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The Effects of the Real Exchange Rate Volatility and Misalignments on Foreign Trade Flows in Uzbekistan

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Abstract:

This study documents a quantitative analysis of exchange rate volatilities and misalignment in Uzbekistan for the period of 1994q3–2005q2. The results suggest that the real exchange rate volatility and misalignment have depressing effects on the volume of trade, mainly exports in Uzbekistan. The Government's currency rationing policy was lessening the volatility proving that the policy-induced changes in exchange rate has a stabilizing effect on trade flows. The implied elasticity for the most significant real exchange rate volatility coefficient is –0.20. Using a two-step Engle-Granger technique import demand and export supply price elasticities are computed. The results are consistent with the predictions from a number of previous studies, and in particular, the estimated exports price elasticity for Uzbek economy ranges from 1.65 to 1.84, while import demand price elasticity is between –0.78 and –0.83. At the same time, relatively lower elasticity during "the currency rationing" period indicate that large devaluations, most likely, did not generate the expected improvements in the overall export performance.

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Contents

Tables

Figures

"I find it difficult to imagine a world in which it would not be important to estimate exchange rate misalignments." John Williamson

1 Introduction

The real exchange rate is one of the essential economic indicators of economy's international competitiveness, and therefore, has a strong influence on country's foreign trade developments. In particular, the impact of the real exchange rate developments on foreign trade has been a topic of discussions in both developed and developing economies.

The relationship between exchange rate movements and trade flows has been studied in a large number of theoretical and empirical papers. It is commonly accepted that the movements of the real exchange rate have a permanent effect on exports and imports. There are several studies that empirically tested this hypothesis using data mostly from developed and developing countries.[1] However, there are several studies that failed to find evidence of an effect of the real effective exchange rate on trade flows.[2].

In the light of recent developments in economic policy in Uzbekistan it becomes quite important to examine the pros and cons of different exchange rate policy strategies. Particularly, in 1996, after low export revenues, the Government took measures to restrict convertibility of the Soum (national currency – UZS) by reducing its quantity that could be officially converted into foreign currency. Since that time there is existed a multiple exchange rate regime in Uzbekistan, which included the official, the commercial bank and parallel market exchange rates.

The Government adopted protectionist measures as part of the import-substitution strategy. In this context, an overvalued official exchange rate has been used to tax exporting sectors (cotton and gold production) in order to subsidize imports of capital and priority consumer goods. As a result, the illegal curb market for foreign exchange rate gained in importance. Staring from October 2003 Uzbekistan has fulfilled its currency convertibility obligations to the IMF and joined the Article VIII of the IMF.

The above changes in economic policy and realities of the current transition period, among other things, put the issue of formulation of an effective exchange rate policy on the top of policy agenda and requires comprehensive analysis and modelling of exchange

[1]For instance, Mordecki (2000) concludes that during the period of 1990–1998 the Uruguayan external sector was permanently affected by the changes in exchange rate.

[2]Rose (1991) and Lahreche-Revil and Benassy-Quere (2001) were not able to evidence an influence of exchange rate uncertainty on trade in the G-7 countries and in China, respectively.

rate behavior in new conditions. In particular, the movements of the real exchange rate should be carefully analyzed and systematically monitored. In this regard, this paper investigate the effect of exchange rate variability on the Uzbek imports from and exports to other countries.[3]

It is often believed that the real exchange rate is overvalued in those economies where restrictive foreign trade policy has been implemented. In this respect, this paper attempts to measure the degree of a possible misalignment in the real exchange rate and to analyze its impact on foreign trade flows in Uzbekistan.

Recent empirical studies suggest that the analysis of exchange rate misalignments plays a key role in designing of policy strategies and may serve as a potential predictor of currency crisis in emerging economies (Kaminsky, Lizondo, and Reinhart 1998). Most studies find evidence for strong negative effects on a country's economic growth rate (for example, Cottani, Cavallo, and Khan (1990), Ghura and Grennes (1993), Yotopoulos (1996)). At the same time, there is a number of cross-country studies investigating the relationship between distortion in real exchange rate and economic growth. They conclude that trade liberalization and devaluation of the real exchange rate could improve export performance and trigger export-led growth (Dollar (1992), Popov and Polterovich (2004)).

The results of this study would assist in assessment of the degree of impact of the exchange rate and show up the possible developments in the case of different policy instruments (including devaluation of exchange rate, tariffs and import protectionism etc.) which also will be useful in designing of export promotion policy.[4]

The estimation results would give an idea for policy makers about the level of the real exchange misalignment and serve as a basis for policy-oriented recommendations related to the modelling and choice of the appropriate the real exchange misalignment. For instance, foreign trade liberalization and greater exchange rate flexibility could increase of both trade flows and exchange rate volatility. Therefore, appropriate estimations, and consequently policies are needed to avoid the underlying causes of unpredictable and damaging movements in exchange rates.

In addition, to our knowledge there is no study on the subject of this paper that documented the impact of real exchange rate variabilities on foreign trade flows in Uzbekistan using econometric techniques. Therefore, in this paper we have used a comprehensive ap-

[3]Despite ongoing developments, some recent studies characterize Uzbekistan as a slow reformer, lagging behind in trade and foreign exchange liberalization. E.g. the EBRD Transition Report 2006 and the World Banks Doing Business 2007 survey are among others.

[4]The results reported in this paper have been generated using Stata, Ox (available free for research purposes) and R codes (open source).

proach to both methodology and interpretation of obtained results in terms of bringing up details.

The plan of the paper is as follows. Section 2 begins with review of the exchange policy episodes for the period of 1993–2005 in Uzbekistan. Section 3 briefly reviews the relevant (selected) literature on empirical evidence of exchange rate volatility and misalignments in both developed and developing countries. In addition, various estimates of exchange rate volatility and misalignment measures for Uzbekistan are reported. Then, Section 4 lays out the theoretical framework. Following the existing literature briefly discussed in Section 3 we estimate several proxies of real exchange rate volatility and misalignment for Uzbekistan. Section 5 contains the empirical results. Finally, Section 6 presents conclusions.

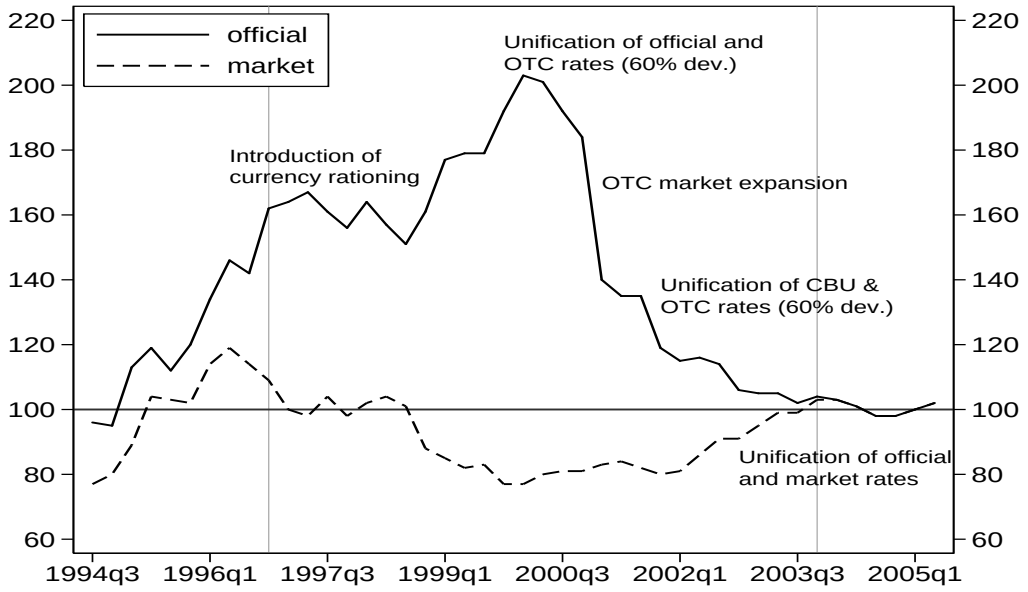
2 Exchange rate policy in Uzbekistan: a brief overview

In Uzbekistan the exchange rate policy can be divided into three periods: the period between 1993 to 1996, late 1996 to 2000, and the post 2000 period. The first period starts when in November 1993 the Government of Uzbekistan introduced a temporary (intermediate) currency "soum-coupon" at the rate of 1:1 to the Russian rouble. In 1993–1994, the Government took several important measures to develop foreign exchange rate market in the country. In July 1994 a full-value national currency "soum" has been introduced at the rate of 1:1000 to the soum-coupon and 7:1 to the U.S. dollars. Next three months exchange rate of UZS stabilized at level of 11–12 UZS/USD.

During the second period, to protect the domestic producers from foreign competition a strategy of import substitution was implemented. In late 1996, after low export revenues, the Government took measures to restrict convertibility of UZS by reducing its quantity that could be officially converted into foreign currency (currency rationing policy). Since that time there is existed a multiple exchange rate regime, which included the official (traded through the Republican Currency Exchange – RCE), the commercial bank (traded through the over-the-counter – OTC – currency market) and parallel market (curb) exchange rates. The Government regularly intervened in the official and commercial markets by controlling the supply and demand for foreign exchange.

An overvalued official exchange rate has been used to tax exporting sectors (cotton and gold production) in order to subsidize imports of capital and priority consumer goods. As a result, the illegal curb market for foreign exchange rate gained in importance (IMF 2000). The official rate is used for surrendering the proceeds from centralized exports,

Figure 1: The RER Dynamics and Policy Episodes in Uzbekistan, 1994–2005



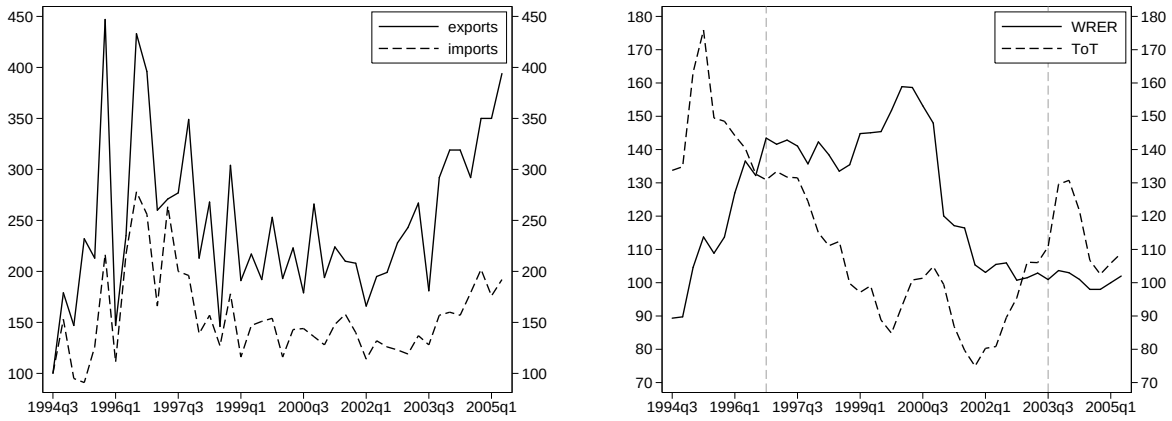
Note: An upward movement is an appreciation of the RER. The time interval between dashed vertical lines denotes the Government's currency rationing policy period. Source: Authors' calculations.

imports of certain capital goods and consumer goods, government purchases, and servicing of government and government-guaranteed debt.

As a result of absence of free foreign exchange market and of coordination between exchange rate, monetary and fiscal policies, the spread between official rate and parallel market rate is gradually increased, and for instance, had widened up to 440% (!) by the second quarter of 2000. Besides, the restrictive foreign exchange and trade regime has led to both import and export declines since 1996 (Figure 2-a). Indeed, large fall in exports prices, mainly world cotton and gold prices, also had a negative impact on export earnings (Figure 2-b). The currency rationing policy had also other negative consequences such as strong distortions of the relative prices; restraint of inflow of direct foreign investments; subsidizing of importers due to exporters; monopolization of the market; and absence of macroeconomic stability.

The third period starts in 2000, when the Government announced gradual liberalization of the foreign exchange and trade regimes. The policy targets were straightforward: reduce the spread between the official and parallel market exchange rates, establishing a realistic and single market rate, liberalizing both access and sale of foreign exchange and promote

Figure 2: The Real Exchange Rate, Trade Flows, and the Terms of Trade, 1994–2005.



(a) Exports & Imports, 1994q3=100

(b) The RER & the Terms of Trade

Notes: WRER is defined as weighted average official and parallel market real exchange rates i.e. WRER$= 0.65 * RER_O + 0.35 * RER_M$. The Terms of Trade is proxied by cotton and gold prices and equal to $0.75 * COT + 0.25 * GOL$. An upward movement is an appreciation of the RER and/or WRER. Time interval between dashed vertical lines denotes the Government's currency rationing policy period: *1996q3 – 2003q4*. Sources: computed from the IMF/IFS data. Authors' calculations.

exports. Particularly, the official rate is allowed to depreciate (against the U.S. dollar) by more than 60% in the first half of 2000, and the spread between the official and parallel market rates has been reduced to about 2.5 times compared to about 3.5 times during certain periods of 1999.

For the purpose of expansion of the over-the-counter exchange market all currency operations, but external debt servicing, have been transferred to the OTC market. As a result of the undertaken measures in May 2000 the RCE (official) and OTC exchange rates were unified. In November 2001, the Central Bank's official exchange rate devalued by about 60% against the dollar, and it was unified with the OTC rate (Figure 1). At the end of 2001, the U.S. dollar was trading at 1497 UZS on the parallel market compared with the official rate of 693 UZS. During 2002 the official exchange rate was devalued in steps by about 30% against the U.S. dollar. At the same time, the parallel market exchange rate appreciated by 12% by year-end; however, the government failed to achieve the 20% target and the spread was equal to 38%.

Taken measures have allowed to unify official and the parallel market exchange rates. Staring from 15 October 2003 Uzbekistan has fulfilled its currency-convertibility obligations

to the IMF and joined the Article VIII of the IMF. Refusal from currency rationing and achievement of convertibility of national currency have considerably strengthened an export orientation of economic policy, as became one of the major factors of growth of foreign trade.

3 Related literature

3.1 Exchange rate and trade flows

It is commonly accepted that the movements of the real exchange rate have a permanent effect on exports and imports.[5] There are several studies that empirically tested this hypothesis using data mostly from developed and developing countries. For instance, Mordecki (2000) concludes that during the period of 1990-1998 the Uruguayan external sector was permanently affected by the changes in exchange rate.

Several studies examined the role of exchange rate policies in export promoting and the effects of exchange rate volatility on exports. McKenzie (1999) provides a comprehensive survey of the existing literature and concludes that the results depends on the estimation technique of volatility. Moreover, most authors argue that short-run volatility has a transitory effect, and that long-run volatility has more impact on trade flows (Sapir, Sekkat, and Weber (1994), Sekkat (1998), Rose (2000) among others).

Another interesting study documented strong evidence that Sri Lanka's exports to the developed countries under investigation were adversely affected by the increased volatility in bilateral real exchange rates during 1978–96 (Weliwita, Ekanayake, and Tsujii 1999). Sekkat and Vaoudakis (1999) made similar conclusion when they analyzed the impact of exchange rate policies on export performance in four North African countries.[6] They also found negative impact of the exchange rate volatility on trade flows.

Lane and Milesi-Ferretti (2001) provides additional evidence that there is a negative long-run association between the trade balance and the real exchange rate, and the relative price of non-tradables is an important channel linking the trade balance and the real exchange rate. Using monthly data Pickard (2003) examines trade flows of certain steel products between Canada, Mexico and the United States. The main conclusion of this

[5]However, Rose (1991) failed to find evidence of an effect of the real effective exchange rate on trade flows for the G-7 countries. Lahreche-Revil and Benassy-Quere (2001) were also unable to evidence an influence of exchange-rate uncertainty on trade in China.

[6]They considered Algeria, Egypt, Morocco and Tunisia and the period of 1970–92.

study is that the effects of exchange rate volatility on bilateral trade flows for steel products sector are relatively small, but may differ depending on the presence of a well-developed forward market.

Frankel and Wei (1993) and Devlin et al. (2001) also observed similar negative effects in Asian countries and a set of 136 countries, respectively. Wang and Barrett (2002) employ sectoral level, monthly data and a multivariate GARCH-M estimator and find that real exchange rate risk has insignificant effects in most sectors, although agricultural trade volumes appear highly responsive to real exchange rate volatility.

Feenstra and Kendall (1991), Caporale and Doroodian (1994) and Lee (1999) also employed a GARCH-type mechanism to estimate the volatility and found negative relationship. Meanwhile, Kroner and Lastrapes (1993) using the similar methodology obtained mixed results with varied signs and magnitudes. Summarizing, most of studies present strong evidence that greater uncertainty in exchange rates (high volatility) reduces the foreign trade flows (imports and exports) of a country.

3.2 Volatility, misalignment and trade flows

This section briefly reviews the selected literature on empirical evidence of exchange rate volatility and misalignments in both developed and developing countries.

Sauer and Bohara (2001) used a large panel of 22 industrialized and 69 developing countries to investigate the link between exchange rate volatility and exports. They employed three alternative proxies of real exchange rate volatility: the conditional variance of a first-order ARCH model; the moving standard error of the estimate from a first-order AR process; and the moving standard error of the estimate from a trend model.

Table 1 reports the sample means and standard errors. The results show that for each volatility measure, the developing countries exhibit much higher real exchange rate uncertainty than the industrialized countries. Besides, the Latin American and African countries have the highest volatility whereas the Asian economies have the lowest uncertainty among developing countries.

Based on a sample of 79 countries over the 1974–2003 period Calderon (2004) constructed the volatility of real effective exchange rate fluctuations as the standard deviation of changes in the real effective exchange rate over a 5-year window. His results also confirm that real exchange rate fluctuations in developing countries are four times as volatile as in industrial economies.

Another interesting finding is that the more flexible is the exchange rate regime, the

Table 1: Real Exchange Rate Volatility: Sample Means

	Developed countries	Developing countries	Latin America	Africa	Asia	Uzbekistan
ARCH-based[a]	0.003	0.004	**0.067**	0.048	0.010	**0.069**
AR-based[a]	0.003	0.017	0.020	0.019	0.017	0.005
Standard deviation[b]	0.037	**0.085**	-	-	-	**0.094**

Notes: ARCH-based volatility is the conditional variance of GARCH-M(2,2) (1973–93). AR-based volatility is the moving standard error of the estimate from AR(1) process (1973–93). Standard deviation is a three year volatility is measured as standard deviation of the growth rate of the real exchange rate (1990–2000). All variables are in logs. Sources: [a] Sauer and Bohara (2001); [b] Hausmann, Panizza, and Rigobon (2004). For the Uzbek case authors' calculations (1994q3–2005q4).

more volatile are the real exchange rate fluctuations. Among industrial countries, real exchange rates among countries with flexible regimes are twice as volatile than among countries with either hard pegs or fixed regimes. On the other hand, real exchange rates among developing countries with flexible regimes are more than three times as volatile as those in developing countries with either hard pegs or fixed regimes.

Hausmann, Panizza, and Rigobon (2004) documents large cross-country differences (74 industrial and developing countries; 1980–2000) in the long run volatility of the real exchange rate. They employed the standard deviation of the growth rate of the real exchange rate as a measure of volatility. The results imply that the real exchange rate of developing countries is approximately three times more volatile than the real exchange rate in industrial countries.

Ofair and Collins (1997) constructed annual misalignment indicators for 93 countries (developed – 23 and developing – 73), over 16 to 18 year periods since 1975. They provide evidence that the real exchange rates were overvalued in most of the developing countries during 1975–83, with the misalignments most pronounced in Sub-Saharan Africa, South Asia and especially Europe and Central Asia. In contrast, the real exchange rates were relatively undervalued in all regions on average in the later period (1984–92).[7]

Lahreche-Revil and Benassy-Quere (2001) emphasized that a domino-style scenario of devaluations and depreciations in East Asia would reduce the share of this region in world

[7]Indeed, such broad regional and time averages can mask significant differences among individual countries.

trade through lower GDPs in dollars, although the domestic value of international trade would be raised.

Nabli and Veganzones-Varoudakis (2002) showed that the Middle East and North African (MENA)[8] countries were characterized by a significant overvaluation of their currency during the period of 1970-90, and that this overvaluation has had a cost for the region in terms of competitiveness. They suggest that such significant overvaluation could be result of the countries delay in adopting more flexible exchange rates and in reforming their economies.

Frait, Komarek, and Melecky (2005) analyzed the misalignment of the real exchange rate in five new European Union member states (namely, Czech Republic, Hungary, Poland Slovakia, Slovenia) with the use of various approaches. In addition to the behavioral model, they utilized the pure statistical techniques like the Hodrick-Prescott and Band-Pass filters. The main finding of the the paper is that the real convergence of these countries has been accompanied by sustained appreciation of the real exchange rate.

Taking into consideration the above discussions the main hypothesis of this study is formulated as follows: exchange rate volatility and misalignments have depressing effects on the volume of trade. We also consider what was causing the shocks to real exchange rate – terms of trade shocks, changes in private capital flows, changes in government borrowing, changes in foreign exchange reserves?

For this purposes we separate two different types of changes in real exchange rate: (1) in response to changes in terms of trade and to private capital flows; (2) policy-induced changes in real exchange rate (i.e. that occur only due to government/central bank policies without any changes in terms of trade and private capital flows). The second hypothesis then would be that the latter type of the changes in real exchange rate could have a stabilizing effect on trade flows, whereas the former type of changes of real exchange rate are increasing the volatility of trade.

4 Exchange rate volatility and misalignment

4.1 Measuring the real exchange rate volatility

Following the existing literature briefly discussed in Section 3 we estimate several proxies of real exchange rate (RER) volatility for Uzbekistan. The first volatility measure (δ_1),

[8]For comparison purposes, in addition to 11 MENA countries they considered 19 African (8 CFA and 11 non-CFA), 13 Latin America and 10 Asian countries. CFA is for "Communaute Francophone dAfrique".

Table 2: RER Volatility Measures: Summary Statistics

	Mean	SD	SW	Q	Q^2	SKE	KUR
δ_1 - S.D.	0.094	0.068	0.825***	72.7***	46.2***	1.5	5.5
δ_2 - GARCH-M(2,2)	0.069	0.057	0.91***	174.6***	80.1***	1.1	4.4
δ_3 - ARCH(1)	0.311	0.386	0.80***	207.0***	124.5***	1.2	3.6

Note: SD – standard deviation. Q and Q^2 Ljung-Box test. SW – the Shapiro-Wilk normality test. SKE – skewness. KUR – kurtosis. Significant at the ***1% (**5%) level. Source: Authors' calculations.

the most traditional one, investigated is the standard deviation of the growth rates of real exchange rates computed as follows:

$$\delta_{1,t+m} = [\sum_{i-1}^{m} (rer_{t+i-1} - rer_{t+i-2})^2/m]^{1/2}.$$

where m is the order of the moving average, and rer_t is a ratio of the U.S. consumer price index (p_t^*) to the domestic consumer price index (p_t), multiplied by the quarterly nominal exchange rate (e_t), expressed as the number of national currency units per foreign currency unit or in logarithms $rer_t = \log(e_t) + \log(p_t^*) - \log(p_t)$. An appreciation is recorded as an increase in the exchange rate index.

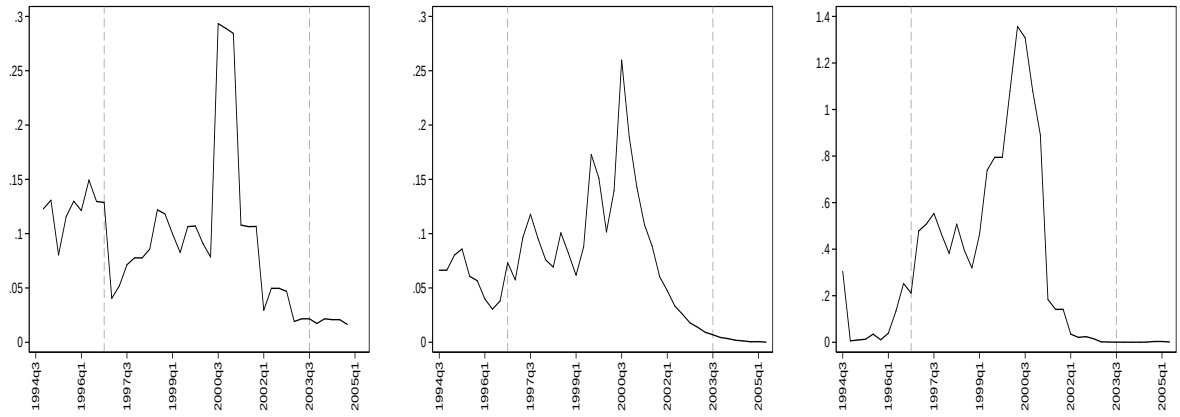
Next we compute other two alternative proxies of RER volatility: the conditional variance of a GARCH-M(2,2) model (δ_2) and the conditional variance of a first-order ARCH model (δ_3). Measuring of volatility using the ARCH-based models allows to capture "volatility clustering", observed in the real exchange rate's behavior. The idea is that large fluctuations of the real exchange rate in the past tend to generate higher expected volatility in the following periods.

In order to calculate an ARCH-based volatility, we employ a first-order ARCH, which takes the form:

$$\begin{aligned} rer_t &= \alpha_0 + \alpha_1 rer_{t-1} + u_t \\ u_t &\sim N(0, \delta_{2,t}) \\ \delta_{2,t} &= \beta_0 + \beta_1 u_{t-1}^2. \end{aligned}$$

Table 2 reports summary statistics, including the mean, standard deviation, skewness

Figure 3: The RER Volatility Measures: Standard Deviation, ACRH and GARCH.



(a) SD-based (b) GARCH-based (c) ARCH-based

Notes: Time interval between dashed vertical lines denotes the Government's currency rationing policy period: *1996q4 – 2003q4*. Source: Authors' calculations.

and kurtosis coefficients for the above discussed various estimates of exchange rate volatility measures for Uzbekistan. In addition, the table includes the the Shapiro-Wilk normality test and the Ljung-Box serial correlation test statistics for both volatility measures (Q) and squared volatility measures (Q^2) with 20 lags.

The Shapiro-Wilk normality test and high kurtosis coefficients show the non-normality of all of these time series. Ljung-Box statistics for volatility measures indicates no autocorrelation for all estimates. At the same time, the Ljung-Box Q^2 statistics is also significant for all series and suggests an ARCH process for the conditional variance. Figure 3 depicts dynamics of all three proxies of the RER volatility computed based on the above discussed techniques.

4.2 Measuring misalignment with a single-equation approach

We follow Edwards (1989) in using the term "misalignment" to denote the gap between the real exchange rate and the equilibrium exchange rate, which is not observable. However, the theory tells us that it is a function of observable macroeconomic variables, and that the actual real exchange rate approaches its equilibrium level over time (Edwards (1989), Montiel (1997)). Based on this logic, we outline an econometric methodology for estimating

the equilibrium real exchange rate and estimate using the Uzbek quarterly data.

Let's define the equilibrium real exchange rate (rer_t^*) as the steady-state real exchange rate conditional on a vector of permanent values for the fundamentals i.e.

$$rer_t^* = \beta' F_t \tag{1}$$

where F_t – the vector of permanent values for the fundamentals and β – long run parameters (coefficients) of interest. As discussed earlier, rer_t^* is not observable, and therefore, to estimate β we need an empirical model that is consistent with the above equation but relates observable variables. Following Baffes, Elbadawi, and O'Connell (2001) Equation 1 comes from a steady state relationship between actual values of the real exchange rate (rer_t) and fundamentals (F_t). This relationship can be analytically expressed as following:

$$rer_t = \beta' F_t + \omega_t \tag{2}$$

where ω_t is a is a mean-zero, stationary random variable. The below specified general error-correction model is consistent with both equations 1 and 2, and embodies the central insight of the single-equation approach: that the equilibrium real exchange rate can be identified econometrically as that unobserved function of the fundamentals towards which the actual real exchange rate gravitates over time:[9]

$$\Delta rer_t = \alpha(rer_{t-1} - \beta' F_{t-1}) + \sum_{j=1}^{p} \mu_j \Delta rer_{t-j} + \sum_{j=0}^{p} \gamma_j' \Delta F_{t-j} + v_t. \tag{3}$$

The equilibrium exchange rate is then the predicted value from this equation based on a given vector of macroeconomic fundamentals (F_t). The following proposed fundamentals have been extensively used by empirical studies on the real exchange rate determinants, for example, Begg, Halpern, and Wyplosz (1999), Csajbok (2003) and Kim and Korhonen (2002) are among others:[10]

- tot = terms of trade. Proxied by cotton and gold prices and equal to $0.75 * Cotton + 0.25 * Gold$. Uzbekistan is a small economy, and therefore price taker in terms of both exports and imports.

- open = exports + imports over GDP. This is an openness indicator that is a proxy

[9] See Baffes, Elbadawi, and O'Connell (2001) for a discussion of the single equation approach.
[10] See Frait, Komarek, and Melecky (2005) and Egert (2003) for detailed survey.

for trade restrictions and/or controls. Certainly, more liberal the trade regime the more total amount of foreign trade. However, its impact on real exchange rate depends on the nature ("direction") of this increase, and therefore the expected sign is ambiguous. For instance, if the current account worsened, then the real exchange rate would be depreciated.

- $gcons$ = share of government consumption in GDP. This is a proxy for government demand for nontradables.In the case of increase in government consumption will result in appreciation of the real exchange rate.

- $ishare$ = share of investment in GDP. The expected sign is ambiguous. Because it heavily depends on the relative factor intensities between sectors of economy.

- gdp = per capita GDP. It is proxy for domestic productivity.

- $d96$ = a policy change dummy variable that takes the value of one for the period of 1996q3–2003q4 and zero otherwise. Since the Governments currency rationing policy has been directed to tax exporting sectors (mainly, cotton and gold production) in order to subsidize imports of capital and priority consumer goods, this shock should appreciate the real exchange rate.

The estimation strategy consists of three steps. First step involves estimating the long-run parameters. We employ the Johansen-Juselius cointegration test in order to investigate the existence of a long-run relationship between the real exchange rate and the selected explanatory variables (determining the order of integration). Another econometric issue we attend is nonstationarity of variables. In this case standard regression techniques such as the Ordinary Least Squares are not useful and could lead to "spurious" results. For that reason, we also report the results of nonstationarity tests i.e. the Augmented Dickey-Fuller and the Philip-Perron unit roots tests.

In the second step, the proposed fundamentals are decomposed into permanent and transitory components. Then the transitory effects are set to zero and actual values of the fundamentals are inserted into the estimated equation. In the final step the real exchange rate misalignments will be estimated as the residuals of Equation 3.

Table 3 shows the results of the Augmented Dickey-Fuller and Phillips-Perron unit-root tests for all variables. Both tests indicate that the real exchange rate and terms of trade are seemingly nonstationarity variables. At the same time, all other variables appear to be

Table 3: Stationarity Statistics: Unit Root Tests

	Without TT		With TT			Without TT		With TT	
	ADF	PP	ADF	PP		ADF	PP	ADF	PP
rer_t	-1.11	-1.38	-1.87	-1.90	Δrer	-4.91	-4.97	-5.31	-5.35
tot_t	-1.38	-1.56	-1.28	-1.60	Δtot_t	-4.59	-4.49	-4.57	-4.45
$open_t$	-1.76	-2.38	-3.15	-2.84	$\Delta open_t$	-8.60	-11.11	-8.80	-10.42
$gcons_t$	-2.28	-2.98	-3.61	-3.51	$\Delta gcons_t$	-7.44	-8.59	-7.52	-9.14
$ishare_t$	-2.57	-2.06	-5.73	-5.73	$\Delta ishare_t$	-7.72	-14.30	-7.62	-14.05
$gdpc_t$	-2.18	-3.82	-4.61	-4.69	$\Delta gdpc_t$	-7.35	-11.76	-7.40	-15.71

Notes: TT – time trend. ADF and PP refer to augmented Dickey-Fuller and Phillips-Perron tests for a unit root, respectively. The number of observations is 44. Source: Authors' calculations.

trend-stationary. The unit root test results also confirm that all variables are stationary in first difference i.e. $I(1)$.

It means that we could employ simple first differencing technique to remove the non-stationarity problem. However, this could result in discarding useful information about relationship among the variables of interest, for example, in our case the relationship between the real exchange rate and its fundamentals.

Therefore we first test for the presence of cointegration between rer_t and F_t. Table 4 reports the estimated cointegrating relationships, and also shows the presence of $I(1)$ cointegrating vectors. Using the λ-max statistic (column 2), we test the null hypothesis that $r = 0$ against the alternative that $r \leq 1$. Our test statistic of 113.44 exceeds the critical value of 45.28 which leads to the rejection of the hypothesis of no cointegrating relationship. The trace statistic of 176.86 also exceeds its corresponding critical value of 124.40 which is consistent with the result using the λ-max statistic.

Next we test the null hypothesis of at most one cointegration vector ($r = 1$). In this case, however, the λ-max statistic of 28.30 is smaller than the critical value of 39.37 and we cannot reject the null hypothesis. The *trace* test leads to the same conclusion. Therefore, regardless of which statistic is used, we cannot reject the hypothesis that we have one cointegrating vector.

We now move on estimating the long-run parameters using the nonstationary panel techniques, in particular, the Engle-Granger two-step method (based on Equation 3). Ta-

Table 4: Results of Cointegration Analysis

			5 percent critical values		10 percent critical values	
	λ-max	*trace*	λ-max	*trace*	λ-max	*trace*
With the policy change dummy variable						
$r = 0$	113.44	176.86	45.28	124.40	42.32	118.50
$r \leq 1$	28.30	63.41	39.37	94.15	36.76	89.48
Without the policy change dummy variable						
$r = 0$	103.54	154.78	39.37	94.15	36.76	89.48
$r \leq 1$	13.28	21.67	33.46	68.52	30.90	64.84

Note: The first row ($r = 0$) tests the null hypothesis of no cointegration; the second ($r = 1$) tests the null hypothesis of at most one cointegration vector, etc. λ_{max} – the estimated Johansen-Juselius likelihood value. *trace* – trace statistics. The Osterwald-Lenum critical values (95% and 90% confidence intervals). Sample size – 44, 1994q3:2005q2. Source: Authors' calculations.

ble 5 contains long-run parameter estimation results for Uzbekistan obtained from the Engle-Granger method, including and excluding the 1996 policy change dummy variable. Unit root tests applied to the estimated residuals obtained from the first step of the Engle-Granger method indicate that there is strong evidence of cointegration in both cases (with/without the policy change dummy variable).

In general the estimated long run parameters are consistent with the predictions from theory. In particular, the government consumption (*gcons*) has an appreciating impact on the real exchange rate. The effect is particularly strong and significant in the model estimated including the policy change dummy variable ($d96$) from the single-equation, suggesting that most government spending is directed toward nontradables.

Investment (*ishare*) has a negative effect on the real exchange rate, suggesting that an increasing share of investment in GDP shifts spending toward tradable goods in the long term. This shift, other things equal, would depreciate the real exchange rate. The implied elasticity suggests that a 10% increase in the investment share in GDP depreciates the real exchange rate by at least 1.4% (2.0% in the second model).[11]

The estimated openness coefficient (*open*) is positive and significant in both models, suggesting that trade liberalization policy would appreciate the long-run equilibrium real

[11] According to Edwards (1989) this indicator is equal to 7% for s group of 12 developing countries.

Table 5: Long Run Parameter Estimates: Two-Step Engle-Granger Method

The First Step			The Second Step		
	with $d96$	without $d96$		with $d96$	without $d96$
Constant	-1.01	2.58	Constant	-0.11	2.56**
	(-0.59)	(1.31)		(-0.16)	(2.37)
			Adjustment speed:		
			u_{t-1}	-0.12	-0.08
				(-0.97)	(-0.70)
			Parameters:		
tot_t	0.08	-0.65*	tot_{t-1}	-0.13	-0.69***
	(0.24)	(-1.76)		(-0.57)	(-3.40)
$gdpc_t$	0.21	-0.05	$gdpc_{t-1}$	0.20*	-0.01
	(1.25)	(-0.21)		(1.76)	(-0.06)
$open_t$	0.27*	0.33*	$open_{t-1}$	0.34***	0.39***
	(1.94)	(1.89)		(3.67)	(3.03)
$gcons_t$	0.13	0.50***	$gcons_{t-1}$	0.18***	0.48***
	(1.13)	(2.78)		(3.25)	(4.59)
$ishare_t$	-0.12**	-0.20***	$ishare_{t-1}$	-0.14***	-0.20***
	(-2.43)	(-3.16)		(-7.99)	(-5.52)
$d96_t$	0.48***	–	$d96_{t-1}$	0.38***	–
	(-4.98)	–		(5.83)	–
R^2	0.68	0.52	R^2	0.91	0.76
DW	0.88	0.92	DW	1.84	1.35
ADF	-3.49	-3.70	ADF	-6.19	-4.83
PP	-3.55	-3.64	PP	-6.20	-4.76

Notes: The numbers in parentheses are t-statistics. DW – the Durbin-Watson statistic. ADF – the augmented Dickey-Fuller test. PP – the Phillips-Perron test. Significant at the ***1% ,**5% and *10% level. The dependent variable is Δrer_t. u_{t-1} – error term. Source: Authors' calculations.

exchange rate. The terms of trade (tot) in both cases has a negative and significant (only in the model corrected for $d96$) impact on the real exchange rate. The positive coefficient on $d96$ dummy variable is consistent, and confirms that the Government's currency rationing policy substantially appreciated the real exchange rate.

Now, we can estimate the degree of misalignment, $ma_{1,t}$, which is simply the percentage difference between the real and equilibrium exchange rates:

$$ma_{1t} = (\frac{rer_t}{rer_t^*} - 1) \cdot 100. \tag{4}$$

Table 6 show alternative measures of the equilibrium real exchange rate and the estimated level of the real exchange rate misalignment. The equilibrium exchange rate has

Table 6: Observed, Equilibrium Real Exchange Rate and Misalignment

		1996q1:96q4	1999q4:2000q4	2003q1:03q4	2004q1:05q2
Observed	rer_t	154	184	103	100
Equilibrium	rer_t^*	126	147	94	104
misalignment I	ma_{1t}	10.1	25.6	6.6	-5.5
misalignment II	ma_{2t}	11.4	24.7	-1.3	-0.3

Notes: The observed RER (rer_t) is the official real exchange rate. $ma_{1t} = 100 * (rer_t - rer_t^*)/rer_t^*$.

been calculated based on the long-run parameter vectors, taken from the Engle-Granger regression in column 5 of Table 5. Equilibrium values are obtained directly from that regression. Figure 4 depicts the observed and equilibrium real exchange rates.

Figure 4-b shows that misalignment patterns are consistent with different policy periods discussed in Section **??**. The estimation results for 1994q3-1995q4 and 1996q1-1996q4 periods do not indicate any major overvaluation, and the real exchange rate was on average undervalued by 10%.

During the Government's currency rationing policy period (late 1996–2000), the above diagram reveals a substantial overvaluation (9% period average) and a widening gap between the actual and the estimated equilibrium real exchange rates. The period from 1999q4 to 2000q4 was , when the estimated overvaluation reached up to 38% in the first quarter of 2000 (25% period average).

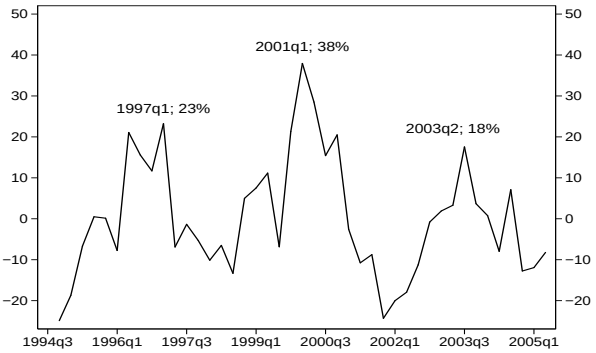
The Government managed to reverse substantial real overvaluation by the end of 2002. After several devaluations the real exchange rate was very close to the estimated equilibrium level. In particular, in the fourth quarter of 2002 the real exchange rate was undervalued only by 1%. The average undervaluation of the real exchange rate during the post 2002-year period was equal to 1%.

In addition to the estimated degree of misalignment ma_{1t} from Equation 4, we use another alternative measure of misalignment. This approach is based on using use the index of country's relative price level (RPL), suggested by Dollar (1992), where $RPL_t = 100 \cdot rer_t \cdot P/P^*$. In other words, he used the RPL index as a measure for the real exchange rate.

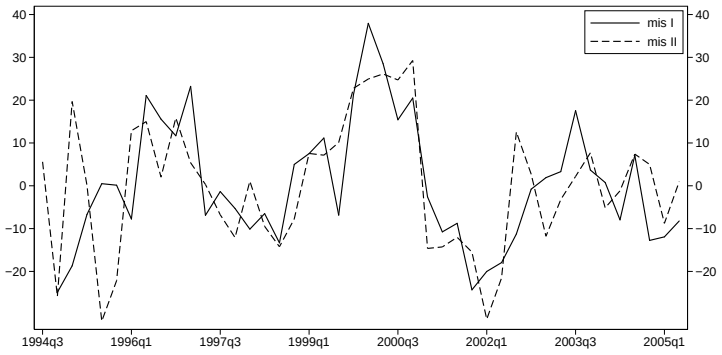
To estimate the relationship between national price level and endowments, Dollar (1992)

Figure 4: Misalignment, Observed and Equilibrium Real Exchange Rates

(a) rer_t and rer_t^*, 2004=100



(b) ma_{1t}: misalignment



(c) ma_{1t} & ma_{2t}: misalignment measures

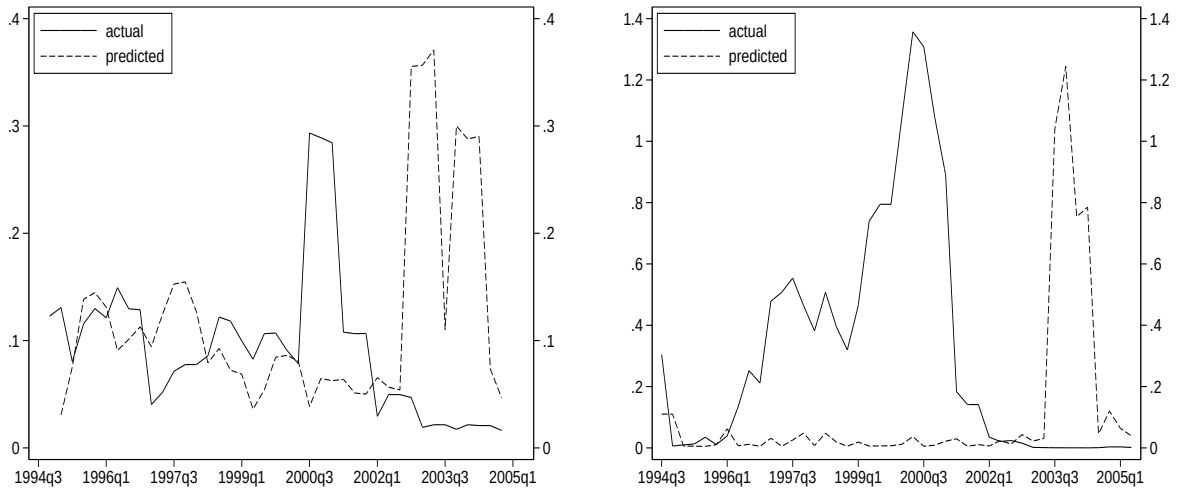
Notes: An upward movement is an appreciation of the RER. $ma_{1t} = 100 * (rer_t - rer_t^*)/rer_t^*$.

used different model specifications of the following regression: $RPL_t = \alpha_0 + \alpha_1 GDP_t + \alpha_3 DENS_t + d_t$, where GDP_t – per capita GDP; $DENS_t$ – population density; and d_t – year dummies. We also constructed the similar equation using the Uzbek data for the period of 1996q3–2005q2. Hence the real exchange rate misalignment (ma_{2t}) is estimated as the residuals from the the following regression:[12]

$$RPL_t = \alpha_0 + \alpha_1 GDP_t + \alpha_2 GDP_t^2 + \alpha_3 d96 + q_k + trend_t + u_t.$$

[12]The regression number 6 in Dollar (1992), Table 2, p. 528.

Figure 5: Exchange Rate Volatility vs. Currency Rationing Policy



(a) SD-based volatility

(b) ARCH-based volatility

4.3 Exchange rate volatility and currency rationing policy

As discussed earlier, it is an important issue to analyze the nature of shocks causing to real exchange rate as well as implications of the governments currency rationing policy for dynamics of the real exchange rate.

For this purpose, we predict the real exchange rate at the second stage (after the cointegration analysis) using the Equation 3 and assuming the inflows of private capital and cotton prices are constant. Comparing the fluctuations of this predicted real exchange rate with the fluctuations of the actual real exchange rate would allow us to estimate to what extent government policy in particular periods was mitigating the volatility or, on the contrary, increasing this volatility.

We plotted actual and predicted exchange rate volatilities in Figure 5. During the period of 1996-2002 the Governments currency rationing policy was lessening the volatility. On the contrary, gradual liberalization of the foreign exchange and trade regimes, aimed at establishing a realistic and single market rate, led to substantial increase of this volatility (the post 2002 period).

5 Exchange rate and trade flows: key findings

In this section, we investigate to which extent, empirically, the real exchange affects foreign trade flows in Uzbekistan. In general, there is, so called, "pessimism" concerning the impact of changes in exchange rates on trade flows in developing countries. Some studies argue that due to low import and export elasticities the required changes in the real exchange rate are not able to improve the trade balance, and therefore, exchange rate adjustment policies are not effective in dealing with balance-of-payments deficits.

Ghei and Pritchett (2001) examines three types of the above-mentioned pessimisms regarding the elasticity of import demand and export supply as well as the elasticity of demand for the country's exports in world markets. They find that none of the three pessimisms is justified for developing countries. Reviewing the existing empirical literature, Ghei and Pritchett (2001) conclude that a reasonable range for the aggregate price elasticity of demand for imports is -0.7 to -0.9, and that elasticities of export supply tend to be in the range of 1.0 to 2.0.

Nevertheless, in most of developing (transition) countries, in particular in Uzbekistan, exchange rate adjustment policy is considered as an essential element of trade policy. Therefore, reasonably accurate and precise estimates of import and export price elasticities can be used by policy advisors and practitioners in applied economic policy analysis, and in designing of development strategies. Following this logic, below we have tried to shed light into possible effects of the real exchange rate movements on export and import flows in Uzbekistan.

In order to analyze the effects of the real exchange rate volatility and misalignments on imports and exports, consistent with the existing studies, we estimate the long-run export and import equations. In particular, the following typical log-linear specifications will be separately estimated using a two-step Engle-Granger estimation method:

$$rm = f(rgd, rer, \delta_i, d96) \tag{5}$$

$$rx = g(rgd, rer, \delta_i, d96) \tag{6}$$

where rm and rx are real aggregate imports and real exports, respectively; rgd is domestic real GDP; rer is the real exchange rate to proxy the relative price competitiveness of commodities between countries; δ_i, $i = 1, 2, 3$ – the estimated measures of the real exchange rate volatility; and $d96$ – the 1996 policy dummy.

All variables are in logs with the exception of the volatility measures. A constant, a

Table 7: Results of Cointegration and Unit Root Tests

H_0	λ-max	trace	$\hat{\lambda}$	$\hat{trace}$
Import equation				
$r = 0$	43.82	68.76	33.46	68.52
$r \leq 1$	15.50	24.94	27.07	47.21
Export equation				
$r = 0$	45.67	70.43	33.46	68.52
$r \leq 1$	17.94	24.76	27.07	47.21

Var	ADF	PP	Var	ADF	PP
rm_t	-2.12	-2.74	Δrm_t	-8.36	-9.00
rx_t	-4.82	-4.78	Δrx_t	-12.1	-14.3
rer_t	-1.12	-1.35	Δrer_t	-5.04	-5.10
rgd_t	-2.34	-3.95	Δrgd_t	-7.07	-8.99
δ_1	-2.33	-2.34	$\Delta\delta_1$	-6.54	-6.62
δ_2	-1.69	-1.56	$\Delta\delta_2$	-6.10	-6.20
δ_3	-1.24	-1.66	$\Delta\delta_3$	-4.90	-4.95

Note: *1) Cointegration test.* The first row ($r = 0$) tests the null hypothesis of no cointegration; the second ($r = 1$) tests the null hypothesis of at most one cointegration vector, etc. λ-max – the estimated Johansen-Juselius likelihood value. $\hat{\lambda}$ and $\hat{trace}$ – the Osterwald-Lenum critical values (95% interval). Sample size – 44 quarterly observations, 1994q3:2005q2. *2) Unit roots tests.* ADF and PP refer to augmented Dickey-Fuller and Phillips-Perron tests for a unit root, respectively. $T = 44$.

trend and a set of seasonal (quarterly) dummies are included in all regressions. Regarding the expected coefficients'signs, theory predicts that the real exchange rate volatility increases uncertainty and therefore could hinder the foreign trade flows.

From this point we use the "appreciation is down" convention of measuring the real exchange rate in domestic-currency terms. In this case, for example, an increase in the real exchange rate in domestic-currency terms is an depreciation.

In order to examine the stationarity of the data, we conducted two unit root tests: the augmented Dickey-Fuller and the Phillips-Perron tests. The test results reported in Table 7 indicate that all variables are integrated of order one i.e. $I(1)$, but rx_t appears to be $I(0)$ at the 1% level. Using the Johansen's method we tested for the number of cointegrating vectors in the system. The results, reported in Table 8, also confirm the presence of $I(1)$.

5.1 The real exchange rate variability and import flows

In the presence of cointegrating vectors, it is advised to employ an error correction model developed by Engle and Granger (1987) that was applied earlier in Section 4 for estimating the long-run parameters of the real exchange rate. Table 8 shows the results for the import demand regressions with different volatility and misalignment measures.

Table 8: Import Demand Equations: Error Correction Model Results

dep.var:	Volatility			dep.var:	Misalignment	
rm_t	with δ_1	with δ_2	with δ_3	rm_t	with mis_1	with mis_2
Constant	2.35***	2.25***	2.45***	Constant	2.35***	2.39***
	(8.77)	(10.51)	(11.09)		(13.47)	(15.53)
Adjustment Speed				*Adjustment Speed*		
rm_{t-1} or u_{t-1}	-0.64**	-0.87**	-0.51**	rm_{t-1} or u_{t-1}	-0.67***	-0.58**
	(-4.11)	(-5.98)	(-3.45)		(-4.65)	(-3.69)
rgd_t	0.38**	0.40***	0.38**	rgd_t	0.46**	0.53***
	(3.02)	(4.10)	(3.00)		(2.95)	(4.65)
rer_t	-0.78**	-0.83**	-0.40	$mis_{i,t}$	-0.007**	-0.003
	(-2.79)	(-3.04)	(-1.19)		(-2.65)	(-1.54)
$\delta_{i,t}$	-0.15**	-0.20***	-0.01	δ_1	-1.10**	-0.92*
	(-2.33)	(-5.72)	(-0.32)		(-2.11)	(-1.86)
$d96$	-0.22**	-0.01	-0.32**	$d96$	-0.12	-0.15*
	(-2.02)	(-0.04)	(-2.25)		(-1.25)	(-1.76)
$trend$	-0.05**	-0.05***	-0.04**	$trend$	-0.05**	-0.06***
	(-2.96)	(-4.10)	(-2.36)		(-2.97)	(-4.40)
R^2	0.69	0.77	0.62	R^2	0.70	0.68
DW	2.19	1.96	2.33	DW	2.25	2.28

Notes: The numbers in parentheses are t-statistics. DW – the Durbin-Watson statistic. Significant at the ***1%, **5% and *10% level. The dependent variable is rm_t. u_{t-1} – error term. Misalignment indicator is converted to rd_t which indicates the estimated depreciation or appreciation required to bring the actual real exchange to the equilibrium level, and calculated as following: $rd_t = (rer_t^*/rer_t - 1) \cdot 100$. Source: Authors' calculations.

As expected import demand price elasticities are negative in all three regressions, but significant only the first two models with average -0.81. The results are consistent with the predictions from a number of studies that estimate import price elasticities for both developed and developing countries (see Table 9).

The real exchange rate volatility coefficients have the expected sign in all three equations[13], but significant at reasonable statistical levels only in two regressions (with standard deviation and GARCH-based volatility measures). The implied elasticity suggests that a 10% increase in the volatility would cause a decrease of imports by at least 1.5% – 2.0%.

Another important observation is the adjustment speed. The estimated adjustment coefficient of the cointegrating vector is for all models ranges from -0.51 to -0.87 and

[13]Which is consistent with the existing empirical works. E.g. Weliwita, Ekanayake, and Tsujii (1999), Sekkat and Vaoudakis (1999), Lane and Milesi-Ferretti (2001), Frankel and Wei (1993), Devlin et al. (2001)

Table 9: Comparative Table: Price Elasticity of Aggregate Import Demand

Countries	Mean of averages	Median of averages	Estimated price elasticity
Developed countries	-0.93	-0.80	-0.64 : -1.51
Developing countries	-0.79	-0.79	-0.51 : -1.07
African countries	-1.14	-1.06	-0.88 : -1.40
Uzbekistan	-0.81	-0.81	-0.78 : -0.83

Source: Adapted from Ghei and Pritchett (2001), pp.475–478. For the Uzbek case authors' calculations.

significantly different from zero in all equations, suggesting a relatively quick adjustment to the past disequilibrium in import trade volumes. Besides, it indicates that the error correction mechanism is stable.

To analyze the impact of the real exchange rate misalignments on imports, the above Equation 5 will be re-estimated substituting real exchange rate misalignments (ma_t) for real exchange rate levels (rer_t) i.e. $rm = f(rgd, ma_j, \delta_i, d96, q_k)$. The second part of the Table 8 summarizes the error correction model estimation results for import demand equations. All the explanatory variables in all model specifications carry the expected signs.

Regarding the exchange rate misalignment, we obtained a significant results at the 5% level when we used a single-equation based misalignment measure (ma_1). The implied elasticity shows that a 100% depreciation of the real exchange would lead to little impact on imports, and could decrease it at least by 0.7%.

5.2 The real exchange rate variability and export flows

To analyze the effects of the real exchange rate volatility and misalignments on exports, consistent with the existing studies, we run the long-run export supply regressions (Equation 6) with different measures of volatility and misalignment.

Table 10 summarizes the results for the quarterly real exports regressions. Overall the results are in line with the theoretical prediction, and all expected signs are in correct direction. As expected export supply price elasticities are positive and significantly dif-

Table 10: Export Supply Equations: Error Correction Model Results

dep.var:	Volatility			dep.var:	Misalignment	
rx_t	with δ_1	with δ_2	with δ_3	rx_t	with mis_1	with mis_2
Constant	2.00**	1.18	1.07	Constant	1.35**	2.04***
	(2.44)	(1.44)	(1.32)		(2.94)	(5.64)
Adjustment Speed				*Adjustment Speed*		
rx_{t-1} or u_{t-1}	-0.98***	-0.88***	-0.88***	rx_{t-1} or u_{t-1}	-0.75***	-0.86***
	(-5.55)	(-5.48)	(-4.93)		(-4.13)	(-6.03)
rgd_t	-0.02	-0.07	-0.07	rgd_t	-0.30	- 0.04
	(-0.06)	(-0.25)	(-0.24)		(-1.02)	(-1.29)
rer_t	1.65**	1.84**	1.82**	$ma_{i,t}$	0.006**	0.006**
	(2.39)	(2.22)	(2.40)		(2.06)	(2.31)
$\delta_{i,t}$	-0.98	-0.07	-0.06	$\delta_{i,t}$	-0.53	-0.69
	(-1.51)	(-0.32)	(-0.05)		(-0.62)	(-1.38)
$d96$	-0.13	0.03	0.03	$d96$	-0.05	-0.27***
	(-0.66)	(0.20)	(0.22)		(-0.31)	(-3.25)
R^2	0.74	0.70	0.70	R^2	0.75	0.78
DW	2.10	2.04	2.04	DW	1.92	2.45

Notes: The numbers in parentheses are t-statistics. DW – the Durbin-Watson statistic. Significant at the ***1%, **5% and *10% level. The dependent variable is Δrer_t. u_{t-1} – error term. Misalignment indicator is converted to rd_t which indicates the estimated depreciation or appreciation required to bring the actual real exchange to the equilibrium level, and calculated as following: $rd_t = (rer_t^*/rer_t - 1) \cdot 100$. Source: Authors' calculations.

ferent from zero at the 5% level in all three regressions (with δ_1, δ_2 and δ_3). Despite the theoretically correct signs on the coefficients of other independent variables, such as the domestic activity term (rgd_t) and the exchange rate volatility (δ_t), they are not significant in any of the three regressions for reasonable statistical levels of significance.

Similar to the above discussed import demand regressions' case, the estimated adjustment coefficient of the cointegrating vector is for all models ranges from -0.88 to -0.98 and significantly different from zero in all equations, suggesting stability of the error correction mechanism, and a relatively quick adjustment to the past disequilibrium in export trade volumes.

Majority of empirical studies documented that, in developing countries a depreciation of the real exchange rate leads to strong increased export supply. In contrast, an appreciation of the real exchange rate could lead to a large deterioration in export performance of economies. Reviewing the exiting literature, Ghei and Pritchett (2001) arrive at a conclusion that a reasonable range for the aggregate price elasticities of export supply tend

Table 11: Comparative Table: Price Elasticity of Aggregate Export Supply

Countries	Exports	Period covered	Price elasticity
Non-oil-exporting developing countries	TME	1963:1981	2.01
Pooled SSA countries	TME	1965:1982	1.01
7 developed countries	TE	–	1.10 : 6.60
Uzbekistan	TE	1994q3:2005q2	1.65 : 1.84
Uzbekistan (currency rationing policy)	TE	1996q3:2003q3	1.24 : 1.57

TE and TME are for total and total merchandize exports, respectively. SSA – Sub-Saharan African countries. Source: Adapted from Ghei and Pritchett (2001), p.489. For the Uzbek case authors' calculations.

to be in the range of 1.0 to 2.0 (see Table 11). In our case, the estimated price elasticity for Uzbek economy ranges from 1.65 to 1.84 (with the period average of 1.77) implying a considerable magnitude of the potential response of aggregate exports to the real exchange variability.

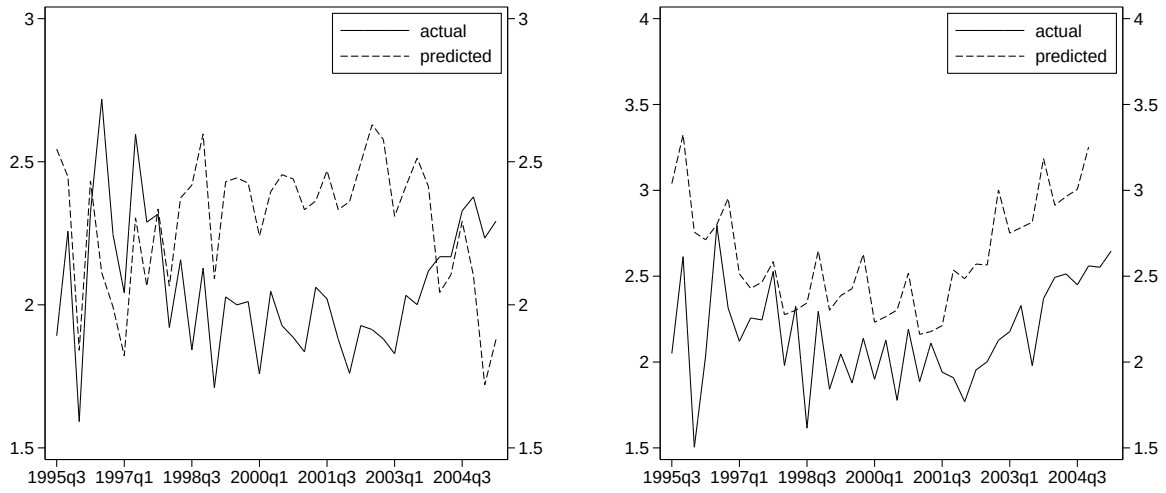
We also computed 'indicative' price elasticity range for the period of the Government's currency rationing policy (1.24 – 1.57 with the period average of 1.45). These relatively lower elasticities indicate that due to Government's restrictive export policy[14] large devaluations, most likely, did not generate the expected improvements in the overall export performance.

The possible impact of the real exchange rate misalignments on exports is analyzed using modified specification of Equation 6. In particular, the real exchange rate misalignments (ma_t) are substituted for real exchange rate levels (rer_t) i.e. $rx = f(rgd, ma_j, \delta_i, d96)$. The second part of the Table 10 summarizes the error correction model estimation results for import demand equations. All the explanatory variables in all model specifications carry the expected signs. Regarding the real exchange rate misalignment impact, both regressions generated almost similar estimates for elasticity coefficients. In particular, the implied elasticity shows that a 100% depreciation of the real exchange would increase exports only by 0.6%.

The estimated results also allow us to analyze possible implications of the Governments

[14]Recall the Government used an overvalued official exchange rate to tax exporting sectors (cotton and gold production) in order to subsidize imports of capital and priority consumer goods.

Figure 6: Uzbekistan: Actual vs. Predicted Trade Flows



(a) Imports

(b) Exports

Note: 'Predicted values' of imports and exports are calculated assuming that there is no currency rationing policy, volatility and misalignment (dashed line). Source: Author's calculations.

currency rationing policy for dynamics of import and export flows. For this purpose, we predict the real imports using the first model specification with mis_1, and assuming the there is no currency rationing policy, volatility and misalignment. In similar manner, we estimate the predicted real exports. During the period of 1996-2002 the Governments currency rationing policy was lessening the volatility (Figure 6).

6 Conclusions

The present study attempted to produce a quantitative analysis of exchange rate volatilities and misalignment in Uzbekistan for the period of 1994–2005. The econometric estimation strategy consists of three main steps. First step involves computing several alternative proxies of the real exchange volatility. Then in the second we estimate the equilibrium exchange rate and misalignment using a two step Engle-Granger method. We followed Edwards (1989) in using the term "misalignment" to denote the gap between the real exchange rate and the equilibrium exchange rate. Finally, we investigate to which extent, empirically, the real exchange affects foreign trade flows in Uzbekistan.

The results of the analysis suggest that there is clear evidence of exchange rate movements' impact on foreign trade flows in Uzbekistan. Below, we have tried to group the main conclusions drawn from the econometric analysis presented in this study.

1. The determinants of the long run real exchange rate in Uzbekistan. In general the estimated long run parameters of the real exchange rate are consistent with the predictions from theory. In particular, the government consumption has an appreciating impact on the real exchange rate. The effect is particularly strong and significant in the model estimated including the 1996 policy change dummy variable, suggesting that most government spending is directed toward nontradables. Besides, the positive coefficient on this dummy variable is consistent, and confirms that the Government's currency rationing policy substantially appreciated the real exchange rate.

Investment has a negative effect on the real exchange rate, suggesting that an increasing share of investment in GDP shifts spending toward tradable goods in the long term. This shift, other things equal, would depreciate the real exchange rate. For example, the implied elasticity suggests that a 10% increase in the investment share in GDP would depreciate the real exchange rate by at least 1.4%-2.0%. The estimated openness coefficient is positive and significant, suggesting that trade liberalization policy would appreciate the long-run equilibrium real exchange rate in Uzbekistan. Seemingly, this is a theoretically ambitious result, and needs for further research.

2. The real exchange rate misalignment. During the Government's currency rationing policy period (late 1996–2000), our analysis reveals a substantial overvaluation (9% period average) and a widening gap between the actual and the estimated equilibrium real exchange rates. The period from 1999q4 to 2000q4 was , when the estimated overvaluation reached up to 38% in the first quarter of 2000 (25% period average).

The Government managed to reverse substantial real overvaluation by the end of 2002. After several devaluations the real exchange rate was very close to the estimated equilibrium level. In particular, in the fourth quarter of 2002 the real exchange rate was undervalued only by 1%. The average undervaluation of the real exchange rate during the post 2002-year period was equal to 1%.

3. The real exchange rate volatility. The real exchange rate volatility is likely to be an increasing concern for foreign trade policy in Uzbekistan. The implied elasticity suggests that a 10% increase in the volatility would cause a decrease of imports by at least 1.5% – 2.0%. At the same time the results indicate that the Governments currency rationing policy was lessening the volatility proving that the policy-induced changes in exchange rate

has a stabilizing effect on trade flows.

Comparing the fluctuations of the predicted real exchange rate with the fluctuations of the actual real exchange rate allows us to estimate to what extent government policy in particular periods was mitigating the volatility or, on the contrary, increasing this volatility. During the period of 1996-2002 the Governments currency rationing policy was lessening the volatility. On the contrary, gradual liberalization of the foreign exchange and trade regimes, aimed at establishing a realistic and single market rate, led to substantial increase of this volatility (the post 2002 period).

4. Exchange rate variability and trade flows. In most of developing (transition) countries, in particular in Uzbekistan, exchange rate adjustment policy is considered as an essential element of trade policy. Therefore, reasonably accurate and precise estimates of import and export price elasticities can be used by policy advisors and practitioners in applied economic policy analysis, and in designing of development strategies. Following this logic, below we have tried to shed light into possible effects of the real exchange rate movements on export and import flows in Uzbekistan.

The exiting empirical literature concluded that a reasonable range for the aggregate price elasticities of export supply tend to be in the range of 1.0 to 2.0. In our case, the estimated price elasticity for Uzbek economy ranges from 1.65 to 1.84 (with the period average of 1.77) implying a considerable magnitude of the potential response of aggregate exports to the real exchange variability.

We also computed 'indicative' price elasticity range for the period of the Government's currency rationing policy (1.24 – 1.57 with the period average of 1.45). These relatively lower elasticities indicate that due to Government's restrictive export policy large devaluations, most likely, did not generate the expected improvements in the overall export performance.

We also provided an empirical evidence of negative impact of the Government's 1996 measures on exports. As it was expected the 1996 policy change had a negative impact on export volumes, and increased imports. The implied elasticity shows that a 100% depreciation of the real exchange would lead to little impact on both imports and exports, and would decrease (increase) imports (exports) only by 0.7% (0.6%).

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