A glance at the supply side of the Russian inflation

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1 Introduction

In todays's Russia, a lively debate is taking place about the supply-side nature of the inflation we observe. Double-digit inflation during most of the years, with the exception of 2006, has been accompanied by a yet faster growth in many of the products and services, which can be considered input of productions, such as electricity, gas, and transportation. To a great extent, the prices of these products are regulated by the government, and hence many believe that these prices are the proper instruments for fighting inflation. Proponents of such a view argue that it is the artificial growth of these prices that is responsible for the Russian inflation.

The alternative and more traditional monetarist view is that the Russian inflation is a monetary phenomenon and reflects excessive growth in the money supply generate by the bank of Russia. If this is the case, then growth in the input prices and other regulated prices, such as housing utilities, is merely a consequence of the overall inflation. At the same time, additional rise in the regulated prices may go on due to the reforms in the corresponding state-controlled sectors, but these reform generate only relative price changes, while the nominal price level should still reflect the growth money.

In this paper, we attempt to clarify these issues by estimating responses of the CPI and the input prices to each other in a structural vector autoregression.

2 Theoretical considerations

In theory, there is no necessary link between cost of inputs, such as electricity prices of gasoline costs, and the consumer prices. On the one hand, increases in cost can lead to what is frequently referred to as cost-push inflation. In response to an exogenous change in the price of input, producers must increase the price of their final product.

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Although cost-push inflation is theoretically plausible, such inflation is easy to show only in partial equilibrium. In general equilibrium, however, things are not so clear-cut. At least four things need to be noted. First, if an increase in production cost has disequilibrium nature, such as for example, an error term in the New Keynesian Phillips curve as in Clarida, Gali and Gertler (1999), then the resultant consumer price inflation can only be short-lived. The economy, as a result of such a cost-push shock, must go into a negative output gap, in which deflationary pressures must return the price level back to equilibrium.

Second, if the increase in cost is permanent and has equilibrium nature, for example, if it occurs as a result of increased monopolization or exhaustion of energy resources, then the resultant consumer price inflation must be accompanied by a fall in potential GDP. In case of increased monopoly power, the fall in GDP is a result of pure dead weight loss; in case of exhaustion of energy resources, the fall is analogous to a technological regress. In any case, such a fall can be described as a shift of the long run aggregate supply (LRAS) curve to the left in a standard AS/AD diagram, resulting in lower output and higher prices.

However, although GDP clearly suffers in the case of such an increase in costs, the response of the price level is much less clear. If the permanent income hypothesis holds, a permanent fall in income must result in a one-for-one fall in the aggregate demand. As a result, the AD curve shifts back together with the LRAS, leaving the price level unchanged. Hence, inflation may arise only to the extent that there are deviations from the PIH, and the fall in expected income does not immediately translate into aggregate demand. Surely, there is ample evidence against the PIH in its pure form, and hence some reaction of the price level is to be expected. However, as time passes, the fall in real income must generate a fall in demand eventually, and therefore, the inflationary reaction to increase in costs once again can be only temporary.

This last result is very similar to the debate about the sources of inflation in Western countries in the 1970s, and more specifically, to the role of the oil price increases. Although some economists, such as Blinder (quotation?) have argued that oil prices were a significant part of that inflation, other argue against such a point of view (Friedman 1975, DeLong 1997). They maintain that an increase in cost of certain inputs is a relative price change, which is irrelevant for determination of the nominal prices. Thus, the increase in price of electricity in the example above must be countered, for example, by a decrease in wages, so that the total change of production does not change. This argument was presented formally in an Ss-type model by Ball and Mankiw (1995).

Third, in analyzing the effect of the Russian cost-push inflation, one must think about the reasons for the increase in input cost. Thus, the official position of the state monopolies is that the increase in their product price is not a deadweight loss. Instead, the rise of housing utilities price or transportation costs represents the removal of implicit subsidies. Hence, this measure is simple re-distribution, whereby increase of certain costs goes simultaneously with reduction of other costs. The CPI may change, but the GDP deflator should not. Likewise, the increase in electricity prices is supposed to bring the price in line with the long run average costs, and the extra receipts are meant to be spent on construction of new generation capacity. If these claims are true, then,

once again, the measure leads to pure re-distribution of economic activity, whereby consumption spending, previously subsidized by the electricity sector, is replaced by investment spending. Again, the CPI may very well increase, but a broader price index should not.

Fourth and last, so far we kept the monetary policy issues out of this discussion, implicitly assuming that the money supply is held constant. However, the ultimate response of the price level is very much dependent on the actions of the monetary authority. The central bank can react to a rise in input costs by expanding the money supply to stimulate production, thereby spurring extra inflation. Or, on the contrary, the central bank may respond by a monetary tightening, resisting the inflationary pressures. Hence, any analysis of the supply side of the Russian inflation must take the monetary policy into account.

3 Empirical estimation

To test the above hypothesis, we build two structural VARs. The first one consists of four variables: p_t, the price level measured as the CPI reported by the Rosstat; $pinput_t$, the index of electricity, gas and water prices reported by the Rosstat (we also experiment with other measures of input costs); $poil_t$, the nominal US dollar spot price of a barrel of the Urals crude oil brand, and m_t, the broadly defined monetary base reported by the Bank of Russia. In the second version of the VAR, we add variable rer_t, the real effective exchange rate reported by the IMF.

We identify the VAR using recursive identification scheme, with standard Cholesky decomposition. The ordering of the VAR is as follows: $poil_t, pinput_t, p_t, m_t$, where a variable that is listed earlier does not react contemporaneously to a variable that is listed later.

In this specification, we assume that the monetary authority uses broad money base as its instrument, responding contemporaneously to all variables in the VAR. We check robustness to usage of other monetary aggregates, such as M0 and M2, and the results are largely unchanged. The shock is interpreted as monetary policy shock, ehnce money base is probably a better measure than either M0 or M2. It is reasonable to assume that the other variables do not react to the money supply contamporaneously: the international oil price is probably exogenous to everything that happens in Russia, while the price variables are likely to be rigid. The consumer price level is then determined by everything other than the current money supply. Here we allow the consumer price level to respond immediately to the cost increases. At the same time, we do not allow the input costs to respond immediately to the CPI. This assumption is logical, because input prices are regulated by government and are even more rigid than the general price level. Lastly, we treat the oil price as something that does not respond to anything contemporaneously.

We put the oil price in the system because money growth in Russia is normally associated with purchases of foreign reserves, which intensify at the time of high oil prices. Hence, this variable is needed in order to properly determined the monetary policy reaction function. In this sense it would be more proper to use the real exchange rate rer_t, since the empirical evidence shows that the Bank of Russia responds to the RER, not oil prices (CITATIONS!!!), and we do so in the second

VAR specification.

Including the RER in the system creates certain problems with the VAR identification. Clearly, the RER, unlike the oil price, can change in response to monetary policy, even contemporaneously, via the nominal exchange rate. At the same time, monetary policy should also be allowed to respond to the RER, which is visible to monetary authorities almost in real time. We think that the better solution would be to put the RER before the money supply in the VAR, before the monetary base. Thus, we assume that the RER does not react immediately to monetary innovations. The reason we think this is proper is that the Bank of Russia is allowing the RER to change via consumer prices, not via the nominal exchange rate, and hence, RER changes happen slowly. However, if this assumption seems questionable, we stress that our primary interest is response of p_t and $pinput_t$ to each other, hence it does not matter how the last two variables are ordered – identification of monetary policy and real exchange rate shocks is unnecessary (a point stressed by Christiano, Eichenbaum and Evans (1999) and **?**). Yet, we will see that the responses of the RER to shocks will also turn out to be interesting.

In the VAR estimation, we take all of five variables in first difference of the logarithm, as we assume that they are integrated of order one. This assumption is somewhat questionable in regards to the real exchange rate, which is stationary according to many theories, hence we check the robustness to inclusion of that variable in levels as well. Our results do not turn out to be sensitive to that assumption. We also do not assume any co-integrating relationships. The only two variables, which could be considered co-integrated by theory, are the CPI and the price of inputs; however, since inputs are considered to be relatively underpriced, their faster-then-average growth in the studied period to a large extent represents permanent adjustment of relative prices. Therefore, the trajectory of, for example, electricity prices and the consumer prices can part indefinitely, and no cointegration is to be expected. We do not perform any formal tests for unit roots or cointegration, because these tests have notoriously low power in small samples, and instead rely solely on theoretical assumptions.

The lag order of the VAR has been chosen to be two lags, based on what is suggested by the Akaike information criterion. The Schwarz criterion actually suggests one lag, but we proceed with two in order to study longer-term effects of shocks.

We also include twelve monthly dummy variables to take care of the strong seasonal pattern in the data.

3.1 The results of the VAR

We run the two VARs on the sample of monthly data for December 1999 - May 2007. The impulse responses are shown in Figures 1 and 2. We do not show responses of the oil price in the first VAR, because this variable responds to nothing either in theory or in the estimation.

Overall, the impulse responses do not look highly significant, and both specifications give very similar impulse responses. Only a few of them, however, show marginally significant differences

from zero at one or two horizons. Let us discuss these few.

An interesting observation is that there seems to be evidence in favor of both the story that input prices respond to consumer inflation and that they follow it. Thus, the impulse response of *pinput* to p is significant at the second lag, while the reverse response is significant at first three lags. The more interesting result is that the response of the price of inputs to the money growth is significant or is bordering significance at the first three lags. The consumer price index, however, does not seem to respond to the money growth at all. Thus, even if there is a link from the input prices to consumer prices, the underlying cause of consumer prices may still be money. This observation follows a standard Keynesian story that increases in money supply first cause growth in wages and other inputs, and only then lead to increase in price of the final goods.

Another interesting finding is that the RER reacts positively innovations in the price level and in the money supply. This finding is in line with the story that the real appreciation in Russia is mostly caused by the growth in prices of domestic goods in services, rather than fluctuations in the nominal exchange rate. Hence, unexpected increase in the price level naturally leads to an immediate appreciation, almost by construction. What is more interesting, however, is that an innovation to money supply also leads to an immediate appreciation, while the official point of view is that purchases of foreign exchange reserves, which are the primary source of extra money in the Russian economy, are called to keep the RER low.

Interestingly, we do not find any significant responses of the monetary base to any of the variables. Thus, monetary policy seems inactive.

3.2 Shutting down the monetary policy response

Although we fail to find an active monetary policy response, in the sense that the impulse responses of the money base are all statistically insignificant, it is still interesting to investigate whether this monetary response drives some of the results obtained. Thus, in the above impulse responses, reactions of different prices to each other are traced taking into account the actions of monetary authority. For example, seeing an increase in input prices, the central bank may increase the money supply to accommodate the shock, and thus lead to an increase in the CPI. Indeed, we do see a positive reaction of m_t to $pinput_t$, and a negative one to p_t.

In order to shut down monetary policy, we do the following. The structural four-variable VAR estimated above is described by the form

$$A_0 Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + U_t, \tag{1}$$

where Y_t is a column vector containing variables (poil, pinput, p, m), A_0 is a lower triangular impact coefficient matrix, while the other As are the structural VAR coefficients for the lagged terms, and U_t is the vector of structural disturbances with identity covariance matrix. The reduced VAR estimated by us is

$$Y_t = A_0^{-1} A_1 Y_{t-1} + A_0^{-1} A_2 Y_{t-2} + A_0^{-1} \varepsilon_t \equiv B_1 Y_{t-1} + B_2 Y_{t-2} + V_t. \tag{2}$$

What we need to do it set to zero all of the coefficients in the lower rows of the matrices A_0, A_1, A_2, with the exception of the last coefficients in these rows. Thus, we are forcing the monetary policy not to respond to anything other than monetary shocks, neither contemporaneously, nor with a lag. In that way, we still have a structural system, in which variables respond to money shocks as estimated in the VAR, but we impose a different monetary policy rule — the one that holds the monetary base constant.

The procedure is the following. We perform the Choleski decomposition of the estimated covariance matrix $\hat{\Sigma}_V$ of reduced form disturbances to produce upper triangular matrix P such that $P'P = \hat{\Sigma}_V$. The inverse of P' is an estimate of A_0. Pre-multiplying the reduced form (2) by $(P')^{-1}$, we get an estimate of the structural VAR (1). Then, we replace all of the monetary response coefficients by zeros, as described above, and re-calculate the impulse responses.

In Figure 3 we show two impulse responses: of the input prices and consumer prices to each other. The solid lines indicate the old impulse responses, with the estimated monetary policy response. The dashed lines indicate the new responses, with the monetary response shut off.

The interesting result is that the response of the CPI to input prices is weakened substantially, especially the instantaneous response, which is now one quarter as big as before. At the second and third lag, the response is weakened not as much, only by about a quarter. Conversely, the response of the CPI to input prices is hardly changed; if anything, it is strengthened. We do not report other changes here, but they are minimal. Indeed, the only response in this system that suffers major change from shutting down monetary policy is the reported response of the CPI to the input price, the one that motivated this paper.

This finding suggests that to a great extent, the response of the CPI to changes in electricity prices is still money-driven. The Bank of Russia responds to such input price hikes by printing more money, thus fueling more inflation. At the same time, direct effect of input prices onto consumer prices also exists.

References

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Figure 1: Impulse responses in the baseline specification with oil price

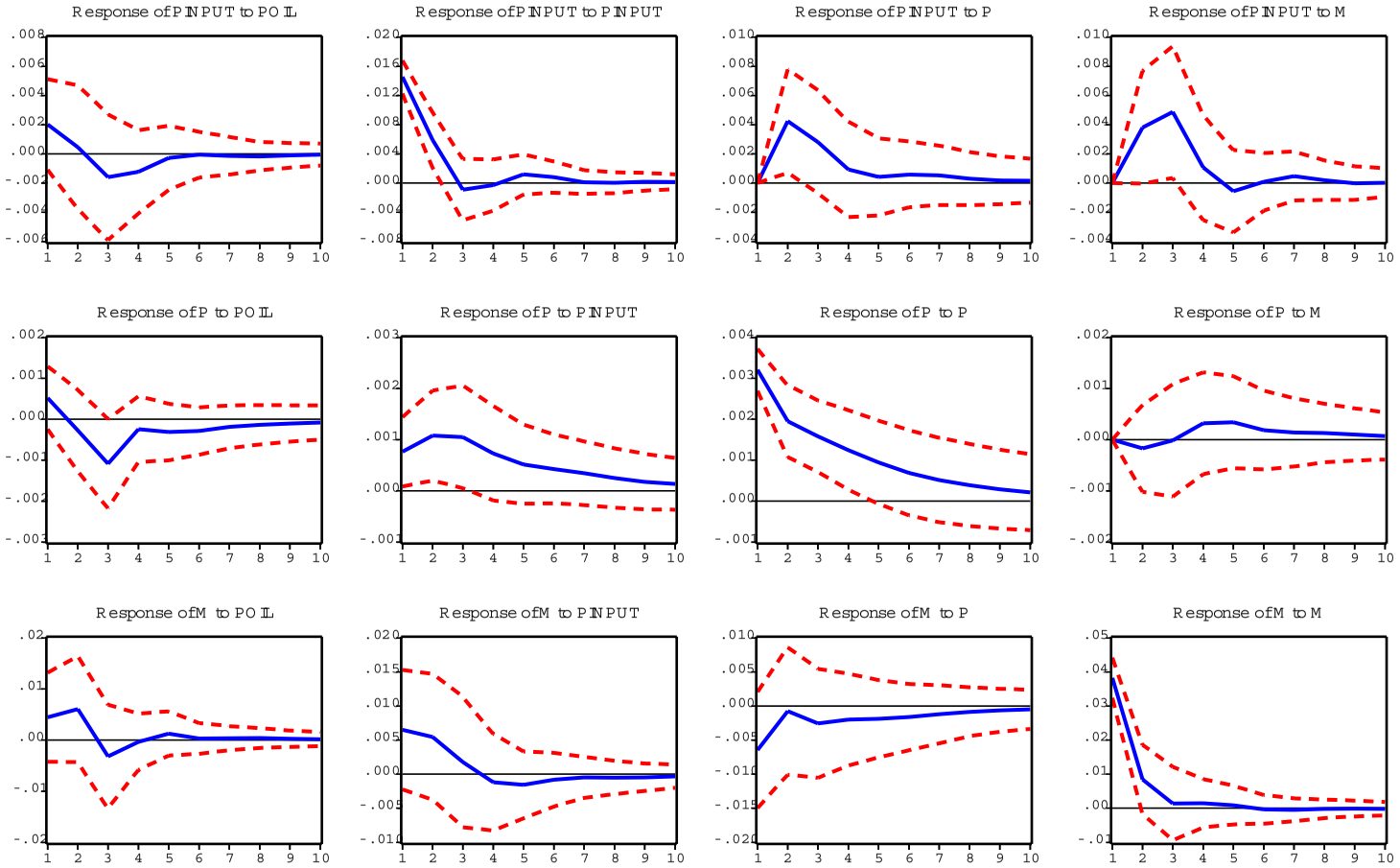

Figure 2: Impulse responses in the baseline specification with real exchange rate

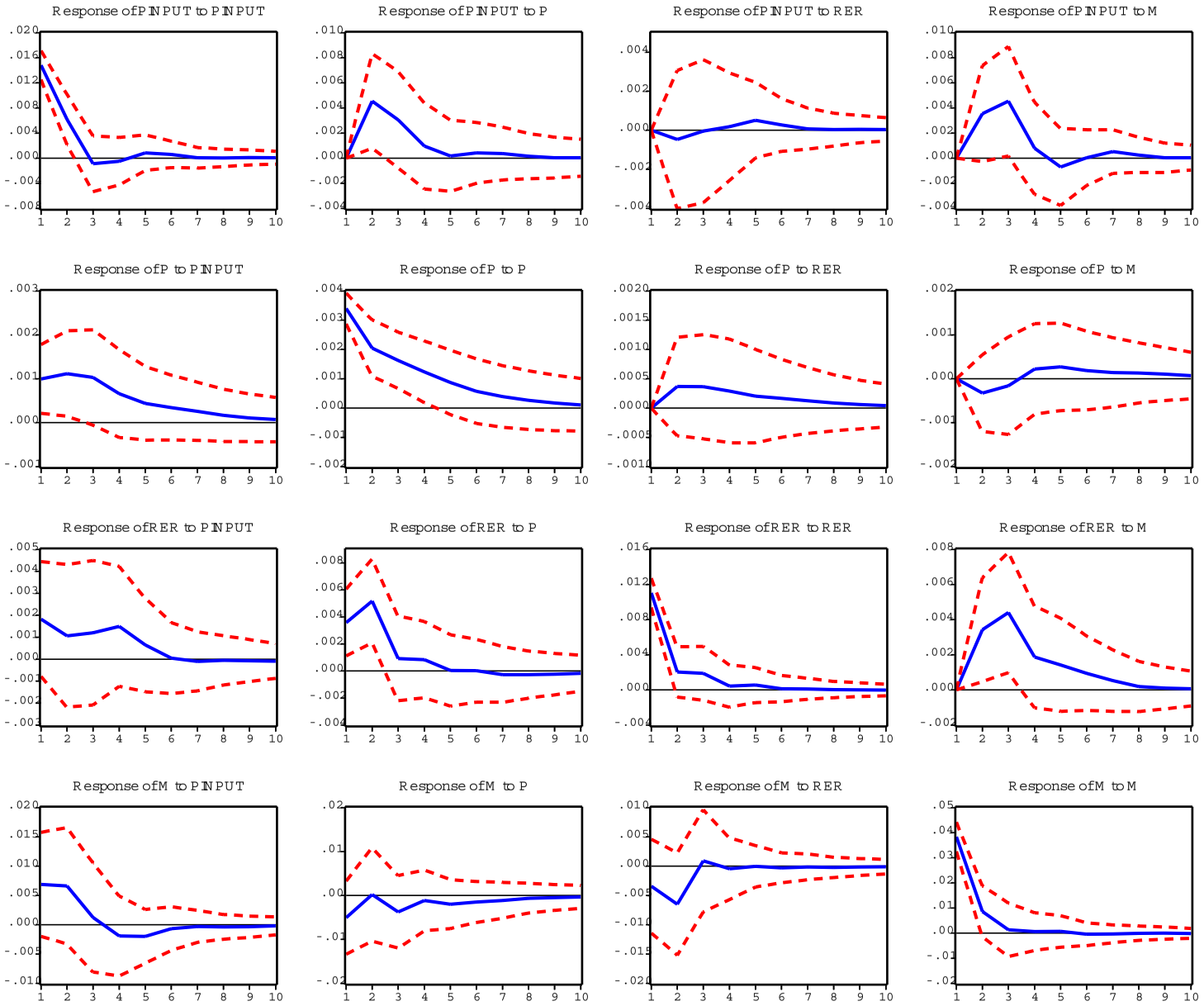

Figure 3: Impulse responses with inactive policy