Economics Education and Research Consortium
Working Paper Series

Real appreciation and output
Russia 1993–1997

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Working Paper No 99/13

This project (No 96-174) was supported
by the Economics Education and Research Consortium

Research area: **Macro & Finance**

CONTENTS

INTRODUCTION

The major exchange rate depreciation at the beginning of any transition process, which is followed by years of real appreciation, is a stylised fact for post-socialist economies moving to the market economy. This stylised fact is described and interpreted by Wyplosz and Halpern (1996):

"The actual real exchange rate initially depreciates and overshoots its equilibrium path so that there is at first sizable undervaluation. Over time the real exchange rate appreciates for two reasons. First, the initial undervaluation is gradually corrected. Second, the real equilibrium exchange rate itself appreciates as a result of the transformation process. The rate of equilibrium appreciation is higher the more complete is the market system and the faster capital is accumulated."

Wyplosz and Halpern (1996) also discuss the determinants of the long-run real exchange rate and the appropriate exchange rate policy during the process of convergence to the long-run equilibrium.

In Russia, since 1992 the management of the exchange rate was extensively used for the purpose of restraining devaluation and controlling inflation. However, a sharp real (and even nominal in the first half of 1995) appreciation caused a dramatic decrease in the profitability of exports and made Russian goods less competitive relative to imported goods. Export effectiveness, calculated by the Central Bank for a representative basket of goods securing approximately 60% of Russian export value, became negative. It is not likely that exporters were trading at a loss even at that time, since domestic costs were not really paid in full due to non-payments and barter. However, a decline in effectiveness was apparent. On the other hand, the share of imported goods in retail trade turnover reached approximately 50%.

To stop the real Ruble appreciation, in July 1995 the Central Bank introduced the foreign currency corridor. In 1996 and 1997, the Central Bank kept the real exchange rate roughly constant.

In 1997, the foreign liabilities of all sectors of the Russian economy increased by US$ 44 billion. Foreign capital inflows to the government sector constituted US$ 21 billion, to the banking sector — US$ 9 billion, and to the corporate sector — US$ 14 billion. According to our estimations, almost one-half of the total increase in foreign liabilities was secured by the short-term borrowings of the Government from participants in the domestic market. Non-resident investments in the GKO/OFZ mar-

ket through "S"-accounts totaled US$ 11 billion, while the increase in the foreign liabilities of the banking sector was mainly due to non-resident investments in the GKO/OFZ market through so-called "grey" schemes.

In the first half of 1997, huge foreign capital inflows and favourable world commodity prices made the Central Bank choose between further real appreciation and mounting international reserves. The "strong" Ruble was often referred to as a bright sign of success for the economic reforms and thus it seemed extremely attractive from the point of view of the governing politicians. However, pressure from the export lobby prevented the Central Bank from changing the targets in 1997. A significant increase in international reserves of US$ 9 billion did not allow the Ruble to appreciate further in the first half of 1997.

However, the bulky reserves made the Central Bank think about altering the exchange rate policy. In November 1997, it was announced that, in 1998, the Central Bank would switch to a more flexible exchange rate policy. The Central Bank refused to guarantee any particular level of exchange rate and decided to allow the rate to fluctuate during 1998 – 2000 almost freely within the new, wide corridor (from 5.25 to 7.15 Rubles per US$). The average exchange rate target for 1998 was set at 6.1 Rubles per US$. In addition, the Central Bank aimed at real exchange rate stability in 1998, as it had done before.

We believe that the choice of exchange rate policy for 1998 – 2000 was made by the Central Bank long before the appearance of the first signs of crisis in the Russian financial markets. We guess that the aim of widening the corridor was to stop the increase in reserves and to allow the exchange rate in future to reach the lower, not the upper, boundary of the corridor. The lower boundary, as well as the target exchange rate for 1998, was set at a very low level (let us recall that, at the end of 1997, the official exchange rate was equal to 6.0 Rubles per US$). The IMF approved the measure and, later, much effort was put in to avoid devaluation.

The reaction of market participants to the announcement of the new policy was a surprise to Central Bank officials. The general opinion was that, soon after January 1 1998, the exchange rate would reach the upper boundary of the corridor. And, in fact, the expectations of devaluation were completely reasonable.

It looked very unlikely that the sharp decrease in world commodity prices, which started at the end of 1997, could be compensated for by new capital inflows to Russia. In order to compensate for the decrease in export earnings without a real depreciation, foreign capital inflows in

1998 had to surpass their 1997 level. In the situation of world financial crisis, which significantly changed the attitude of private investors to emerging markets, a sharp decrease in such inflows looked much more probable.

On the other hand, there were no clear signs of a decrease in resident capital outflows or even factors that could diminish capital flight. In 1997, the net outflows of Russian capital from the private sector (without taking into account cash currency purchases) stabilised at the level they had been in 1996, *i.e.* US$ 31 billion. The Central Bank and the Government did not pay sufficient attention to this problem. It was assumed that restricting capital flight by setting better state controls would not be consistent with the liberal economic policy being implemented.

By the end of 1997, international reserves had fallen to US$ 17.8 billion from the maximum of US$ 24.5 billion they had been in the middle of the year. On the other hand, at the end of 1997 the face value of GKO/OFZ bonds officially held by non-residents was close to US$ 18 billion. At that time, the short-term foreign liabilities of the banking system, which were mostly hidden foreign investment in the GKO/OFZ market, amounted to US$ 16.5 billion.

Theoretically, it was possible that foreign capital inflows would decrease a little, although IMF loans and a decrease in reserves would cover the shortfall. But the situation was clearly very unstable and the probability of a significant weakening of the Ruble was very high.

The Russian Government tried to stabilise the situation by attracting massive foreign financing and allowing interest rates to rise when the situation worsened. The idea was to prevent foreign capital from being withdrawn from the GKO/OFZ market, since withdrawal would immediately lead to both fiscal and monetary catastrophe. Let us recall that, in the middle of 1997, the share of non-residents in the GKO/OFZ market ("S"-accounts only) reached 30% and it remained approximately at this level throughout the rest of 1997 and 1998. We have already mentioned that the stock of foreign investment in the GKO/OFZ market was enormous when compared to the level of official international reserves.

The Government supposed that foreign borrowings, which increase foreign reserves, would help to kill the expectations of devaluation and stop foreign capital outflows from the GKO/OFZ market. In this way, the Government hoped to avoid domestic currency devaluation. It was expected that lower devaluation expectations and a lower level of domestic borrowing could decrease interest rates and help to avoid fiscal catastrophe.

Following this logic, the Government announced a policy for the substitution of domestic short-term borrowings, which were extremely expensive, by longer-term and "cheap" foreign borrowings. In the first half of 1998, the Government placed four new issues of eurobonds, which totalled US$ 4.8 billion. Additionally, the Federal Government received US$ 2.9 billion in loans and credits from international financial organisations and foreign governments. The exchange of a part of GKO/OFZ bonds to eurobonds in July 1998 was the climax of the policy.

As a result of the deal, the Government changed a part of short-term domestic debt amounting to US$ 4.4 billion (if converted at the official exchange rate at the moment of the deal), including interest, for a long-term foreign currency debt amounting to US$ 6.0 billion (not including coupon payments). The coupon was set at 8.75% yearly for eurobonds with a maturity of 7 years and 11% yearly for eurobonds with a maturity of 20 years. Thus, the Government borrowed US$ 6.0 billion on the world capital markets at 15% yearly in order to sell foreign currency in Russia at an exchange rate which was much lower than the potential one. Even taking into account the fact that the eurobonds placed in July were medium and long-term, it is difficult to call the deal beneficial for the Russian Government.

The substitution policy clearly did not achieve its targets. The massive loans from the international capital markets increased more and more the foreign liabilities of the Russian Government. This increase in foreign liabilities strengthened expectations of the bankruptcy of the Government in the case of devaluation. This led to a fall in the attractiveness of GKO/OFZ bonds, even if devaluation expectations remained stable. The probability of defaulting on domestic debt was clearly much higher than it was on eurobonds simply because it was the Russian, and not the international, legislation which regulated GKO/OFZ issuance.

From the beginning of the crisis in November 1997, any period of temporary stabilisation was immutably succeeded by a sharp aggravation of the situation in the GKO/OFZ and foreign exchange markets. Average interest rates in the secondary GKO/OFZ market in November 1997 – – May 1998 constituted 32% yearly. However, during the aggravation of the crisis at the end of January 1998, the average interest rate reached an annualised rate of 46%. At the end of May 1998, in response to the new wave of the crisis, the Central Bank raised the refinancing rate up to 150%. The average interest rate in the GKO/OFZ market at that time reached 78% yearly. The rise in the interest rate in the GKO/OFZ market to 120% at the beginning of July 1998 was the cause of the halting of placements of new GKO/OFZ bonds and the offer to exchange part of GKO/OFZ issues for eurobonds.

Despite aggressive federal eurobond placing and very high interest rates, in the first half of 1998 international reserves decreased by US$ 1.5 billion and, on July 1 1998, constituted US$ 16.2 billion. The attraction of foreign finance, which was intended to stop capital outflows from the GKO/OFZ market, to kill expectations of devaluation and, thus, to prevent devaluation itself, did not, in the best case, improve the situation.

The halting of placements of new GKO/OFZ bonds from July 1998, exchanging a part of short-term GKO/OFZ bonds for long-term eurobonds in the same month and reaching agreement with the IMF about a significant stabilisation credit, the first tranche of which (US$ 4.8 billion) was also disbursed in that month, became the last, unsuccessful, attempts of the Federal Government and the Central Bank to avoid the financial crisis.

In the first half of August, interest rates in the GKO/OFZ market, which decreased just after the IMF credit disbursement, renewed their growth. By August 13 – 14 1998, interest rates became higher than 160% yearly. The liquidity of the market almost reached zero.

The fact that the crisis was not even delayed by the agreement with the IMF about the huge disbursements probably means that investors did not believe that something could prevent devaluation. On the other hand, the moment after the agreement had been reached was the best time for selling GKO/OFZ bonds.

In announcing that it was defaulting on domestic debt, the Government probably hoped to avoid huge devaluation, since capital could not be withdrawn from the GKO/OFZ market. But it did not help and, in a few months, the Ruble became weaker in real terms by a factor of two. External debt service became unbearable for the budget, despite the default on domestic debt.

In this paper, we restrict our consideration to the time period from 1992 to 1997. The aim of this project is to study the negative and positive consequences for Russian GDP of the real appreciation in those years. The consequences of the sharp real depreciation occurring in 1998 remain beyond the scope of the paper.

As a result of the real appreciation, imported goods become cheaper with respect to domestic ones, and, hence, more affordable. This is especially important in the case of high-tech equipment, which is a key factor in the renewal of economic growth in Russia. Moreover, due to the income effect, demand for domestic consumption and investment goods may fall very weakly or even increase. Furthermore, because of

decreases in the prices of imported inputs, the costs for domestic producers fell, which could increase domestic supply.

The strengthening of the Ruble diminishes the attractiveness of a foreign currency as a financial instrument, which could lead to the de-dollarisation of the economy, an increase in Ruble credit resources and growth in the official foreign exchange reserves. Furthermore, the foreign debt service burden decreases.

Among the negative consequences of the real appreciation, one could mention the loss of competitiveness of Russian goods, which could influence Russian exports negatively and shift domestic demand from Russian to imported goods. Furthermore, real appreciation leads to an erosion in the real value of the dollar savings of the population.

Thus, it is not clear *a priori* if the cumulative effect of the real appreciation on the economy, on the whole or on output in particular, is positive or negative since some economic agents gain and others lose.

The literature on the point contains vast discussions of the possible contractional effects of devaluation. Hirschman (1949), Diaz-Alejandro (1963) and Krugman and Taylor (1978) discussed the impact of devaluation on demand. An increase in total import costs and a cut in real wages due to increases in internal prices (through increases in intermediate import costs) have been considered. Later papers by Buffie (1986) and van Wijnberger (1986) have taken the supply side into account. These papers mention, among the contractional effects of devaluation, an increase in intermediate import prices (Buffie), and an increase in imported consumer goods prices and a reduction in real foreign credit volume (van Wijnberger).

Buffie (1984) created a model in which devaluation could have an expansionary effect through a decrease in the market interest rate, if the share of dollar-denominated bonds in financial wealth remained high enough.

The contractionary effect of devaluation could be exaggerated by static models which do not take into account the lagged response of exports. Solimano (1986) took some steps to resolve the problem, finding several quarters of initial contraction in Chile.

Thus, the available literature on the subject gives some grounds to suspect that the short-run effect of devaluation on output is negative.

Among recent literature, there exist numerous papers on a related subject: the connection between inflation and growth. Barro (1995) con-

sidered inflation as one of the determinants of the long-run supply curve and Karras (1993) estimated an AD–AS model with inflation as the endogenous variable. An attempt to find a relationship between inflation and short-run growth in Russia was carried out by Granville, Dynnikova and Larichev (1996).

The further structure of this paper is as follows. Section 1 contains the description of the data which we use in our research. Section 2 discusses in more detail the effects of the real appreciation on foreign trade. Section 3 studies the effects of the real appreciation on consumption. Section 4 describes the model we use for the estimation of the cumulative effects of the real exchange rate on output. Section 5 contains the results of the model estimation. And, finally, Section 6 gives some conclusions.

1. THE DATA

We use monthly observations for 1992 – 1997. The data on real GDP are available only from the beginning of 1993.

Descriptions of the data used in the estimation of the model (Section 4):

Variable	Indicator	Source
Y	Real GDP	Real GDP – MoF Economic Expert Group calculations on the base of GKS data
P	CPI	Goskomstat, Kratkosrochnye ekonomichekie pokazateli
M	M2	MoF Economic Expert Group
E	Average monthly $ exchange rate at MICEX	CBR, Bjulleten bankovskoj statistiki
P^*	US CPI	3% inflation per year
P_{fuel}	PPI for fuel	Goskomstat, Kratkosrochnye ekonomichekie pokazateli
P_{energy}	PPI for electricity	Goskomstat, Kratkosrochnye ekonomichekie pokazateli
π^e	The second lag of inflation	Goskomstat, Kratkosrochnye ekonomicheskie pokazateli

The table contains information on the data used for our analysis of the real exchange rate impact on foreign trade (Section 2):

Variable	Indicator used	Source
Real exchange rate	Nominal exchange rate, multiplied by US CPI and divided by Russian CPI	Russian CPI – Goskomstat, Kratkosrochnye ekonomicheskie pokazateli, RECEP, Monetary and Financial Report; For a description of the nominal exchange rate and US CPI data, see the previous table.
Non-CIS imports of white sugar and meat	Volumes, measured in dollars; Volumes, measured in tons; Price, equal to dollar volume, divided by the number of tons exported	Goskomstat, Department of National Accounts
Exports of crude oil and natural gas to non-CIS countries and to CIS countries	Volumes, measured in dollars; Volumes, measured in tons (m^3); Price, equal to dollar volume, divided by the number of tons exported	Goskomstat, Department of National Accounts
Non-CIS exports, taxes on crude oil and natural gas	ECU per ton; Real Ruble value of tax per ton	Economic Expert Group of the Ministry of Finance
Excise taxes on natural gas and crude oil	Rubles per ton; % of producer price	Economic Expert Group of the Ministry of Finance
Domestic price of crude oil and natural gas	Producer price; Producer price plus domestic transportation costs	Goskomstat, Kratkosrochnye ekonomicheskie pokazateli Economic Expert Group of the Ministry of Finance
Domestic price of meat	Producer price	Goskomstat, Kratkosrochnye ekonomicheskie pokazateli Economic Expert Group of the Ministry of Finance
Meat and white sugar import tariffs	% of customs value	Economic Expert Group of the Ministry of Finance

2. IMPORTS, EXPORTS AND THE REAL EXCHANGE RATE

Since we are studying the connection between the real exchange rate and real GDP, let us consider the real value of exports and imports, measured in the domestic currency. The real value is equal to the physical volume V multiplied by the unit price measured in dollars $p_{\$}$ and the nominal exchange rate, divided by the domestic price level, *E/P*:

$$EX = V^{EX} \times p_{\$}^{EX} \times E / P, \tag{2.1}$$

$$IM = V^{IM} \times p_{\$}^{IM} \times E / P. \tag{2.2}$$

The physical volumes of exports (imports), in general, depend on the real price of the exported (imported) good, measured in the domestic currency

$$\frac{p_{\$} \times E}{P}.$$

So, any change in this ratio influences the real value of exports (imports), measured in the domestic currency, through two channels: the revaluation of the physical volumes; and the impact this has on the volumes traded. For exports, the direction of both effects is the same: a rise in the real price of the exported good boosts both the number of units exported and the real value of every unit. For imports the cumulative effect is ambiguous: a rise in the real price of the imported good lowers domestic demand for the import of the good but increases the real value of every unit imported.

Unfortunately, Goskomstat and the Customs Committee do not publish a monthly series on cumulative export and import price indices. In this section, we study foreign trade in particular goods for which we have managed to obtain data on physical volumes and prices.

2.1. Exports

We studied the influence of the real export price, measured in the domestic currency, on the physical volumes of exports of crude oil and natural gas, which are the most important Russian export products. Each of these two commodities attained approximately one-fifth of the total value of exports in recent years.

We assumed that the physical volume of exports *V* (to non-CIS or to CIS countries) would depend on the real prices at which the product was

exported to non-CIS countries and to CIS countries,

$$\frac{P_{\$}^{non\text{-}CIS} \times E}{P} \text{ and } \frac{P_{\$}^{CIS} \times E}{P},$$

and the real domestic price. Our assumption reflects three possibilities for the producer: to export to non-CIS countries; to export to CIS countries; or to sell in the domestic market. Also, we considered the possibility of supply constraints and we introduced the domestic extraction of the product into our considerations.

We adjusted the prices for different taxation regimes. In the case of exports to non-CIS countries, we did this by subtracting the export duty[1] and the excise tax from the contract price of the exported product. In the case of exports to CIS countries, we deducted the excise tax and VAT from the contract price of the product. As regards the real domestic price, we considered the domestic producer price, which does not include excise tax or VAT.

In the case of perfect markets, all three considered prices must be equal (after adjustment for transportation costs). There are some reasons why this is not the case in Russia. These include non-tariff export regulations (quotas, institute of special exporters), long-term fixed price export contracts, the limited capacity of pipelines and non-payments in Russia and in the CIS.

Thus, in the case of crude oil and natural gas we decided to study the relationships between the physical volume of exports, the price at which the product is sold abroad and domestically (excluding taxes), and extraction, using a reasonable number of lags.

We used pairwise Granger tests to check the direction of causality, to choose the proper functional form for our regressions and to avoid any interpretation of correlation through the third variable as a causal relationship. We implemented Granger tests with a number of lags from 2 to 6, using all available observations. In general, we rejected or assumed the hypothesis of causality if the result was stable over a lag structure starting from a sufficiently high number of lags.

Since most of the series used in the research looked to have trends we implemented stationarity tests. We used augmented Dickey–Fuller tests

[1] All export taxes (except for crude oil) were removed from April 1 1996. The export tax for crude oil was removed on July 1 1996. Export taxes were reintroduced in 1999.

with different numbers of lags and all available observations. In small samples, unit root tests tend to lose power the larger the number of lags that are included. That is why we rejected the hypothesis of the unit root if we were able to do it at the 1% level of significance on the basis of an ADF test with a small number of lags but without signs of auto-correlations in the residuals.

We checked for the possibility of co-integration between non-stationary variables using numerous augmented Engle–Granger tests and Johansen co-integration tests but we were not able to find any reasonably strong evidence of co-integration. Results of different tests were extremely controversial and inconsistent. And it is not surprising. In the small samples which we have (4–6 years of observations), asymptotical co-integration test results cannot be reliable. As mentioned in Davidson and MacKinnon (1993), in estimating regressions at such levels we risk either finding a purely spurious relationship or making wrong inferences about the estimated coefficients of the co-integrating vectors due both to non-standard asymptotic properties of the parameters and to small sample bias. So, we strongly preferred the estimation of stationary differences despite the difficulties with the interpretation of the results.

2.1.1. Crude oil. In the case of crude oil we excluded the real domestic price from the consideration for the reasons explained below.

Fig. 1 shows the dynamics of the price of exported crude oil (net of

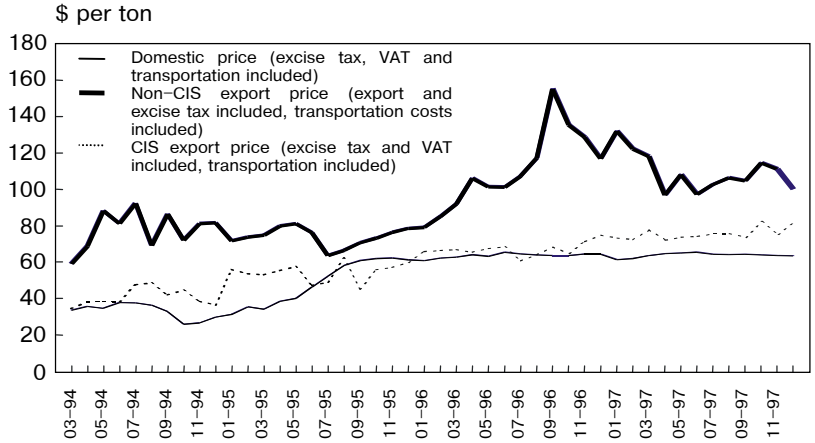

Figure 1. Crude oil domestic and export prices.

taxes, but transportation included[2]) and the domestic price converted into dollars (net of both taxes and transportation costs). Though not regulated by the Government, the domestic producer price for crude oil has been almost constant in dollar terms since the middle of 1995. It could be explained by the fact that oil refineries, closely affiliated to oil extracting companies, purchase the majority of crude oil sold domestically. Thus, the movement of oil within a group of related companies and changes in its price does not matter for the group. So, the price level could be chosen almost arbitrarily. In all probability, the managers of Russian oil companies have agreed some constant common level for the producer price of crude oil just for convenience. Given this, the uselessness of domestic oil prices in explaining the behaviour of export volumes is clear.

It can be seen from the fig. 1 that the prices at which crude oil is exported to non-CIS and CIS countries (excluding taxes) are not strongly correlated. Appendix I contains the table of mutual correlations for current values and lagged changes in the logarithms of seasonally adjusted prices of exported crude oil.

The implemented ADF tests did not allow us to reject the hypothesis of unit root in the levels of export volumes (both to CIS and to non-CIS countries) and the prices of exported crude oil. At the same time, the first differences for all the variables turned out to be stationary. Thus, we assumed crude oil export volumes and the prices of exported crude oil as I(1). As for the domestic extraction of crude oil, the ADF tests allow us to reject the hypothesis of non-stationarity. So, we considered the extraction variable as I(0). The results of the ADF tests are given in Appendix III.

The next step was to check which considered variables (if any) Granger-cause the month-to-month changes[3] in seasonally-adjusted export volumes. The results of the tests are given in Appendix VI. Tests showed that the change in the real price of crude oil exported to non-CIS countries

$$D\left\{\frac{P_{\$}^{non\text{-}CIS} \times E}{P}\right\}$$

[2] We were not able to extract transportation costs due to the lack of data. According to LUKoil experts, they were equal to approximately $10 per ton in 1994 and $20 in 1996 and 1997.

[3] Here and elsewhere the lower "change of Y" or the "short-term adjustment of Y" refer to the "month-to-month change in the logarithm of (seasonally-adjusted) Y".

Granger-causes the change in the volumes of exports both to CIS and to non-CIS countries (with no causality in the opposite direction). We found no causality between

$$D\left\{\frac{P_{\$}^{CIS} \times E}{P}\right\}$$

and changes in the volumes of exports both to CIS and to non-CIS countries. Also, the Granger tests did not detect any causality between changes in the prices of the crude oil exported to non-CIS and to CIS countries.

As for domestic extraction, the tests detected causality leading from changes in export volumes to extraction (and to the change in extraction), but not in the opposite direction. We could suggest the following explanation for the demonstrated direction of the dependence. On the one hand, short-term adjustments in export volumes are small enough and thus are not constrained by the level of supply. On the other hand, additional external demand could lead to short-run increases in export volumes at the current level of extraction with a further adjustment in production, partly as a result of additional export earnings which give additional liquidity for investment and production.

Thus, the Granger tests suggest that we estimate the influence of the change in the real price of crude oil exported to non-CIS countries on the change in the export volumes of crude oil (both to non-CIS and to CIS countries).

Assuming a loglinear form of dependence, and restricting our attention to the first three lags of the explanatory variable, we obtained the following equation to estimate:

$$D(\ln V) = a + \sum_{i=0}^{3} b_i D\left\{\ln \frac{p_{\$}^{non-CIS} \times E}{P}(-i)\right\}, \qquad (2.3)$$

for non-CIS countries: $\sum_{i=0}^{3} b_i > 0$, $\sum_{i=0}^{3} b_i$ is the steady state[4] elasticity of $D(V)$ with respect to $D\left\{\frac{P_{\$}^{CIS} \times E}{P}\right\}$. While we expected $\sum_{i=0}^{3} b_i$ to be

[4] In a steady state the real price of crude oil exports to non-CIS countries does not change with time.

clearly positive in the case of non-CIS countries, the impact of the changes in the real price of crude oil exported to non-CIS countries on changes in the physical volumes of exports to CIS countries *a priori* is unclear. On the one hand, a higher increase in the price of crude oil exported to non-CIS countries means a larger increase in the attractiveness of exports to non-CIS countries when compared to exports to the CIS. On the other hand, the greater the increase in the price of crude oil exported to non-CIS countries, the greater is the improvement in the bargaining power of Russia in trade with CIS countries.

In the case of perfect markets, the improvement would immediately lead to an increase in the price of crude oil exported to CIS countries. However, on the basis of Granger tests we concluded that the increase in the price of crude oil exported to non-CIS countries did not actually cause the increase in the price of crude oil exported to CIS countries. The improvement in bargaining power may not imply an increase in prices to the CIS, but instead the improvement of other (formal or informal) terms and conditions of the contracts (time and timeliness of payment, clearing of arrears, type of currency, conditions of barter and so on). Thus, increases in the price of crude oil exported to non-CIS countries could well result in larger, as well as in smaller, increases in the volumes of crude oil exported to CIS countries.

The results of the estimation of (2.3) are in Table 1. The sample of regression starts in March 1995, when quotas and the institute of special exports were removed. We used the first lag of the dependent variable in the regression for non-CIS countries in order to account for autocorrelations in the residuals.

For the "short" regression for crude oil exports to CIS countries (the last column of the table), we tested the hypothesis that

$$\sum_{i=0}^{3} b_i < 0 .$$

On the basis of the F-test, we were not able to reject the hypothesis that the sum is equal to zero, even at the 15% level of significance.

Thus, we have evidence that short-run changes in the real price of crude oil exported to non-CIS countries implies changes in the physical volumes of crude oil exports to non-CIS countries. At the same time, changes in the physical volumes of crude oil exported to CIS countries do not appear to be sensitive to constant changes in the real price of crude oil exported to non-CIS countries, as well as to any changes in the real price of the crude oil exported to the CIS countries themselves.

Table 1.

Dependent variable: The month-to-month change in the physical volume of crude oil exported.
Sample: March 95 – December 1997.
Method of estimation: OLS.

All variables were taken in logarithms and were seasonally adjusted before differentiation. Standard errors are in parentheses.

Variable	Non-CIS exports of crude oil		CIS exports of crude oil	
	All lags	Only significant lags	All lags	Only significant lags
Constant term	0.01 (0.01)	0.01 (0.01)	0.00 (0.04)	0.00 (0.05)
The month-to-month change in the real price of crude oil exported to non-CIS countries:				
Current	−0.03 (0.09)		0.58*** (0.37)	0.68** (0.36)
First lag	−0.07 (0.09)		−0.92* (0.38)	−1.02* (0.36)
Second lag	−0.03 (0.08)		0.21 (0.37)	
Third lag	0.21* (0.09)	0.20* (0.08)	−0.39 (0.39)	
First lag of the dependent variable	−0.57* (0.13)	−0.56* (0.12)		
R-squared	0.50	0.48	0.31	0.28
Q-statistic	9.10	9.13	15.70	9.79
(16 lags)****	(0.91)	(0.90)	(0.47)	(0.87)
$\sum_{i=0}^{3} b_i$	0.08	0.20	−0.51	−0.34

* — Significant at the 5% level of significance.

** — Significant at the 10% level of significance.

*** — Significant at the 15% level of significance.

**** — P-value in parentheses.

2.1.2. Natural gas. In the case of crude oil exports, we used prices including transportation costs because of the lack of data but, in the case of natural gas, the use of such prices is fully justified. The reason for this is that the same company, RAO "Gazprom", is responsible both for the extraction and the transportation of natural gas. Fig. 2 shows the dynamics of the prices at which natural gas is exported to non-CIS and to CIS countries, and the domestic price measured in dollars. Here, all the prices are adjusted to the different taxation regimes and include transportation costs.

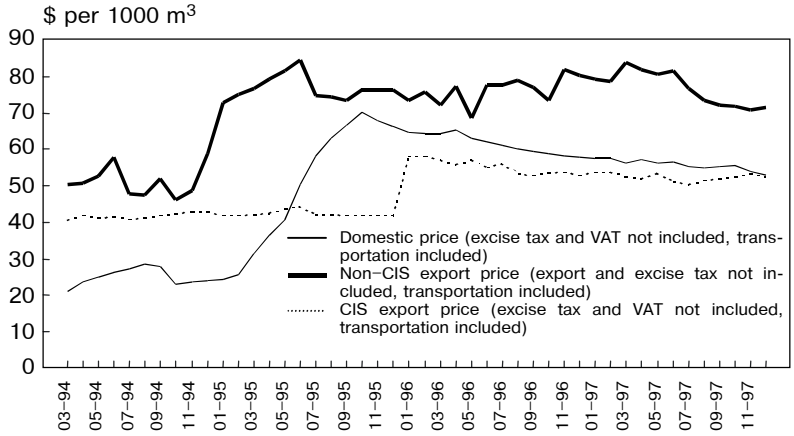

Figure 2. Natural gas domestic and export prices.

As in the case of crude oil, the prices do not look strongly correlated. Appendix II contains a table of the mutual correlations between the current and lagged values of the logarithmic changes in the seasonally-adjusted prices at which natural gas is exported to non-CIS countries, to CIS countries, or at which is sold domestically.

On the basis of the ADF tests, we concluded that, in the case of the natural gas prices at which the product is exported to non-CIS countries and to CIS countries, the physical volume of exports to non-CIS countries and the domestic extraction of natural gas are I(1) variables. At the same time, the volume of exports to CIS countries turned out to be stationary, while the real domestic price was the I(2) variable. The results of the ADF tests are given in Appendix III.

On the basis of the Granger causality tests, we concluded that short-run changes in natural gas domestic extraction Granger-cause a change in

the physical volumes of natural gas exports to non-CIS countries (with no causality in the opposite direction). The change in the real price of natural gas exported to non-CIS countries and the second change in the real domestic price Granger-cause each other. We did not find any other causal relationships between the changes in domestic extraction, the export volumes and the prices at which natural gas is exported, and the second change in the real domestic price. The results of the tests are given in Appendix VII.

Thus, the Granger causality tests suggested only one relationship to estimate: that between the month-to-month change in the seasonally-adjusted domestic extraction of natural gas and the month-to-month change in the seasonally-adjusted physical volumes of natural gas exports to non-CIS countries. The results of the estimation are given in Table 2.

According to our estimates, larger increase in the domestic extraction of natural gas implies smaller increase in the physical volumes of exports to non-CIS countries. Possibly, "Gazprom" considers an extra increase in exports as a way of compensating for the loss of revenues caused by the smaller increase in production.

Thus, the change in the physical volume of natural gas exported to both CIS and non-CIS countries are insensitive to changes in the real prices of exported natural gas.

According to our results, the decrease in E/P (the real appreciation) influences the month-to-month changes in the real Ruble equivalent of natural gas export earnings (for both CIS and non-CIS countries) only through the revaluation effect. The same statement is true for crude oil exports to CIS countries. In the case of crude oil exports to non-CIS countries, in addition to a negative revaluation effect, a larger month-to-month real appreciation implies a smaller month-to-month increase in the physical volume of exports.

2.2. Imports

Raw and processed foodstuffs and agricultural products accounted for 25–30% of the imports registered by customs in recent years. We studied the influence of the real price of imported meat and white sugar, measured in the domestic currency, on the physical volume of the products imported.

We assume that the physical volume of imports *V* (from non-CIS countries or CIS countries) could depend on the real prices at which

Table 2.

Dependent variable: The month-to-month change in the physical volume of natural gas exported.
Sample: August 93 – December 1997.
Method of estimation: OLS.

All the variables were taken in logarithms and seasonally adjusted before differentiation. Standard errors are in parenthesis.

Variable	Non-CIS exports of natural gas	
	All lags	Only significant lags
Constant term	0.00 (0.01)	0.00 (0.01)
The month-to-month change in the domestic extraction of natural gas:		
Current	0.43 (0.37)	
First lag	0.46 (0.36)	
Second lag	−0.43 (0.36)	
Third lag	−1.03* (0.36)	−0.87* (0.33)
Fourth lag	−0.03 (0.40)	
Fifth lag	0.14 (0.41)	
Sixth lag	0.44 (0.40)	
R-squared	0.22	0.12
Q-statistic	28.49	24.39
(24 lags)**	(0.24)	(0.44)

* — Significant at the 5% level of significance.

** — P-value in parenthesis.

a product is imported from non-CIS countries and from CIS countries

$$\frac{P_{\$}^{non\text{-}CIS} \times E}{P} \text{ and } \frac{P_{\$}^{CIS} \times E}{P},$$

and the real domestic price of the product. Also, we considered the possibility of domestic supply constraints and introduced domestic production into our consideration. Finally, we assumed that real GDP could influence the physical volumes of imports through income.

We adjusted prices to the different regimes of taxation, that is, we added VAT and import tariffs to the price at which products were imported from non-CIS countries, while we added VAT to the domestic producer price and VAT to the price of white sugar imported from the CIS (for September 1996 – February 1998, when imports from the Ukraine were taxed).

Thus, in the cases of meat and white sugar, we decided to study the connection between the physical volume of imports, the prices at which a product is imported, the domestic price (applicable taxes added), domestic production of the product and real GDP, including a reasonable number of lags.

As in the case of exports, we used pairwise Granger tests to check the direction of causality, as well as choosing the proper functional form for our regressions and avoiding the interpretation of correlation through a third variable as a causal relationship. We also used augmented Dickey–Fuller tests with a different number of lags and all available observations to check the series for the degree of integration. We checked for the possibility of co-integration between import volumes and the other considered variables, but were not able to reject the absence of co-integration.

2.2.1. Meat. The implemented ADF tests did not allow us to reject the hypothesis of unit root in the levels of import volumes (both from CIS and non-CIS countries) and the prices of meat imports from CIS and non-CIS countries, as well as in the level of the domestic production of meat. At the same time, all the differences turned out to be stationary. Thus, we can assume that the domestic production of meat, the import volumes and the prices at which meat was imported are I(1). As for real GDP, the ADF tests led us to reject the hypothesis of non-stationarity. So, we considered real GDP to be the I(0) variable. The results of the ADF tests are given in Appendix IV.

The next step was to check which considered variables (if any) Granger-cause the month-to-month changes in the volumes of imports. The results of the tests are given in Appendix VIII.

The tests showed that changes in the volume of meat imported from non-CIS countries Granger-cause the change in domestic meat production and the change in the real price of meat imported from non-CIS countries (with no causality in the opposite direction). The change in the physical volume of meat imported from CIS countries Granger-causes the change in the real price of meat imported from CIS countries (also with no causality in the opposite direction).

We found a mutual causality between month-to-month changes in real GDP (seasonally-adjusted) and changes in the volume of meat imports from non-CIS countries.

At the same time, the month-to-month change in the real price of meat imported from CIS countries

$$D\left\{\frac{P_{\$}^{CIS} \times E}{P}\right\}$$

does not Granger-cause the change in the non-CIS import volumes. Changes in real GDP and in domestic production do not Granger-cause the change in CIS import volumes. Also, Granger tests did not detect any causality between the changes in the prices of meat imported from non-CIS or from CIS countries.

Thus, the Granger tests suggest that the volume of meat imports turned out to be primary to both the prices of the meat imported and domestic meat production. So, we decided to estimate numerically the influence on domestic meat production of month-to-month increases in the volume of meat imported from non-CIS countries.

Assuming the loglinear form of the dependence, and restricting our attention to the first six lags of the explanatory variable, we obtained the following equation to estimate:

$$D\ln(\text{Domestic production}) = a + \sum_{i=0}^{6} b_i \ln(V)(-i)\,, \qquad (2.4)$$

$\sum_{i=0}^{6} b_i$ is the steady state[5] elasticity of $D\ln(\text{Domestic production})$ with respect to $D\ln(V)$. The expected $\sum_{i=0}^{6} b_i$ is negative, since an additional increase in import volumes takes away an additional share of the domestic market.

The results of the estimation of (2.4) are in Table 3. The sample of the

[5] In a steady state, the physical volume of meat imported from non-CIS countries does not change with time.

Table 3.

Dependent variable: The month-to-month change in domestic meat production.
Sample: August 93 – December 1997.
Method of estimation: OLS.

All variables were taken in logarithms before differentiation. Standard errors are in parentheses.

Variable	Non-CIS imports of meat	
	All lags	Only significant lags
Constant term	0.00 (0.03)	0.01 (0.03)
Month-to-month change in the volume of meat imported from non-CIS countries:		
Current	−0.11 (0.10)	
First lag	−0.19* (0.09)	−0.18* (0.09)
Second lag	−0.20* (0.09)	−0.20* (0.09)
Third lag	0.04 (0.09)	
Fourth lag	0.04 (0.09)	
Fifth lag	−0.05 (0.09)	
Sixth lag	−0.03 (0.10)	
First lag of the dependent variable	−0.59* (0.15)	−0.59* (0.13)
Second lag of the dependent variable	−0.31* (0.15)	−0.34* (0.13)
Sixth lag of the dependent variable	0.20 (0.14)	0.16 (0.13)
R-squared	0.39	0.37
Q-statistic	16.48	19.19
(16 lags)**	(0.42)	(0.26)
$\sum_{i=0}^{6} b_i$	−0.50	−0.38

* — Significant at the 5% level of significance.

** — P-value in parenthesis.

regression is determined by the availability of data on domestic meat production. We used lags in the dependent variable to account for the autocorrelations in the residuals.

For the "short" regression (the last column of the table), we tested the hypothesis that

$$\sum_{i=0}^{6} b_i < 0 .$$

On the basis of the F-test, we rejected the hypothesis that the sum is equal to zero, at the 5% level of significance.

Thus, we have the evidence that larger short-run changes in the volume of meat imported from non-CIS countries implies a smaller change in domestic meat production.

Changes in the physical volume of imported meat do not look sensitive to changes in the real prices of imported meat. So, we conclude that short-run import adjustments were not caused by changes in the real exchange rate.

Thus, the additional increase in the amount of meat imported was not determined by an additional increase in the demand for imported meat, arising either from any additional increase in the competitiveness of imported goods or from an additional fall in the domestic supply of meat. Instead, the additional increase in non-CIS meat supply crowded out some part of the increase in domestic production.

2.2.2. White sugar. Here, we do not take into consideration the domestic price due to the lack of data.

On the basis of the ADF tests, we concluded that the prices of white sugar imported from non-CIS countries and from CIS countries, and the physical volume of white sugar imported from non-CIS countries, are I(1) variables. At the same time, the volume of white sugar imported from CIS countries and the domestic production of granulated sugar turned out to be stationary. The results of the ADF tests are given in Appendix IV.

On the basis of the Granger causality tests, we concluded that short-run changes in seasonally-adjusted real GDP Granger-cause a change in the physical volume of the total amount of white sugar imported (with no causality in the opposite direction). We did not find any causal relationships between import volumes and the price at which white sugar is imported, or the import volumes and the domestic production of white sugar. The results of the tests are given in Appendix IX.

Thus, the Granger causality tests suggested one relationship to estimate: between the month-to-month change in seasonally-adjusted real GDP and the month-to-month change in the physical volume of white sugar imports.

Assuming the loglinear form of the dependence, and restricting our attention to the first three lags of the explanatory variable, we obtained the following equation to estimate:

$$D\ln(V) = a + \sum_{i=0}^{3} b_i D\left(\ln Y(-i)\right), \qquad (2.5)$$

$$\sum_{i=0}^{3} b_i > 0 .$$

The results of the estimation are given in Table 4. The sample of the regression is determined by the availability of data on white sugar imports from CIS countries. We used the second lag of the dependent variable to account for the autocorrelations in the residuals.

According to our estimates, short-run changes in real GDP imply a significant change in the physical volume of white sugar imports. At the same time, changes in the physical volume of white sugar imports do not appear to be sensitive to changes in the real prices at which white sugar is imported.

Thus, we found the real appreciation had no effect on the physical volumes of meat and white sugar imported. The real appreciation influenced the month-to-month change in the real Ruble value of meat and white sugar imports only through the revaluation effect, which decreased import expenditure.

3. THE REAL EXCHANGE RATE AND CONSUMPTION

The real exchange rate could influence consumption through real incomes. Worse terms of trade decrease real income at any given level of income measured in terms of exportables, through making imports relatively more expensive than exports. As a result, savings decrease and the current account will deteriorate (where incomes, measured in terms of exportables, are held constant) — the so-called Harberger–Laursen–Metzler effect. Along with many papers offering models supporting the effect, some authors, for example Obstfeld (1982), argue that a worsening of the terms of trade could lead to an increase in savings and

Table 4.

Dependent variable: The month-to-month change in the physical volumes of total white sugar imports.
Sample: April 95 – December 1997.
Method of estimation: OLS.

All variables were taken in logarithms before differentiation. Real GDP is seasonally adjusted. Standard errors are in parenthesis.

Variable	Total imports of white sugar	
	All lags	Only significant lags
Constant term	0.01 (0.01)	0.00 (0.01)
The month-to-month change in real GDP:		
Current	2.45 (4.63)	
First lag	9.04** (4.67)	8.23** (4.14)
Second lag	1.01 (4.90)	
Third lag	11.79* (4.78)	11.70* (4.41)
Second lag of the dependent variable	–0.32** (0.18)	–0.34* (0.16)
R-squared	0.31	0.30
Q-statistic	9.03	7.83
(8 lags)***	(0.34)	(0.45)

* — Significant at the 5% level of significance.

** — Significant at the 10% level of significance.

*** — P-value in parenthesis.

an improvement in the current account. The paper of Svensson and Razin (1983) is consistent with both the Harberger–Laursen–Metzler effect and Obstfeld's findings. It divides the effect on real expenditure of a worsening in the terms of trade into two parts: the wealth effect on real expenditure and the inter-temporal substitution effect, incorporating both static and inter-temporal effects. The inter-temporal effect occurs due to changes in the real interest rate. As long as the wealth effect of the real depreciation is negative, the substitution effect is ambiguous.

Table 5.

Dependent variable: The month-to-month change in the real per capita consumption of the population.
Sample: February 94 – December 1997.
Method of estimation: OLS.

All variables were taken in logarithms and seasonally-adjusted before differentiation. Standard errors are in parentheses.

Variable	Coefficient
Constant term	0.00 (0.01)
The month-to-month change in real wages:	
Current	0.54* (0.20)
First lag	−0.22 (0.21)
Second lag	0.12 (0.20)
Third lag	−0.11 (0.18)
The month-to-month change in the real stock of household deposits	0.10 (0.14)
The month-to-month change in the real exchange rate:	
Current	0.14 (0.11)
First lag	−0.06 (0.11)
Second lag	0.22** (0.12)
Third lag	−0.23* (0.11)
R-squared	0.33
Q-statistic	11.93
(20 lags)***	(0.92)

* — Significant at the 5% level of significance.

** — Significant at the 10% level of significance.

*** — P-value in parentheses.

In this part, we study the effects of the real exchange rate (E/P) on the real *per capita* consumption of the population, keeping constant both real disposable income and real wealth, proxied by real wages and the real stock of household bank deposits. Again, we avoid working with non-stationary series by differentiating them. We restrict our attention to the first three lags of the explanatory variables. We do not consider the lagged values of the real stock of household deposits since changes in the stock are closely correlated with savings. The results of the estimation are contained in Table 5.

Considering only the statistically significant variables, and replacing the second and the third lags of differentiation in the real exchange rate by the second lag of the second differentiation, we came to the following regression (Table 6):

Table 6.

Dependent variable: The month-to-month change in the real per capita consumption of the population.
Sample: February 94 – December 1997.
Method of estimation: OLS.

All variables were taken in logarithms and seasonally adjusted before differentiation. Standard errors are in parenthesis.

Variable	Coefficient
Constant term	0.006 (0.005)
The month-to-month change in real wages	0.48* (0.16)
D (Real exchange rate(–2), 2)	0.18* (0.08)
R-squared	0.26
Q-statistic	16.65
(20 lags)**	(0.68)

* — Significant at the 5% level of significance.

** — P-value in parentheses.

According to our results, an increase in the rate of real appreciation decreases the rate of increase in real consumption two months later. This could be referred to by the decrease in the real Ruble value of the foreign currency stock held by the population.

4. THE MODEL

The model which we are using for the estimation of the cumulative effect of the real exchange rate on output is basically the standard AD-AS static model.

The *demand side* is described by the following system of equations:

$$Y = C + I + G + EX - IM ;$$
$$M / P = L(i, Y) ;$$
$$C = C(r, Y - T) ;$$
$$T = T(Y) ;$$
$$I = I(r, R) ;$$
$$G = G(T, P_{electricity} / P) ;$$
$$EX = R \times EX_{ph}(R) ;$$
$$IM = R \times IM_{ph}(Y, R) ;$$
$$r = i - \pi^{e} ;$$
$$R = E P^{*} / P ;$$
$$L_i < 0, L_Y > 0; C_r < 0, C_{Y-T} > 0; T_Y > 0; I_r < 0, I_R < 0 ;$$
$$G_T > 0, G_{P_{electricity} / P} > 0; EX_R > 0; IM_Y > 0, IM_R < 0 ;$$

where:
Y — output,
C — consumption,
I — investment,
G — government induced demand,
EX — export of goods and services (real ruble value),
IM — import of goods and services (real ruble value),
EX_{ph} — export of goods and services (physical volumes),
IM_{ph} — import of goods and services (physical volumes),
M — nominal money balances,
P — domestic price level,
T — net taxes,
L — demand for money function,
i — nominal interest rate,
r — real interest rate,
R — real exchange rate,
$P_{electricity}$ — domestic price of electricity,
P^* — foreign price level,
E — nominal exchange rate,
π^e inflation expectations.

The first and the second equation of the system are equilibrium conditions for the goods and the money market respectively.

The third equation relates consumption to the real interest rate and to disposable income. Consumption depends positively on disposable income and negatively on the real interest rate, which may be interpreted as either the price of credit or the opportunity cost of consumption today as opposed to saving. Disposable income is equal to real GDP minus the net taxes collected by consolidated budget and extra-budgetary funds.

The fourth equation relates net taxes to GDP. Thus, the model does not take into account other factors (for example, the political ones) which determine tax collection and payment, as well as the non-payment of pensions, stipends and so on.

The fifth equation says that investment depends negatively on the real interest rate (which is the price of credit) and also on the real exchange rate, reflecting the price of imported investment goods.

Government-induced demand is assumed to depend both on net taxes and the real domestic price of electricity. First of all, in Russia, government-induced demand is not necessarily actually paid and, thus, is not equal to actual consolidated budget non-interest expenditures. The services of under-financed government institutions enter GDP in accordance with costs, which include wages, heating and electricity (whether paid or unpaid). The paid part of government-induced demand is positively related to net taxes. At the same time, government consumption (both paid and unpaid) increases with the real price of electricity since costs are higher.

Exports are positively related to the real exchange rate, which is the measure of the competitiveness of domestic goods against foreign ones.

The physical volume of imports is an increasing function of output and a decreasing function of the real exchange rate. The real Ruble value of spending on imported goods is an increasing function of output, but the effect of the real exchange rate is unclear here. Growth in the real exchange rate leads to a decrease in the number of units imported but to an increase in the real price of each unit.

The two last equations are definitions of the real interest rate and the real exchange rate.

The solution of the system gives us aggregate demand as a function of the real money balances, the real electricity price, the real exchange rate and inflation expectations, which we assume to have a loglinear

form:

$$\ln Y = a_0 + a_1 \ln \frac{M}{P} + a_2 \ln \frac{P_{electricity}}{P} + a_3 \ln \frac{E P^*}{P} + a_4 \pi^e, \quad a_1, a_2, a_4 > 0. \tag{4.1}$$

Note that the effect of the real exchange rate on aggregate demand is unclear, for the reasons stated above.

Aggregate supply is assumed to be a function of real non-wage producer costs and inflation expectations. Inflation expectations could increase supply due to an increase in profit expectations and a decrease in the real lending rate, which is the cost of working capital. On the other hand, they could influence supply negatively since producers could consider high inflation as a sign of a deteriorating economic situation. Real producer costs are determined not only by the domestic prices of fuel and energy but also by the price of imported components, which is assumed to depend on the real exchange rate.

Thus, aggregate supply is a function of the real domestic prices of fuel and energy, the real exchange rate and inflation expectations:

$$\ln Y = b_0 + b_1 \ln \frac{P_{fuel}}{P} + b_2 \ln \frac{P_{energy}}{P} + b_3 \ln \frac{E P^*}{P} + b_4 \pi^e, \quad b_1, b_2, b_3 < 0. \tag{4.2}$$

The sign of b_4 is uncertain.

Using the equilibrium condition

$$a_0 + a_1 \ln \frac{M}{P} + a_2 \ln \frac{P_{electricity}}{P} + a_3 \ln \frac{E P^*}{P} + a_4 \pi^e = b_0 + b_1 \ln \frac{P_{fuel}}{P} + b_2 \ln \frac{P_{energy}}{P} + b_3 \ln \frac{E P^*}{P}, \tag{4.3}$$

we can exclude P and develop a reduced form of output equation:

$$\ln Y = c_0 + c_1 \ln \frac{M}{P_{fuel}} + c_2 \ln \frac{EP^*}{P_{fuel}} + c_3 \pi^e + c_4 \ln \frac{P_{energy}}{P_{fuel}}, \quad c_1 > 0. \tag{4.4}$$

The impact of the real exchange rate, inflation expectations and the real electricity price on equilibrium output is uncertain.

5. MODEL ESTIMATION

We need to estimate the equilibrium output equation (4.4) as well as the demand and supply equations (4.1) and (4.2).

Inflation expectations are proxied by the second lag of inflation.

On the basis of the ADF tests, we conclude that all variables which enter (4.1), (4.2) and (4.4), except real GDP and the domestic electricity price in terms of fuel, are I(1). The real GDP and the domestic electricity price in terms of fuel turned out to be stationary. Thus, we differentiated all the estimations. The results of the ADF tests are given in Appendix V.

We estimate the reduced form equation by OLS, using TSLS to estimate the demand and supply equations but also estimating these by OLS for comparison.

We have not carried out a seasonal adjustment of the series, assuming that the seasonality in real output is explained mainly by seasonality in the explanatory variables, although we did add a dummy variable for January to the set of explanatory variables.

Table 7 contains the results of the estimation of the reduced form equation.

The coefficient of the change in the real exchange rate is negative and statistically significant at the 10% level.

We then estimated the structural equations in the differentiations by TSLS and OLS (Tables 8, 9).

Following Davidson and MacKinnon (1993), we tested jointly for the correctness of the model specification and the validity of the instruments. The test statistic is the number of observations multiplied by the uncentred R-squared of the regression of the TSLS residuals on the set of instruments. The test statistic is asymptotically chi-squared with (l–k) degrees of freedom, where l is the number of instruments and k is the number of explanatory variables. For our demand equation, the test statistic is virtually zero (0.00), so we could accept the hypothesis at the 10% level of significance.

Thus, we did not discover a statistically significant influence of the real exchange rate on the demand side. This result is consistent with our findings in Sections 2 and 3.

Again for our supply equation, we tested jointly for the correctness of the model specification and the validity of the instruments. The test statistic is equal to 1.24; thus, we can accept the hypothesis at the 10% level of significance.

Table 7.

Dependent variable: The month-to-month change in real GDP.
Sample: February 93 – November 1997.
Method of estimation: OLS.

All variables (except inflation) are taken in logarithms before differentiation. Standard errors are in parentheses.

Variable	Coefficient
Constant term	0.01 (0.00)
$D\frac{M}{P_{fuel}}$	0.14* (0.07)
$D(\text{inf}(-2))$	0.01* (0.00)
$D\frac{EP^*}{P_{fuel}}$	−0.10** (0.06)
$D\frac{P_{electricity}}{P_{fuel}}$	0.07 (0.05)
January	−0.21* (0.02)
R-squared	0.83
Q-statistic	29.14
(24 lags)***	(0.22)

* — Significant at the 5% level of significance.

** — Significant at the 10% level of significance.

*** — P-value in parentheses.

Here, we found that the real depreciation had a negative effect on the supply side which was statistically significant at the 10% level of significance. The coefficient on the second lag of inflation (by which we proxied inflation expectations) is positive and statistically significant at the 5% level of significance. The result probably needs the construction of an underlying micromodel and further research.

Precautions in interpretation. In this section, we would like to summarise what precautions are necessary in interpreting the results of the paper.

First of all, since we were not able to prove the existence of cointegrating relationships between the studied variables, all our results are formulated in terms of stationary differences.

Table 8. Demand equation.

Dependent variable: The month-to-month change in real GDP.
Sample: February 93 – November 1997.
Method of estimation: TSLS and OLS.

List of instruments: constant term, $D\frac{M}{P_{fuel}}$, $D(\inf(-2))$, $D(\inf(-1))$, $D\frac{EP^*}{P_{fuel}}$, $D\frac{P_{electricity}}{P_{fuel}}$, January.

All variables (except inflation) are taken in logarithms before differentiation. Standard errors are in parentheses.

Variable	Coefficient	
	TSLS	OLS
Constant term	0.02* (0.00)	0.02* (0.00)
$D\frac{M}{P}$	0.32* (0.11)	0.26* (0.08)
$D(\inf(-2))$	0.01* (0.00)	0.01* (0.00)
$D\frac{EP^*}{P}$	0.05 (0.09)	0.01 (0.06)
$D\frac{P_{electricity}}{P}$	0.21* (0.10)	0.15* (0.06)
January	−0.20* (0.00)	−0.20* (0.02)
R-squared	0.85	0.85
Q-statistic	17.09	22.69
(24 lags)**	(0.85)	(0.54)

* — Significant at the 5% level of significance.

** — P-value in parentheses.

Table 9. Supply equation.

Dependent variable: The month-to-month change in real GDP.
Sample: February 93 – November 1997.
Method of estimation: TSLS and OLS.

List of instruments: constant term, $D\frac{M}{P_{fuel}}$, $D(\text{inf}(-2))$, $D(\text{inf}(-1))$, $D\frac{EP^{*}}{P_{fuel}}$, $D\frac{P_{electricity}}{P_{fuel}}$, January.

All variables (except inflation) are taken in logarithms before differentiation. Standard errors are in parentheses.

Variable	Coefficient		
	TSLS		OLS
	Regression 1	Regression 2	
Constant term	0.012* (0.006)	0.012* (0.006)	0.02* (0.00)
$D\frac{EP^{*}}{P}$	−0.19*** (0.13)	−0.18** (0.09)	−0.00 (0.07)
$D(\text{inf}(-2))$	0.01* (0.00)	0.01* (0.00)	0.01* (0.00)
$D\frac{P_{fuel}}{P}$	−0.17** (0.09)	−0.17* (0.08)	−0.02 (0.06)
$D\frac{P_{electricity}}{P}$	−0.02 (0.10)		
January	−0.22* (0.02)	−0.22* (0.02)	−0.23* (0.02)
R-squared	0.76	0.77	0.80
Q-statistic	31.16	30.71	34.49
(24 lags)****	(0.15)	(0.16)	(0.08)

* — Significant at the 5% level of significance.

** — Significant at the 10% level of significance.

*** — Significant at the 15% level of significance.

**** — P-value in parentheses.

If the levels are not co-integrated, then we can not expect that the variables will satisfy any relationship, even in the long run. At the same time, the stable differences could well satisfy some equilibrium equation.

Thus, all the connections which we discovered do have a place for month-to-month adjustments to short-run shocks. On the other hand, at this stage we can say nothing about the relationships between the levels of the variables.

Second, it is necessary to mention that, within the time period studied (1993–1997), we mainly observed a month-to-month real appreciation, not a depreciation. Simply reversing the results of the paper to explain a connection between a real depreciation and output could lead to the wrong conclusions. That is why, in the case of a real depreciation, one should not apply the results of the paper without further research.

6. CONCLUSIONS

Our estimations show that, in 1993–1997, the larger month-to-month real appreciation was connected with the larger month-to-month increase in aggregate supply (supposedly due to the stronger decrease in the prices of imported production inputs). At the same time, according to our estimations, the short-term adjustments of aggregate demand were insensitive to the month-to-month real appreciation.

Our results allow us to suggest that the sharp contraction of output soon after 17 August 1998 was caused by the sharp real depreciation in that August and September. Another conjecture suggested by the paper is that the recovery of output after several months of contraction was due to the increase in real money holdings. This increase in real money demand we attribute to the disappeared GKO/OFZ market. However, the explanation of the post-crisis dynamics of real GDP need to be verified thoroughly.

We found no evidence that short-run changes in the physical volume of crude oil exports to CIS countries were influenced negatively by the month-to-month real appreciation. The same statement is true for natural gas exports both to non-CIS and to CIS countries. However, the revaluation effect of the real appreciation, which decreased the profits of exporters, certainly had a place. On the other hand, the larger short-run increase in the real price of crude oil exported to non-CIS countries led to a greater increase in the physical volume of non-CIS crude oil exports.

We have no evidence that the month-to-month real appreciation increased the short-run changes in the physical volumes of meat and white sugar imports. The revaluation effect of the real appreciation, which made every imported unit cheaper and, thus, increased real domestic incomes, could not be harmful to the demand for domestically-produced goods. On the other hand, the additional short-run increase in non-CIS meat imports crowded out a part of the increase in domestic meat production. That is, the month-to-month increase in domestic production suffered from the short-run increase in import volumes, but not from the real appreciation.

Thus, we have no evidence that the cumulative effect of the month-to-month real appreciation on the changes in the net export part of aggregate demand was definitely negative. So, our findings in Section 2 are consistent with our main results in Section 5.

APPENDICES

I. Coefficients of the correlations of the price of crude oil exports to CIS and to non-CIS countries

Sample: March 95 – December 1997.
All variables are changes of seasonally-adjusted logarithms.

	A	A (−1)	A (−2)	A (−3)
B	0.13	0.06	0.29	−0.05
B (−1)	0.03	0.16	0.08	0.26
B (−2)	0.11	0.05	0.04	0.04
B (−3)	−0.03	0.09	0.10	0.06

A — $\frac{p_{\$}^{non-CIS} \times E}{P}$; B — $\frac{p_{\$}^{CIS} \times E}{P}$.

II. Coefficients of the correlations of the domestic price of natural gas and the price at which natural gas is exported to non-CIS and CIS countries

Sample: April 94 – December 1997.
All variables are changes of seasonally adjusted logarithms.

	A	A (−1)	A(−2)	B	B (−1)	B (−2)
A				0.00	−0.09	0.16
A (−1)				0.21	0.10	−0.13
A (−2)				−0.04	−0.18	0.23
B	0.00	0.21	−0.04			
B (−1)	−0.09	0.10	−0.18			
B (−2)	0.16	−0.13	0.23			
C	−0.09	0.04	0.30	−0.09	0.07	−0.03
C (−1)	−0.18	−0.08	0.01	−0.12	0.11	−0.05
C (−2)	−0.22	−0.18	−0.07	−0.25	−0.03	0.08

A — $\frac{p_{\$}^{non-CIS} \times E}{P}$; B — $\frac{p_{\$}^{CIS} \times E}{P}$; C — $\frac{p_{dom} \times E}{P}$.

III. Results of ADF tests (exports)

Variable	SA	S	NL	TS	1%	Q	P
Physical volume of crude oil exports:							
Non-CIS:							
Level	+	03.92–07.98	1	–3.15	–3.52	13.63	0.63
Difference	+	06.92–07.98	3	–6.36	–3.52	14.74	0.54
CIS:							
Level	+	04.94–06.98	2	–1.76	–3.56	8.56	0.93
Difference	+	05.94–06.98	2	–6.19	–3.57	9.94	0.87
Real export price of crude oil (free of taxes):							
Non-CIS:							
Level	+	12.92–06.98	2	–2.78	–3.53	15.43	0.49
Difference	+	01.93–06.98	2	–4.7	–3.53	16.87	0.39
CIS:							
Level	+	04.94–06.98	2	–1.45	–3.57	19.53	0.24
Difference	+	05.94–06.98	1	–7.23	–3.57	19.20	0.26
Domestic extraction of crude oil:							
Level	+	04.93–07.98	2	–3.71	–3.53	8.90	0.92
Physical volume of natural gas exports:							
Non-CIS:							
Level	+	05.92–12.97	3	–1.39	–3.53	15.35	0.50
Difference	+	05.92–12.97	2	–8.74	–3.53	15.61	0.48
CIS:							
Level	+	03.94–12.97	1	–4.53	–3.58	0.54	0.54

SA — Seasonal adjustment; S — Sample; NL — Number of lags (ADF); TS — ADF test statistic; 1% — 1% critical value; Q — Q-statistic (16 lags); P — P-value.

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Variable	SA	S	NL	TS	1%	Q	P
Real export price of natural gas (free of taxes):							
Non-CIS:							
Level	+	11.93–12.97	2	−2.23	−3.56	17.69	0.34
Difference	+	11.93–12.97	1	−4.42	−3.57	19.91	0.22
CIS:							
Level	−	06.94–12.97	2	−1.66	−3.59	12.93	0.68
Difference	−	07.94–12.97	2	−4.04	−3.59	11.72	0.76
Real domestic price of natural gas:							
Level	−	03.94–12.97	2	−2.64	−3.58	10.09	0.86
Difference	−	04.94–12.97	2	−3.31	−3.58	7.75	0.96
Second difference	−	05.94–12.97	2	−4.8	−3.59	11.48	0.88
Domestic extraction of natural gas:							
Level	+	03.94–07.98	2	−2.47	−3.53	12.53	0.71
Difference	+	03.94–07.99	2	−4.52	−3.54	12.71	0.69

SA — Seasonal adjustment; S — Sample; NL — Number of lags (ADF); TS — ADF test statistic; 1% — 1% critical value; Q — Q-statistic (16 lags); P — P-value.

IV. Results of ADF tests (imports)

Variable	SA	S	NL	TS	1%	Q	P
Physical volume of meat imports:							
Non-CIS:							
Level	–	04.92–08.98	2	–1.97	–3.52	13.72	0.69
Difference	–	05.92–08.98	2	–5.34	–3.52	15.25	0.51
CIS:							
Level	–	04.94–07.98	2	–2.39	–3.57	20.54	0.20
Difference	–	05.94–07.98	2	–5.85	–3.58	10.76	0.82
Real import price of meat (taxes added):							
Non-CIS:							
Level	–	04.92–07.98	2	–1.81	–3.52	17.42	0.36
Difference	–	05.92–07.98	2	–4.56	–3.52	16.00	0.45
CIS:							
Level	–	04.94–12.97	2	–3.12	–3.60	6.20	0.99
Difference	–	05.94–12.97	2	–5.59	–3.61	7.25	0.99
Domestic production of meat:							
Level	–	05.93–07.98	3	–1.78	–3.54	20.12	0.22
Difference	–	05.93–07.98	3	–5.56	–3.54	19.48	0.25
Real domestic price of meat:							
Level	–	04.94–07.98	2	–1.18	–3.56	3.89	0.99
Difference	–	05.94–07.98	2	–3.94	–3.56	3.98	1.00

SA — Seasonal adjustment; S — Sample; NL — Number of lags (ADF); TS — ADF test statistic; 1% — 1% critical value; Q — Q-statistic (16 lags); P — P-value.

Continued from p. 43

Variable	SA	S	NL	TS	1%	Q	P
Physical volume of white sugar imports:							
Total:							
Level	–	04.95–07.98	2	–1.50	–3.60	18.22	0.31
Difference	–	05.95–07.98	2	–5.34	–3.61	18.90	0.27
Non-CIS:							
Level	+	04.92–08.98	2	–1.73	–3.52	10.91	0.82
Difference	+	05.92–08.98	2	–4.62	–3.52	8.17	0.94
CIS:							
Level	–	04.95–07.98	2	–1.25	–3.60	13.01	0.67
Difference	–	04.95–07.98	2	–4.72	–3.61	16.34	0.43
Real import price of white sugar (taxes added):							
Non-CIS:							
Level	–	04.92–07.98	2	–2.46	–3.52	13.01	0.67
Difference	–	05.92–07.98	2	–5.58	–3.52	7.74	0.96
CIS:							
Level	–	02.95–07.98	0	–4.18	–3.63	7.65	0.96
Domestic production of white sugar:							
Level	+	03.93–07.98	1	–3.59	–3.53	14.22	0.58

SA — Seasonal adjustment; S — Sample; NL — Number of lags (ADF); TS — ADF test statistic; 1% — 1% critical value; Q — Q-statistic (16 lags); P — P-value.

V. Results of ADF tests (model)

Variable	SA	S	NL	TS	1%	Q	P
Real GDP:							
Level	+	05.93–07.98	3	–4.07	–3.54	10.35	0.85
Real M2:							
Level	–	05.92–07.98	3	–1.53	–3.52	18.30	0.31
Difference	–	05.92–07.98	2	–5.25	–3.52	18.81	0.28
Real exchange rate:							
Level	–	03.92–06.98	1	–2.19	–3.52	20.03	0.22
Difference	–	04.92–06.98	1	–5.58	–3.52	19.62	0.24
Real price of electricity:							
Level	–	11.93–07.98	10	–3.36	–3.55	16.75	0.40
Difference	–	08.93–07.98	6	–5.47	–3.54	17.05	0.38
Real price of fuel:							
Level	–	02.93–07.98	1	–2.68	–3.53	18.34	0.30
Difference	–	03.93–07.98	1	–6.99	–3.53	15.45	0.49
Inflation:							
Level	–	05.92–07.98	2	–1.74	–3.52	13.28	0.65
Difference	–	06.92–07.98	2	–6.07	–3.52	14.79	0.54
M2 in terms of fuel:							
Level	–	04.93–07.98	3	–2.97	–3.53	13.78	0.62
Difference	–	04.93–07.98	2	–5.21	–3.53	13.85	0.61
Exchange rate in terms of fuel:							
Level	–	05.93–06.98	4	–2.77	–3.54	16.72	0.40
Difference	–	02.93–06.98	0	–6.42	–3.53	17.15	0.38
Electricity price in terms of fuel:							
Level	–	07.93–07.98	6	–3.69	–3.54	18.55	0.29

SA — Seasonal adjustment; S — Sample; NL — Number of lags (ADF); TS — ADF test statistic; 1% — 1% critical value; Q — Q-statistic (16 lags); P — P-value.

VI. Results of Granger causality tests (exports of crude oil)

All variables are changes of logarithms.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)			
		4 lags	5 lags	6 lags	7 lags
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause $DV^{non-CIS}$	69	2.65*	1.96**	3.02*	
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause $DV^{non-CIS}$	51	1.77	0.86	0.82	
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause DV^{CIS}	51	1.57	1.97***	2.58*	2.25*
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause DV^{CIS}	51	1.69	1.21	0.85	
D(*Extraction*) does not Granger-cause $DV^{non-CIS}$	66	0.94	0.63	0.70	
D(*Extraction*) does not Granger-cause DV^{CIS}	53	0.98	0.67	0.41	
$DV^{non-CIS}$ does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	69	1.73	1.55	1.55	
$DV^{non-CIS}$ does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	51	1.49	0.96	1.33	
DV^{CIS} does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	51	1.05	0.54	0.73	

* — Rejection at the 5% level of significance.

** — Rejection at the 10% level of significance.

*** — Rejection at the 15% level of significance.

Continued from p. 46

All variables are changes of logarithms.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)			
		4 lags	5 lags	6 lags	7 lags
DV^{CIS} does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	51	1.39	1.38	1.31	
$DV^{non-CIS}$ does not Granger-cause *D*(*Extraction*)	66	3.51*	3.30*	3.54*	
DV^{CIS} does not Granger-cause *D*(*Extraction*)	53	0.70	1.02	0.63	
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	51	0.75	0.83	1.48	
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	51	1.14	1.20	1.46	

* — Rejection at the 5% level of significance.

VII. Results of Granger causality tests (exports of natural gas)

All variables are changes of logarithms.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)		
		4 lags	5 lags	6 lags
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause $DV^{non-CIS}$	52	0.46	0.28	0.36
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause $DV^{non-CIS}$	45	0.58	0.52	0.50

Continued from p. 47

All variables are changes of logarithms.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)		
		4 lags	5 lags	6 lags
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause DV^{CIS}	47	0.40	0.82	0.62
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause DV^{CIS}	45	0.31	0.21	0.40
D(*Extraction*) does not Granger-cause $DV^{non-CIS}$	59	3.22*	2.42**	2.19**
D(*Extraction*) does not Granger-cause DV^{CIS}	47	2.82*	2.22**	1.73
$DV^{non-CIS}$ does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	52	0.30	0.42	0.93
$DV^{non-CIS}$ does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	45	1.63	1.44	1.31
DV^{CIS} does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	47	0.84	0.60	0.55
DV^{CIS} does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	45	1.41	1.35	0.40
$DV^{non-CIS}$ does not Granger-cause *D*(*Extraction*)	59	1.76	1.32	1.08

* — Rejection at the 5% level of significance.

** — Rejection at the 10% level of significance.

Continued from p. 48

All variables are changes of logarithms.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)		
		4 lags	5 lags	6 lags
DV^{CIS} does not Granger-cause D(*Extraction*)	47	0.06	0.43	0.58
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	45	0.91	0.92	2.07**
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	45	1.08	0.81	1.38

** — Rejection at the 10% level of significance.

VIII. Results of Granger causality tests (imports of meat)

All variables are changes of logarithms. Real GDP is seasonally-adjusted.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)			
		4 lags	5 lags	6 lags	7 lags
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause $DV^{non-CIS}$	78	1.96***	1.45	0.83	
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause $DV^{non-CIS}$	41	0.26	0.23	0.44	
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause DV^{CIS}	48	0.46	0.51	0.22	

*** — Rejection at the 15% level of significance.

Continued from p. 49

All variables are changes of logarithms. Real GDP is seasonally-adjusted.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)			
		4 lags	5 lags	6 lags	7 lags
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause DV^{CIS}	41	0.17	0.12	0.69	
D(*Domestic production*) does not Granger-cause $DV^{non-CIS}$	66	0.49	0.83	0.64	
D(*Domestic production*) does not Granger-cause DV^{CIS}	48	0.38	0.41	0.88	
$DV^{non-CIS}$ does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	78	3.20*	2.36*	2.16**	
$DV^{non-CIS}$ does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	41	0.52	0.41	0.95	
DV^{CIS} does not Granger-cause $D\frac{P_{\$}^{Non-CIS}\times E}{P}$	48	3.23*	1.93***	1.72	
DV^{CIS} does not Granger-cause $D\frac{P_{\$}^{CIS}\times E}{P}$	41	3.18*	2.73*	2.33**	
$DV^{non-CIS}$ does not Granger-cause *D*(*Domestic production*)	66	2.27**	2.27**	1.87***	

* — Rejection at the 5% level of significance.

** — Rejection at the 10% level of significance.

*** — Rejection at the 15% level of significance.

Continued from p. 50

All variables are changes of logarithms. Real GDP is seasonally-adjusted.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)			
		4 lags	5 lags	6 lags	7 lags
DV^{CIS} does not Granger-cause *D*(*Domestic production*)	48	0.86	0.82	0.55	
$DV^{non-CIS}$ does not Granger-cause *D*(*Y*)	66	0.86	1.04	1.78***	2.41*
D(*Y*) does not Granger-cause $DV^{non-CIS}$	66	2.98*	3.12*	3.92*	

* — Rejection at the 5% level of significance.

*** — Rejection at the 15% level of significance.

IX. Results of Granger causality tests (imports of sugar)

All variables are changes of logarithms. Real GDP and domestic production are seasonally-adjusted.

Hypothesis	Number of observations			
		4 lags	5 lags	6 lags
$D\frac{P_{\$}^{Non-CIS} \times E}{P}$ does not Granger-cause $DV^{non-CIS}$	78	0.52	0.68	0.40
$D\frac{P_{\$}^{CIS} \times E}{P}$ does not Granger-cause $DV^{non-CIS}$	35	0.39	1.99***	
$D\frac{P_{\$}^{Non-CIS} \times E}{P}$ does not Granger-cause DV^{CIS}	42	0.30	0.61	0.64
$D\frac{P_{\$}^{CIS} \times E}{P}$ does not Granger-cause DV^{CIS}	35	0.42	0.70	

*** — Rejection at the 15% level of significance.

Continued from p. 51

All variables are changes of logarithms. Real GDP and domestic production are seasonally-adjusted.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)		
		4 lags	5 lags	6 lags
$D\frac{P_{\$}^{Non-CIS}\times E}{P}$ does not Granger-cause $D(V)$	42	1.00	1.70	1.31
$D\frac{P_{\$}^{CIS}\times E}{P}$ does not Granger-cause $D(V)$	35	0.89	0.78	
D(*Domestic production*) does not Granger-cause $DV^{non-CIS}$	66	1.76	1.44	1.46
D(*Domestic production*) does not Granger-cause DV^{CIS}	42	1.26	0.75	1.16
D(*Domestic production*) does not Granger-cause $D(V)$	42	0.92	0.65	1.17
$DV^{non-CIS}$ does not Granger-cause D(*Domestic production*)	66	0.74	0.67	0.85
DV^{CIS} does not Granger-cause D(*Domestic production*)	42	0.80	1.41	0.90
$D(V)$ does not Granger-cause D(*Domestic production*)	42	0.40	1.00	1.12
$DV^{non-CIS}$ does not Granger-cause $D(Y)$	66	0.33	0.22	0.24
DV^{CIS} does not Granger-cause $D(Y)$	42	0.23	0.63	0.46
$D(V)$ does not Granger-cause $D(Y)$	42	1.37	1.34	1.24

Continued from p. 52

All variables are changes of logarithms. Real GDP and domestic production are seasonally-adjusted.

Hypothesis	Number of observations	F-statistic (P-value in parenthesis)		
		4 lags	5 lags	6 lags
$D(Y)$ does not Granger-cause $DV^{non-CIS}$	66	0.64	0.74	0.76
$D(Y)$ does not Granger-cause DV^{CIS}	42	0.46	0.41	0.60
$D(Y)$ does not Granger-cause $D(V)$	42	2.75*	2.24**	2.02***

* — Rejection at the 5% level of significance.

** — Rejection at the 10% level of significance.

*** — Rejection at the 15% level of significance.

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