Analyzing exchange rate volatility around the August 1998's Russian crisis

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Abstract

This article presents a new model of the Russian federation and applies it to the recent crisis. It examines a range of policy options designed to improve the current economic situation. The objective is to show that the decline in output can mainly be explained by a fall in potential output that has render the economy supply-side constrained. More precisely the Russian crisis may be explained by capital stock obsolescence that has rendered enterprises unable to face international competition. Hence the optimal policy should not focus on fiscal consolidation alone but rather to achieve this while undertaking supply side reforms aimed at rebuilding the capital stock.

Introduction

The purpose of this paper is to examine the exchange rate volatility of the ruble, before the August 1998 crisis, using a macroeconomic model of the Russian Federation developed by Basdevant (1999).

A main issue is to use this simulation exercise to find out what was the origin of this financial crisis. This paper will show how expectations of the exchange rate played a crucial role. Nevertheless this analysis does not seek to explain the Russian crisis only by a specific shock on expectations. The objective is more to provide an analysis of the timing of the crisis rather than the crisis itself. A further objective is to demonstrate a new methodology which allows an econometric model to be used to forecast the possibility of a financial crises. The origin of the Russian crisis lay in structural problems: mainly capital stock obsolescence and shortage (see Hall and Basdevant (1999) and Basdevant (1999)) and also institutional ones. In particular the two main aspects are: the cooperation (or lack of) between industry and the banking system, and the inefficiency of markets (there is no real market clearing, and non-cash transaction are widespread).

Before presenting the model and simulation results, it is necessary to characterize the crisis with some stylized facts, as the model should obviously reflect these.

The crisis begun on the 17th of August 1998, when the Prime Minister announced that the government would allow the ruble to be devaluated 34 percent by the end of the year. He also declared a 90-day foreign debt moratorium, and announced a de-facto default on the government's domestic bond obligations. On August 26th the Russian Central Bank announced that it would not be able to support the ruble any longer. In less than a month the national currency collapsed by three hundred percent, from 6.2 rubles to the dollar to over 20. Inflation shot up 15 percent in August compared with 0.2 percent in July, and has continued to climb.

The crisis came mainly from the inability of the government to raise enough taxes to reduce the public deficit. Hence it became indebted towards international creditors, and thus rendered the Russian Federation dependent on capital inflows. By the middle of 1998 the external terms of trade had deteriorated by almost 18 percent compared to a year earlier due to a drop in international prices for Russia’s main exports. From late 1997 onwards, domestic interest rates were increased sharply in response to developments in the balance of payments. While the ruble was successfully maintained within its band until mid-August 1998, in the absence of fiscal adjustment the policy resulted in a decline of international reserves. The problem that has rendered the debt unsustainable is the loss of international investor's confidence in the Russian economy. This happened because too few structural reforms were implemented (most probably because of a strong conflict between the Duma – the lower house of parliament – and the Government) and also because even Russian owned capital moved abroad in very large amounts. At this time it was becoming increasingly clear to international investors that Russia would not be able to sustain the ruble. The Central Bank could not defend the ruble indefinitely, hence the problem was simply to know when the ruble should be devaluated.

It is almost obvious that we can not expect a model to accurately forecast a unique event such as the Russian financial crises. This does not however mean that the model is not able to tell us a great deal about the probability of such an event happening. In this paper we therefore propose a new methodology which draws on ideas from the financial econometric literature on ARCH and GARCH modelling and the standard macroeconomic literature on stochastic simulations to derive a time varying measure of the probability of a financial crises occurring. Further details are given below but essentially the idea is that the model and its errors are a complete description of the data generation process. Any misspecification or omitted effect from the model is, by identity captured in the errors of each equation. So unless the crises happens without any warning at all either the model, or its error processes should be able to predict that something is going to occur. We therefore propose using the technique of stochastic simulation to calculate the standard error bands of the model variables. But instead of doing this in the conventional way where the shocks are drawn from a constant distribution we will base the distribution of the shocks on the properties of the very recent model residuals. Much as is done in a standard ARCH model. We will thus be able to calculate a time varying volatility profile for each variable in the model. If the technique is successful we would expect the volatility (or standard error) of variables such as the exchange rate to increase dramatically just prior to the crises. Thus indicating the rising probability of such a crises.

The rest of the paper is organized as the following: section 1 describes the structure of the model, section 2 presents stochastic simulations results, and section 3 concludes. The reader will find the complete model at the following web site http://www.eeg.ru.

1. The model

In this section the model of Basdevant (1999) is briefly presented. The purpose of this section is to present the modeling strategy that was adopted, i.e. to explain how we model an economy that faces structural change, and for which only a limited data set is available. Following Hall (1993) or Greenslade and Hall (1996) this article assumes that despite structural change econometric modeling can still be useful if it takes explicitly into account the form of change, which has taken place. Basically we consider the two following elements:

- In the long run the Russian economy should conform to economic theory. Hence, many long-run parameters can be calibrated according to theory;
- Structural change makes some coefficient unstable, and also has lead to a measurement problem.

The Kalman filter is an appropriate method to integrate those two issues. More precisely, this section deals with five issues. First, the data set available from the Goskomstat is limited and subject to measurement errors (see sub-section 1.1). Second, the supply-side constraint is outlined in sub-section 1.2. Next the process of disequilibrium adjustment is described in sub-section 1.3. Two sections give a specific analysis for the role of the dollar in the Russian economy (sub-section 1.4 and 1.5). Finally a sixth section provides a description on how economic policy is integrated in the model.

1.1. Modeling an economy with a low-quality and limited data set

The basic structure is a variant of an equilibrium correction model (ECM) that sets for each endogenous variable X_t the following form:

$$\Delta X_t = \sum_{i=1}^{k} \left(\alpha_{0i}\Delta X_{t-i} + \alpha_{1i}\Delta Y_{t-i}\right) - \gamma\left(X_{t-1} - X_{t-1}^{*} - \varepsilon\right) + \nu_t \tag{1}$$

where Y_t is a vector that represents other variables that influence the dynamic of X_t, and $X_t^*+\varepsilon$ is the long-run value for X_t, where ε is a constant, X_t^* is a linear combination of different variables and ν_t a white noise. The second-term of the equation is the equilibrium correction term: when X_t is above its long-run target, then it tends to render the variation of X_t negative, and then makes X_t move back to the target. The first-term describes the short-run dynamic followed by X_t.

A major issue has concerned the availability of data and its quality. The data period is limited (the full data set is only available from the last quarter of 1994). Moreover it is widely recognized that its quality is poor, there are many non-official transactions, and Russian official national accounts contain large statistical discrepancies (see Nakamura (1998)). Hence, the first idea was to build a rather small and simple model, i.e. to incorporate a lot of prior information and economic theory. It is also helpful to limit the lags in the model, in order to preserve degrees of freedom (the lag depth is limited to 2). To deals with the structural change we draw on the result of Hendry and Clements (1996a 1996b 1998a and 1998b) who demonstrate that changes in the deterministic component of a model dominate its forecasting performance. The main implication of this work is that consistent intercept adjustment may compensate for a wide range of structural change. We implement this by introducing a time varying constant (estimated with a Kalman filter) in each ECM equation that will capture most of the structural change. As an example, economic theory predicts that consumption is related to disposable income. Nevertheless, disposable incomes have sharply declined over the transition period, while consumption remained constant. The stochastic constant then suggests that transition has led to an increasing consumption to income ratio which has been almost exactly offset in terms of actual consumption by the fall in incomes. Hence the basic ECM has been changed in order to specify the rule for ε:

$$\Delta X_t = \sum_{i=1}^{k} \left(\alpha_{0i}\Delta X_{t-i} + \alpha_{1i}\Delta Y_{t-i}\right) - \gamma\left(X_{t-1} - X^*_{t-1} - \varepsilon_t\right) + \nu_t \tag{2}$$

$$\varepsilon_t = \varepsilon_{t-1} + \delta_t \tag{3}$$

where ν_t and δ_t are white noises. Using a Kalman filter on this structure allows us to compute data for ε_t that will adjust to the structural change present, while it minimizes the variance of ν_t and δ_t (See Hall (1993) for greater details on the use of Kalman filter). The variable ε_t is modeled as a random walk.

1.2. Modeling the supply-side

The Russian economy faces a supply-side constraint. The official measures of the capital stock in Russia show no decline in the capital stock over the transition period. In particular despite the major fall in GDP and production generally the official decline in the factors of production (labour and capital) is insignificant. Anecdotally the explanation for this seems to be clear. A large part of the capital stock that was in use under the soviet system was simply not profitable at world prices. As the Russian economy has been opened up to world prices and competition from international imports this situation has become apparent and large sections of the capital stock are not being used. One way to view this is by defining a concept of an effective capital stock as opposed to the official measured capital stock. Anecdotal evidence would suggest that this effective capital stock has declined considerably in recent years.

The Kalman filter is a suitable framework to estimate an effective capital stock which will then explain the fall in potential output. This is discussed more fully in Hall and Basdevant (1999). Briefly, assume that the underlying technology is Cobb-Douglas. Output is a measured variable which is assumed to be generated by the following measurement equation:

$$\log(Y_t) = \alpha_0 + \alpha_1 \log(K_t) + \alpha_2 \log(N_t) + e_t \tag{4}$$

Y and N are directly observed variables while K and the depreciation rate of capital δ are unobserved state variables. The effective capital stock is generated by the following state equation:

$$\log(K_t) = \log(K_{t-1}) + \log(1 + TI_t / K_0) - \delta_{t-1} + v_{1t} \tag{5}$$

This is a standard state equation in the log (K_t), 1+TI/K is total investment expressed in proportional terms. Total investment is the sum of private investment (I), foreign direct investment (FDI) and public investment (GI):

$$TI_t = I_t + GI_t + FDI_t \tag{6}$$

and δ_{t-1} is the unobserved rate of depreciation and v_{1t} is an error term. The unobserved depreciation rate is then assumed to be generated by a second state equation (where v_{2t} is also an error term):

$$\delta_t = \delta_{t-1} + v_{2t} \tag{7}$$

So the depreciation rate follows a random walk which allows it to freely increase to allow for the higher rate of scrapping during the transformation period in Russia. Together these three equations form a simple state space model and the Kalman Filter may be used to estimate the unobserved effective capital stock and the rate of depreciation.

In implementing the above model we began by calibrating some of the parameters. This is due to the fact that it is not possible to estimate a co-efficient on an unobserved state variable. We therefore fixed the parameter α_1, in principle we could have estimated the coefficient on labour (α_2) as this is directly observed. However, in order to produce a stable long run model, we required constant returns to scale and hence $\alpha_2 = 1 - \alpha_1$. We then calibrated α_1 on the basis of the approximate share of total income going to capital and labour in the Russian economy and hence $\alpha_1 = 0.6$ and $\alpha_2 = 0.4$. Further, since we are modeling in the logs of the variables, the scaling of the unobserved capital stock has determined α_0. This parameter may therefore be fixed at any arbitrary level and can simply change the units of measurement of the capital stock and so we set a value of zero for this parameter.

This system defines total supply in the model and hence a supply side constraint: in the real sector, many long-run relations depend on the output gap (the difference between potential and real output). Hence, the expansion of the economy depends on the ability of the economy to expand domestic production that is to say on the capacity for the capital stock to expand output. This is also the reason why an appropriate policy should first focus on rebuilding the capital stock.

1.3. The lack of a market-clearing condition and the output gap

The assumption of market clearing obviously does not hold in Russia. Hence the reduced form equations should reflect both supply and demand factors. This is another way to take into account the structural change, as a basic result is that the economy does not evolves along an equilibrium path. More precisely we introduced in some GDP components (consumption, investment and exports) the output gap, i.e. the difference between potential output (using the capital stock estimated with a Kalman filter) and actual output. All these variables depend positively on potential output and negatively on actual output, as the main explanation behind this specification is that to enhance one of the GDP components it is necessary to have additional unused production capacity. If this additional capacity is not available the economy will not be able to grow. For employment the explanation is similar, except that in this case we argue that employment evolves in the long-run as a function of potential output.

Let's consider now a brief description of those equations. For each variable X the variable ε^X refers to the time-varying parameter that is estimated with a Kalman filter.

The evolution of consumption is given by:

$$\begin{aligned}\Delta LogC_t = {} & 0.2\Delta Log\left(Y_t - TT_t + GTR_t\right) + 0.2Log\left(\tfrac{YPF_{t-1}}{Y_{t-1}}\right) \\ & - 0.3\left(Log\left(\tfrac{C_{t-1}}{Y_{t-1} - TT_{t-1} + GTR_{t-1}}\right) + 0.2LogWAR_{t-1}\right) + \varepsilon_t^C\end{aligned} \tag{8}$$

where C is consumption, TT total taxes, GTR net transfers, Y-TT net disposable income, YPF the potential output defined with the production function, $Log(YPF/Y)$ the output gap, and finally WAR is wage arrears. Consumption mainly depends on disposable income (income minus taxes) and also wage arrears. It also depends on output gap, i.e. the potential output over output ratio: an increase in consumption depends on the possibility to expend the domestic production of consumer goods. This term reflects the influence of a non-market clearing condition as consumption depends not only on demand factors but also on a supply factor, represented by the output gap. The long-run relation has been calibrated with a strong keynesian structure where consumption depends on current income. Therefore we did not include the influence of wealth on consumption, as a free borrowing and lending condition does not hold for Russia, and the low level of the average income make a life-cycle model implausible (see Shorrocks and Khokhlova (1999) for a detailed description of living standards in Russia).

It is also worth noticing that we have introduced wage arrears in the long-run relation. As Ivanova and Wyplosz (1999) state, the increase of wage arrears are a spontaneous response to a key failure of the Russian economy: firms use their worker and providers as implicit bankers because they have no access to proper credit. Then, wage arrears may be seen as forced saving. however, this is a rather inefficient method, as it undermines a proper allocation of savings, and also encourage the development of barter trade and non-cash payment of taxes.

The evolution of investment is given by:

$$\Delta \log I_t = 0.4\Delta \log I_{t-1} + 0.4\log\left(\frac{YPF_{t-1}}{Y_{t-1}}\right) - 0.5\log\left(\frac{I_{t-1}}{Y_{t-1}-TT_{t-1}+GTR_{t-1}}\right) + \varepsilon_t^I \qquad (9)$$

where I is investment. At present no detectable influence of interest rates on investment is observable (it may be that interest rate is not an adequate proxy for the cost of capital).

The equation for exports is almost standard, and depend on exchange rate (E), world price index (WPPI) on the output gap and oil prices. As for consumption and investment, a durable increase of exports will be possible only if there is an improvement of potential output. It is also worth noticing the positive effect of oil prices on exports, Russia's external sources of income mainly come from oil and gas.

$$\begin{aligned}\Delta LogXS_t &= 0.2\Delta LogXS_{t-1} + 0.2\Delta Log\left(\frac{OP_{t-1}}{WPPI_{t-1}}\right) + 0.3Log\left(\frac{YPF_{t-1}}{Y_{t-1}}\right) \\ &\quad - 0.5\left(LogXS_{t-1} - LogWY_{t-1} - 0.05LogER_{t-1} - 0.1Log\left(\frac{OP_{t-1}}{WPPI_{t-1}}\right)\right)\end{aligned} \qquad (10)$$

Employment follows output in the long run:

$$\Delta LogN_t = 0.2\Delta LogN_{t-1} + 0.1\Delta LogY_{t-1} + 0.4Log\left(\frac{YPF_{t-1}}{Y_{t-1}}\right) + \varepsilon_t^N \qquad (11)$$

where N is employment, it will evolve according to the marginal labor cost that is a proportion of potential output (as the production function is Cobb-Douglas). Due to this property, a durable increase in employment requires first an increase in potential output, which again emphasis the major role of investment and the capital stock.

1.4. Modeling the specific role of the dollar in domestic transactions

Another interesting property of the Russian economy is the large use of the dollar in many transactions. As many prices are set in dollars any change in the exchange rate has an immediate effect on prices. It is the reason why the consumer price index, CPI, depends on the current variation in the exchange rate:

$$\begin{aligned}\Delta LogCPI_t &= 0.2\Delta LogCPI_{t-1} + 0.4\Delta LogPPI_{t-1} + 0.05\Delta LogM2_{t-1} + 0.05\Delta LogM2_{t-2} \\ &+ 0.2\Delta LogE_t - 0.58\left(LogCPI_{t-1} - 0.5LogPPI_{t-1} - 0.5LogE_{t-1}\right) + \varepsilon_t^{CPI}\end{aligned} \quad (12)$$

where PPI is the producer price index, M2 money supply[1] and E the nominal exchange rate. In the long-run the consumer price index is constrained to follow the evolution of the producer price index and the exchange rate.

The producer price index depends on both wages and the exchange rate, in order to reflect the influence of costs on prices. It is also important to notice that in a highly dollarised economy like the Russian one, the exchange rate has a signal effect. Firms use the exchange rate as a signal to increase their own prices, even if they are not explicitly quoted in dollars (see Grafe, Kirsanova and Wyplosz (1996)). Moreover the producer price index depends also on the output gap: an increase in demand relatively to potential output will induce higher prices.

$$\begin{aligned}\Delta LogPPI_t &= 0.1\Delta LogE_{t-1} + 0.3\Delta LogWN_{t-1} + 0.5\Delta LogPPI_{t-1} - 0.1Log\left(\tfrac{YPF_{t-1}}{Y_{t-1}}\right) \\ &- 0.4\left(LogPPI_{t-1} - 0.6LogWN_{t-1} - 0.4LogE_{t-1}\right) + \varepsilon_t^{PPI}\end{aligned} \quad (13)$$

where WN is nominal wages.

1.5. The (in)stability of the exchange rate

The equation for the exchange rate is a standard open arbitrage one, it depends on expectations of the exchange rate and also the interest rate differential:

$$LogE_t = LogEE_t - \left(\tfrac{DR_t - FR_t}{400}\right) + \varepsilon_t^E \quad (14)$$

where E is the nominal exchange rate[2], EE_t the expectation made in t for E_{t+1}, DR the domestic interest rate and FR the foreign interest rate[3]. The stochastic constant ε_t^E has to be viewed as the exchange rate risk premium.

The expected exchange rate does not follow rational expectations: agents use the observed exchange rate and the evolution of oil prices and consumer prices to build their expectations. It is also worth noticing that expectations are not rational, as RE presupposes that agents have too much information and understanding about the economy. The expectations rule we adopt has the following form:

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[1] Which is taken from the Central Bank of Russia.
[2] Which is taken from the Central Bank of Russia.
[3] Which is taken from OECD.

$$\Delta LogEE_t = \Delta LogCPI_{t-1} - 0.02NIR_{t-1} + \varepsilon_t^{EE} \quad (15)$$

where NIR is net international reserves.

Another direct influence of the exchange rate is on foreign direct investment. FDI is sensitive to external shocks and financial crisis, which increase the risk factor of new investments. In Russia FDI represents only 0.8 % of GDP (source: United Nations, EBRD). It is then worth noticing that a way to improve the transition process is to promote FDI in Russia[4]. We adopt a simple specification, where FDI depends on the volatility in the exchange rate: foreign investors are willing to invest in Russia only when the current situation is stable:

$$\Delta FDI_t = 0.4\Delta FDI_{t-1} - 0.2\left(FDI_{t-1} - 0.05TREND_t + 0.302\left(\left(E_t - E_{t-1}\right)/E_{t-1}\right)^2\right) + \varepsilon_t^{FDI} \quad (16)$$

where TREND is a linear trend.

1.6. The economic policy

Before describing the simulation results it is convenient to first describe how government may influence activity. There are basically two major instruments: public expenditures and the interest rate.

Government expenditures are divided between investment (GI) and consumption (GC), debt burden (GINT) and transfers (GTR). The interest in the distinction between GI and GC lies in the fact that investment directly contributes to the stock of capital. Moreover, due to the specification of the private investment function, this will also have a positive influence on private investment, as it does not depends on interest rate. Hence, total government expenditures GT is given by:

$$GT_t = GC_t + GI_t + GTR_t + GINT_t \quad (17)$$

Government revenues are composed by taxes (TT) and non-tax revenue (NTR). The model has a complex treatment of taxes but conceptually it may be thought of as allowing taxes to grow in line with output after allowing for various special effects:

$$\Delta Log(TT_t) = \Delta Log(Y_t) \quad (18)$$

$$\Delta Log(NTR_t) = \Delta Log(Y_t) \quad (19)$$

Then, the total revenue (REV) is then the sum of TT and NTR:

[4] Moreover so far much of FDI were in Moscow (around 50% of FDI in Russia were located in Moscow in 1995, and for 1996-7 this share went up to 70%, source: Goskomstat), and FDI in Russia are low compared with other emerging markets. For example, between 1994 and 1998 cumulative FDI in Russia was estimated at about $ 9 billion, which is below cumulative FDI inflows in Poland ($ 12 billion) or Hungary ($ 17 billion).

$$\mathrm{REV_t = TT_t + NTR_t} \tag{20}$$

and the public deficit is given by:

$$\mathrm{DEF_t = GT_t - REV_t} \tag{21}$$

We suppose that the Money supply adjusts itself to money demand, while real interest rates are used to target a desired inflation rate (π_t).

$$\begin{aligned}\Delta\mathrm{DRR_t} &= 150(\Delta\mathrm{LogEE_t} - \pi_t) + 50(\Delta^2\mathrm{LogE_t}) \\ &\quad + 200(\Delta\mathrm{LogPPI_t} - \pi_t) + 50(\Delta^2\mathrm{LogPPI_t})\end{aligned} \tag{22}$$

$$\begin{aligned}\Delta\mathrm{LogM2_t} &= 0.4\Delta\mathrm{LogM2_{t-1}} + 0.2\Delta\mathrm{LogCPI_{t-1}} \\ &\quad - 0.49(\mathrm{LogM2_{t-1} - LogCPI_{t-1} - LogY_{t-1} + 0.01DR_{t-1}} - \varepsilon_t^{M2})\end{aligned} \tag{23}$$

2. Stochastic simulations

2.1 Methodology adopted

In this section we outline the new way of applying stochastic simulations which we are proposing in this paper. Stochastic simulations (a variant of the monte carlo method applied to econometric models) is a technique for calculating the standard error of a models forecast or simulation properties which has been used for many years (a survey of the technique may be found in Hall and Henry(1988))

In general notation the reduced form of a non-linear model may be described as follows,

$$Y_t = f(B(L)X_t, e_t, \alpha) \text{ (24)}$$

Where Y is a vector of endogenous variables, B(L) is a lag polynomial matrix, X is the vector of exogenous variables, e is the vector of structural errors and α is the vector of model parameters. If we assume that e_t~N(0, Ω) then stochastic simulations allow us to calculate numerically the variance of Y_t. The conventional practice is to assume that the covariance matrix Ω is constant over time and it is typically measured by a range of existing techniques surveyed in Hall and Henry(1988). In this application however we want to capture the information which may be in the errors about the changing probability of a crises. We therefore assume that Ω follows a standard ARCH process. That is

$$\Omega \sim NID(0, \sum_{i=1}^{k} \tau_i e^2{}_{t-i})$$

When we then run the stochastic simulation based on this variance matrix we will generate the time varying variances of all the endogenous variables implied by this ARCH process. We need to then specify both the lag length k and the weighting parameters τ_i, to fully specify the model. Clearly we want to specify k as quite a small number as we want to capture the most recent information contained in the models errors. We decided that as the model is quarterly and structural change seems to be very rapid in Russia that a maximum lag of 4 was desirable. In addition given this fairly short lag length we decided to use an equal weighting system

2.2 Validation of the model using variance analysis

From figure 1 demonstrates that the model is able to reproduce a higher volatility of the exchange rate as the simulation period gets closer to the crisis. It is also worth noticing that in the scale of the Y-axis is the variance deflated by the simulated value of the exchange rate. This was convenient to purge the results from a scaling effect: as the simulation date get closer to the crisis the exchange rate is rising, which can be sufficient to induce a higher variance.

The crisis happened in the third quarter of 1998. With simulations proposed the variance reaches a maximum exactly at this date, and begins to growth just the quarter before.

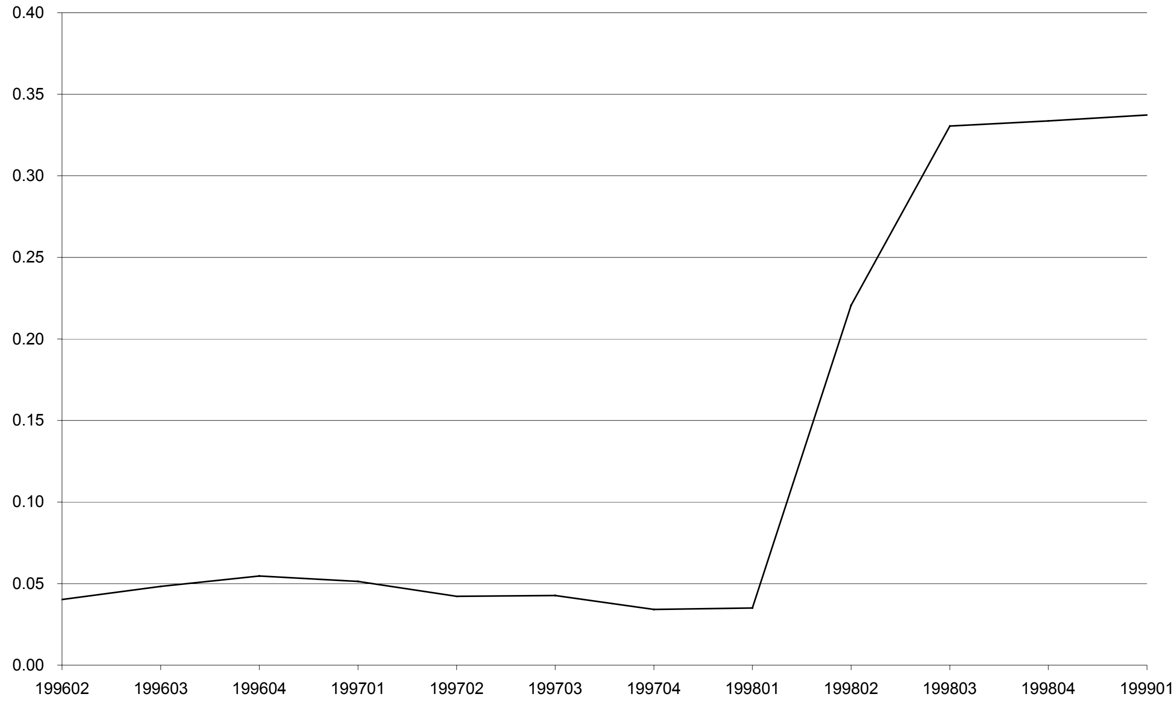

figure 1: standard deviation of the exchange rate

Explaining the crisis

Using this simulation, it is also possible to find out what shocks were the main cause of this higher volatility. In the following diagram all the variable with a sharp change in the variance are included.

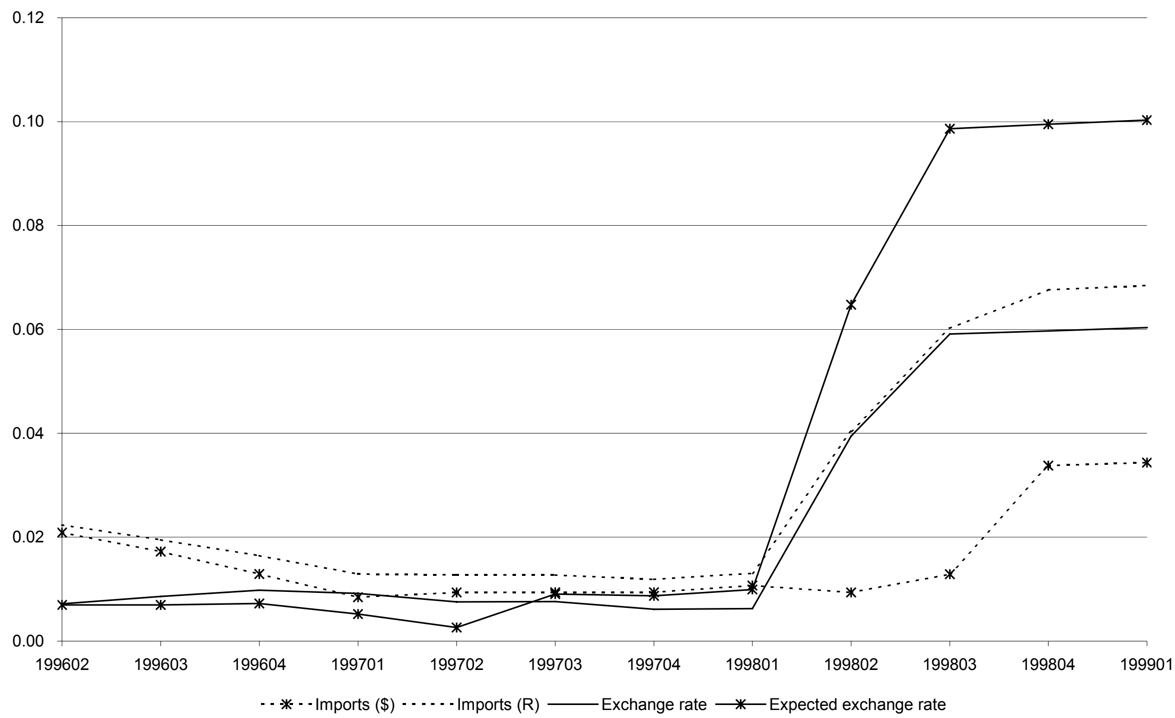

figure 2: standard deviation of relevant variables

As we can see the main changes occur in the exchange rate and expected exchange rate equations (see solid lines). The interesting property is that expected exchange rate variance is rising at the same time that the exchange rate. From equations (14) and (15) it can be seen that the current level of expectations affects the level of the exchange rate. In another term, it means that the greater variance of the exchange rate comes from a greater variance of expectations, as shocks on the latter will currently affect the former. Hence the turning point is explained by a higher volatility of expectations that has induced a higher volatility in the exchange rate.

Following this increase, imports react also after two quarters, while exports variance remains stable: exports are less sensitive to a change in exchange rate. As Russian exports are mainly products for which prices are fixed on international markets (e.g.oil), and thus they do not respond to a depreciation (or appreciation) of the ruble.

One of the results of a devaluation is inflation, as many intermediate goods are imported, as well as consumer goods. Moreover many prices are set in dollars, as a result of the large dollarisation of the economy. Then, when the ruble fluctuates there is a snowball effect on domestic inflation.

3. Conclusion

When the government was offering 200 percent yields on GKOs in 1996, or even 50 percent in a time of low-inflation in 1998 Russian banks lent their free cash on the bond market. As a result the government's financial needs over-shadowed those of the real economy. This as induced a crowding out effect on financial needs of the industry, and then has contributed to enhance the deficit in investment.

In this paper we have demonstrated that a model can be used to asses the likelihood of an unusual event such as the Russian financial crises by exploiting the information which is contained in the models own residual process. Using this technique we have demonstrated that the variance of exchange rates produced by the model rose dramatically in anticipation of the full crises in 1988.

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