of the estimation method used (DOLS, ARDL or year-on-year changes).[17]

[15] *The full results are available from the authors upon request.*

[16] *We did not construct dummies as the exchange rate regimes in these countries remained unchanged.*

[17] *The fact that the coefficient estimates, if significant, usually bear the expected sign deserves mention. For real exports, the sign on the real exchange rate is, however, negative, which indicates that an appreciation of the exchange rate is associated with an increase in exports. Time and again, the sign on FDI has a counterintuitive negative sign.*

4.2.2 The Czech Republic, Hungary, Poland, Russia and Slovakia

This section dissects the results obtained for the group of countries which experienced a number of changes in their exchange rate regimes. Putting the Czech Republic under the microscope reveals that exports, especially those to the euro area, are hampered by exchange rate volatility, conditioned on the other variables included in the export functions. This result comes instantaneously without using lagged variables. What is somewhat surprising is the finding that when we use the dummy variables to capture volatility increases related to regime changes, the estimated coefficients usually turn out to be positive, indicating that the shift toward a more flexible regime tends to generate more export flows. This holds true for both dummy variables, each of which captures a somewhat different time period. The fact that a negative relationship could be found between the direct measure of forex volatility and exports and that the relationship is reversed for the dummies may possibly be explained by a changing exchange rate volatility during the float and, perhaps more importantly, during the period prior to the float.

The story of Hungary is a little bit different from that of the Czech Republic. For nominal and real exports, the direct volatility measure is mostly significant and always has a positive sign. However, when volatility is considered with a lag of 12 months, the coefficients switch sign all of a sudden. This is something that we could observe for the panel estimations; it indicates the delay with which an increase in exchange rate volatility (negatively) affects export flows. Such a delay might result from export contracts which often have a duration of up to one year. Coming to the dummy variables, it appears that the dummy that covers the recent widening of the fluctuation bands to ±15% most often has a negative sign, with or without lags. However, this observation only holds for the real export equation, as the relationship turns out to be rather insignificant for nominal exports. Regarding the dummy covering the period from 1995 to 2004, the results are conflicting in the sense that the direction of the relationship is fairly difficult to establish across the nominal and real export equations.

In Poland, we can observe a situation partly similar to the Hungarian story. For both nominal and real exports, the effect of the lagged direct volatility measure on export flows is negative if there is a statistically significant relationship. Exactly the same applies for the first dummy spanning the period from October 1998 to September 2004: The lagged dummy always bears a negative sign. However, for the second dummy, which took the value of 1 from March 2000 to September 2004, the sign is found to be consistently positive. A first explanation for this phenomenon may be that exchange rate volatility generated by the widening of the fluctuation bands impacted negatively on exports; when poorly performing export firms dropped out after a while, only those which were able to cope with increased volatility remained. The second explanation is similar in spirit to the one provided for the Czech case. Over the period from 1998 to 2004, there may have been several forex volatility regimes. Thus, volatility increased after the widening of the bands and calmed down later on. This may have coincided with the official move toward a free float, which did not generate any additional forex volatility.

Tabelle 7a

Exchange Rate Volatility and Exports for the Czech Republic and Russia

Czech Republic			Russia		
Real exports					
VOL					
EFF	DOLS (0,3) SIC		EFF	DOLS (0,0) SIC	
	ARDL (1,1) SIC			ARDL (1,1) HQ	−0.052***
	YOY	0.016		YOY	0.004
EUR	DOLS (0,0) SIC	−0.026***	EFF	DOLS (0,0) SIC	0.045***
	ARDL (1,1) SIC	−0.028**	VOL-12	ARDL (1,1) SIC	0.053***
	YOY	0.005	FDI-12	YOY	0.044***
DUM1					
EFF	DOLS (0,0) SIC		EFF	DOLS (0,1) SIC	
	ARDL (2,2) SIC			ARDL (1,1) SIC	0.025
	YOY	0.071***		YOY	0.111***
EUR	DOLS (1,0) HQ	−0.035**			
	ARDL (1,1) SIC				
	YOY	0.069***			
DUM2					
EFF	DOLS (0,3) SIC				
	ARDL (2,2) SIC				
	YOY	0.065***			
EUR	DOLS (0,0) SIC	0.008			
	ARDL (1,1) SIC				
	YOY	0.065***			
Nominal exports					
VOL					
EFF	DOLS (0,0) SIC	−0.022**	EFF	DOLS (4,4) AIC	−0.002
	ARDL (1,1) SIC	−0.024		ARDL (1,1) HQ	−0.024**
	YOY	0.002		YOY	0.025
EUR	DOLS (0,0) SIC	−0.072***	EFF	DOLS (0,0) SIC	0.042***
	ARDL (1,1) SIC		VOL-12	ARDL (1,1) SIC	0.043***
	YOY	−0.013	FDI-12	YOY	0.065***
DUM1					
EFF	DOLS (0,0) SIC	0.068**	EFF	DOLS (0,0) SIC	−0.155**
	ARDL (2,2) SIC	0.081		ARDL (2,2) SIC	
	YOY	0.076***		YOY	0.043
EUR	DOLS (0,0) SIC				
	ARDL (1,1) SIC				
	YOY	0.124***			
DUM2					
EFF	DOLS (3,3) HQ	0.062***			
	ARDL (1,1) SIC	0.058			
	YOY	0.077***			
EUR	DOLS (3,4) AIC				
	ARDL (1,1) SIC				
	YOY	0.182***			

Source: Authors.

Notes: Figures in parenthesis after DOLS (ARDL) show the number of leads and lags (lags) used. SIC: Schwarz, HQ: Hannan-Quinn, AIC: Akaike; SIC, HQ and AIC indicate that the lag structure is determined using the respective information criteria. YOY refers to the OLS estimates on year-on-year changes. VOL is the direct volatility measure, DUM1 and DUM2 are the dummies shown in table 4. EFF indicates effective exports while EUR denotes exports to the euro area. VOL-12 and FDI-12 show that volatility and FDI are used with a lag of 12 months. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 7b

Exchange Rate Volatility and Exports for Hungary, Poland and Slovakia

Hungary			Poland			Slovakia		
Real exports								
VOL								
EFF	DOLS (0,0) SIC	0.082***	EFF	DOLS (0,0) SIC		EFF	DOLS (0,0) SIC	0.099***
	ARDL (4,4) FIX	0.116***		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.057**		YOY	–0.03		YOY	0.081***
EUR	DOLS (0,0) SIC		EUR	DOLS (4,4) AIC		EUR	DOLS (0,0) SIC	0.029**
	ARDL (2,2) SIC			ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.079***		YOY	–0.045			
EFF	DOLS (0,0) SIC	–0.06***	EFF	DOLS (0,2) HQ	–0.069*			
(VOL-12)	ARDL (4,4) FIX	–0.102**	VOL-12	ARDL (1,1) SIC				
	YOY	–0.127***	FDI-12	YOY	0.029			
EUR	DOLS (0,0) SIC		EUR	DOLS (0,0) SIC				
(VOL-12)	ARDL (2,2) SIC		VOL-12	ARDL (1,1) SIC				
	YOY	–0.09***	FDI-12	YOY	0.029			
DUM1								
EFF	DOLS (0,0) SIC	–0.074**	EFF	DOLS (0,0) SIC	0.069***	EFF	DOLS (0,0) SIC	–0.162***
	ARDL (2,2) SIC	–0.164**		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.083**		YOY	–0.013		YOY	0.066**
EUR	DOLS (0,0) SIC		EUR	DOLS (1,0) SIC		EUR	DOLS (0,0) SIC	–0.063***
	ARDL (2,2) SIC	–0.185**		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.02		YOY	–0.004		YOY	0.029
EUR)	DOLS (4,4) FIX	–0.115***	EFF	DOLS (0,2) HQ	–0.05*			
(VOL-12)	ARDL (2,2) SIC	–0.204***	FDI-12	ARDL (1,1) SIC				
	YOY	–0.049*		YOY	–0.048			
			EUR	DOLS (0,2) HQ	–0.088***			
			FDI-12	ARDL (1,1) AIC				
				YOY	–0.04			
DUM2								
EFF	DOLS (0,0) SIC	–0.018	EFF	DOLS (0,4) AIC	0.098***	EFF	DOLS (1,2) AIC	0.218***
	ARDL (4,4) FIX	0.013		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.094***		YOY	0.097***		YOY	0.088***
EUR	DOLS (0,0) SIC		EUR	DOLS (0,0) SIC	0.178***	EUR	DOLS (0,0) SIC	0.157***
	ARDL (2,2) SIC	0.014		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.102***		YOY	0.088***		YOY	0.041**
Nominal exports								
VOL								
EFF	DOLS (0,0) SIC	0.03***	EFF	DOLS (0,0) SIC	0.097***	EFF	DOLS (0,0) SIC	0.058***
	ARDL (2,2) SIC	0.04*		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.04***		YOY	–0.028		YOY	0.14***
EUR	DOLS (0,0) SIC	0.033***	EUR	DOLS (0,0) SIC	0.11***	EUR	DOLS (0,4) AIC	–0.104*
	ARDL (1,1) SIC			ARDL (1,1) SIC			ARDL (4,4) FIX	–0.132*
	YOY	0.064***		YOY	0.018		YOY	–0.064
EFF	DOLS (0,0) SIC	–0.039***	EFF	DOLS (0,0) SIC	–0.051***	EUR	DOLS (0,0) SIC	0.124***
VOL(-12)	ARDL (1,1) SIC		VOL-12	ARDL (1,1) SIC		VOL-12	ARDL (1,1) SIC	
	YOY	–0.06***	FDI-12	YOY	–0.067**	FDI-12	YOY	0.139***
EUR	DOLS (0,0) SIC	–0.025***	EUR	DOLS (0,0) SIC	–0.06***			
VOL(-12)	ARDL (3,3) AIC	–0.033**	VOL-12	ARDL (1,1) SIC				
	YOY	–0.071***	FDI-12	YOY	–0.121***			
DUM1								
EFF	DOLS (0,0) SIC	–0.016	EFF	DOLS (4,4) AIC		EFF	DOLS (1,0) AIC	–0.166***
	ARDL (4,4) AIC	–0.01		ARDL (1,1) SIC			ARDL (1,1) SIC	
		0.134***		YOY	–0.09***		YOY	0.069**
EUR	DOLS (0,0) SIC	–0.005	EUR	DOLS (4,4) AIC		EUR	DOLS (0,0) SIC	–0.179***
	ARDL (2,2) SIC			ARDL (1,1) SIC			ARDL (3,3) AIC	–0.197***
	YOY	0.083		YOY	–0.018		YOY	0.02
			EFF	DOLS (0,0) SIC	–0.068***	EUR	DOLS (1,0) AIC	–0.096*
			FDI-12	ARDL (1,1) SIC		VOL-12	ARDL (1,1) SIC	
				YOY	–0.087***	FDI-12	YOY	–0.108*
			EUR	DOLS (0,0) SIC	0.021			
			FDI-12	ARDL (1,1) SIC	–0.059*			
DUM2								
EFF	DOLS (0,0) SIC	–0.091*	EFF	DOLS (0,0) SIC	0.044	EFF	DOLS (1,1) AIC	0.155***
	ARDL (4,4) AIC	–0.098		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	0.063**		YOY	0.112***		YOY	0.113***
EUR	DOLS (0,0) SIC	–0.111*	EUR	DOLS (0,0) SIC		EUR	DOLS (0,4) AIC	–0.136
	ARDL (1,1) SIC	–0.088		ARDL (1,1) SIC			ARDL (1,1) SIC	
	YOY	–0.135***		YOY	0.059*		YOY	–0.013
						EUR	DOLS (0,0) SIC	0.207**
						FDI-12	ARDL (1,1) SIC	
							YOY	0.036

Source: Authors.

Note: See table 7a.

The case of Slovakia contrasts with the findings for the other countries because the direct volatility measure seems to be positively associated with exports, and this assessment remains unchallenged even when using the volatility measure with lags. Concerning the impact of the different exchange rates regimes, the situation is astonishingly similar to that observed in Poland: the dummy variable that covers the period starting in January 1997, when the fluctuation margins were widened to ±7%, indicates a negative relationship between the regime shift and exports. However, when a managed float was officially introduced in October 1998, this conclusion did not apply any more, as the sign becomes positive. The two explanations put forward for Poland may also apply here.

Let us now take a closer look at Russia, for which we only examined exports in effective terms because of the unavailability of data for exports to the euro area or the U.S. economy alone. The results contradict each other, as both negative and positive signs can be found even if the positive signs appear to outweigh the negative ones. The fact that no clear relationship between volatility and exports could be found is not very surprising in the light of the high share of oil-related products in total exports (amounting to about 50% of total exports in 2003). Exports of oil-related products may be suspected to be linked more closely to the level of the (real) exchange rate than to its volatility. While

Table 7c

Exchange Rate Volatility and Exports for Slovenia, Romania and Croatia

Slovenia			**Romania**			**Croatia**		
Real exports								
VOL								
EFF	DOLS (0,0) SIC	0.032	EFF	DOLS (0,4) SIC	–0.03*	EFF	DOLS (4,1) AIC	0.172
	ARDL (3,3) SIC	0.02		ARDL (2,2) SIC			ARDL (1,1) SIC	
	YOY	0.043		YOY	0.000		YOY	–0.346**
EUR	DOLS (0,0) SIC	0.015	EUR	DOLS (0,3) SIC	–0.017	EUR	DOLS (0,0) SIC	0.028
	ARDL (3,3) SIC	0.016		ARDL (2,2) SIC			ARDL (4,4 AIC	0.034
	YOY	–0.006		YOY	0.006		YOY	0.103
			EFF	DOLS (0,4) SIC		EUR	DOLS (4,1) AIC	–0.087*
			Vol(-12)	ARDL (2,2) SIC		VOL-12	ARDL (4,4) FIX	–0.071*
			FDI(-12)	YOY	–0.034*	FDI-12	YOY	–0.134*
			EUR	DOLS (0,0) SIC				
			Vol(-12)	ARDL (2,2) SIC				
			FDI(-12)	YOY	–0.041*			
Nominal exports								
VOL								
EFF	DOLS (0,0) SIC	–0.004	EFF	DOLS (0,1) SIC	–0.019	EFF	DOLS (0,0) SIC	–0.057
	ARDL (3,3) SIC	0.014		ARDL (2,2) SIC			ARDL (1,1) SIC	
	YOY	0.033		YOY	0.004		YOY	–0.458***
EUR	DOLS (0,0) SIC	–0.052*	EUR	DOLS (3,4) AIC	0.012	EUR	DOLS (3,3) AIC	0.035
VOL-12	ARDL (1,1) SIC	–0.058		ARDL (1,1) SIC			ARDL (2,2) SIC	
FDI-12	YOY	–0.008		YOY	0.061		YOY	0.090
						EFF	DOLS (0,0) SIC	0.124*
						VOL-12	ARDL (1,1) SIC	
						FDI-12	YOY	0.1
						EUR	DOLS (1,0) AIC	–0.083**
						VOL-12	ARDL (2,2) AIC	–0.125***
FDI-12	YOY	–0.21***	FDI-12	YOY	–0.21***	FDI-12	YOY	–0.21***

Source: Authors.

Note: See table 7a.

for the other countries both real and nominal exchange rates are correlated positively with exports, i.e. a depreciation results in an increase in exports, the results for Russia indicate the opposite to be the case, which is especially true of the real exchange rate: An appreciation of the exchange rate is linked to a rise in exports.

5 Concluding Remarks

In this paper, we made an attempt to provide answers to the questions of whether changes in exchange rate regimes and exchange rate volatility have any impact on the exports of transition economies.

The countries under study can be divided into two broad groups reflecting the evolution of exchange rate regimes over time. One group of countries, which includes the Czech Republic, Hungary, Poland and Slovakia, started transition with pegged regimes and then moved, at different paces, toward more flexibility. Bulgaria first had a managed float and then switched to a currency board in 1997. Russia and Ukraine experienced cyclical movements from flexibility to more rigid regimes and then back again to more flexibility. The other group, which contains Croatia, Romania and Slovenia, has experienced no changes in their exchange rate regimes for the last ten years or so.

Both the direct impact of forex volatility and its indirect impact via changes in the exchange rate regime were assessed on the basis of standard export equations, augmented with FDI, which captures the very essence of economic transformation. The estimation results for panels including ten and eight transition economies suggest that a rise in forex volatility measured either directly or via changes in the exchange rate regime weakens exports to some extent, and that this negative impact is transmitted with some delay rather than being instantaneous. A meticulous look at sectoral exports confirms this finding in the sectors chemicals and different types of manufacturing. These sectors, which together account for up to 80% of total exports, are found to be adversely affected by increased exchange rate volatility.

More country-specific insights can be gained from time series estimations based on cointegration and using year-on-year changes in the variables. The results range from one end of the spectrum to the other. For some countries, such as Slovenia and Russia, there is little evidence of a negative relation between forex volatility and exports. This outcome is not surprising in view of the low volatility observed for the Slovenian tolar, as the Bank of Slovenia was trying to target not only the level but also the volatility of the exchange rate. An explanation for Russia's lack of sensitivity toward forex volatility might be the high share of oil-lock of products in total exports (close to 50%), the demand for which depends more on the exchange rate level than on its variance. The evidence for Romania is weak. Croatia, the Czech Republic, Hungary and Poland are located at the other end of the spectrum; for these countries, the estimation results provide some evidence of the adverse effect of forex volatility on exports. Although the results are sensitive to the use of real and nominal variables and to different estimation methods, some general conclusions may be drawn if we bear these caveats in mind. While exchange rate volatility seems to have an instantaneous effect on exports in the Czech case, it translates into poor export performance only with some delay in the three other countries.

Regarding shifts in the exchange rate regime, or more specifically, a move toward more flexibility, it appears that the recent period of widening fluctuation bands to ±15% in Hungary can be associated with a fall in exports, conditioned, of course, on other variables such as foreign and domestic output, prices, the level of the exchange rate and FDI. For Poland and Slovakia, we can observe the onset of more exchange rate flexibility being accompanied by a drop in exports, but exports seem to have recovered later on.

To summarize, we did not embark on this enterprise in vain, as we found convincing evidence that exchange rate volatility might impact negatively on export flows in the CEE transition economies. Hence, our project turns out to have been more than just another blur project. We also found that key exporting sectors, e. g. manufacturing, might be badly affected by exchange rate volatility. Nonetheless, country-specific results also showed that some countries are concerned to a large extent whereas others seem to be spared the harmful effect of exchange rate volatility. However, the countries with the largest share of manufacturing goods in total exports, such as the Czech Republic and Hungary, are found to be more likely to be exposed to exchange rate volatility than the others. Another reason for the higher vulnerability of these countries to forex volatility might be their large share of intraindustry trade in total trade, and in particular in manufacturing (Fontaigné and Freudenberg, 1999).[18] Furthermore, this negative impact might be related to higher exchange rate flexibility for some countries. This may be an important motivation for the new EU Member States, especially for Hungary and – perhaps to a lesser extent – for the Czech Republic and Poland, to aim at achieving greater exange rate stability.

[18] *See Fidrmuc and Korhonen (2004) for the share of intraindustry trade in total trade of the countries under study.*

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