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Abstract

This paper develops and estimates a small macroeconomic model of the Russian economy. The model is tailored to analyze the impact of the oil price, the exchange rate, and political stability on economic performance. The model does very well in explaining Russia's economic history in the period 1995-2002. We then use the model to simulate two sets of scenarios, one with various oil price scenarios and one with various adverse shocks. The simulations suggest that the Russian economy is still very vulnerable to oil price swings, and that these swings have asymmetric effects. Indeed the cost of a downward swing of oil prices seems to be larger than the benefit of an upward swing. We also find that the aggregate effects of an oil price collapse are comparable to these of renewed political instability. Although their propagation mechanism is quite different, both adverse shocks do have a similar effect on real GDP. A real exchange rate appreciation on the other hand has relatively mild effects on real GDP. All in all, it is suggested that Russia should reduce its vulnerability to adverse oil price shocks and maintain political stability.

Keywords: Russia, Macroeconomic Modeling, Macroeconomic stabilization
JEL codes: C70, E17, E58, E16, E63

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1 Introduction

Macroeconomic adjustment in the Russian economy has displayed remarkable variations during the last decade. The period before the Russian crisis of 1998 was marked by high inflation, failing macroeconomic stabilization and disappointing macroeconomic performance. The Russian government did not succeed to balance its budget and had to draw increasingly on foreign lending to fund its recurrent deficits. This unsustainable budgetary and exchange rate policy and the remaining instability that governed this period of transitional recession, culminated in a severe crisis in August 1998 when Russian authorities were forced to devalue the ruble, suspend payments on government paper, and announce a moratorium on the Russian foreign debt. By September 20 the ruble had fallen from 6 to 22 rubles per dollar[1].

Rather than the expected final blow, the crisis turned out to be Russia's economic catharsis[2]. Indeed, since 1999 the real side of the economy has improved substantially and the volatility of nominal variables such as prices, wages, interest rates and exchange rates has declined markedly. There have been various explanations for the recent good macroeconomic performance of Russia. Some observers suggest that the deadly stabilisation of 1995-1997 was the consequence of an inappropriate exchange rate policy. They argue that the overvaluation of the ruble during the 'corridor' policy yielded stabilisation at the cost of a prolongued economic recession. In the line of this argument the devaluation of the ruble in August 1998 kickstarted economic growth through a broad process of import substitution across all sectors. Others put forward that Russia's economic well-being depends largely on the oil price. In fact, after 1998 oil prices increased rapidly from a relatively low level of below 15$ to levels around 41$ per barrel due to a string of external events. As largest crude oil producer and second-largest crude oil exporter of the world, Russia strongly benefited from higher world oil prices with a strongly positive current account, abundant foreign reserves and more money flowing into government coffers. Finally, some political economists argue that the political and economic stabilisation brought by President Putin reduced economic and political risk, which supposedly created the confidence and trust so badly needed for economic recovery.

[1] World Bank (2002) offers a detailed survey of the transitional experience in the countries of Eastern Europe and the Former Soviet Union. EBRD (1998) and Gobbin and Merlevede (2000) provide a detailed account of the Russian Crisis of August and September 1998.

[2] OECD (2004) compares the consensus growth forecast and its own forecast to actual growth performance in 2000-2003. Actual Russian GDP growth consistently outperformed the expectations during this period.

This paper develops and estimates a dynamic open economy macroeconomic model of Russia. This model is then employed to analyze (future) Russian macroeconomic performance in general, and the role of the oil price, the exchange rate, and political stability in particular. Modelling and understanding the Russian economy is important since Russia is arising as the largest neighbour of the enlarged European Union. Moreover, because of increasing flows of goods, services, capital, and persons between the EU and Russia, both economies will become more intertwined. Russia also plays an important strategic role as a supplier of energy and raw materials to the EU, decreasing the EU's dependence on Middle East energy sources. Gaining insight in the 'economics' of this strategic partner to the EU is therefore not without importance.

The model contains estimated relationships for the basic macroeconomic relations that govern macroeconomic adjustment, notably private consumption, investment, exports, imports, money demand, labour demand, wage inflation, consumer and producer price inflation. Further, we model government expenditures and revenues as a function of oil price movements because of the important links between the government budget and oil revenues, a typical feature of the Russian economy (see Rautava, 2004, and Kirsanova and Vines, 2002). Starting from the observation in the data that our consumption and investment equations do not entirely pick up the increase in the respective growth rates since about 2000:1, we allow for an 'increased confidence' effect by means of two dummy variables. Since Putin became acting president in 2000 after the surprising new year's eve resignation speach of President Yeltsin and after having wun Duma support in the December 1999 elections, we tentatively refer to this as the 'Putin'-effect. Since the three effects mentioned above are explicitly present in the model, we can simulate different scenarios to shed some light on how Russia's economy will react to shocks in the oil price, the exchange rate and the political stability. Furthermore, we can identify the channels through which the various effects are propagated.

The remainder of the paper is organised as follows. In section 2 we present and discuss a small log-linear macroeconomic model of the Russian economy. Section 3 describes the data and the estimation methodology. Section 4 estimates this model using quarterly data for the period 1994:1-2002:4. In section 5 we present in-sample simulation results and discuss some stylized facts regarding Russia's macroeconomic adjustment during the last decade. Section 6 evaluates the impact of shocks in the oil price, in the exchange rate and in political stability on Russia's near economic future by means of dynamic out-of-sample simulations. The final section summarises and derives policy conclusions.

2 A small macroeconomic model of the Russian economy

The model is a dynamic, small open economy AD-AS-LM model (see Merlevede et al, 2003, and Basdevant, 2000). It is tailored to capture the effects of the oil price, exchange rate and political stability on the Russian economy. This approach will allow us to simulate the effects of different scenarios regarding the three mentioned effects and to uncover the channels along which the effects arise. Our intention is to find a reasonable fit with a model as parsimonious as possible, since parsimonity fosters the tractability of the model and the interpretability of the simulation results. The model consists of eleven macroeconomic behavioral relations, (1)-(11), and a set additional definitions, (12)-(19), to complete the model. The model is presented in its long-term form below.

$$c = \alpha_0 + \alpha_1 y_d \quad (1)$$

$$i = \beta_0 - \beta_1 (r - \Delta p_y) + \beta_2 y \quad (2)$$

$$x_{USD} = \gamma_0 + \gamma_1 wtr + \gamma_2 p_{OIL} \quad (3)$$

$$z_{USD} = \delta_0 + \delta_1 y - \delta_2 s \quad (4)$$

$$
\begin{aligned}
m_1 &= \vartheta_0 - \vartheta_1 r + \vartheta_2 y && (5)\\
p_y &= \phi_0 + \phi_1 w + \phi_2 \left(p_y^{EU} - e_{EUR}^{USD} + e_{USD}\right) && (6)\\
p_c &= \kappa_0 + \kappa_1 p_y + \kappa_2 \left(p_c^{EU} - e_{EUR}^{USD} + e_{USD}\right) && (7)
\end{aligned}
$$

$$
\begin{aligned}
w &= \lambda_0 + \lambda_1 p_c + \lambda_2 y - \lambda_3 u && (8)\\
n &= \mu_0 + \mu_1 y + \mu_2 (w - p_y) && (9)
\end{aligned}
$$

$$
\begin{aligned}
rev &= \rho_0 + \rho_1 p_{OIL} + \rho_2 y && (10)\\
gex &= \theta_0 + \theta_1 p_{OIL} + \theta_2 y && (11)
\end{aligned}
$$

$$
\begin{aligned}
Y &\equiv C + I + G_{C,I} + X - Z - CIN && (12)\\
Y_D &\equiv Y - REV + GEX - G_{C,I} && (13)\\
DEF &\equiv REV - GEX && (14)\\
U &\equiv N^s - N && (15)\\
c &\equiv \log(\frac{C}{P_c}), y_d \equiv \log(\frac{Y_d}{P_c}), i \equiv \log(\frac{I}{P_y}), y \equiv \log(\frac{Y}{P_{c,y}}) && (16)\\
x &\equiv \log(\frac{X}{P_y}), z \equiv \log(\frac{Z}{P_y}), m_1 = \log(\frac{M_1}{P_y}) && (17)\\
s &\equiv \log(\frac{E_{USD}.P_y^{US}}{P_y}) && (18)\\
x_{USD} &\equiv x - s,\ \ z_{USD} \equiv z - s && (19)
\end{aligned}
$$

The (unknown) parameters are assumed to be non-negative, lower-case variables are defined in logarithms, except for the (short-term) interest rate r, and Δ denotes the first difference operator. The following variables are used: c denotes real private consumption, i real investment, x real exports, z real imports, p_y the producer price index, p_c the consumer price level, n the employment level, w the nominal wage per employee, u the log of the number of unemployed, e the exchange rate defined as the nominal price in rubles of one unit of foreign currency, subscripts USD and EUR refer to the respective exchange rates (so, a rise in e corresponds to a devaluation of the home currency), y real aggregate output, measured by GDP (the consumption part is deflated by consumer prices, the remainder by producer prices (see also (12))), DEF the government deficit, with EXP equal to total government expenditures and REV equal to government revenues, whereas $G_{C,I}$ is the sum of nominal government expenditure on consumption and investment, N^s the labour supply measured by the labour force, m_1 the level of money demand (which is equal to the money supply in this equilibrium model).

The first four behavioural relations of the model combine to a standard IS-curve for aggregate demand. More specifically, (1) represents real private consumption, c, as a function of real disposable income, y_d. Consumer prices, P_c, are used to deflate consumption and disposable income (see (16)). Real private investment, i, in (2) is specified as a function of real output, y, and the real interest rate, $r - \Delta p_y$. Producer prices, P_y, are used to deflate investment (see (16)). Russian exports, X, consist for more than 70% of oil, other raw materials and metals. Typically prices for these primary goods are formed on world markets and contracts are USD-denoted, even though 49% of Russia's exports go to EU(25). Therefore the ruble dollar exchange rate, e_{USD}, is unlikely to influence Russia's export performance in the conventional way, i.e. a ruble devaluation against the dollar does not make the majority of Russian exports more competitive on world markets or vice cersa. Still the ruble dollar exchange rate will play a role in the the conversion of USD export revenues into rubles in our model, since GDP is ultimately defined in rubles. Therefore we model real exports denoted in dollars, x_{USD} -defined in (19)-, in (3) as a function of world trade and of the oil price. The oil price is chosen because oil accounts for the bulk of Russia's exports and the price of natural gas, the second most important export category, is closely related to that of oil. This brings an explicit link in the model between Russia's economic performance and the international oil price.[3] Since most import contracts are made up in USD, even though 47% of the imports come from the EU(25), imports, Z, are also modelled in real USD in (4). Obviously, a depreciation of the real ruble to dollar exchange rate (i.e. USD appreciation) -defined in (18)- is expected to affect imports negatively. Real imports in USD, z_{USD} -defined in (19)-, are a function of the real USD exchange rate and real GDP. Finally, aggregate output (12) is

[3] Note that it is not possible to capture a quantity effect. By deciding on the number of barrels exported, Russia can influence its export revenues beyond the impact of the oil price. The world trade indicator can probably account to some extent for this effect.

defined by the equilibrium condition that equates aggregate supply and aggregate demand. $G_{C,I}$ stands for government consumption and investment. Adding changes in inventories, CIN, make this equation an identity.

Consumer prices are defined in (7) as a weighted basket of domestic and foreign producer prices. The domestic output price level is explained in a standard way. It is specified in (6) as a non-decreasing function of domestic factor costs, represented by the (private) wage costs, and import prices, proxied by EU-prices. EU-prices are first converted to dollars and then to rubles because to date contracts are generally made up in dollars.

The money market equilibrium is given by the LM curve (5). Money demand is specified as a decreasing function of interest rates and an increasing function of real income. Unemployment (15) is defined as the difference between the labour force, N^s, and total employment, N. Nominal per capita wages (of the private sector), w, in (8) are assumed to depend positively on consumer prices, according to a price indexing elasticity λ_1, and negatively on unemployment, u (reflecting a Phillips curve relation). When unemployment is rising, workers are more concerned with jobs than with wages. This constrains their wage claims, while at the same time the presence of a larger pool of employable workers will allow employers to moderate their wage offers. Finally, the nominal per capita wages depend positively on economic activity. The domestic labour demand (9) is determined by real economic activity and by the real wage.[4]

Russia's dependency on oil (prices) is also captured by a link between oil prices and the government budget (14). Government revenues in (10) depend on the level of real GDP and on the oil price. Oil prices are expected to affect government revenues positively. Under President Yeltsin the fiscal obligations of oil and gas companies were not well defined and subject to *ad hoc* negotiations. This has been referred to as informal fiscal rules (see Tompson, 2002). The outcome of these negotiations was largely subject to the oil price. Under Putin's presidency, at least two channels through which oil prices are transmitted directly to government revenues have been created, namely profit taxes paid by the exporters (with profit directly a function of the oil price) and variable export duties on raw materials

[4] Wages do not have an impact on employment:
$$\Delta n_t = \underset{(5.58)}{1.440} - \underset{(-3.42)}{0.142}\, n_{t-1} + \underset{(2.16)}{0.031}\,(y_{t-1} - p_{y,t-1}) - \underset{(-0.15)}{0.003}\, w_{t-1} - \underset{(-1.08)}{0.018}\, \Delta w_t;$$
adj. R^2=0.55; DW=1.93; n=36

exports installed by the Putin administration (the export duties vary in function of prices on international markets). There are also indirect effects of the oil price on government revenues through spillovers via higher economic growth created by the higher oil price. Government expenditures in (11) are also related to both real GDP and oil prices. Obviously if the government is aware of a strong link between revenues and oil prices, it is reasonable to expect that a decline in oil prices will pass through to expenditure. Indeed, recent government budgets have been explicitly based on oil price expectations, and this was implicitly the case before. The comparison of elasticities of both revenues and expenditures is interesting as will be explained below.

3 Data and estimation methodology

Quarterly data were drawn from the International Financial Statistics database from the IMF. In choosing an estimation strategy we need to address: (i) the limited quality of the data (e.g. the restricted number of observations), (ii) the seasonal pattern in the unadjusted raw data, (iii) the non-stationarity of almost all variables. Given the presence of seasonal patterns in most variables, the Census X12-method is used to obtain seasonally adjusted data (this method has the advantage that the seasonal component can change from year to year). Once seasonal adjustments are made the non-stationarity of almost all variables, is taken into account by estimating the behavioral relations (1)-(11) in error-correction form (ECM), according to the Engle-Granger representation theorem, which can be expressed for K explanatory variables as follows:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{k=1}^{K} \beta_k x_{k,t-1} + \sum_{k=1}^{K} \sum_{l=0}^{L_k} \delta_{k,l} \Delta x_{k,t-l} + \sum_{m=1}^{M} \gamma_m \Delta y_{t-m} + \varepsilon_t$$

where ε_t is a white noise error term. Given the restricted number of observations in our quarterly (seasonally adjusted) dataset we assume in our case that M is equal to 1 and L_k is equal to 0 for all k. Coefficients from the long term relationship ($y = f(x_k)$) can then be calculated as $-\beta_k/\alpha_1$.

Therefore we estimate first-order ECMs of the structural macroeconomic relations in our model. Generally the period of estimation is 1995:I-2002:IV, but the sample size varies across the equations due to data availibility. As indicated before we prefer parsimonity and therefore removed insignificant variables. Parameter testing occurred both on statistical and economic grounds. Estimation results and interpretation are given in the next section

4 Results and interpretation

The estimates of the structural parameters are shown below.

$$
\begin{aligned}
\Delta c_t &= \underset{(1.91)}{0.026} d_c - \underset{(-5.14)}{0.316} c_{t-1} + \underset{(5.15)}{0.287} y_{d,t-1} + \underset{(3.88)}{0.192} \Delta y_{d,t-1} && (1') \\
& \quad \text{Adj. R}^2 = 0.52;\ n = 31:\ 1995\text{:II - }2002\text{:IV} \\
\Delta i_t &= \underset{(1.77)}{0.044} d_i - \underset{(-2.10)}{0.209} i_{t-1} - \underset{(-4.24)}{0.070} \left(r_{t-1} - \Delta p_{y,t-1}\right) + \underset{(2.11)}{0.143} y_{t-1} && (2') \\
& \quad - \underset{(-3.85)}{0.067} \Delta \left(r_t - \Delta p_{y,t}\right) \\
& \quad \text{Adj. R}^2 = 0.65;\ n = 32:\ 1995\text{:I - }2002\text{:IV} \\
\Delta x_{USD,t} &= \underset{(0.56)}{0.032} - \underset{(-2.32)}{0.348} x_{USD,t-1} + \underset{(1.76)}{0.080} wtr_{t-1} + \underset{(2.69)}{0.157} p_{OIL,t-1} && (3') \\
& \quad + \underset{(1.74)}{0.174} \Delta p_{OIL,t} + \underset{(2.38)}{0.923} \Delta wtr_t \\
& \quad \text{Adj. R}^2 = 0.51;\ n = 32:\ 1995\text{:I - }2002\text{:IV} \\
\Delta z_{USD,t} &= -\underset{(-0.43)}{0.229} - \underset{(-3.04)}{0.429} z_{USD,t-1} + \underset{(2.67)}{0.337} y_{t-1} - \underset{(-2.94)}{0.325} s_{t-1} && (4') \\
& \quad + \underset{(2.34)}{0.211} \Delta y_t - \underset{(-8.56)}{0.664} \Delta s_t \\
& \quad \text{Adj. R}^2 = 0.71;\ n = 35:\ 1994\text{:II - }2002\text{:IV} \\
\Delta m_{1,t} &= -\underset{(-1.89)}{0.145} m_{1,t-1} - \underset{(-1.89)}{0.057} r_{t-1} + \underset{(1.96)}{0.127} y_{t-1} + \underset{(1.74)}{0.284} \Delta y_t + \underset{(1.76)}{0.327} \Delta m_{t-1} && (5') \\
& \quad \text{Adj. R}^2 = 0.14;\ n = 30:\ 1995\text{:III - }2002\text{:IV} \\
\Delta p_{y,t} &= \underset{(1.20)}{0.078} - \underset{(-7.94)}{0.411} p_{y,t-1} + \underset{(4.88)}{0.185} w_{t-1} && (6') \\
& \quad + \underset{(6.01)}{0.146} \left(p^{EU}_{y,t-1} - e^{USD}_{EUR,t-1} + e_{USD,t-1}\right) + \underset{(1.90)}{0.182} \Delta p_{y,t-1} \\
\text{Adj. R}^2 &= 0.91;\ n = 32:\ 1995\text{:I - }2002\text{:IV} \\
\Delta p_{c,t} &= -\underset{(-2.67)}{0.221} - \underset{(-4.66)}{0.421} p_{c,t-1} + \underset{(3.62)}{0.246} p_{y,t-1} + \underset{(3.85)}{0.334} \Delta p_{c,t-1} && (7') \\
& \quad + \underset{(4.65)}{0.179} \left(p^{EU}_{y,t-1} - e^{USD}_{EUR,t-1} + e_{USD,t-1}\right) + \underset{(10.84)}{0.367} \Delta \left(p^{EU}_{y,t} - e^{USD}_{EUR,t} + e_{USD,t}\right) \\
\text{Adj. R}^2 &= 0.94;\ n = 36:\ 1994\text{:I - }2002\text{:IV}
\end{aligned}
$$

$$\Delta w_t = \underset{(-2.34)}{-0.178} w_{t-1} + \underset{(2.28)}{0.163} p_{c,t-1} - \underset{(-2.99)}{0.067} u_{t-1} + \underset{(3.72)}{0.175} y_{t-1} + \underset{(4.80)}{0.565} \Delta p_{c,t} \qquad (8')$$

Adj. $R^2 =$ 0.62; n = 36 : 1994:I - 2002:IV

$$\Delta n_t = \underset{(6.28)}{1.456} - \underset{(-6.38)}{0.143} n_{t-1} + \underset{(2.30)}{0.024} \log\left(Y_{t-1}/P_{y,t-1}\right) \qquad (9')$$

Adj. $R^2 =$ 0.56; n = 36 : 1994:I-2002:IV

$$\Delta rev_t = \underset{(-2.66)}{-3.115} - \underset{(-2.86)}{0.428} rev_{t-1} + \underset{(2.25)}{0.225} p_{OIL,t-1} + \underset{(2.61)}{0.721} y_{t-1} \qquad (10')$$

$$+\underset{(1.63)}{0.250} \Delta^2 p_{OIL,t} + \underset{(4.40)}{1.424} \Delta y_t$$

Adj. $R^2 =$ 0.46; n = 28 : 1996:I - 2002:IV

$$\Delta gex_t = \underset{(-4.51)}{-0.293} d_{crisis} - \underset{(-2.77)}{0.180} gex_{t-1} + \underset{(1.63)}{0.085} p_{OIL,t-1} + \underset{(1.63)}{0.086} y_{t-1} \qquad (11')$$

$$+\underset{(2.52)}{0.252} \Delta^2 p_{OIL,t} + \underset{(2.29)}{0.191} \Delta y_t$$

Adj. $R^2 =$ 0.46; n = 33 : 1994:IV - 2002:IV

Taking into account the limited sample and the fact that especially the third quarter in 1998 presents a serious distortion because of the August 1998 crisis, the explanatory power of the estimations is generally fairly high. Real disposable income has a strong positive impact on consumption in the long run (0.287/0.316=0.908) which is statistically significant. The short run impact is also statistically significant, but somewhat smaller than in the long run. Russian economic growth is hence clearly driven by consumption decisions. Real investment is negatively related to the real interest rate and to real economic activity. The former also has a considerable short-run impact. Starting from the observation in the data that our consumption and investment equations did not entirely pick up the increase in the respective growth rates since about 2000:I, we allowed for an 'increased confidence' effect by means of two dummy variables that take the value 1 from 2000:I onwards. We have assumed that the economic and political stability brought by the Putin administration has positively affected consumer and investor confidence. This implies a structural change in the relationship between the variables in the consumption and the investment equation. However, the limited amount of observations since 2000 would severely affect the power of our econometric work. Therefore we prefer to take this 'Putin-effect' into account by including a dummy variable (d_c and d_i respectively) in (1) and (2). This has the added benefit that it provides a simple way to simulate later on the effect of renewed economic and political uncertainty on the Russian economy, by simply setting these 'stability' dummies to zero in the simulations.

In the long run exports (in USD) depend strongly on oil price movements. The indicator of world trade is significant at the 10% level, but has a small impact. In the short run however, changes in the world trade indicator have a large and significant impact on changes in export revenues. The contribution of oil prices is present, but smaller in magnitude and only borderline significant. Imports depend negatively on the real exchange rate and positively on real GDP, as expected. This holds both in the short and the long run. Both consumer and producer prices are explained very good. EU prices are of considerable importance in explaining consumer and producer prices, reflecting the effects from pass-through. In both equations there is a significant lagged dependent variable with a positive coefficient, reflecting the amount of persistence. For both prices the positive long run effects are strongly significant. Last quarter's inflation therefore feeds this quarter's inflation. Nominal per capita wages exert a considerable long run impact on producer prices (long run coefficient = 0.45). A short-run effect is not present.

There is a long run relationship between nominal wages, consumer prices, the number of unemployed and real economic activity. The long run elasticities of consumer prices and real economic acitivity are high (0.92 and 0.98), for unemployment it is -0.38. Employees are thus to a large extent compensated for price increases and also profit from changes in real economic activity, while unemployment exerts downward pressure on wages, as expected. In the short run changes in consumer prices have a positive contemporaneous effect on changes in nominal wages. For employment we only find a long term relationship with real economic activity.

Turning to government revenues and expenditures, one can infer that in both cases both the oil price and real economic activity are (significantly) present in both the long and short run relationship. With respect to economic activity the long and short run elasticities are higher than the one for revenues. Next to changes in the tax base this probably also reflects changes in the effectiveness of tax collection, which has risen considerably during the last five years that happen to coincide with the period of economic growth. For expenditures the measured elasticities are much lower. Comparing revenues and expenditures, one can infer an automatic stabilizer function (in normal times) since expenditures react less to economic activity than revenues. Indeed, the point estimate of the long run oil price elasticity is considerably lower for the expenditures equation, whike the short run effects are very comparable. The budgetary balance, defined as the difference between revenues and expenditures, feeds directly into real disposable income, affecting thereby real consumption and ultimately all endogenous variables further down the road.

5 Macroeconomic adjustment in Russia in the period 1994-2002 and dynamic in-sample simulation of the model

In the previous section we have estimated a small but concise macroeconomic model of the Russian economy. An interesting and important application of the model concerns its tracking ability of the actual macroeconomic adjustment dynamics of the Russian economy. That is even more interesting in the light of the interesting macroeconomic developments in the Russian economy. Figure 1 collects the adjustments of the most important macroeconomic variables. Solid lines indicate the actual adjustments, dashed lines the adjustments predicted by a (stochastic) dynamic in-sample simulation of our macroeconomic model of the Russian economy during the period 1994:IV-2002:IV. From the solid lines one can infer the substantial macroeconomic fluctuations both in real and nominal variables during the last decade.

[Insert Figure 1 around here]

A dynamic simulation is a very useful (and demanding) instrument to assess the model's performance: it provides the model with the initial variables of the endogenous variables and the time paths of the exogenous variables. With this information it solves for the in-sample dynamics of the endogenous variables. Our interest focuses on the subset of model variables displayed in Figure 1.

Real private consumption in the Russian economy has displayed significant shifts and the model has some difficulties in tracking the strongest shifts. Real investment was mostly negative in the first halve of the sample but then picked up; this is also the case in the model. Growth rates of real imports and exports display a peak one year after the August 1998 crisis.

The dynamic simulation displays an accurate replication of the dynamics of exports and imports. Therefore, the model follows also relatively closely the observed current account.

Also the dynamics of real GDP and real disposable income display a marked break in 1998. Before 1998 there is largely stagnation of real output and real disposable income, after 1998 there is a marked recovery which is also picked up well by the model. The disappointing growth experience before 1998 and the marked recovery ever since are also reflected in employment growth. Employment growth is also accurately tracked by the model.

The Russian economy has not only gone through a period of gradual stabilization of the real side, also nominal variables like prices (PPI, CPI), wages, and M1-money have seen a dramatic shift from high inflation and volatility until 1999 and more stability since then. With the exception perhaps of money growth, whose behavior has been very volatile, the model tracks very good the dynamics of these variables. The volatility of money balances is related to the shifts in velocity of M1.

In the model a lot of attention has been given to the modelling of government revenues, government expenditures and their sum, the fiscal deficit. Fiscal balances have improved markedly since 1998 as can be clearly seen in Figure 1. The efforts put on modelling the fiscal variables yield a respectable tracking ability of the model for these variables.

6 Simulating shocks in the oil price, the exchange rate, and political stability

We now use the model to simulate Russia's economic future under different assumptions regarding the oil price, the exchange rate, the confidence effect and the interest rate evolution. The confidence effect refers to the stability dummies in the consumption and investment equations. Each simulation consists of 1000 stochastic replications of the model under the different scenarios for the period 2000:I to 2007:IV. Hence, the simulations consist of an in-sample part, where we use the actual data of 2000-2002 and an out-of-sample part, where we simulate 20 quarters ahead. The Gauss-Seidel algorithm is used to solve the model. The simulations allow us to compare the effects of different scenarios and to uncover the channels along which these effects arise. The model's parsimonity fosters the tractability and interpretability of the simulation results.

We consider two sets of simulations. Both sets of simulations start from a baseline scenario 1 that assumes a constant oil price of 27.7$ per barrel since 2003:I, a depreciating nominal exchange rate in line with the average depreciation rate since about 2001 and a lasting positive confidence effect. The interest rate is determined by the covered interest rate parity. In the first set of simulations we concentrate on the effect of oil price shocks on Russia's economic future. We consider four oil price scenarios (see figure A.1 for details) that lie symmetrically around the benchmark scenario of 27.7$ per barrel: i) scenario 2 (the solid line in figure 2) assumes an abrupt fall of the of the oil price to 12$ per barrel, i.e. the approximate sample low; ii) scenario 3 (the solid line with dots in figure 2) assumes a gradual fall of the oil price to 12$ per barrel; iii) scenario 4 (the dashed line in figure 2) assumes an abrupt increase of the oil price to 43.4$ per barrel; iv) scenario 5 (the dashed line with dots in figure 2) assumes a gradual increase in the oil price to 43.4$ per barrel. In a second set of simulations we compare the same benchmark simulation to different negative shocks to the Russian economy. We start again with i) the same scenario 2 (again the solid line, now in figure 3) exhibiting the oil price collapse to 12$ per barrel. In addition we add the following scenarios: ii) scenario 6 (the dashed line in figure 3) assumes an abrupt appreciation of the exchange rate with resulting loss of competitiveness of Russian goods on the domestic market in comparison with imports (see figure A.1) and the interest rate now including a 5% risk premium; iii) scenario 7 (the solid line with diamond dots in figure 3) exhibits the reappearance of political and economic instability by setting the stability dummies in the investment and consumption relation to 0; iv) scenario 8 (the solid line with triangular dots in figure 3) calculates the worst-case scenario incorporating the cumulated effect of all three negative shocks of the previous three scenarios, with the risk premium on the interest now assumed at 10%. Note that the return of uncertainty in scenario 4 may be less unlikely than one would wish, as shown by the troubles around Yukos in 2004 and the August 2004 banking panic. Table 1 summarizes the characteristics of all 8 scenarios. Annex A.1 shows the precise oil price paths in scenarios 2-5 and the exact exchange rate path assumed in scenario 6 and 8.

Figures 2 and 3 report 12 quarters of the main simulated endogenous variables. In both figures the simulations are reported as deviations from the baseline scenario 1, which is represented by a horizontal line at zero. The results of our first set of simulations with oil price scenarios are shown in figure 2. The results of our second set of simulated negative

Scenario	Oil price per barrel	Exchange rate	Confidence	Interest rate
1	constant at 27.7$	depreciation	yes	CIP*
2	collapse to 12$	depreciation	yes	CIP
3	gradual to 12$	depreciation	yes	CIP
4	shift to 43.4$	depreciation	yes	CIP
5	gradual to 43.4$	depreciation	yes	CIP
6	constant at 27.7$	appreciation	yes	UIP** (RP 5%)
7	constant at 27.7$	depreciation	no	CIP
8	collapse to 12$	appreciation	no	UIP (RP 10%)

* CIP means that the interest is set by the covered interest rate parity, that contains only exogenous variables; ** UIP means that the interest rate is set by the uncovered interest rate parity, with the assumed risk premium (RP) indicated between brackets

Table 1: Scenario overview

shocks to the Russian economy are shown in figure 3.

[Insert Figure 2 around here]

The simulations of the oil price in figure 2 show that large swings of the oil price are expected to yield large swings of Russia's economic success.

Real GDP is strongly affected by oil price shocks, mainly because oil prices have a strong impact on exports, government revenues and government expenditure, which through a series of second-order effects in the model affects all other endogenous variables. The simulations highlight Russia's striking oil-dependence found in the empirical model. There are two patterns of asymmetry: (i) negative oil price shocks cause stronger economic adjustments than positive oil price shocks, and (ii) instantaneous and permanent oil price shocks create stronger adjustments than gradual changes in the oil price of the same amount. As explained earlier, these asymmetries are to a significant degree caused by the asymmetric way in which oil price shocks affect government revenue and government spending in the model.

Indeed, compared to the benchmark, falling oil prices have a stronger effect on real growth than increasing oil prices, which implies that the Russian economy is still very vulnerable to downward oil price swings. Note that the same conclusion is reached in Rautava (2004).[5]

[5] Rautava (2004) estimates the effects of oil price changes and real exchange rate changes on Russian output and government revenue using a VAR model. It is found that oil prices and real exchange rate shocks have a significant impact on Russian output and government revenue. A 10% permanent increase in oil

The cause for this asymmetric effect on GDP of symmetric oil price shocks lies predominantly in the elasticities of government revenue and government expenditure to the oil price and GDP. Government revenues are in the long run much more elastic than government expenditures to both oil prices and real GDP. If oil prices fall, government revenue will fall more than government expenditure, creating a budgetary deficit. Also exports will be negatively affected which will also induce lower growth. These growth effects will in turn affect revenues more severely than expenditures, exacerbating the budgetary problems. This puts Russia very quickly in a negative spiral, with falling exports, falling budgetary revenues, falling government expenditure and falling GDP. In further rounds the falling GDP affects private consumption and investment, which further fuels the downward spiral. In the opposite case (increasing oil prices) the effects are less dramatic, because the relatively low elasticity of government expenditure to both oil prices and growth will dampen the positive cycle. Not all the increased revenues will be immediately spent, inducing less than possible government consumption (or in other words a budgetary surplus), which in turn marginally constrains real growth and its multiplicator effects through private consumption and investment in the next period. As regards the asymmetry between gradual and instantaneous oil price shocks, the real effects of a gradual versus an abrupt change in the oil price are relatively comparable for oil price increases, but this is not the case for falling oil prices. The abrupt collapse of the oil price to 12$ per barrel in scenario 2 has a much more severe and lasting effect on economic growth than a more gradual fall in oil prices. The most important reason for this lies in the different degrees of persistence estimated for the government revenue and the government spending function. The persistence of the revenue function is much higher than that of government spending. The abrupt decline of the oil price leads to a sharp and continued fall in revenues that aggravates the economic downturn. With a gradual decline in oil prices, revenus and spending adjust much more smoothly and there are considerably less negative effects on output.

All in all, our simulations suggest that the Russian economy is still very vulnerable to downward oil price swings. The simulations show precisely how the oil price first transmits itself through exports and fiscal variables and from there to the rest of the economy. Interestingly, symmetric oil price swings have asymmetric effects on real GDP. Indeed the cost

prices and a 10% permanent real depreciation are found to raise real GDP by 2.2% and 2.4%, respectively. Moreover, no evidence is found that the Russian economy would have become less sensitive to oil price and exchange rate developments during the period 1995-2001.

of a downward swing of oil prices seems to be larger than the benefit of an upward swing. Note also that scenario 5, with a gradual shift to higher oil prices has become reality. Our simulations therefore suggest that a considerable part of Russia's current macroeconomic success is due to the gradually increasing oil price.

[Insert Figure 3 around here]

Figure 3 presents results for the various adverse shocks hitting the Russian economy. One can infer that a collapse of the oil price and the reappearance of instability have similar effects on real GDP, but the propagation mechanism is quite different. Instability mainly affects growth through a direct impact on real investment and real consumption and in second order through feedback effects on real wages, employment and government revenues. The oil price primarily affects real exports (not unexpected given the fact that 70% of exports is in raw materials, mainly oil and gaz) and the government budget, where revenues expenditure and the fiscal balance are all negatively affected by the lower oil price. These initial effects than feed back into real wages and employment and finally all other variables. Although the initial propagation is quite different, the ultimate effect on GDP is comparable in adversity (see the closely related effects of scenario 2 and 4 in the real GDP panel of figure 3).

A real exchange rate appreciation (the dotted line) has milder effects on real GDP. The exact result of an appreciation obviously depends on the precise degree of appreciation, but the conclusion that appreciation has milder effects on real GDP remains qualitatively the same. This is because opposite effects are at work. An appreciation mainly works through lower real exports, which affects real GDP negatively, and lower inflation, which mildly stimulates real consumption and affects GDP positively. Because of these mixed effects the feed-back mechanisms are moderated and the long term effect of a continued appreciation is very mild. In fact something like the appreciation scenario already occurred previously in Russia in 1995-1997, where an exchange rate based stabilization induced moderate inflation and even yielded moderate consumption-driven growth in 1997. While appreciation by itself is mild in its effects, it can be very detrimental if combined with shocks in the oil price and confidence of investors and consumers, as shown in scenario 5.

7 Conclusions and policy recommendations

Macroeconomic adjustments in the Russian economy have displayed remarkable variations during the last decade. A first period marked by severe instability culminated in a severe crisis in August 1998. The crisis proved to be a purifying event, because the real side of the economy has improved substantially and the volatility of nominal variables such as prices, wages, interest rates and exchange rates declined markedly since 1998. Various explanations for Russia's recent economic successes have been put to the fore. Some observers have suggested that the devaluation of the ruble in August 1998 kickstarted economic growth through a broad process of import substititution across all sectors. Others have put forward that Russia's economic wellness depends largely on the favorable evolution of the oil price. Thirdly some political economists argue that the current succes is due to the political and economic stabilisation brought by Putin.

We estimate a dynamic open economy model to analyse macro-economic adjustment in the Russian economy. The model consists of the basic macro-economic relations that govern macro-economic adjustment. The estimated model behaves relatively well and it seems that Russia's macroeconomic evolution can be understood to a large extent by looking at standard macro-economic relations. An interesting and novel feature of the model is the strong correlation between oil price movements, and government expenditures and revenues. We also find an 'increased confidence' effect in the consumption and investment equations, in line with the argument that since Putin became acting president in 2000 economic and political risk have decreased. In a next step, we simulate Russia's economic future and consider 8 different scenarios related to the suggested explanations of Russia's current good performance. Our baseline assumes a constant oil price, a depreciating nominal exchange rate in line with the average depreciation rate since about 2001 and a lasting positive confidence effect. Then we estimate two sets of simulations.

The first set simulates the effects of oil price shocks on the Russian economy, looking at both negative and positive shocks. Our simulations suggest that the Russian economy is still very vulnerable to oil price swings, and that these swings have asymmetric effects. Indeed the cost of a downward swing of oil prices seems to be larger than the benefit of an upward swing. The government would therefore be well advised in the short run to adopt policies aimed at reducing the country's vulnerability to adverse oil price shocks. One possibility is the introduction of an oil stabilization fund. This is not a new idea and has been previously applied in countries as the USA (Alaska Permanent Reserve Fund since 1976) and Norway (Norway's Government Petroleum Fund was activated in 1996), to name only the biggest funds. The idea is to try and balance the budget over the oil price cycle (which roughly follows the normal business cycles) by means of a fund. The fund should ensure that budget surpluses because of high oil prices are not wasted but saved instead for a rainy day. This would also stress Russia's commitment to fiscal sustainability. However, it requires clear and transparent rules about deposit and withdrawal for the fund to be used in a non-partisan way. The Russian government is doing exactly this by creating a stabilization fund that accumulates funds as long as the price of Ural crude oil exceeds 22$ a barrel and drawing on this fund in the reverse case. In the light of our results, this policy seems wise and should be boosted. Another and possibly better alternative to deal with budgetary windfall gains from high oil prices could be to frontload foreign debt payments. This policy has also been used by Russia in 2001-2003 and enabled Russia to shave the peaks of its foreign debt obligations and made its fiscal policy more sustainable and credible. It seems therefore that Russian policymakers are aware of Russia's sensitivity to the oil price and is taking advisable steps to reduce this sensitivity. In the long run the first best is trying to diversify the production and export structure of the country, so that the oil price elasticities in the model diminish altogether. This requires an appropriate industrial policy, which falls far beyond the scope of this paper.

In the second set of simulations we look at several adverse shocks to the Russian economy. We compare i) a sudden collapse of the oil price to 12$ per barrel (scenario 2 in the first set of simulations); ii) a quickly appreciating exchange rate with resulting loss of competitiveness; iii) the reappearance of political and economic instability; iv) a worst-case scenario incorporating all three negative shocks. A collapse of the oil price and the reappearance of instability have similar effects as regards their effect on real GDP, but the propagation mechanism is quite different. Instability affects growth mainly through a direct impact on real investment and real consumption and in second order through feedback effects on real wages, employment and government revenues. The oil price primarily affects real exports and the government budget. These initial effects then feed back into disposable income, real wages and employment and finally into all other variables. Although the initial propagation is quite different, the ultimate effect on GDP is comparable. A real exchange rate appreciation has milder effects on real GDP. This is because opposite effects are at work. An appreciation mainly works through lower real exports, which affects real GDP negatively, and lower inflation, which mildly stimulates real consumption and affects GDP positively. Because of these mixed effects the feed-back mechanisms are moderated and the long term effect of a persistent appreciation is relatively mild. While appreciation by itself is mild in its effects, it can be very detrimental if combined with shocks in the oil price and confidence of investors and consumers, as shown in the worst-case scenario.

We found that the recent success of the Russian economy to a considerable extent hings on the thread of the oil price, and we explained how Russia is trying to steer the economy away from its oil-dependence. However the simulations suggest that the adverse effect of lost political stability and confidence has on aggregate adverse effects that are comparable to these of an oil price collapse, although the propagation mechanism is entirely different. While the oil price is ultimately out of her control, the government can be held responsible for stability and confidence. Maybe the increased consumer and investor confidence is the main contribution of the Putin administration to Russia's long term economic success. Spoiling this gained confidence, which is probably less unlikely than apparent from the 2004 election outcome, would be a capital mistake. The worst case scenario, where lost confidence, a ruble appreciation and low oil prices go hand in hand, would still yield a collapse of the Russian economy, as was the case in 1998 under Yeltsin. Therefore the stress on stability and the drive for industrial diversification are well-placed and its importance for the long term economic success of Russia should not be underestimated.

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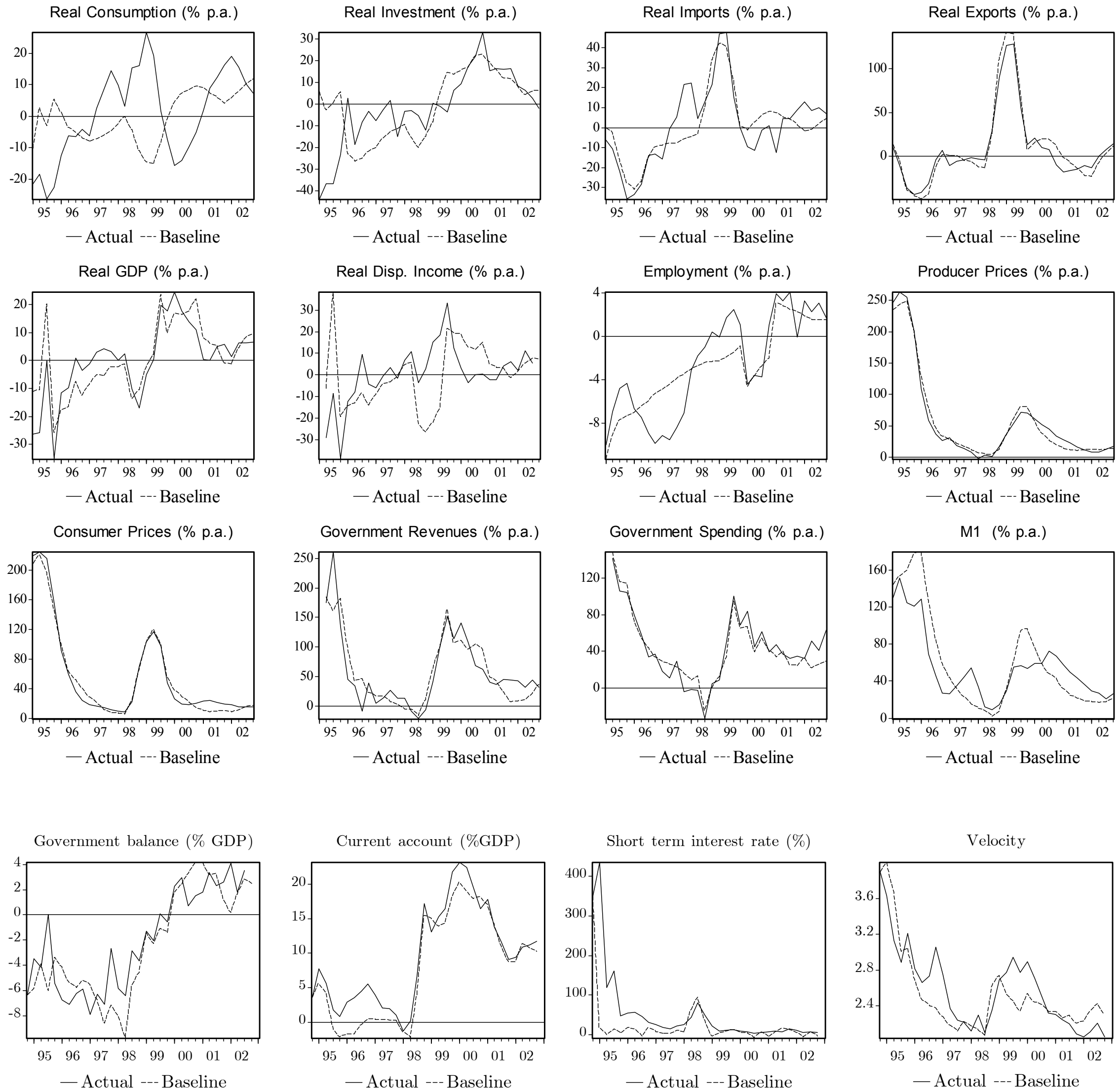

Figure 1: Macroeconomic adjustment in Russia 1994-2002
and dynamic in-sample simulation

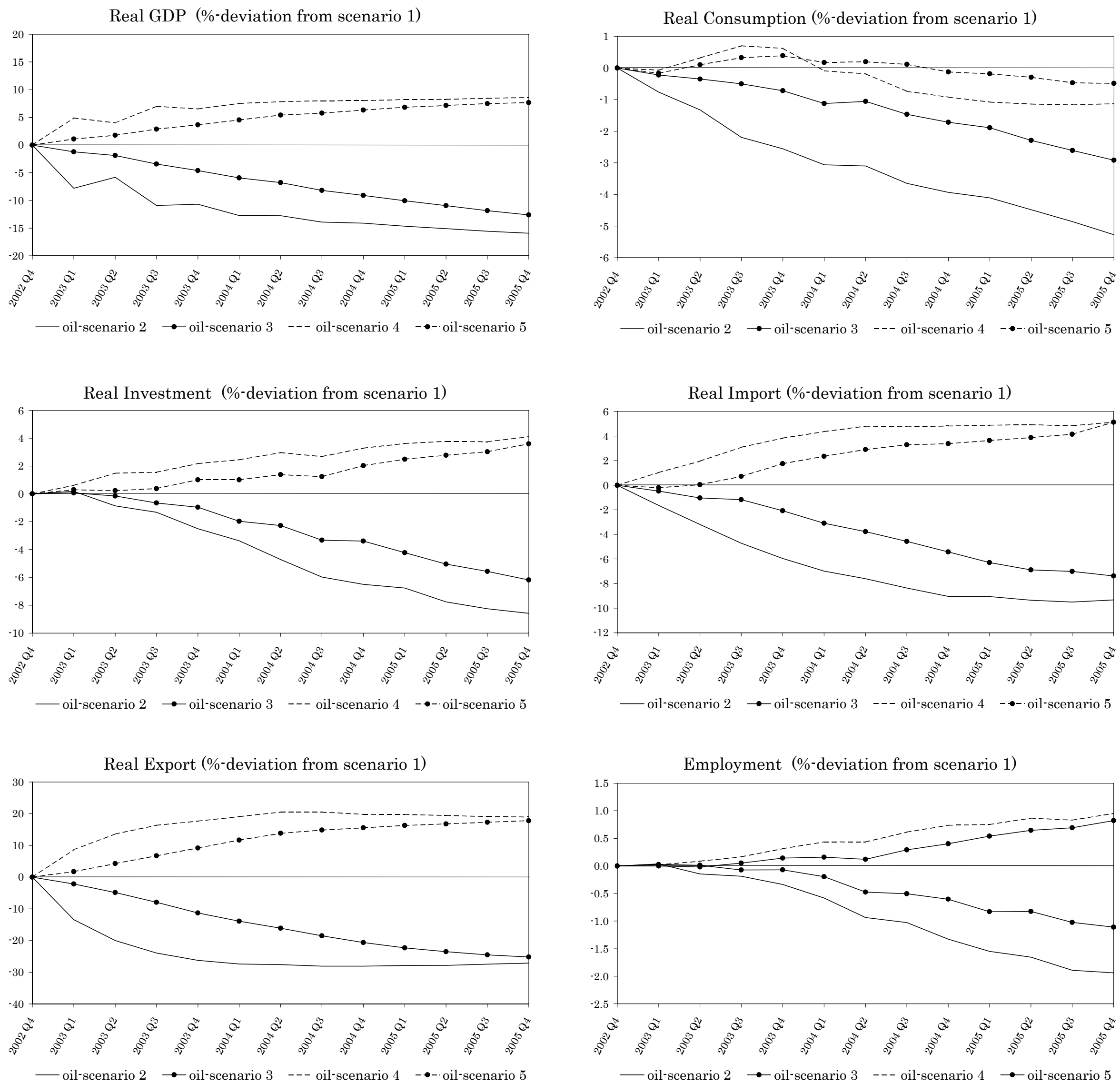

Figure 2 – Deviations from scenario 1 (baseline) under different oil-price-scenarios for core set of macro variables (baseline: constant oil price; scenario 2: shock to 12$/barrel; scenario 3: gradual decrease to 12$/barrel; scenario 4: shock to 43.4$/barrel; scenario 5: gradual increase to 43.4$/barrel)

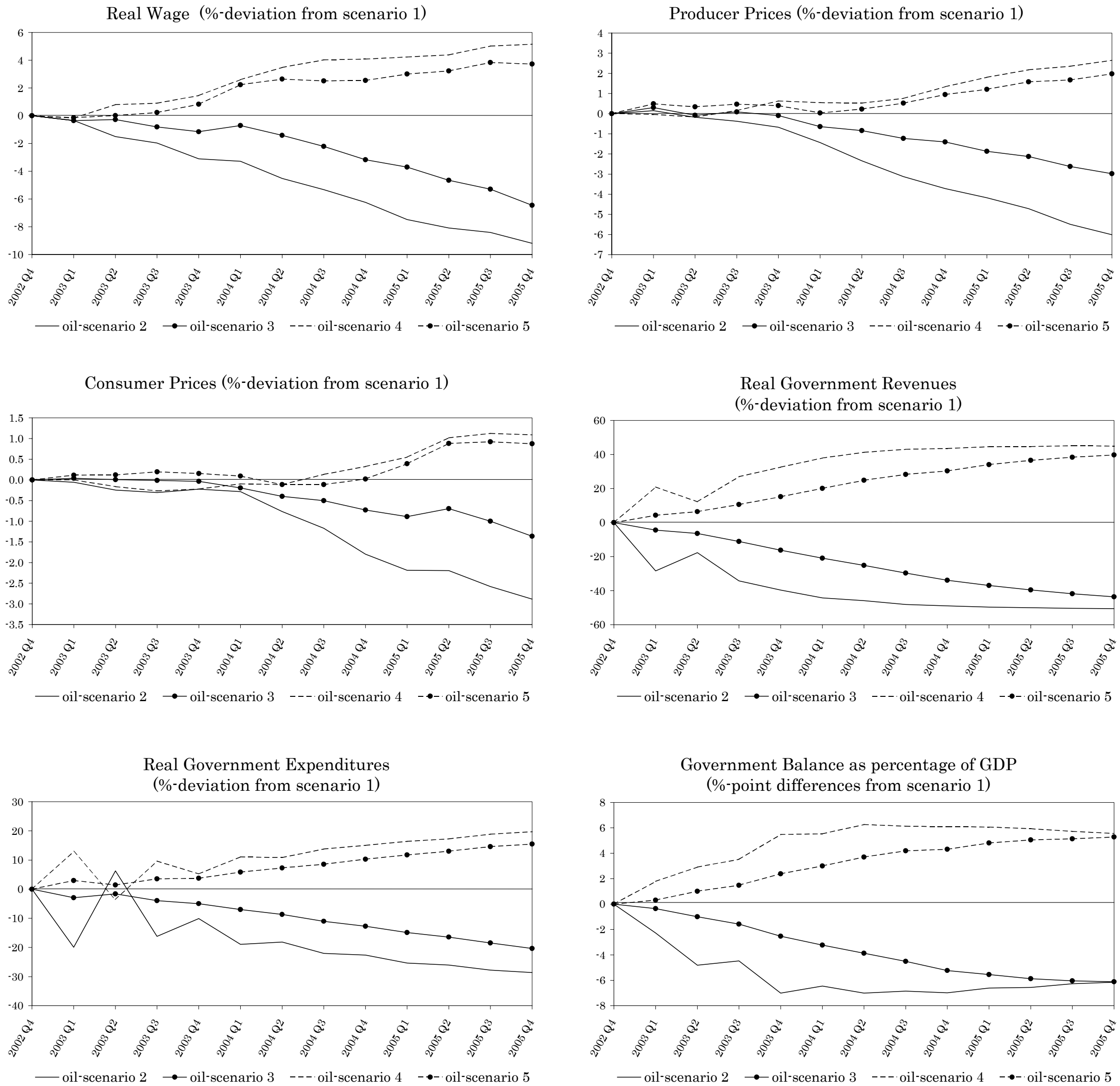

Figure 2*cntd* – Deviations from scenario 1 (baseline) under different oil-price-scenarios for core set of macro variables (baseline: constant oil price; scenario 2: shock to 12$/barrel; scenario 3: gradual decrease to 12$/barrel; scenario 4: shock to 43.4$/barrel; scenario 5: gradual increase to 43.4$/barrel)

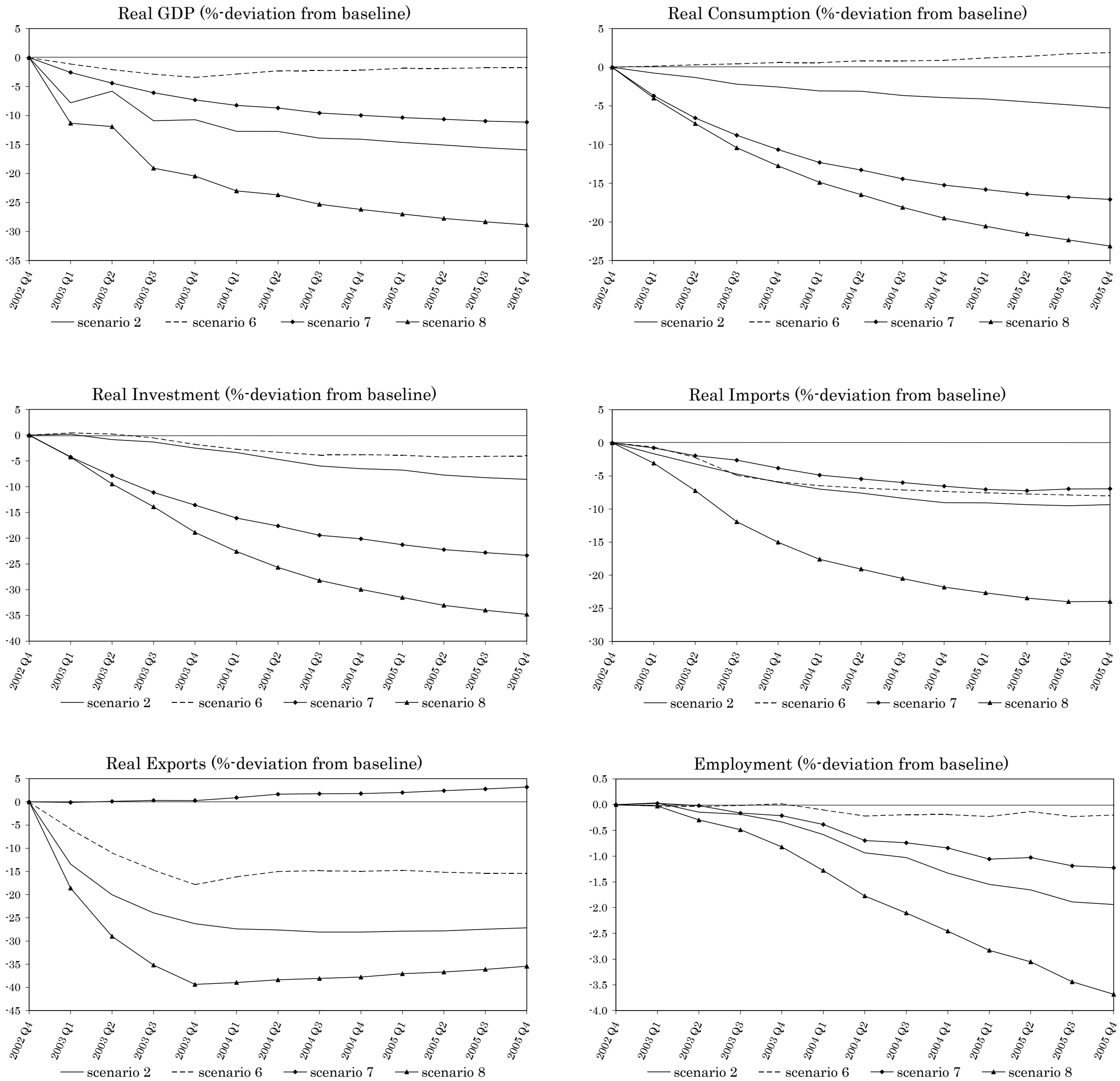

Figure 3: Deviations from scenario 1 (baseline) under different scenarios for core set of macro variables (scenario 2: oil shock – sudden decrease to 12$/barrel; scenario 6: exchange rate appreciation; scenario 7: confidence shock; scenario 8: combination of scenarios 2, 6, and 7)

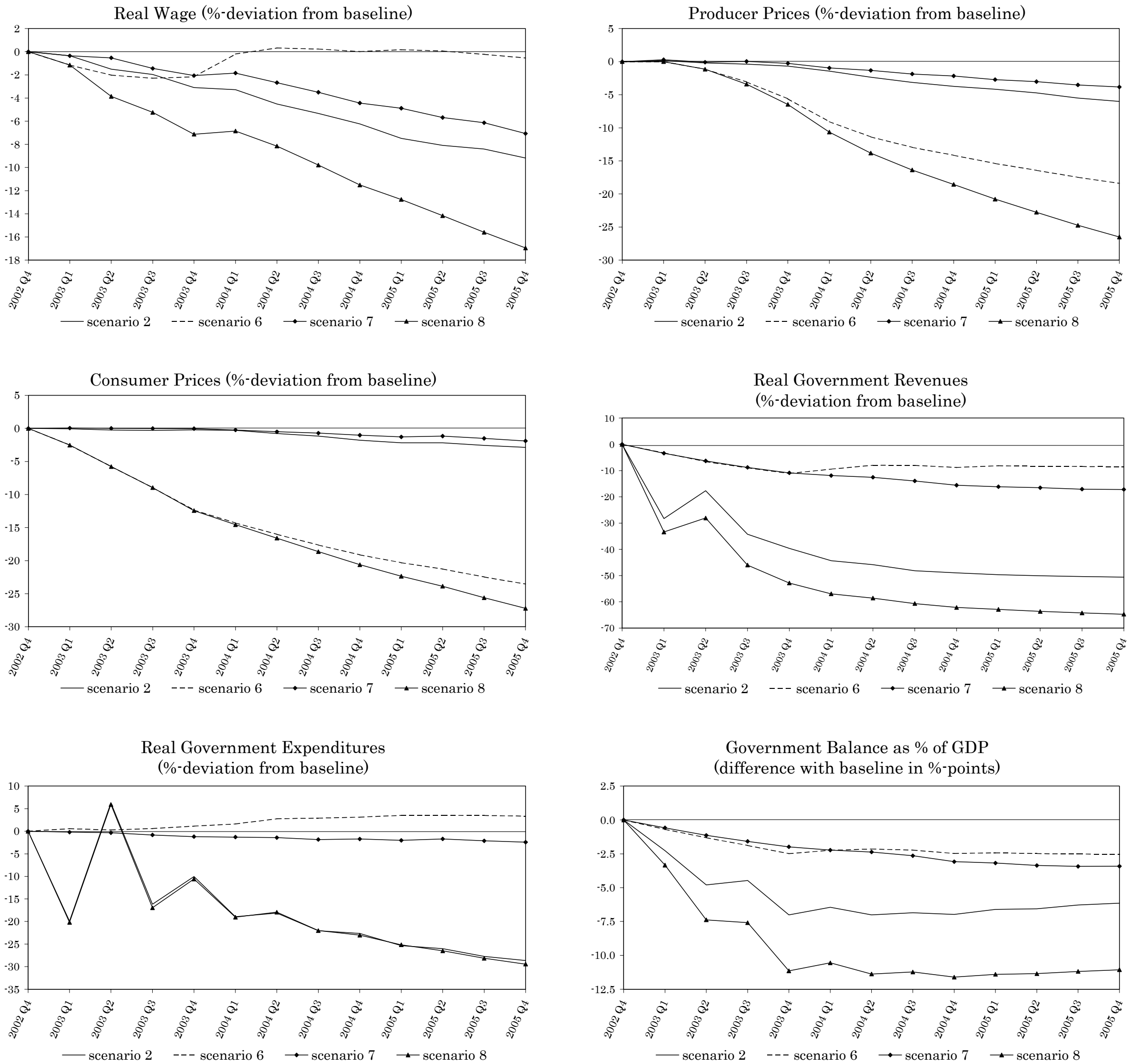

Figure 3*cntd*: Deviations from scenario 1 (baseline) under different scenarios for core set of macro variables (scenario 2: oil shock – sudden decrease to 12$/barrel; scenario 6: exchange rate appreciation; scenario 7: confidence shock; scenario 8: combination of scenarios 2, 6, and 7)

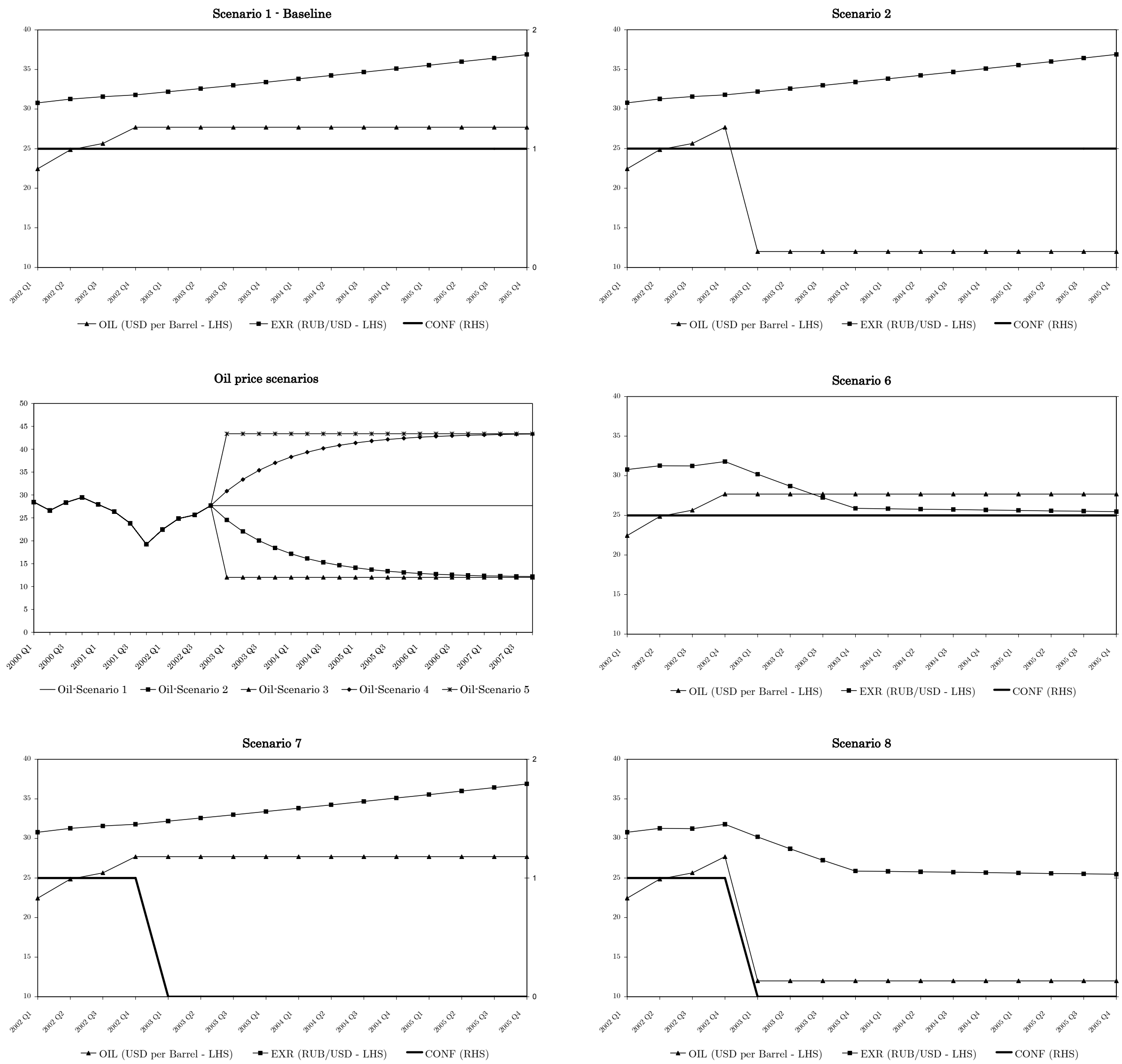

Figure A.1: Representation of different scenarios

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