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**EXCHANGE RATE IN A RESOURCE-BASED ECONOMY IN THE SHORT-TERM:  
THE CASE OF RUSSIA**

**Vladimir Popov<sup>1</sup>**

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**ABSTRACT**

What should be the appropriate macroeconomic policy to minimize the volatility of output in a resource-based economy, i.e. in an economy that is highly dependent on export of resources with very volatile world prices? This paper examines the sources of volatility of output in Russia as compared to other countries and concludes that in 1994-2004 volatility of Russian growth rates was mostly associated with internal monetary shocks, rather than with external terms of trade shocks.

In all countries that export resources with highly volatile prices, like Russia, volatility of economic growth is associated with volatility of RER, which in turn is mostly caused by the inability to accumulate enough foreign exchange reserves (FOREX) in central bank accounts and in stabilization funds (SF). However, in Russia, volatility of RER and GDP growth rates in recent 10 years was associated not so much with objective circumstances (terms of trade – TT – shocks), but with poor macroeconomic policies – despite intuition, volatility of real exchange rate (RER) was caused mostly by internal monetary shocks rather than by external terms of trade shocks.

It is argued that the good (minimizing volatility) macroeconomic policy for Russia would be (1) not to generate monetary shocks (2) to cope with inevitable external shocks via changes in FOREX and SF, while keeping the RER stable.

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# EXCHANGE RATE IN A RESOURCE-BASED ECONOMY IN THE SHORT-TERM: THE CASE OF RUSSIA

Vladimir Popov

## 1. The problem: options for managing external shocks

Usually the issue of the exchange rate in a resource based economy is discussed in the framework of the Dutch disease model – the overvaluation of the exchange rate that undermines non-resource exports and has negative implications for economic growth. Russia definitely developed a Dutch disease prior to the currency crises of 1998 (Montes, Popov, 1999; Popov, 2003a,b) and developed it again recently (the real exchange rate in 2005 exceeded the pre-crisis level of 1998). This paper, however, deals with a different issue – the short term adjustment of the resource based economy to changes in terms of trade. The long run equilibrium level of the real exchange rate and the policy to influence it via foreign exchange reserves accumulation (disequilibrium exchange rate) is a separate issue that is considered elsewhere (Polterovich, Popov, 2004).

*Back of the envelope calculations.* Russia exported in 2005 about 150 million tons of oil and 150 billion cubic meters of gas worth about \$100 billion (all numbers are rounded for simplicity). The price of oil and gas varied greatly – only in recent decade oil prices went from \$10 to over \$60 a barrel (\$70 to \$400 a ton), and gas price changed accordingly – they are strongly correlated with oil prices. Imagine a pretty bad (for Russia), but not totally unrealistic scenario – oil prices would drop to \$10 a barrel and would stay at this level for 5 years. Annual Russian revenues from exports of hydrocarbons would fall to about \$20 billion instead of \$100 billion, so that in 5 years there would accumulate a \$400 billion shortfall (Russian GDP at official exchange rate in 2005 totaled about \$600 billion). How could Russia adjust to such a negative trade shock (deterioration in terms of trade)?

There are basically three options for the country dependent on export/import of commodities with highly volatile prices to cope with terms of trade (TT) shocks: (1) to adjust by importing/exporting capital, (2) to carry out adjustment via changes in foreign exchange reserves (FOREX) and/or Stabilization Fund (SF) with appropriate sterilization and without changing real exchange rate (RER), (3) to adjust via changes in RER (allowing either an adjustment of nominal exchange rate or a change in money supply altering the rate of inflation). The first two mechanisms (assuming other good macroeconomic policies) are not associated with the adjustment in real trade flows and hence do not entail adjustments in the real sector of the

economy because the RER remains stable. The third mechanism implies that the volumes of export and import change in response to changes in RER, hence the real sector of the economy also responds (output changes).

*Option #1: Borrowing abroad to dampen the negative trade shock.* Private international capital flows are volatile and do not mitigate fully fluctuation in terms of trade. They seem to be procyclical, rather than countercyclical – when terms of trade deteriorate, capital flees the country instead of coming in. The empirical evidence suggests that this is true for most countries and in particular – for Russia. So, in fact, private capital flows add insult to injury and reinforce the terms of trade shocks. Official capital flows are counter-cyclical with respect to terms of trade shocks – international financial institutions, such as IMF and World Bank, and national governments provide additional credits to countries affected by negative trade shocks, but the amounts are too small, if not to say negligible, to fully counter the negative impact of deterioration of the balance of payments caused by the fall in export prices and the outflow of private capital. Suffice it to recall the role of international financial institutions in recent currency crises in the world – in East Asian countries in 1997, in Russia in 1998, in Brazil in 1999, in Argentina in 2002: in all these cases the official capital flows were by far not enough to counter the effects of private capital flight. So long as the international financial architecture remains as it is, countries are basically left to themselves to manage shocks that affect their current and capital accounts. In the Russian case it is unreasonable to expect that a country would be able to borrow in just several years funds abroad comparable to the size of its GDP.

*Option #2. Running down foreign exchange reserves and stabilization fund.* Foreign exchange reserves and stabilization funds, if they are large enough, provide a reliable cushion to dampen the impact of negative trade and capital flows shocks. However today among major resource exporters only Norway (oil exporter) and Botswana (diamond exporter) may have enough money in FOREX and SF (more than their annual GDPs) to counter fully the impact of volatile prices for resources and capital movements. By the end of 2005, Russia had about \$180 billion in FOREX, including \$30 billion in SF – this is definitely a tangible amount (1/3 of GDP), but at least twice as much is needed to survive the “rainy day”. One of the central arguments of this paper is that under the current circumstances Russia needs a larger Stabilization Fund.

*Option #3: Real devaluation.* Putting aside part of the GDP into FOREX and SF is costly, even more so that this money should be invested in short-term low risk and hence low yield securities abroad. This is exactly the reason, why current Russian policy of building up FOREX and SF

faces heavy criticism at home and abroad: why not use this money for the improvement of health care and education, for helping the poor and for investment into ailing infrastructure (the list could be continued, of course), say the critics. The counter-argument, however, is no less powerful: if there is no cushion in the form of FOREX and SF, the only way to cope with the negative trade shock and the associated outflow of capital is to devalue the real exchange rate. When oil prices fall and capital flees, the deteriorating balance of payments could be remedied only by nominal exchange rate devaluation (in case of floating exchange rate) or (in case of fixed rate) by the slow down of growth of money supply (due to reduction of FOREX that is not sterilized; if it is sterilized, the balance of payments will not get back to the equilibrium, so FOREX would eventually be depleted). In both cases the result is the real devaluation of the national currency, i.e. the decrease of the ratio of domestic prices (expressed in foreign currency) to foreign prices. Such a real devaluation is a bad policy because it inevitably causes adjustments in the real sector and these adjustments are by definition temporary.

Suppose oil prices fall and the ruble is devalued to keep the balance of payments in the equilibrium. For oil producers the positive impact of devaluation neutralizes the negative impact of falling oil prices, but for other producers of tradable goods (machinery, for instance) real devaluation means higher prices and profits, so there is a reallocation of resources (capital and labor) from oil to machinery sector. The problem is that this reallocation is *temporary* because after some time oil prices will rise and resources should flow in the opposite direction. Inasmuch as oil and gas prices fluctuate around the trend, it does not make sense to change the structure of the economy in response to their fluctuations – this is just too costly. To word it differently, real exchange rate should be as stable as possible; if it fluctuates a lot, this is a definite sign of bad policy that misleads economic agents.

Literature review. The adjustment to external shocks in resource oriented economies were studied extensively in the past. Balassa (1984) decomposed the policy responses to external shocks into four components (foreign borrowing, export expansion, import compression, and slower GDP growth). Auty (1994) argued that East Asian countries (Korea, Taiwan) responded to shocks mainly by export growth and import cuts, so did not experience the growth collapse after these shocks like Latin American countries (Argentina, Mexico) that responded to shocks mainly by increasing their external debt. Implicitly this is an argument in favor of real devaluation that helps to restore growth by promoting export and curbing import. But such a policy comes at a price – real devaluation causes reallocation of capital and labor and thus is associated with adjustment costs.

Sosunov and Zamulin (2005) developed and calibrated the model of a resource exporting economy experiencing external terms of trade shocks to study the volatility of output and inflation: the result was that the monetary policy rule of responding to inflation and RER fluctuations allows to limit the output-inflation volatility better than the other monetary policy rules. Vdovichenko and Voronina (2004) showed that in 1999-2003 the central bank of Russia (CBR) actually did not follow meticulously the proclaimed targets of fighting inflation. In regulating money supply it also took into account changes in output (the deviation of actual output from trend) and changes in real exchange rate. The authors estimated separate equations for interventions (change in foreign exchange reserves) and sterilization (change in net domestic credit). It turned out that the accumulation of reserves accelerated when the RER appreciated, but it was not influenced by changes in output and prices. On the contrary, sterilization operations were influenced by the behavior of output and prices. Because the appreciation of the RER has a suppressing effect on output and prices, it means that by trying to limit the real appreciation of the ruble via reserve accumulation the CBR was de facto trying to support output at the expense of inflation.

There are a number of studies of exchange rate misalignment and volatility in various countries (), as well as studies that use decomposition technique from the paper by Blanchard and Quah (1989) that analyzed the fluctuations of real GDP (supply and demand shocks, demand shocks were treated as temporary, i.e. assumed to have no effect on real GDP in the long run). These studies, however, are based on a certain assumptions about the nature of the impact of supply and demand shocks and about the equilibrium long term real exchange rate that are often difficult to justify. In particular, the assumption that nominal shocks (nominal money supply) does not affect the real exchange rate in the long run, i.e. may have only transitional impact on real exchange (this assumption is needed to close the BVAR model) does not appear to be very reasonable. It may be appropriate for more mature market economies, but not for transition economies especially for a relatively short (several years) period of time. In transition economies, especially in resource rich countries, prices for quite a number of goods are controlled by the government – these prices do not change in response to changes in money supply; hence the ratio prices of tradables to non-tradables (with controlled prices) and thus real exchange rate may react even in the long run to changes in money supply.

This paper makes no special *ex ante* assumptions on the nature of shocks and the long term equilibrium real exchange rate. It is an empirical study of factors that influence output volatility –

how terms of trade shocks and internal monetary shocks are mitigated/reinforced by the specific macroeconomic policies, i.e. monetary and exchange rate policy, including sterilization of changes in money supply. In the next section 2, the evidence from cross-country regressions, explaining volatility of output, is presented. Section 3 compares this evidence with the stylized facts derived from regressions on Russian time series: it turns out that in both cases volatility of GDP growth rates is linked to the volatility of RER, but in Russia, unlike in other countries, sterilization policy of the central bank increases the volatility of output. In section 4 a possible explanation for the identified puzzle is suggested: as improbable as it sounds, it seems like the volatility of Russian GDP growth rates resulted in 1994-2004 mainly from internal monetary shocks, not from the terms of trade shocks. Finally section 5 concludes and discusses policy implications.

## **2. Adjustment to external shocks: evidence from cross-country regressions**

Would a particular country be willing to reduce volatility at the expense of lowering the long term growth rate, if there is a tradeoff between volatility and growth? Fortunately, there is no such a trade off. As many studies have documented (see Aghion, Angeletos, Banerjee, Manova, 2004 for a recent survey of the literature) the relationship between volatility and growth is negative, i.e. rapid growth is associated with lower volatility. This result holds, if one compares fast and slow growing countries, as well as periods of fast and slow growth/recessions in the same country. So policies to promote growth, if successful, are likely to reduce volatility as well, even though the mechanism of such spin-off is not well understood. Nevertheless, volatility of macro variables cannot be totally explained by their growth rates: even controlling for the average speed of change, there remain huge variations in volatility in various countries and periods.

*Volatility of GDP is associated with external trade shocks.* In the first approximation, volatility of GDP growth rates is caused by external trade shocks. As the chart below suggests, there is a positive correlation, albeit not a strong one, between volatility of trade/GDP ratio and volatility of GDP itself: countries with greater volatility of trade experience normally higher volatility of growth.

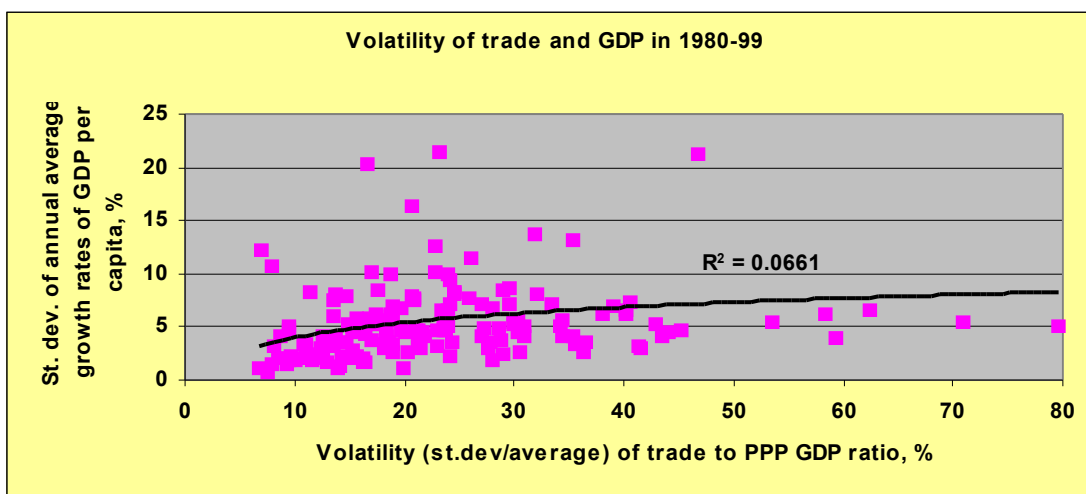
In turn, volatility of trade is greater in poorer countries and resource exporting countries:

$$\text{Trade volatility} = 27.6 - 0.001 * Y_{cap75} - 0.25 * \text{Net Fuel Import},$$

(Adjusted R2 = 25%, N=105, all coefficients significant at 1% level),

where:

Trade volatility - standard deviation of external trade to PPP GDP ratio in 1980-99, %,  
 Ycap75 – PPP GDP per capita in 1975, \$,  
 Net Fuel Import - Net fuel imports, % of total imports, average for 1975-99.



As regressions presented later (table 2) suggest, volatility of GDP is in fact linked positively to the volume of external trade and its volatility, even if we control for the initial level of development (PPP GDP per capita in 1975 – volatility is greater in less developed countries) and average growth rates (rapidly growing countries have lower volatility of growth rates).

Overall, initial conditions (level of development and average growth rates) and external factors (share of trade in GDP, volatility of the terms of trade) and the way the country manages external volatility (fluctuations of real exchange rate and foreign exchange reserves) explain at least 50% of the aggregate GDP volatility, as the following regression suggests:

$$\text{GDPvol} = \text{CONST.} + \text{CONTR.VAR.} + 0.02\text{TR/Y} + 0.04\text{TTvol} + 1.51\text{RERvol} + 2.46\text{FOREXvol}$$

(Robust estimate,  $R^2 = 47\%$ ,  $N=80$ , all coefficients significant at 10% level or less), where:

GDPvol – standard deviation of annual growth rates of GDP per capita in 1975-99, %,  
 TR/Y – average ratio of external trade to PPP GDP in 1980-99 (no data for 1975-80),  
 TTvol – standard deviation of the terms of trade index for the period of 1975-99, %  
 RERvol – coefficient of variation of real exchange rate (standard deviation of real exchange rate to the dollar in 1975-99 divided by the average real exchange rate)  
 FOREXvol – coefficient of variation (standard deviation to average ratio) of foreign exchange reserves to GDP ratio for 1975-99 period,

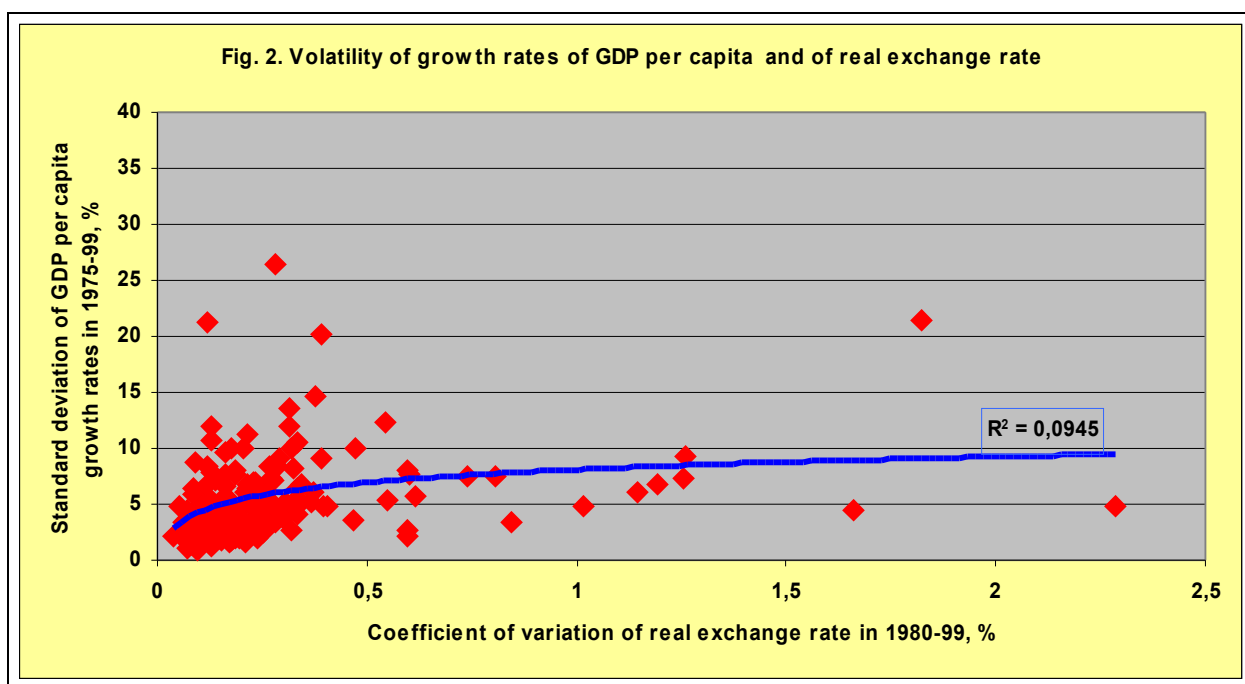


Control variables - PPP GDP per capita in 1975, \$, and annual average growth rates of GDP per capita in 1975-99, %.

Not a single variable in this regression is strongly correlated with another ( $R < 50\%$ ), in particular, despite intuition, volatilities of terms of trade (TT), real exchange rate (RER) and foreign exchange reserves (FOREX) are correlated very poorly ( $R < 20\%$ ). That is to say, that the volatilities of all three variables (TT, RER, FOREX) contribute largely independently to greater GDP volatility. It is argued below that the impact of terms of trade shocks on aggregate volatility depends on the way the country manages the shock – by changing FOREX with sterilization and keeping RER stable or by allowing the RER to change (FOREX change without sterilization leading to changes in domestic prices or change in nominal exchange rate).

The impact of external trade shocks on volatility of GDP depends on the dynamics of real exchange rate. As was argued above, countries where changes in terms of trade are absorbed by the fluctuations in foreign exchange reserves (rather than by the fluctuations of the real exchange rate) cope with the trade shocks better than countries where changes in foreign exchange reserves do not follow changes in terms of trade.

In fact, volatility of RER (coefficient of variation, i.e. standard deviation divided by the average) is closely related to the volatility of GDP growth rates (standard deviation) – see chart below:



It may be difficult for poor countries to respond to all negative trade shocks and to outflows of capital via changes in reserves, because these foreign exchange reserves are limited (Fanelli, 2005, p.17). However, there is at least an option of mitigating positive trade shocks and inflows of capital via accumulation of reserves. Some countries apparently try to pursue this type of policy.

Three options of managing TT shocks under different exchange rate regimes are summarized in table 1. Under fixed exchange rate with no sterilization (crawling peg is also regarded as fixed rate, since we are interested in volatility, i.e. deviations from trend), nominal exchange rate is stable, but domestic inflation accelerates when FOREX expands due to positive trade shock, so RER appreciates. Under floating rate, positive TT shock causes the appreciation of nominal exchange rate, which leads to the appreciation of RER. And only under fixed exchange rate regime (including crawling pegs and dirty floats with nominal rate following a stable trend) with full sterilization of money supply changes resulting from FOREX fluctuations due to TT shocks, RER can remain relatively stable – because all TT shocks are absorbed by increase/decrease in FOREX that are fully sterilized.

**Table 1. Options for managing the terms of trade shock for resource exporting country**

Patterns of change in variables // Exchange rate and macro regime	FOREX	Nominal exchange rate	RER	Correlation between			
				FOR-M	TT-FOREX	TT-RER	FOR-RER
<b>EXTERNAL SHOCKS</b>							
Fixed exchange rate without sterilization (currency board)	VOLAT	STABLE	VOLAT (prices)	HIGH	HIGH	HIGH	HIGH
Fixed exchange rate with sterilization	VOLAT	STABLE	STABLE	0	HIGH	0	0
Clean float	STABLE	VOLAT	VOLAT (nom. rate)	HIGH	0	HIGH	0

The empirical evidence (Popov, Peresetsky, Polterovich, 2005) suggests that volatility of RER (coefficient of variation, i.e. standard deviation divided by the mean) was closely related to the volatility of GDP growth rates (standard deviation) for a large sample of countries in 1975-1999. It also suggests that countries where changes in terms of trade are absorbed by the fluctuations in foreign exchange reserves (rather than by the fluctuations of the real exchange rate) cope with

the trade shocks better than countries where changes in foreign exchange reserves do not follow changes in terms of trade:

$$\text{GDP volatility} = \text{CONST.} + \text{CONTR.VAR.} + \text{Trade Volatility} * (0.002\text{TR/Y} - 0.04 \text{TT\_FORcorr})$$
  
(Adjusted R<sup>2</sup> = 41%, N=66, all coefficients significant at 10% level or less), where:

Trade volatility - standard deviation of trade to PPP GDP ratio in 1980-99, %,

TR/Y – average ratio of external trade to PPP GDP in 1980-99 (no data for 1975-80),

TT\_FORcorr – correlation coefficients between the index of terms of trade and the ratio of foreign exchange reserves to GDP, calculated for the period of 1975-99,

Control variables - PPP GDP per capita in 1975, \$, and annual average growth rates of GDP per capita in 1975-99, %.

The equation suggests that, if the correlation coefficient is positive (i.e. reserves move in line with the terms of trade), volatility of GDP is lower. But if correlation coefficient is negative (i.e. reserves move in the direction opposite to changes in terms of trade), the volatility of GDP increases. To test the robustness, more cross-country regressions are presented in table 2. It turns out that countries that carried out reasonable macroeconomic policies (accumulated foreign exchange reserves in good times and spent them during “rainy days”) were able to lower the volatility of GDP growth rates.

There is an additional complication, though. High correlation between changes in TT and FOREX is a necessary, but not a sufficient condition for coping with terms of trade shocks in such a way they do not lead to greater volatility of GDP growth rates. Suppose a country responds to the positive TT shock by accumulating FOREX (i.e. carries out “good” policy), but this is not enough to prevent an appreciation of RER. Such a situation always occurs in countries with currency boards (dollarized economies as well): FOREX increase in response to improvement of TT, money supply expands, prices increase and RER appreciates. But similar mechanism can also operate under fixed exchange rate arrangements or dirty float, if there is no complete sterilization of changes in money supply, resulting from changes in FOREX caused by TT shocks. Hence, because any volatility in RER contributes to the volatility of GDP growth rates, it could be expected that when RER moves in line with FOREX (even though the correlation between TT and FOREX is high), volatility of GDP increases.

Changes in nominal rate occur quicker than price changes, hence RER can be more volatile under cleanly floating exchange rates as compared to currency boards. But if RER changes due to nominal rate adjustment, price ratios (between tradables and non-tradables) adjust instantly and the volatility of output may be lower than in case of the adjustment of RER due to fluctuations in money supply resulting from FOREX fluctuations and imposing pressure not only on prices, but on output as well. Since most countries with currencies of their own exercise dirty floats and carry out some degree of sterilization, this argument is consistent with the findings of Edwards and Magendo (2003): they find that dollarized economies and currency unions have higher volatility than countries with a currency of their own. Our argument, though, is a bit different: among countries with currencies of their own external shocks are best dampened (evened out, mitigated) when FOREX absorb completely TT shocks, and fluctuations of FOREX are completely sterilized, so that RER stays stable.

Cross-country regressions support the logical prediction: given the certain level of the correlation between TT and FOREX, the volatility of GDP growth rates is the higher in countries with low correlation between FOREX and RER and high volatility of RER (table 2). Consider equation 1:

$$\text{GDPvol} = \text{CONST.} + \text{CONTR.VAR.} + \text{Trade Volatility} * (0.005 \text{TR/Y} * \text{RERvol} - 0.036 \text{TT\_FORcor})$$

(Robust estimate,  $R^2 = 46\%$ ,  $N=66$ , all coefficients significant at 10% level or less), where:

Trade volatility - standard deviation of trade to PPP GDP ratio in 1980-99, %,

TR/Y – average ratio of external trade to PPP GDP in 1980-99 (no data for 1975-80),

TT\_FORcor – correlation coefficients between the index of terms of trade and the ratio of foreign exchange reserves to GDP, calculated for the period of 1975-99,

Control variables - PPP GDP per capita in 1975, \$, and annual average growth rates of GDP per capita in 1975-99, %.

This equation explicitly suggest that for a country with given GDP per capita and average growth rates, and with given degree of dependence on external trade (trade to GDP ratio) and volatility of external trade, the volatility of GDP growth can be reduced via policies that stabilize RER via fluctuations of FOREX in line with the fluctuations in TT. Consider now equation 5 from table 2:

**Table 2. Factors explaining volatility (correlation between TT and FOREX and RER and FOREX) – cross country regressions for 1975-99 (T-statistics in brackets)**

Dependent variable	Standard deviation of annual GDP per capita growth rates, %				
	1	2	3	4	5
Equations	1	2	3	4	5
Number of observations	66	66	66	66	67
PPP GDP per capita in 1975, \$	-.0005 *** (-4.94)	-.0005 *** (-4.02)	-.0004 *** (-4.01)	-.0004 *** (-4.01)	-.0004 *** (-3.11)
Annual average growth rates of GDP per capita in 1975-99, %	-.40*** (-2.56)	-.41*** (-2.87)	-.38*** (-2.74)	-.33** (-2.33)	-.34** (-2.61)
(Average ratio of trade to PPP GDP in 1980-99) x (Standard deviation of trade to PPP GDP ratio in 1980-99)		.001*** (4.47)	.001*** (4.09)		
Average ratio of trade to PPP GDP in 1980-99					.002** (2.18)
Correlation coefficient between the index of terms of trade and the ratio of FOREX to GDP in 1975-99			-1.35 *** (-2.81)	-1.10 ** (-2.19)	-.97* (-1.75)
Correlation coefficient between the real exchange rate to the dollar and the ratio of FOREX to GDP in 1975-99			.93** (2.17)		1.11** (2.42)
(Correlation coefficient between the real exchange rate to the dollar and the ratio of FOREX to GDP in 1975-99)x(Standard deviation of trade to PPP GDP ratio in 1980-99)		.04* (1.96)	.64 (1.41)		
(Standard deviation of trade to PPP GDP ratio in 1980-99, %) x (Correlation coefficient between TT and the ratio of FOREX to GDP in 1975-99)	-.004** (-1.84)	-.006** (-2.47)			
Standard deviation of trade to PPP GDP ratio in 1980-99, %)x(Correlation coefficient between TT index and the ratio of FOREX to GDP in 1975-99)x(Coefficient of variation of RER to the dollar in 1975-99)	.005 *** (5.91)				
Standard deviation of trade to PPP GDP ratio in 1980-99, %)x(Average ratio of trade to PPP GDP in 1980-99)x(Coefficient of variation of RER to the dollar in 1975-99)				.004 *** (3.68)	
TTvol – standard deviation of the index of terms of trade in 1975-99					.004 (1.58)
FORvol – coefficient of variation of the ratio of FOREX to GDP		1.99* (1.66)	2.03* (1.74)	2.02* (1.71)	2.46** (2.01)
Constant	5.4*** (11.37)	4.5*** (5.45)	4.5*** (5.46)	4.4*** (5.17)	3.6*** (3.72)
R <sup>2</sup> , %	46	49	49	49	50

\*, \*\*, \*\*\* - Significant at 10%, 5% and 1% level respectively.

$$\text{GDP}_{\text{vol}} = \text{CONST.} + \text{CONTR.VAR.} + 0.24\text{TR/Y} + 0.044\text{TT}_{\text{vol}} + 2.46\text{FOR}_{\text{vol}} - 0.97\text{TT\_FOR}_{\text{cor}} + 1.11\text{RER\_FOR}_{\text{cor}}$$

(Robust estimate, R2 = 50%, N=67, all coefficients significant at 10% level or less, except TTvol coefficient which is significant at 12% level), where:

TTvol – standard deviation of terms of trade index, %,

TR/Y – average ratio of external trade to PPP GDP in 1980-99 (no data for 1975-80),

TT\_FORcorr – correlation coefficients between the index of terms of trade and the ratio of foreign exchange reserves to GDP, calculated for the period of 1975-99,

RER\_FORcor – correlation coefficient between real exchange rate and FOREX,

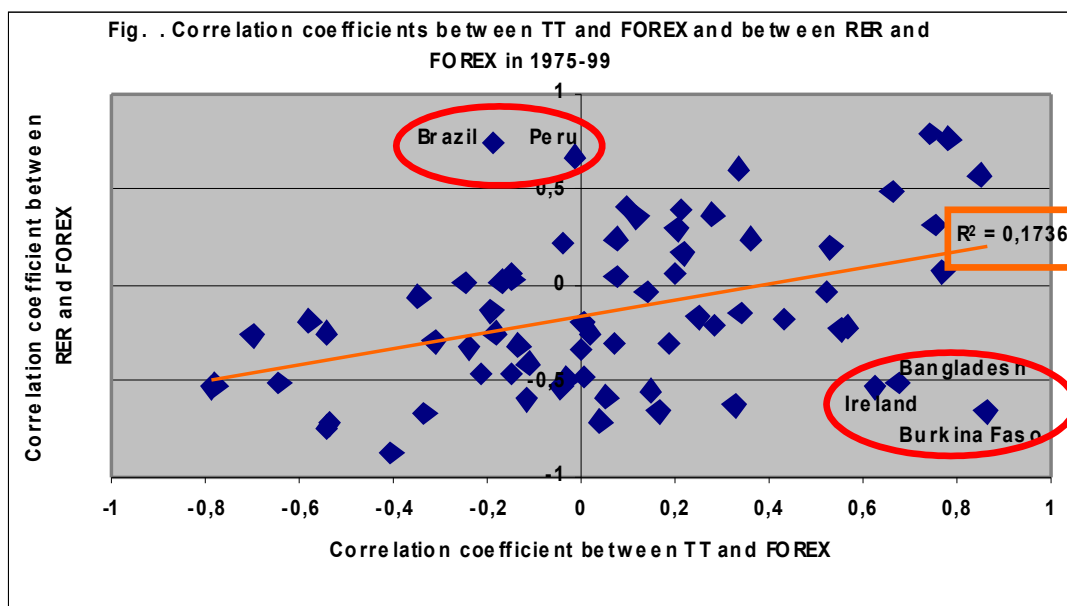
FORvol – coefficient of variation (standard deviation to average ratio) of foreign exchange reserves to GDP ratio for 1975-99 period,

Control variables - PPP GDP per capita in 1975, \$, and annual average growth rates of GDP per capita in 1975-99, %.

The equation suggest that in a country with given level of development and with given growth rates, given trade to GDP ratio and given volatility of trade and capital flows (resulting in the volatility of FOREX), volatility of economic growth can be reduced by policies of responding to TT shocks via FOREX fluctuations that prevent RER from fluctuating together with FOREX (low correlation between the movement of RER and FOREX).

In fact, the these two correlation coefficients – that between TT and FOREX, and that between RER and FOREX – are closely correlated themselves (see chart below ) suggesting that most countries, when faced with a TT shock respond not only by adjusting their foreign exchange reserves, but also by changing the real exchange rate of their currency in the same direction. The point is that countries that *completely* absorbed TT shocks through changes in FOREX (so correlation between TT and FOREX was high) and prevented their RER from fluctuating together with TT and FOREX (so that the correlation between FOREX and RER was low) experienced less volatility than the others. On the chart below the extreme cases are that of Bangladesh, Burkina Faso and Ireland – these countries had high TT–FOREX correlation and low RER–FOREX correlation and experienced low volatility of growth (standard deviation of GDP per capita growth rates in 1975-99 are 2.7%, 3.7% and 3.2% respectively). The other extreme points are Brazil and Peru, which responded to TT shocks not via changes in FOREX (low TT–FOREX correlation), but via changes in RER (high RER–FOREX correlation), and

hence experienced high volatility of growth (standard deviation of GDP per capita growth rates in 1975-99 are 4.5% and 7.4% respectively).



To test this hypothesis explicitly a variable for sterilization (correlation coefficient between FOREX to GDP ratio and M2 to GDP ratio) was introduced into the right hand side of the equation – the higher this coefficient, the lower is sterilization of changes in the money supply resulting from the fluctuations of FOREX. The resulting equation is given below (it is equation 5 from table 2, but with additional sterilization variable; it is not shown in table 2):

$$\text{GDPvol} = \text{CONST.} + \text{CONTR.VAR.} + 0.24\text{TR/Y} + 0.044\text{TTvol} + 2.44\text{FORvol} - 1.65\text{TT\_FORcor} + 1.23\text{RER\_FORcor} + 1.02\text{M\_FORcor}$$

(N=58, R2=47, all coefficients significant at less than 8% level, except for TTvol coefficient, which is significant at 13% level), where:

Control variables - PPP GDP per capita in 1975, \$, and annual average growth rates of GDP per capita in 1975-99, %,

M\_FOR cor – no-sterilization variable, correlation coefficient between FOREX to GDP ratio and M2 to GDP ratio in 1975-99, and all other notations are same as before.

It turns out that countries that were carrying out sterilization policies (low M\_FORcor), while responding to TT shocks via changes in FOREX (high TT\_FORcor) and not allowing the RER to fluctuate together with FOREX (low RER\_FORcor), were most successful in reducing volatility of their economic growth.

Similar results can be obtained for explaining the volatility of RER:

$RER_{vol} = 0.42 + 0.29FOR\_RER_{cor} - 0.27TT\_RER_{cor} - 0.26TT\_FOR_{cor} + 0.017FOR\_M_{cor}$   
(Robust estimates, N=59, R2=28, all coefficients significant at less than 6% level, except for coefficient of FOR\_M2cor that is insignificant), where all notation are same as before.

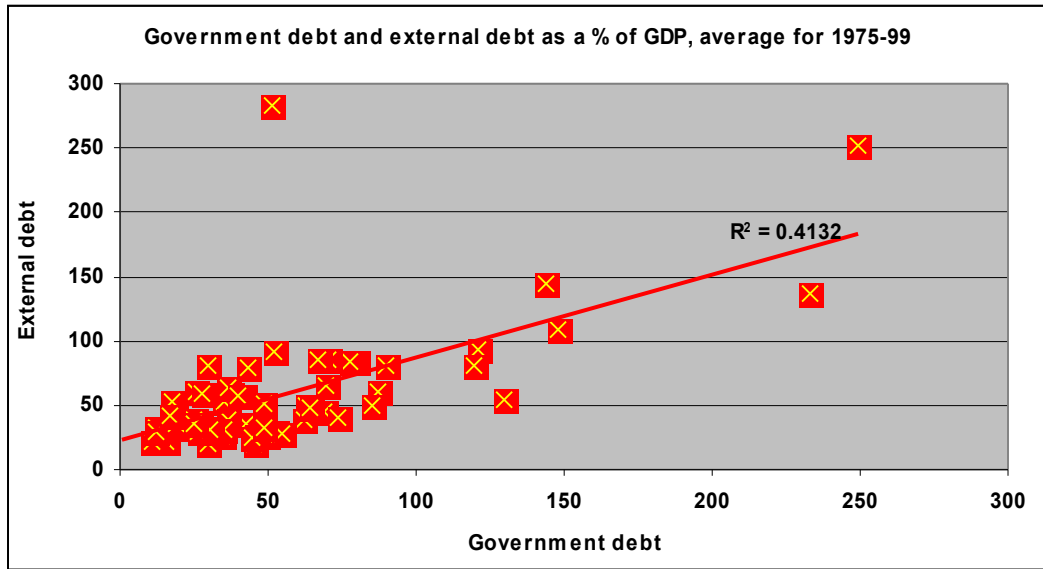
It turns out that the volatility of RER is linked positively (although not significantly) to the correlation between FOREX and M2 (no sterilization indicator), positively and significantly to the correlation coefficient between FOREX and RER (suggesting that volatility of RER is higher, when, for instance, accumulation of FOREX cannot prevent the appreciation of RER), but it is linked negatively to the correlation coefficients between TT and FOREX (it is high, when changes in FOREX do not absorb fully the TT shock, so RER changes) and between TT and RER (suggesting, probably, that when RER changes without TT shocks, i.e. due to domestic shocks, this correlation coefficient is low and volatility of RER is high).

Large government debt and external debt contribute to greater volatility. It appears that the response to a negative terms of trade shock via external debt accumulation, even if such an option is feasible (i.e. even if capital is not fleeing the country in bad times), helps to maintain the growth rate only temporarily, but increases the volatility of output in the longer term. Why capital is fleeing the country in times of the greatest need, i.e., when a country experiences an adverse trade shock? There may be several explanations that are tested below:

- (1) large government debt prohibits the authorities from borrowing more money in the international capital markets,
- (2) large external debt prohibits the private agents from borrowing more money in the international capital markets in bad times,
- (3) herd behavior of international investors that pull the money out of the country experiencing negative trade shock: even though this country's government debt and external debt are low, the credit rating of a country deteriorates because of its reduced ability to earn foreign currency and service its debt.

The evidence below suggests that all three factors played a role. Government debt and external debt are strongly correlated (see chart below), but not necessarily because government debt is mostly to foreigners or because external debt consists largely of the government debt.





With respect to government debt, it looks like the volatility is higher, when the debt is higher, irrespective of the external debt:

$$\text{GDP volatility} = \text{CONST.} + \text{CONTR.VAR.} + \text{TRvol} * (0.001\text{TR/Y} - 0.04\text{TT\_FORcor} - 0.003\text{M1/Y} + 0.0004\text{GD/Y})$$

(Adjusted R2 = 42%, N=52, all coefficients significant at 10% level or less), where:

M1/Y – the ratio of M1 to GDP in 1998, % (to control for the monetization of the economy that helps to absorb shocks),

INVcl – investment climate index from ICRG (ranges from 0 to 100%, the higher the better the climate),

GD/Y – average ratio of the government debt to GDP in 1975-99, %

Because the government debt is quite correlated with external debt, both variables cannot be introduced into the right hand side of the equation simultaneously. It is interesting to note, though, that substituting government debt for the external debt yields similar results:

$$\text{GDP volatility} = \text{CONST.} + \text{CONTR.VAR.} + \text{TRvol} * [0.001\text{ED/Y} + \text{TT\_FORcor}(0.006\text{Ycap75} - 0.001\text{INVcl} - 0.001\text{M2/Y})]$$

(Adjusted R2 = 42%, N=42, all coefficients significant at 10% level or less), where:

Control variables - PPP GDP per capita in 1975, \$, and annual average growth rates of GDP per capita in 1975-99, %,

ED/Y – average ratio of the government debt to GDP in 1975-99, %

The final result thus is the negative impact of all three factors on volatility of growth rates of GDP – worse investment climate (that worsens in times of adverse trade shocks and lowers the credit rating), larger external debt and government debt limit possibilities for external financing forcing countries in trouble to adjust to shocks via changes in RER and hence real restructuring.

Private capital flows contribute to greater volatility instead of mitigating it. It is shown in Fanelli, (2005, p. 19) that “a close relationship between the volatility of imports and exports exists in the case of both high-income and developing countries, although the volatility of imports tends to be higher than the volatility of exports in many countries, suggesting that the bulk of macroeconomic fluctuations fall on imports. This suggests that imports and exports are correlated and is consistent with the Feldstein-Horioka puzzle (Feldstein and Horioka, 1980) according to which financial market imperfections are present all around the world and impede that countries generate large current account deficits.....These countries tend to induce severe cuts in domestic absorption – and therefore in imports – when they face a fall in export revenues (due, for example, to a fall in the terms of trade). The credit constraints in international credit markets make the bulk of the necessary adjustment fall on current absorption rather than allowing it to be distributed over time” (Fanelli, 2005, p. 19).

It is also explicitly tested whether the inflows of capital (“fresh money” indicator equal to the difference between the reserve accumulation and the result of the trade account) contribute to consumption volatility (CONSVol) after controlling for GDP volatility and TT volatility: it turns out that all coefficients are significant and have the correct sign (Fanelli, 2005, p.32):

$$\text{CONSVol} = -0.02 + 0.76\text{GDPvol} + 0.32\text{TTvol} + 0.13\text{FRESH MONEY}$$

(N= 66, R2=66, all coefficients significant at 1% level, White heteroskedasticity-consistent standard errors & covariance).

Running cross-country regressions with another indicator – private capital flows as a % of GDP – yields similar results:

$$\text{GDPvol} = \text{CONST.} + \text{CONTR. VAR.} + \text{TRvol} * (0.0004\text{GD/Y} + 0.005\text{CF/Y} - 0.04\text{TT\_FORcor} - 0.002\text{M1/Y})$$

(N=52, R2=43%, all coefficients significant at 10% or less),

and

$$\text{GDPvol} = \text{CONST.} + \text{CONTR.VAR.} + \text{TRvol} * [0.007\text{CF/Y} + \text{TT\_FORcor}(0.005\text{Ycap75} - 0.001\text{INVcl}) - 0.001\text{M2/Y} + 0.0004\text{ED/Y}]$$

(N=42, R2=65%, all coefficients significant at 10% or less, except for the interaction term between external debt and trade volatility, which is significant only at 12.5%),

and

$$\text{GDPvol} = 4.1. + \text{TRvol} * [\text{TT\_FORcor}(0.005\text{Ycap75} - 0.001\text{INVcl}) + 0.0005\text{ED/Y} - 0.001\text{M2/Y}] + 0.25\text{CF/Y}$$

(Robust estimate, N=42, R2=71%, all coefficients significant at 1% or less), where:

Control variables - PPP GDP per capita in 1975, \$, and annual average growth rates of GDP per capita in 1975-99, %,

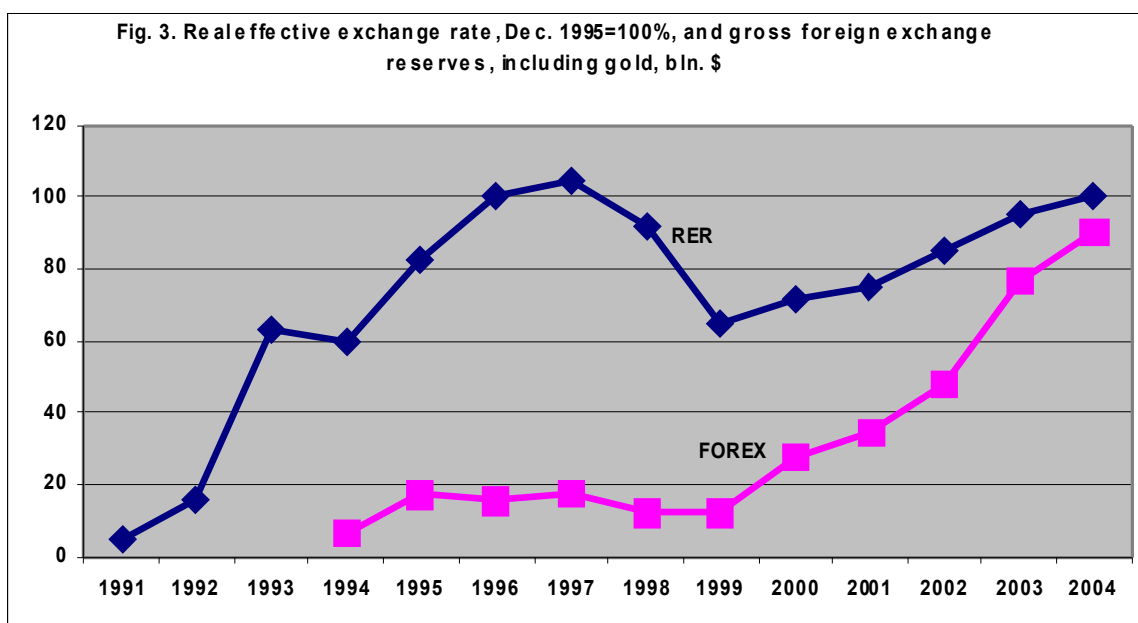
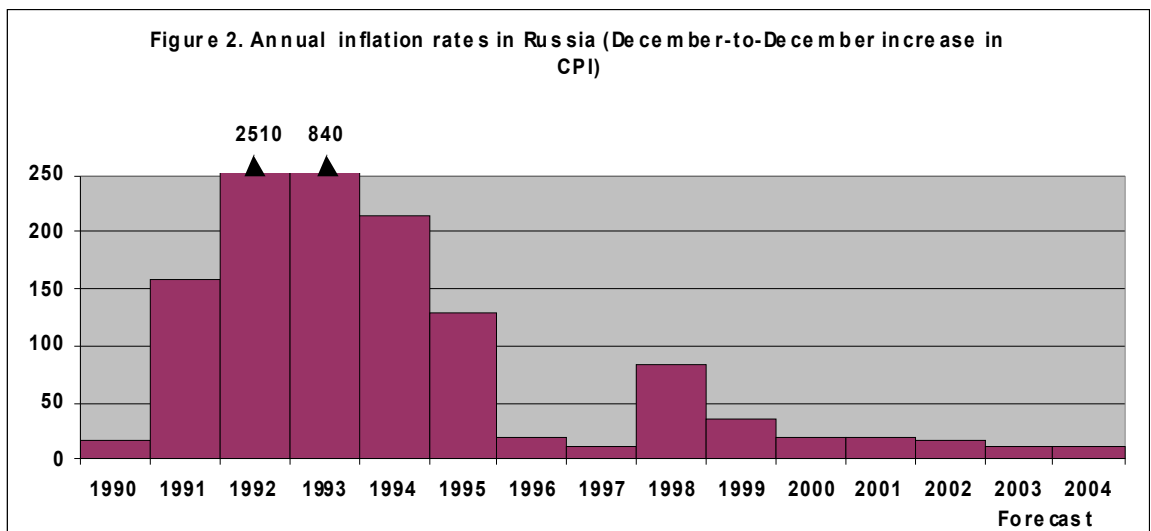
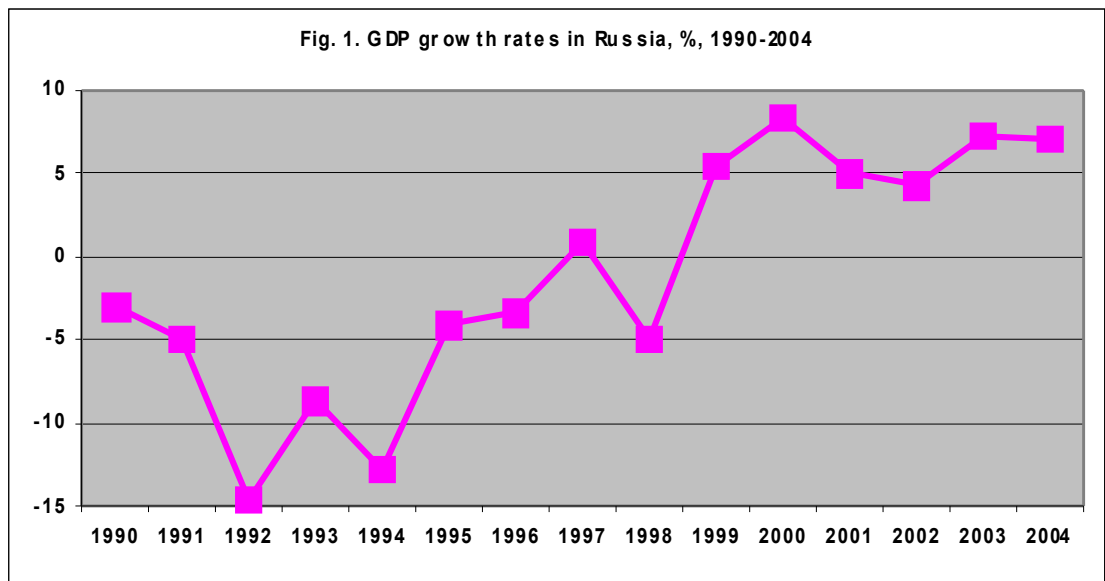
CF/Y – average gross private capital flows (% of PPP GDP in 1975-99) and all other notations are the same.

Thus, private capital flows only “rock the boat” – increase the volatility of output instead of mitigating it – because the deterioration of terms of trade is normally associated with the outflow of private capital, whereas positive trade shocks are accompanied by the inflow of private capital. This is very much true for the Russian case as well – later it is shown that private capital flows and terms of trade move pro-cyclically, and even though official capital flows move in the opposite direction and mitigate somewhat TT shocks, they are by far not enough to counter the pro-cyclical impact of private capital flows.

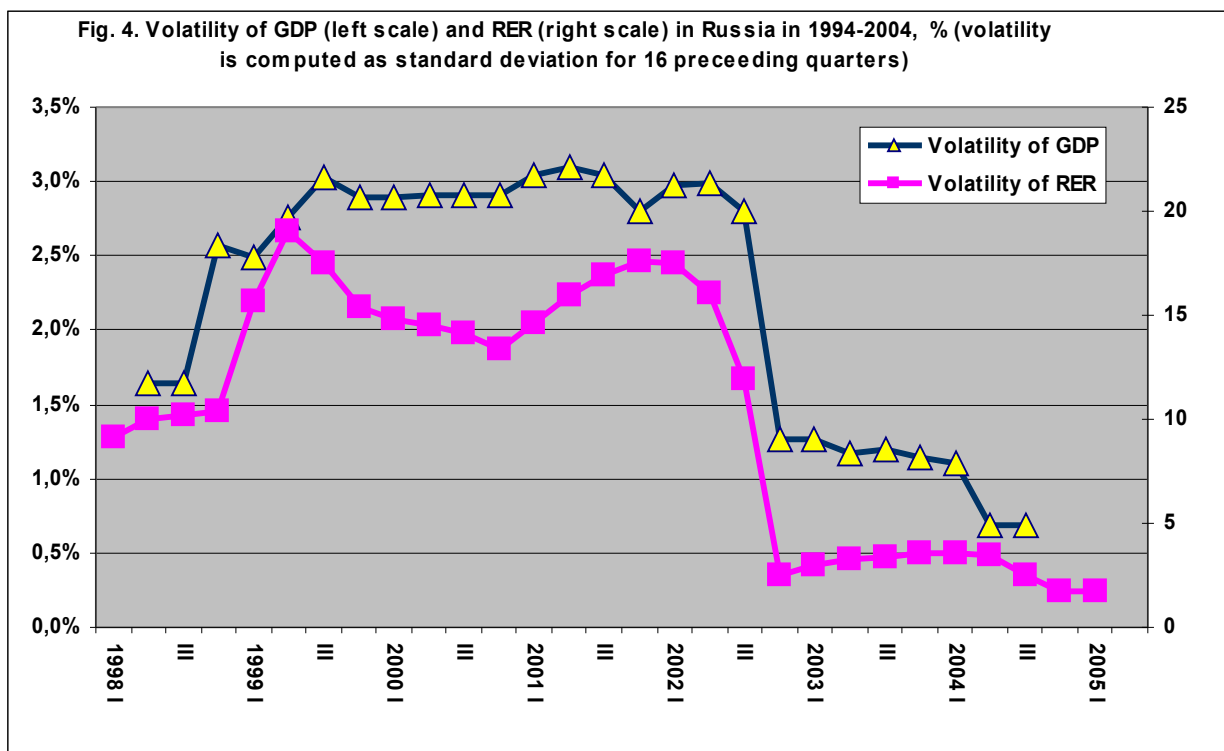
### **3. Russian experience in managing external shocks**

Russian experience in managing the external shocks in 1992-2005 does not look very impressive, to put it mildly. GDP growth rates fluctuated greatly (fig.1), the rates of inflation varied dramatically (fig. 2) and real exchange rate was most unstable even though in recent 5 years monetary authorities were trying to prevent its appreciation by accumulating FOREX (fig.3). In 1992-96 RER increased more than twofold, then fell during the August 1998 currency crisis nearly by half, and then increased again nearly twofold in 1999-2005 (fig. 3). Because volatility of output in all countries is closely correlated with the fluctuations of real exchange rate, no wonder Russian growth rates were very volatile. Unfortunately Russia did not manage to prevent sharp fluctuations in real exchange rate of the ruble, which disoriented producers and consumers and forced the economy to adjust to external shocks via real restructuring, which in turn caused greater volatility of output. No surprise, the highest volatility of output in Russia in

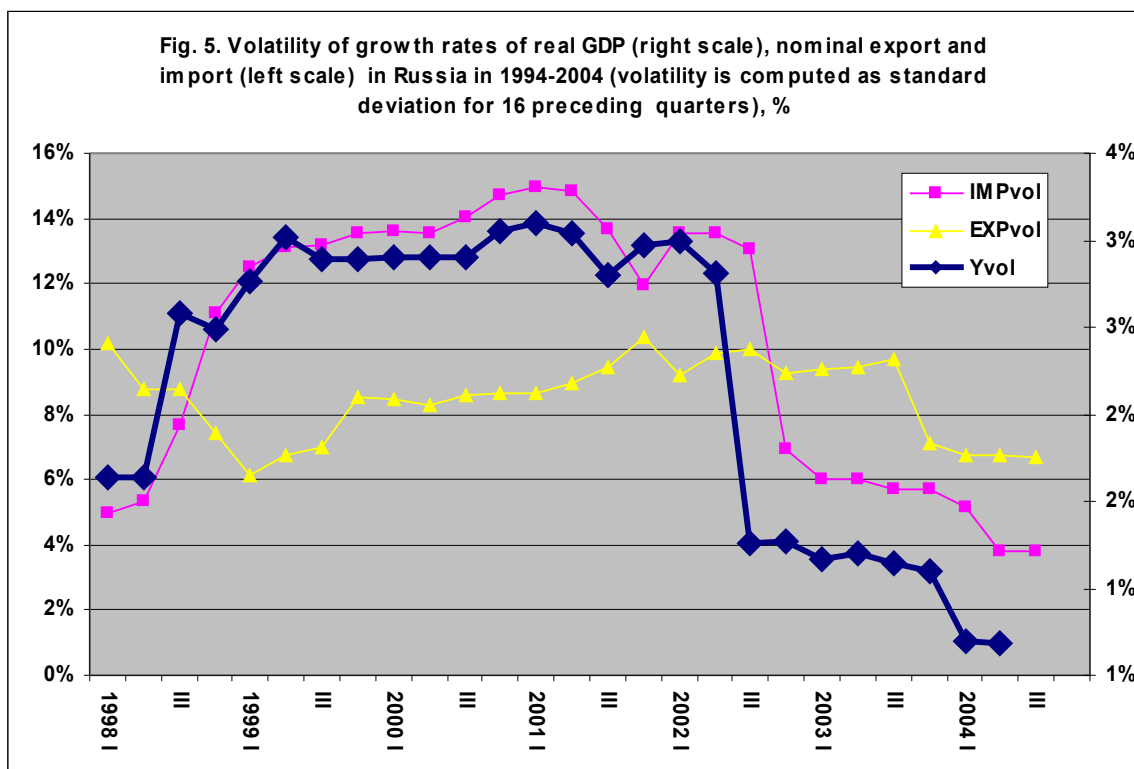
recent 10 years was observed immediately after the 1998 currency crisis that led to the greatest devaluation of real exchange rate.



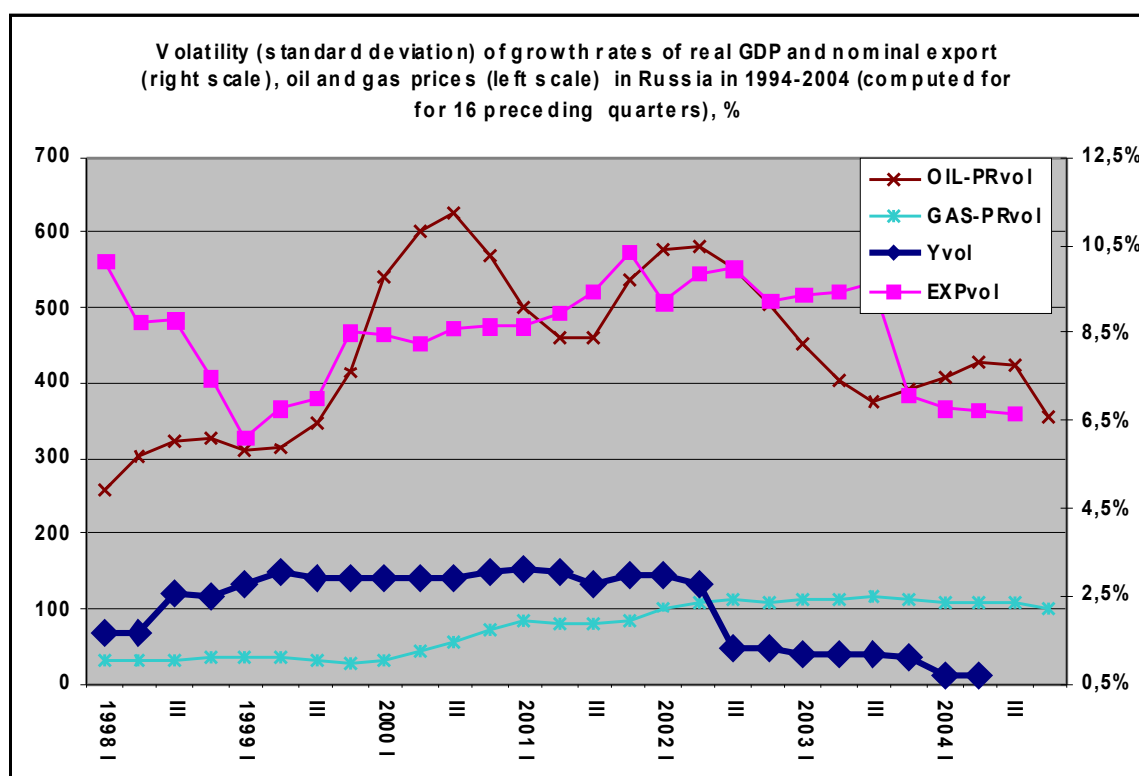
In Russia, pretty much like in other resource oriented economies volatility of growth rates of GDP is strongly correlated with the volatility of RER (fig. 4). However, there are some important inconsistencies with the international story, i.e. with conclusions that could be derived from cross-country comparisons.



*First*, volatility of GDP growth rates in Russia is linked to the volatility of external trade even stronger than in most other countries. Despite intuition, however, it is import, not export, volatility that is closely correlated with the volatility of GDP growth rates. Even more so, it is clearly visible on the chart below (fig. 5) that changes in import volatility sometimes lags behind changes in real GDP volatility, so it is plausible to conclude that the volatility of imports is caused by the volatility of GDP and not vice versa.



Up to 70% of Russian exports consists of fuel goods (gas, oil, oil products) with highly volatile prices, so it could have been hypothesized that the volatility of Russian growth is caused by the terms of trade shocks, i.e. changes in the world prices for oil and gas. However, volatility of exports and volatility of oil and gas prices are not closely related to the volatility of GDP growth rates (see chart below).



Overall, volatility of GDP growth rates in 1994-2004 is very well explained by the volatility of external trade:

$$\text{GDPvol} = -0.0015 - 0.11\text{Ygr} + 0.36\text{TRvol}$$

(N = 28, R<sup>2</sup>=86%, all coefficients are significant at 1% level, DW = 1.87) , where

GDPvol – standard deviation from trend of GDP growth rates in 16 preceding quarters,

Ygr – average growth rates of GDP for 16 preceding quarters,

TRvol – volatility of nominal \$ value of external trade in 16 preceding quarters.

However, this regression obviously captures the post-factum impact of GDP volatility on import volatility, when import changes in response to changes in income (GDP). To analyze the mechanism of the influence of terms of trade shocks on the volatility of GDP, it is necessary to have a closer look at the changes in real exchange rate and foreign exchange reserves.

The best equations obtained for explaining volatility of GDP growth rates by RER volatility are the following:

$$\text{GDPvol} = 0.0002 - 0.04\text{Ygr} + 0.002\text{TTvol} + 0.001\text{RERvol}$$

(N=28, R2=95, all coefficients significant at less than 3% level DW=1.72)

and

$$\text{GDPvol} = 0.002 - 0.02\text{Ygr} + 0.002\text{TTvol} + 0.001\text{RERvol} - 0.003\text{TT\_FORcor}$$

(N=28, R2=95, all coefficients significant at less than 2% level except for Ygr, which is significant at 11%, DW=1.88), where:

GDPvol – standard deviation from trend of GDP growth rates in 16 preceding quarters,

Ygr – average growth rates of GDP for 16 preceding quarters,

TTvol – volatility of world oil in 16 preceding quarters,

RERvol – volatility of RER index in 16 preceding quarters,

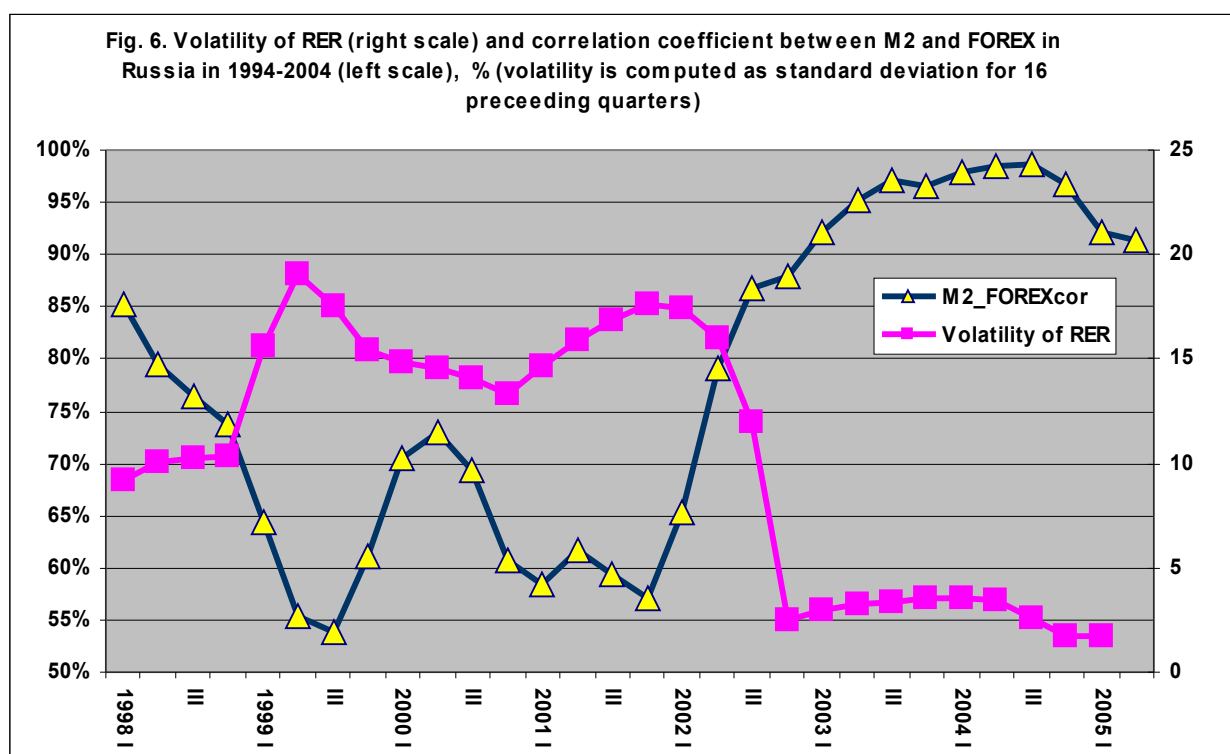
TT\_FORcor – correlation coefficient between TT and FOREX in preceding 16 quarters.

Adding the indicator of the volatility of FOREX and the correlation coefficient between the movement of RER and FOREX does not improve the goodness of fit; both variables have predicted negative sign, but are not statistically significant.

These results could be interpreted in line with the previous findings from cross-country regressions: given the terms of trade shocks, in particular, changes in oil prices (that are closely correlated with gas prices – another major item of Russian export), the volatility of the economy (GDP growth rates) is lower, the higher the correlation between TT and FOREX and the lower the volatility of RER. There is an important deviation, however, from the international story that was derived from cross-country regressions. As fig. 4 suggests, volatility of GDP is extremely closely correlated with the volatility of real exchange rate: it seems like periods of high volatility of Russian GDP growth were associated not so much with volatility of oil and gas prices, but rather originated due to direct government/central bank mismanagement – inability to keep the RER stable. Volatility of RER in time series regressions for Russia turns out to be by far the most important and the most statistically significant variable.

*Second*, high volatility of Russian GDP and RER is associated not so much with the volatility of oil prices, but with the absence of sterilization policy – high correlation between changes in money supply (M2/GDP ratio) and foreign exchange reserves (FOREX/GDP ratio). The higher the correlation coefficient between M and FOREX, the lower the volatility of RER and GDP – these indicators move obviously in opposite directions (fig.6).





Such a result – negative impact of sterilization on volatility of GDP – is directly the opposite from the result observed in the cross-country comparisons and it seems to be inconsistent with economic logic. As was argued earlier, the best exchange rate regime for mitigating volatility is the stable real exchange rate achieved via relatively stable nominal rate (crawling peg), absorption of TT shocks by the fluctuations of FOREX, and sterilization of changes in money supply caused by the FOREX fluctuations. To reiterate, in cross country regressions no-sterilization policy (high correlation coefficient between FOREX and M2) turns out to be an important and significant factor of higher, not lower volatility of GDP growth rates, whereas in regressions on Russian time series it is exactly the opposite.

#### 4. Sources of output volatility: external versus internal shocks

This puzzle is resolved by making the distinction between external and internal shocks. As was argued earlier (table 1), in the presence of external shock, sterilization under fixed nominal rate means low correlation between FOREX and money supply, so the higher this correlation, the less pronounced sterilization and the higher the volatility of growth. But if shocks come from domestic sources, for instance from the central bank altering money supply without any external shocks, high correlation between M and FOREX signifies the absence of internal shocks themselves – how can money supply change, if FOREX remain stable and on top of that all changes in money supply are sterilized?

Consider, for instance an exogenous increase in money supply by the central bank in the absence of external shocks. Under fixed nominal rate this would cause an increase in prices (hence increase in RER and additional RER volatility) and a drop in real interest rates, and later – the balance of payments deficit (due to lower trade competitiveness and outflow of capital), decrease in FOREX and finally – the contraction of the money supply. Under fully flexible rate monetary expansion would also immediately cause increase in prices (hence increase in RER) and decrease in real interest rates, and later devaluation (with no changes in FOREX). In both cases initially RER would change, which is bad for volatility of GDP, while the correlation between money supply and FOREX would be low (money supply increases, but FOREX do not), so high GDP and RER volatility would be associated with low correlation between FOREX and M. High correlation between FOREX and M under the circumstances, i.e. if there are no external shocks, is possible only if money supply is stable.

Table 3 summarizes changes in variables in question caused by internal monetary shock. The bottom line is that, unlike in table 1, which describes the story of the dynamics of variables during the external shock, in this case, under the domestically generated monetary shock, lower volatilities of GDP and RER are associated with higher, not lower correlation coefficients between FOREX and M. This higher FOR\_Mcor coefficients prove in fact that the exogenous monetary shocks are largely absent.

**Table 3 . Impact of internal monetary shocks on volatility (in the absence of terms of trade shocks)**

Patterns of change in variables // Exchange rate and macro regime	FOREX	Nominal exchange rate	RER	Correlation between			
				FOR-M	TT-FOREX	TT-RER	FOR-RER
<b>INTERNAL MONETARY SHOCKS (IN THE ABSENCE OF EXTERNAL SHOCKS)</b>							
Fixed exchange rate without sterilization (currency board)	VOLAT	STABLE	VOLAT (prices)	0	0	0	HIGH
Fixed exchange rate with sterilization	STERILIZATION MEANS THE ABSENCE OF INTERNAL MONETARY SHOCKS BY DEFINITION (high FOR_Mcor)						
Clean float	STABLE	VOLAT	VOLAT (nom. rate)	0	HIGH	0	0

Regressions on Russian time series data provide additional support for the existence of the described relationship. First, unlike in cross-country regressions, TTvol does not have any significant explanatory power for RERvol, even when included into the right hand side of the equation without any other variables. Although TTvol matters for explaining the GDP growth

rates volatility, the significance of coefficient of RERvol is much higher. Second, unlike in cross-country regressions, the correlation coefficient between TT and RER is negative, not positive. And, third, unlike in cross-country regressions, FOR\_Mcor, the correlation coefficient between M and FOREX, characterizing the absence of sterilization policies, enters into the right hand side with significant, but negative sign:

$$\text{RERvol} = 34.1 - 0.52\text{AR}(-1) - 30.7\text{FOR\_Mcor} - 4.7\text{TT\_RERcor} + 0.01\text{TTvol}$$

(N=28, R2= 91, all coefficients significant at less than 1% level, except for TTvol that is insignificant (99%), AR(-1) term is included because without it DW statistics is bad)

and

$$\text{RERvol} = 16.5 + 0.95\text{AR}(-1) - 16.4 \text{RER\_FORcorr}$$

(N=28, R2= 95, all coefficients significant at less than 1% level, AR(-1) term is included because without it DW statistics is bad), where:

AR(-1) – volatility of RER in the preceding 16 quarters,

RER\_FORcorr – correlation coefficient between RER and FOREX,

FOR\_Mcor – correlation coefficient between FOREX and M2,

TT\_RERcor – correlation coefficient between TT and RER

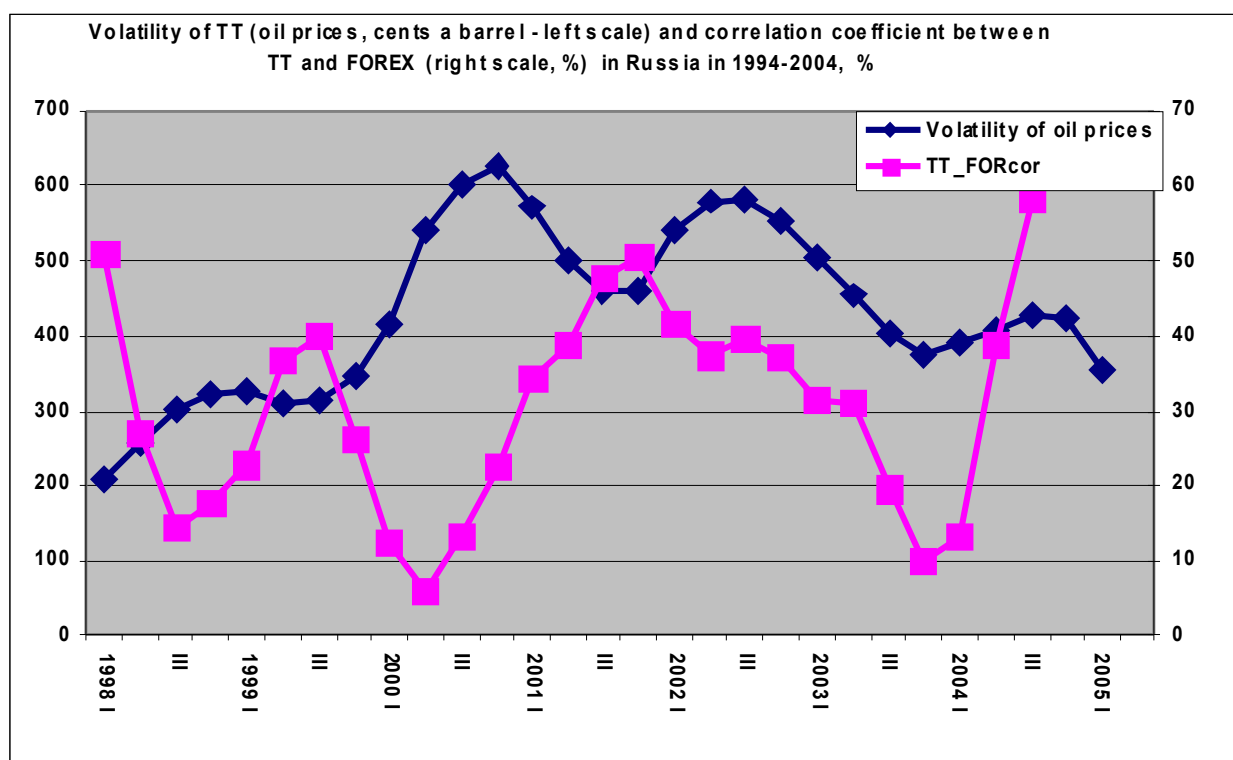
TTvol – volatility of oil prices, \$ a barrel.

These equations imply that volatility of RER is negatively, not positively as in cross-country regressions, linked to the non-sterilization indicator (correlation between changes in FOREX and M2) and to the correlation between RER and FOREX. As was argued above, this is consistent with the assumption that the volatility of RER in Russia was primarily caused by internal monetary shocks: expansion, for instance, of money supply happening without any apparent reason, led to the increase in prices and appreciation of RER (higher volatility of RER); whereas TT of trade did not change (so correlation between TT and RER was low) and FOREX were stable (so the correlation between money supply and FOREX was low), the volatility of GDP was on the rise due to RER appreciation.

Hence, it may be hypothesized that the main causes of volatility in Russia were not foreign, but domestic made, i.e. the volatility of growth resulted not so much from the volatility of terms of trade (even though TT volatility was high and Russia was very dependent on exports of oil and gas with highly volatile prices). It is one of the main conclusions of our paper: even in countries that export resources with highly volatile prices, like Russia, volatility of economic growth could

be associated not so much with objective circumstances (TT shocks), but with poor macroeconomic policies – inability to keep the RER stable.

The additional evidence of poor macroeconomic policy in Russia is on chart below. First, Russia failed to respond to the TT fluctuations by altering FOREX – only in 3 quarters out of 28, for which correlation coefficients between TT and FOREX were computed for 16 quarters moving window, this correlation coefficients were higher than 50%.



Second, for most sub-periods of 1994-2004 these correlation coefficients were moving in the direction opposite to the volatility of oil prices – when volatility of TT increased, government policies of stabilizing RER via adjusting FOREX in line with changes in TT were especially weak. Instead of mitigating the volatility from external shocks, the Russian government and monetary authorities were adding insult to injury by contributing to the economic volatility through generating their own monetary shocks.

In a regression linking RER volatility with the volatility of terms of trade (proxied by volatility of oil prices) and volatility of M2 growth rates, only the latter variable is significant, while the former is not:

$$\text{RERvol} = -0.02 + 0.83\text{AR}(-1) + 0.01\text{TTvol} + 1.14\text{Mvol}$$

(N=27, R2=86%, DW = 2.08, all coefficient significant at 6% level or less, except TT volatility coefficient that is insignificant), where:

Mvol – standard deviation of M2 quarterly growth rates in 16 preceding quarters.

To put it differently, the instability of RER is determined mostly by the instability of the money supply, not by the instability of the terms of trade.

Similarly, in a regression linking GDP growth rates volatility to TT volatility, RER volatility and M2 volatility, all three explanatory variables are highly statistically significant:

$$\text{GDPvol} = -0.01 + 0.003\text{TTvol} + 0.07\text{RERvol} + 0.27\text{Mvol}$$

(N=28, R2=97, DW=1.7, all coefficients significant at less than 2% level).

That is to say, even controlling for the volatility of terms of trade and volatility of RER, volatility of output growth in 1994-2004 in Russia was dependent on the volatility of money supply caused by unstable monetary policy.

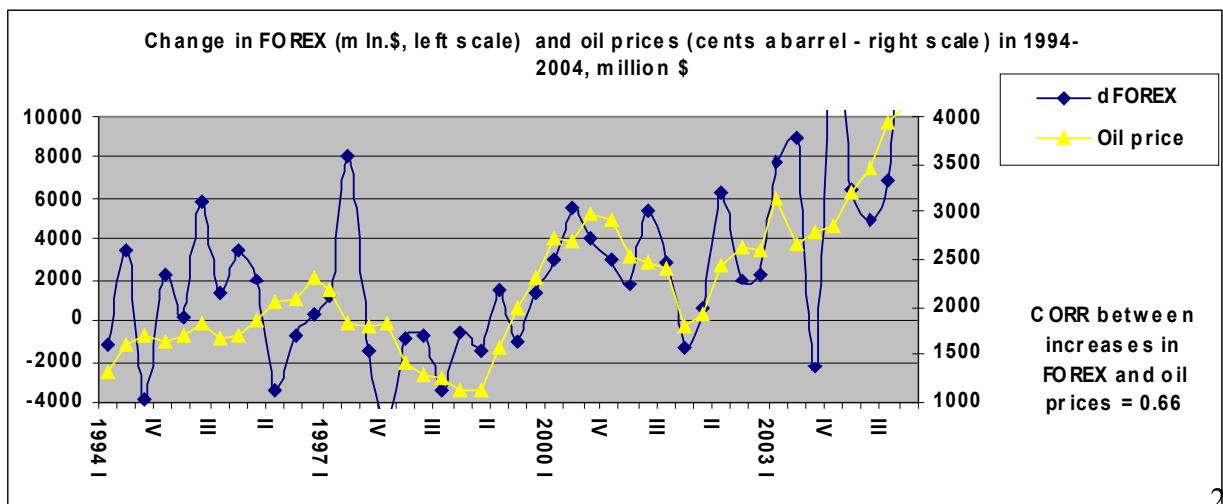
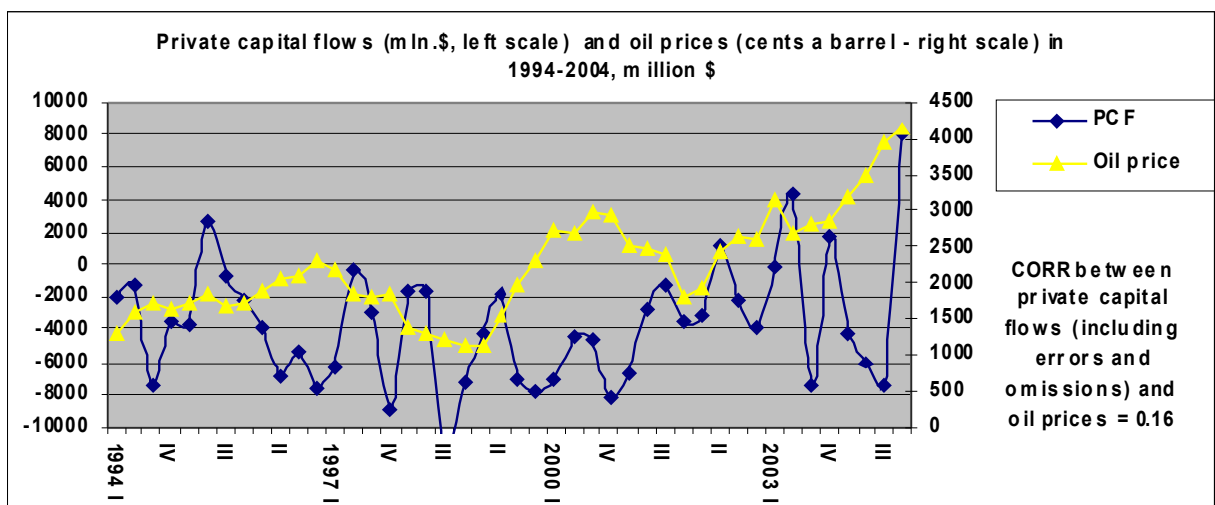
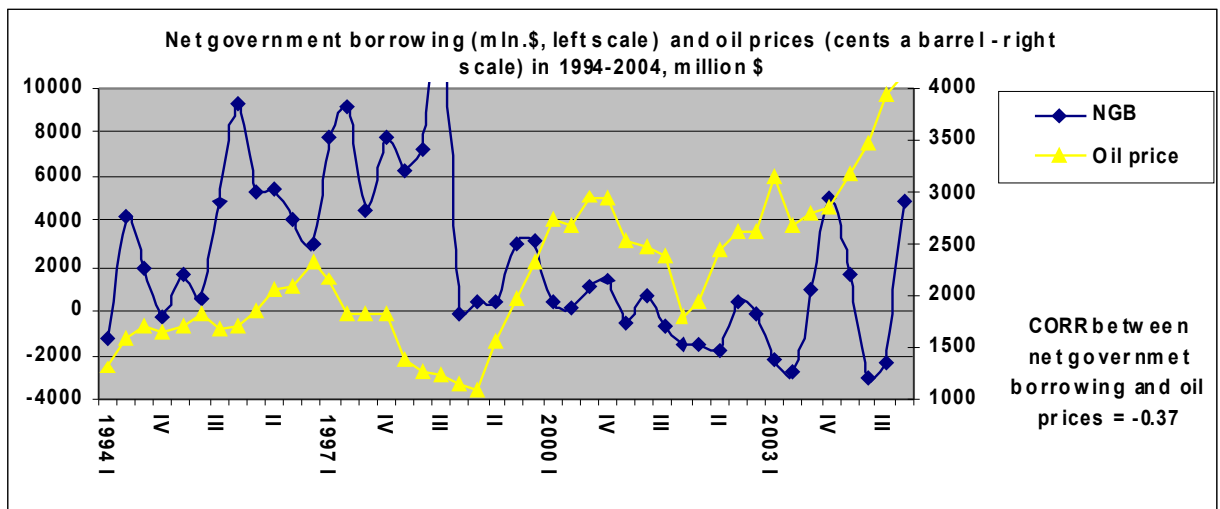
## **5. Conclusions and policy implications**

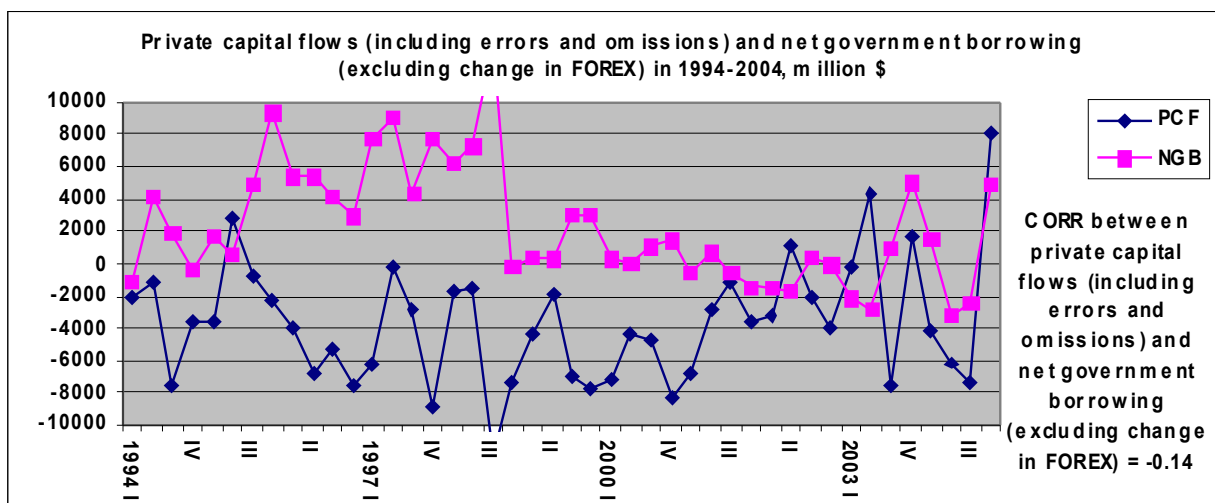
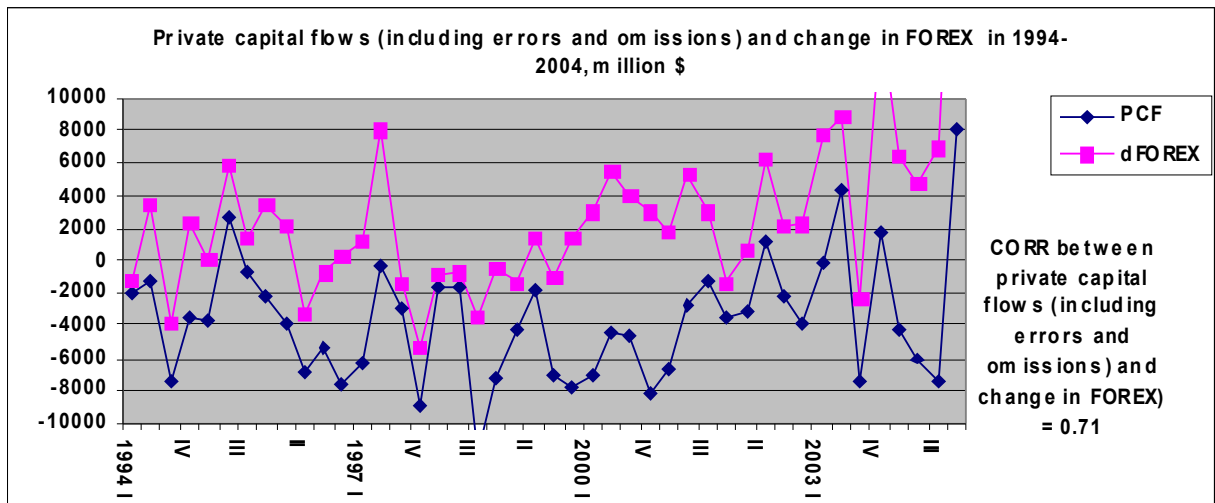
In countries that export resources with highly unstable prices, like Russia, volatility of economic growth is associated with volatility of RER, which in turn is mostly caused by the inability to accumulate enough reserves in FOREX and SF. The option of attracting foreign capital in difficult times, when the country faces a negative trade shock, seems to be unavailable for resource based developing countries because private capital flows change pro-cyclically with terms of trade, thus reinforcing the trade shocks, whereas official capital flows, even though may be counter-cyclical, are not enough to compensate the destabilizing effect of private capital movements.

Russian experience in this respect constitutes no exception. *First*, as charts below suggest, private capital flows reinforce the destabilizing effects of trade shocks, whereas official capital flows and changes in foreign exchange reserves, even though mitigate trade shocks, are not enough to counter them completely. To investigate the issue more closely, all capital flows were grouped into three categories: (1) PCF – net private capital flows (including sizable “errors and

omissions” in the balance of payments that are widely believed to be a euphemism for capital flight), minus sign indicates outflow of capital, (2) NPB – net borrowing by the public authorities, minus sign indicates the outflow of capital, and (3) dFOREX – increase in FOREX, plus sign indicates the outflow of capital. The sum of these items equals current account deficit (CA):

$$CA_{\text{deficit}} = PCF_{\text{inflow}} + NPB_{\text{inflow}} - FOREX_{\text{increase}}$$





It turns out that PCF move mostly in line with oil prices (terms of trade), although the correlation is weak, NGB is negatively (also weakly) correlated with oil prices, whereas increase in FOREX (dFOREX) exhibits pretty high positive correlation with oil prices. It means that only net government borrowing and change in reserves help to counter trade shocks, whereas private capital flows reinforce these shocks.

*Second*, the mitigating influence of official capital flows and changes in FOREX was not enough to counter all the terms of trade shocks, so real exchange rate fluctuated greatly in response to changes in terms of trade.

*Third*, the most surprising finding is that fluctuations of RER were caused not so much by the TT shocks, but by domestically generate monetary shocks – highly volatile monetary policy. That is why in Russia, volatility of GDP growth rates in recent 10 years was associated not so much with objective circumstances (TT shocks), but with poor macroeconomic policies –

unstable money supply that contributed to the volatility of RER more than external terms of trade shocks.

The policy implications thus are pretty obvious. The good macroeconomic policy for Russia would be (1) not to generate monetary shocks (2) to cope with inevitable external shocks via changes in FOREX and SF, while keeping the RER stable.

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