



Statistisk sentralbyrå
Statistics Norway

Working Paper 2009-002

An Econometric Macro Model of the Russian Economy

Andreas Benedictow
Daniel Fjærtoft
Ole Løfsnæs

RUSS'GASP
FNI – NUPI – ECON PÖYRY

This working paper is a product of the research project "RUSSCASP - Russian and Caspian energy developments and their implications for Norway and Norwegian actors", financed by the PETROSAM program of the Research Council of Norway. The project is carried out with the Fridtjof Nansen Institute, the Norwegian Institute for International Affairs and Econ Pöyry as consortium partners and also includes other institutions and researchers as participants.

This working paper version does not include appendix. A full version can be downloaded at www.fni.no/russcasp.

econ
MEMBER OF THE PÖYRY GROUP

An Econometric Macro Model of the Russian Economy

Andreas Benedictow - Statistics Norway (SSB)

Daniel Fjærtøft – Econ Pöyry

Ole Løfsnæs – Econ Pöyry*

Abstract

A macroeconometric model of the Russian economy is developed, containing 13 estimated equations – covering major national account variables, government expenditures and revenues, interest rates, prices and the labour market – and a number of identities. The model is tailored to analyze effects of changes in the oil price and economic policy variables, and to make economic forecasts. The model has nice statistical properties and tracks history well over the estimation period, which runs from 1995Q1 to 2008Q1. Model simulation indicates that the Russian economy is vulnerable to large fluctuations in the oil price

Key Words:

Russia, macroeconometric model, oil price dependency, growth

*Corresponding author, Pöyry AS, P.O.Box 5, 0051 OSLO, Norway

Tlf.+47 97 69 04 78; faks: 22 42 00 40, <http://www.econ.no>, e-mail: ole.lofsnes@poyry.com .

Econ-Working Paper no 2009-002. , 18. December 2009, project no. 21700.10.11 .

Working papers are research material intended for international journals or books, and also to stimulate discussion. The interpretations and conclusions are those of the author(s).

Table of Contents

1	Introduction.....	1
2	Russian Oil Economics.....	2
3	Developing a macro model for Russia.....	7
3.1	Model relationships.....	7
3.2	Assumptions and hypotheses.....	8
4	Data and estimation.....	9
4.1	Data.....	9
4.2	Software.....	9
4.3	Modelling methodology.....	9
4.4	Estimation.....	10
5	Fit.....	15
6	Changing the oil price.....	15
6.1	Mean Reversion Oil Price Scenario.....	16
6.2	Early Boom Scenario.....	20
7	Summary.....	24

1 Introduction

The impact of higher oil prices on the Russian economy has some features that are similar to the effects in any oil consuming country. End user prices on energy increase, leading to substitution and income effects for non-oil producers and consumers. In general the macroeconomic impact is lower GDP and higher inflation. The negative effects on GDP depend on policy responses of the authorities including monetary and fiscal policy measures. However, in an oil and gas producing country there will be additional positive income effects due to higher national income through positive terms of trade effects. How this income is spent is crucial for the macroeconomic outcome for Russia. We construct a model for the Russian economy that incorporates estimated reaction functions for fiscal as well as monetary policy. This provides us with the option of leaving economic policy endogenous, based on the estimated behaviour of fiscal and monetary authorities over the sample period.

Computable General Equilibrium (CGE) modelling has often been applied for analyses of the Russian economy. There is a number of studies that use CGE models of the Russian economy to assess impacts of trade policy options such as EU enlargement, Russia's WTO accession and the creation of the Common European Economic Space on Russian economy; see e.g. Jensen et al. (2004), Rutherford et al. (2005), Alekseev et al. (2003), Sulamaa and Widgren (2004). BOFIT (Bank of Finland, Institute for Economies in Transition) used a multiregional general equilibrium model GTAP (Global Trade Analysis Project modelling framework) to study impacts of Russian energy policy instruments on the Russian economy (Kerkelä, 2004). BOFIT also developed a vector autoregressive (VAR) model for the Russian economy (see Rautava, 2004). This model is used for forecasts of the Russian economic development. The Russian central Bank has a model framework closely related to the BOFIT models. International models like the Fair-model (Fair 2004), OECD's Interlink model (cf. Dalsgaard et al. 2001), UN's LINK model and IMF's Multimod (Laxton et al. 1998) do not have specific models for the Russian economy.

However, there is a need for robust, empirically based modelling of the Russian economy, of which we have found few attempts in the literature. Merlevede et al. (2009) stands out as an exemption. Data for macroeconomic variables are now available for a sufficient time period and of satisfactory quality to make possible the development of a model with desirable theoretic as well as statistic properties.

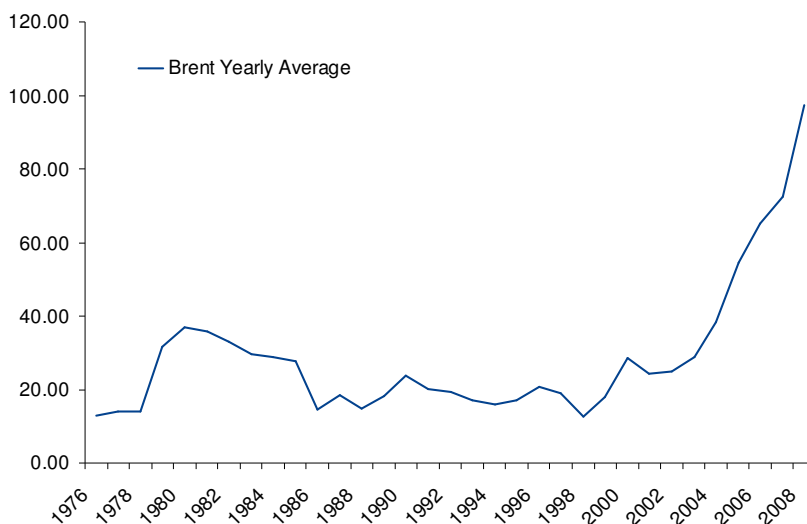
We develop a macroeconometric model of the Russian economy, containing 13 estimated equations covering major national account variables, prices, the exchange rate and the labour market. Central policy variables are also modelled, and we introduce an option for endogenous fiscal policy. A number of identities are also included. The estimation period runs from 1995Q1 to 2008Q1. The estimated equations are interpretable in accordance with economic theory, and satisfy standard statistical tests of residual properties and parameter stability. The model makes possible analyses of effects of changes in a number of central macro variables, as economic policy variables, the exchange rate, international demand and prices – including the oil price. The oil price is of substantial importance, as illustrated in model simulations of alternative scenarios for the oil price.

The outline of the paper is as follows: There is a brief description of vital aspects of the oil market and its importance to the Russian economy in section 2. In section 3 there is a general introduction to the model, followed by a discussion of the econometric equations and central identities in section 4. Section 4 also presents data sources, explains estimation procedures and presents results of the empirical investigations. In section 5 there is an evaluation of overall model performance, while section 6 reports the effects of a change in the oil price. Section 7 contains a discussion of possible extensions and modifications of the model. The final section sums up and concludes.

2 Russian Oil Economics

Following the collapse of the Soviet Union, Russia engaged in an ambitious shock therapy privatization program under IMF guidance. Broken down supply chains, withdrawal of government demand and uncompetitive production led to widespread industrial insolvency and a collapse in government tax revenue. This, coupled with low oil prices and an IMF devised plan of pegging the ruble to counter inflation, led the government to accumulate large foreign loans in an attempt to offset capital outflows and cover the increasing budget deficit. The setup was not built to last and in 1998 the government defaulted on its foreign payments, floated the ruble and introduced capital restrictions. Departure from the artificially strong ruble gave Russian enterprises a chance to recover and 1999 returned positive growth rates, see Figure 2.2. For nine consecutive years, Russia stayed on a steady growth path until the global recession set in in 2008.

Figure 2.1: Brent Nominal USD/bbl. 1976-2009¹



Source: EIA

The importance of oil exports to Russia's economic development is a matter of much discussion. The breakup of the Soviet Union was preceded by an abrupt fall

¹ The correct reference price for Russian exports would be the price of the Urals grade. However, since Urals time series are not readily available for the desired time period and at desired frequency we have chosen Brent as an acceptable proxy. Due to higher sulfur levels Urals is generally traded a couple of USD below Brent.

in nominal crude prices in early 1986, from an average of USD 30–40 in the first half of the 1980s to hovering around USD 16 USD in the second half. Gaidar (2007) among others provides a drop in oil revenues as the prime trigger of Soviet collapse. The economic boom of Putin’s presidency with average GDP growth in excess of 7 per cent has been accompanied by a positive growth in oil prices equivalent to the fall in the early 80s. While the 2009 slump was preceded by a USD 100 drop in the oil price from July 2008 to January 2009, one should be careful to expect similar effects of oil price volatility today as those experienced by the Soviet Union. For the Soviet economy hard currency oil income was the main remedy against systemic flaws that were making the socialist economy increasingly infeasible. In modern day Russia oil, though important, plays a different role.

Figure 2.2: *Russian Real GDP Growth and Inflation 1993-2009*



Note: Numbers for 2009 are estimates of April 2009

Source: IMF WEO

Russia ranks as the world’s second largest oil producer, occasionally creeping up on Saudi Arabia in export volumes. The country’s production reached a temporary post-communism peak in 2007 of almost 10 million bbl/day. It has been argued that mature Russian provinces have seen their ‘peak oil’ and that production from now will steadily decline or best be maintained if new provinces are developed (Jackson and Razak, 2008).

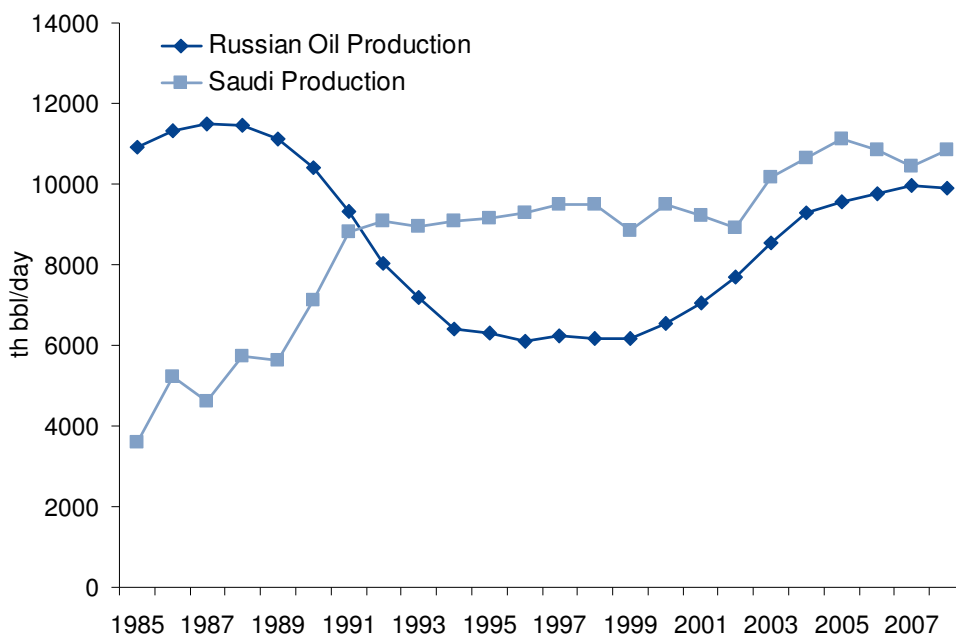
In September 2009, however, Russia reached a new record level of oil production averaging 10 million bbl/day surpassing Saudi Arabia as the world’s largest oil producer.² In addition Russian exports surpassed Saudi Arabia’s in 2009 Q1 exporting 7.4 compared to 7 million bbl/day.³

² http://www.oilexp.ru/news/russian_rinok/rossiya-postavila-novyj-rekord-dobychi-nefti/29723/

³ <http://www.bloggingstocks.com/2009/09/08/russia-beats-saudia-arabia-to-become-the-worlds-biggest-oil-exp/>

Russia's production decreased during the price hike of 2008 and beat a new record under relatively modest prices in 2009. Thus it seems more appropriate to describe Russia's behaviour as maximizing output subject to production constraints. Rather than coordinating cuts with OPEC, Russia has eaten in to OPEC market shares following OPEC cutbacks.⁴ There seems to be both little scope and incentive for Russia to maintain a flexible production. Unless the OPEC capacity contracts sharply or OPEC–Russian relations develop significantly, Russia is best viewed as a price taker in today's oil markets.

Figure 2.3 Russian and Saudi Historic Oil Production



Source: BP, 2008

Russia exports a significant amount of natural gas as well as petrochemical products in addition to crude oil. The slight increase in petrochemicals' contribution to hydrocarbon export value seen in Figure 2.4 is a response to Russian policy of increased domestic processing. Gas has reduced its share compared to crude. This can be explained by the fact that gas production (and hence exports) remained relatively stable throughout the 90s and therefore has not seen the same rebound as crude production. With crude production at a perceived peak, one might expect the importance of gas to increase in years to come.

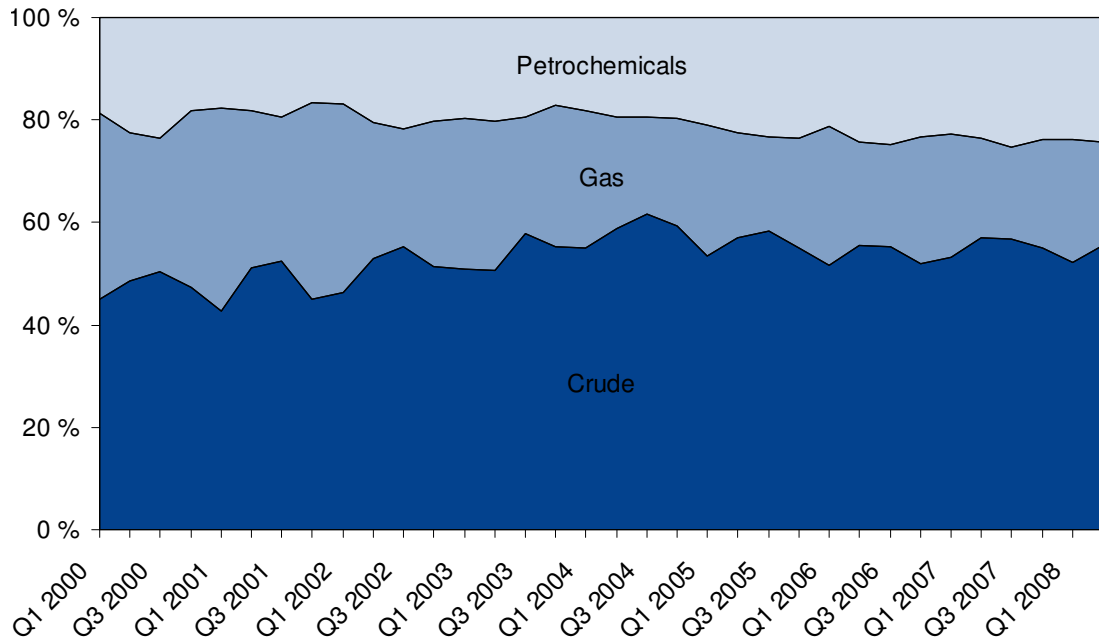
Although global interest is mostly directed to Russia's role as an energy exporter, Russia is also a significant consumer. Whereas Russia's gas market is characterized by low, regulated domestic prices, price formation in the oil market was liberalized in the 90s. Domestic prices therefore reflect changes in world prices despite distortions arising from regional monopolistic market structures.⁵ Rising oil prices can therefore be expected to entail usual negative net effects on domestic consumption, non-oil output and more. Gas has been exempted from international price volatility, but Russian policy makers are moving for a closer

⁴ <http://www.bloggingstocks.com/2009/09/10/opec-vs-russia-power-struggle-in-the-oil-market/>

⁵ http://www.fas.gov.ru/competition/goods/analisis/a_226.shtml

link between domestic and international prices. As the price of gas is linked to oil one might expect increased negative net effects as reform proceeds.

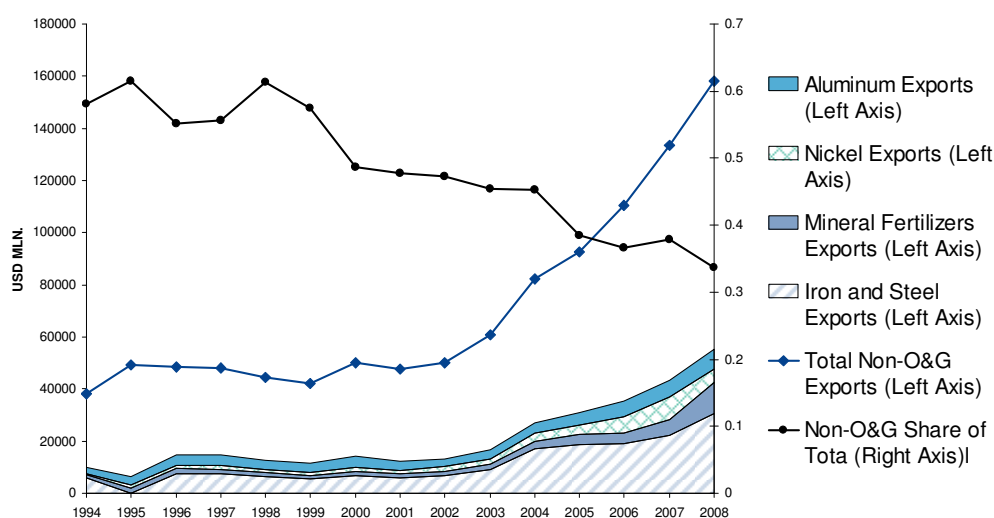
Figure 2.4: *Russia's Hydrocarbon Exports (Product Shares of Total By Value)*



Source: CBR, Econ Pöyry Analysis

Non-hydrocarbon exports have not kept-up with hydrocarbons in recent years. In part this can be explained by the positive change in world prices for energy carriers, but the fact that non-hydrocarbon competitiveness has lagged behind cannot be ignored. Energy intensive, raw material based production make up a significant share of Russia's non-hydrocarbon exports. As an example the production of iron and steel, nickel, aluminium and mineral fertilizers alone accounted for 30 per cent of non-hydrocarbon exports in 2008. The share of these export items has furthermore remained stable at around 25–30 per cent since 1994. Russian non-hydrocarbon exports cannot, however, be seen entirely disconnected from energy. Cheap, subsidized domestic energy supply allows these industries' competitiveness vis-à-vis foreign producers to increase with increasing world energy prices. Liberalized energy markets would cause the cost structure of Russian industry to move more in tact with its international competitors.

Figure 2.5: Non-O&G Exports



Source: Rosstat, Econ Pöyry Analysis

The importance of oil exports and hydrocarbon exports in general to the Russian economy arises along several channels. Income from crude has accounted for a significant share of Russian export revenues increasing from 25 per cent in 2000 to more than 35 per cent in Q2 of 2008. Total hydrocarbon exports (inclusive natural gas and petrochemicals) accounted for 65 per cent of total export revenues in Q2 2008. The price of crude is therefore a key driving force behind Russia's trade flow driven exchange rate (Fjaertoft, 2008). Hydrocarbon exports generated 50 per cent of federal budget revenues in 2008 (EEG, 2009) and the governments scope of manoeuvre is directly linked to the price of crude. On a larger scale the oil and gas sector is estimated to account for 20–25 per cent of GDP (Anker and Sonnerby, 2008). The oil and gas sector also accounts for an important share of investment demand (WB, 2008).

As all economies dominated by resource extraction and export, Russia has faced and faces Dutch Disease effects. In recognition of the detrimental long-run effects from instantly spending windfall profits the Russian government has repaid sovereign debt and starting in 2004 accumulated reserves in the Stabilization fund, see Anker and Sonnerby (2008) for a review. The Stabilization Fund was transformed into a Reserve Fund and National Welfare Fund in 2008. Budget surpluses would be channelled into the second once the first had reached 10 per cent of GDP. Apart from this Russia does not practice a formalized rule for how much oil and gas revenues are to be spent.

Gurvich (2004) provides a comprehensive macro assessment of the Russian economy's oil price dependency. He argues that the influence of increased oil prices in the period 2000–2003 is lower than commonly claimed in the Russian discourse. Moreover, Gurvich (2004) finds GDP growth with unchanged oil prices at 5 per cent compared to the actual 6.8 per cent annual average. It should be noted that the period of 2000–2003 displayed a modest level of oil prices compared to the subsequent five years. The oil price fluctuated around USD 25/bbl. from a maximum of USD 35/bbl. in September 2000 to a minimum of USD 16/bbl in November of the following year. The contrast to USD 20/bbl is not so high and might have allowed the devaluation effects to dominate economic

growth. IMF (2003) argues that most of the devaluation boost had been exhausted by 2003. In addition the continuous rise in oil prices in later years might have led to important structural changes to how oil influences economic growth.

In summary, relations to, and the significance of, world oil prices can be found along several lines in the Russian economy. Government revenue and expenditure, investment demand and the exchange rate, to mention a few, all trace back to export of oil. Russia also exports significant amounts of natural gas and petrochemical products. The export price of these has however been closely linked to the price of crude. For this reason we believe that modelling the Russian economy with particular attention to effects of the oil price should provide important insights.

3 Developing a macro model for Russia

The preceding discussion has shown that oil, and in particular the oil price, is central to Russian economic development. Furthermore, there is a need for a verifiable model to quantify the effects on key economic variables of changes in the oil price. This paper lines out a macroeconometric model of the Russian economy in order to assess consequences of oil prices shocks on the Russian economy.

The model is simple compared to large scale macroeconometric models like for instance National Institute of Economic and Social Research's NIGEM model (Barrel et al 2001)⁶, Ray C. Fair's US model (Fair 2004) and Statistics Norway's MODAG (Baug et al. 2004), and more in line with the small scale country models in Fair's global model (Fair 2004) and the Norwegian Aggregate Model (NAM) (cf. Nymoen 2008). Simplicity makes the model more accessible to researchers and analysts – including those not trained in advanced economics – and is thereby contributing to a better understanding of core driving forces in the Russian economy.

3.1 Model relationships

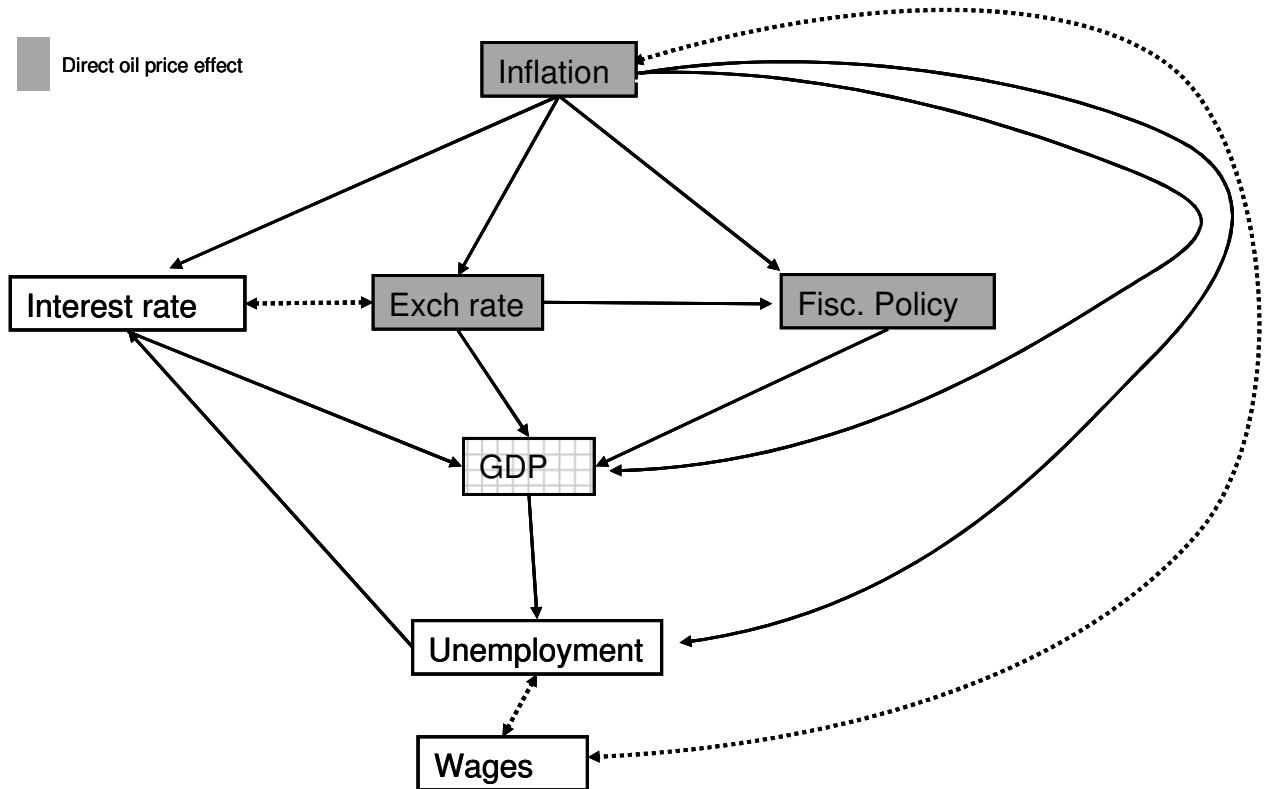
The model of the Russian economy is made up of 13 estimated equations and a number of identities. Household consumption, private domestic investment, oil exports, exports excluding oil and imports are modelled econometrically in real terms. Furthermore, there are estimated equations for the RUB/USD exchange rate, consumer prices, the GDP deflator and the labour market and also an estimated reaction function for the money market interest rate and government revenues and expenditure. GDP follows by identity as the sum of domestic demand and net exports. The model facilitates analyses of, among other things, effects on the economy of changes in interest rates, government expenditure, international demand and prices – including the oil price.

The oil price is exogenous in our model. We assume that although Russia is the second largest oil exporter in the world, Russia's market power is not sufficient to influence oil prices in the way OPEC attempts to do.

⁶ See also <http://www.niesr.ac.uk/research/research.php#1>

Key model relations are outlined in Figure 3.1. Dotted arrows reflect mutual interdependencies. Grey boxes indicate variables directly affected by oil prices, whereas remaining variables are affected indirectly. GDP is chequered grey, indicating that it is modelled as an identity in which exports are directly affected by oil prices.

Figure 3.1: Empirical oil price channels



3.2 Assumptions and hypotheses

Our starting point is a relatively standard macroeconomic IS-LM framework, which includes macroeconomic relationships for the labour market, a fiscal block and a monetary policy rule captured in the interest rate equation. The model is presented in its entirety in **Error! Reference source not found.**

The model's IS side consists of consumption, investment, public activity and net exports, which again define GDP. The LM side of the model is modelled through equations for the exchange rate and inflation. We assume a direct effect of oil prices on the exchange rate along the lines of Spatafora and Stavrev (2003) and likewise for producer and consumer prices.

We model oil exports and non-oil exports separately to allow for testing of Dutch Disease hypotheses and dependence of oil export volumes on the oil price.

The model includes an endogenous treatment of fiscal policy where government revenue and expenditure are directly affected by the oil price, inspired by the approach in Merlevede et al. (2009). These assumptions reflect a hypothesis of resource rent collection by the state and allows testing for the effects of the Putin

administration's provision to channel some of the windfall profits into debt repayments and wealth accumulation (Robinson, 2003).

Monetary policy is modelled according to a Taylor rule where unemployment and inflation are assumed to be the target variables influencing domestic money market rates.

Unemployment is assumed to depend on economic activity and wages. Wages depend positively on consumer prices and negatively on unemployment (reflecting a Phillips curve relation). In addition, labour productivity is assumed to have a positive effect on wages.

4 Data and estimation

4.1 Data

The model is estimated on quarterly data. National accounts data are from IMF's IFS database. Data for government expenditure and revenues are from the Russian Ministry of Finance, Economic Expert Group. Other data are from Reuters EcoWin. See appendix A for details.

As macroeconomic models rely heavily on data, data collection and scrutiny form a significant part of this study. Russian macroeconomic data has recently become more available due to increased and improved reporting, though data for the period prior to 1999 should be treated with some caution. Moreover, over the entire period for which we have obtained data Russia has to some degree experienced structural changes. An aggregate macroeconomic model is not able to handle these structural changes.

4.2 Software

The software EViews6 is used for all estimation and simulation procedures. The estimation period is limited by data availability, and runs from 1994Q1 to 2008Q1.⁷ Because of dynamics, simulation of the full model can start in 1995Q1.

4.3 Modelling methodology

The modelling strategy is the general to specific approach (cf. Davidson et al. (1978)), using ordinary least squares to estimate equilibrium correction models. Restrictions based on economic theory are applied when statistical support is found. Other parameter restrictions are implemented if contributing to simplify the model without reducing the fit. It is also emphasized that the final estimated equations should pass standard statistical tests for serial correlation, heteroscedasticity and normality in the residuals. Parameter stability is tested through recursive estimation. Statistical outliers are removed by impulse dummies if explainable and/or if substantial improvement in residual properties is achieved.

All equations are estimated using the full sample period, except for the interest rate and the exchange rate equations, where the estimation period starts in

⁷ The only exception is the exchange rate equation, which estimation period starts in 1999Q1, when the ruble was floated.

1999Q1, when the ruble was floated. In all estimated equations the coefficient relating to the equilibrium correction term is significant with a negative sign, indicating a cointegrating relationship between the variables in the long run.

4.4 Estimation

In this section we present the estimated equations for the model. Lower case letters indicate logs. The delta (Δ) symbol represents change from the previous quarter. The terms in levels are interpreted as long term effects, while the delta terms correspond to short-run effects. Standard errors are presented below the coefficient estimates. All included variables are statistically significant at the 5 per cent level.

Standard diagnostic tests for normality, heteroscedasticity and serial correlation do not indicate serious signs of misspecification for any of the estimated equations, see **Error! Reference source not found.** This is further confirmed by recursive estimation, demonstrating reasonable constancy as reported in **Error! Reference source not found.** Impulse-, level- and seasonal variables are omitted in this presentation for simplicity. Detailed estimation results are displayed in **Error! Reference source not found.E.**

4.4.1 Consumption

Equation 1:

$$\Delta c_t = -0.149_{(0.027)} - 0.214_{(0.057)} [c_{t-1} - yd_{t-1}] + 0.346_{(0.05)} \Delta yd_t$$

Real household consumption in Russia (c) depends on real disposable income (yd). The equilibrium correction term enters significantly. The estimated coefficient of -0.21 implies *ceteris paribus* a half-life of adjustment towards a new equilibrium of 3.5 quarters following a permanent shock to real disposable income. Consumption is homogenous of degree one in real disposable income in the long run, implying that a 1 per cent increase in real disposable income eventually will lead to a 1 per cent increase in household spending, all else equal. The homogeneity restriction is tested and not rejected. The positive estimated short-run elasticity of disposable income is close to 1/3 of its long-run counterpart, speeding up adjustment to a new equilibrium after a permanent change in real disposable income.

Data for household wealth was not available. Accumulated household wealth in Russia remains low compared to Western European countries, and Russians remain largely unable to properly smooth consumption in order to counter income shocks. This was the case particularly during the transition period. Empirical research by Notten and Crombrughe (2006) supports the notion that wealth does not have a significant influence on Russian consumption decisions in aggregate.

The real interest rate was not found to be significant, and has therefore been left out. To some extent, this could be explained by the low level of Russian wealth accumulation, as the ruble interest rate is not perceived by Russians to be an opportunity cost of holding cash, implying that money to a large extent is spent or invested in foreign currency.

4.4.2 Investment

Equation 2:

$$\Delta i_t = -1.204_{(0.148)} - 0.378_{(0.074)} [i_{t-1} - y_{t-1}]$$

Investment (i) is homogenous of degree one in GDP in the long run, and indicates that over time investments in Russia tend to follow the overall economy. We do not find support for a long-run relationship between investments and real interest rates (RPY). This is attributable to the fact that bank financing accounts for just 10 per cent of corporate sector fixed investments in Russia, and that most investments are sourced through internal sources, less dependent on interest rates.

Ideally, we would prefer to model oil investments separately, as this is an important sector in the Russian economy. If there is a long-run relationship between the oil investments and the oil price for instance, it would be easier to detect with a more disaggregated approach. Unfortunately, we have not been able to find sufficient data, and leave this for later research.

4.4.3 Non-oil exports

Equation 3:

$$\Delta xexoil_t = -1.828_{(0.428)} - 0.355_{(0.081)} [xexoil_{t-1} - wimp_{t-1}] - 0.087_{(0.045)} rex_{t-1} + 0.375_{(0.11)} \Delta xexoil_{t-1}$$

Exports excluding oil (xexoil) depend in the long run on international demand (wimp) and the real exchange rate (rex), increasing in international demand, international prices (pyusa) and a weaker ruble (rubusd) and decreasing in domestic prices (py). This is in line with the standard export model proposed by Armington (1969). Price homogeneity is tested and not rejected. An increase in the oil price yields a real appreciation of the ruble, leading to reduced exports, in line with the Dutch disease hypothesis.

4.4.4 Oil exports

Equation 4:

$$\Delta xoil_t = 0.561_{(0.194)} - 0.098_{(0.033)} xoil_{t-1} + 0.06_{(0.024)} \frac{poilrub_{t-1}}{\Delta py_{t-1}} - 0.323_{(0.156)} \Delta py_{t-3}$$

Oil exports (xoil) depend positively on the oil price (POIL) in rubles relative to domestic prices (PY) in the long run. This result is consistent with: (1) that an increased oil price yields lower domestic demand leading to higher exports at a given level of production, and (2) that domestic production depends positively on the oil price, as higher oil prices make more sources for oil production economically viable. International demand is tested and rejected as an explanatory variable in the model. The estimated coefficient of the equilibrium correction term of -0.01 implies relatively slow adjustment of oil production in the event of a shock in the oil price. This reflects that great volatility of the oil price and the magnitude of investments necessary to increase production foster conservative behaviour and correspondingly slow adjustment of production capacity in response to changing oil prices in the petroleum sector.

4.4.5 Imports

Equation 5:

$$\Delta z_t = -0.384 - 0.292z_{t-1} + 0.078[c_{t-1} + i_{t-1} + g_{t-1} + xexoil_{t-1}]$$

(0.166) (0.072) (0.017)

Imports (z) depend in the long run on domestic demand (c + i + g) and exports excluding oil, as non oil exports include imported input. Relative prices and the exchange rate was not found to be significant, indicating that growth in imports have mainly come as a result of increased economic growth. This is contrary to other studies, cf. Merlevede et al. (2009), finding support for the real exchange rate as an explanatory variable for imports.

4.4.6 Unemployment

Equation 6:

$$\Delta U_t = 0.199 - 0.243U_{t-1} - 0.028y_{t-1} + 0.0089(w - py)_{t-1}$$

(0.039) (0.05) (0.007) (0.005)

The unemployment rate (U) depends negatively on GDP and positively on real wages (w-py) in the long run. Notice that the coefficient estimate of the unemployment rate is a semi-elasticity as U is defined as a rate variable with no logarithmic transformation. This implies that the estimated long-run coefficients are to be interpreted as the *percentage point* change in unemployment following a change of 1 per cent of GDP and real wage respectively.

4.4.7 Wages

Equation 7:

$$\Delta w_t = 0.679 - 0.267[w_{t-1} - pc_{t-1}] - 1.137U_{t-1} + 0.212prod_{t-1} + 0.28\Delta pc_{t-1}$$

(0.155) (0.042) (0.31) (0.04) (0.053)

Nominal wages (w) depend positively on consumer prices and productivity and negatively on the unemployment rate in the long run. Nominal wages are homogenous of degree one in consumer prices in the long run, implying that a 1 per cent increase in consumer prices eventually will lead to a 1 per cent increase in nominal wages, all else equal. This restriction is tested and not rejected. There is also a positive impact effect on wages of consumer prices.

The coefficient estimate of the unemployment rate is a semi-elasticity as U is defined as a rate variable with no logarithmic transformation. Correspondingly, the estimated long-run coefficient of the unemployment rate should be interpreted as the percentage change in nominal wages following a change of 1 *percentage point* in the unemployment rate.

Wages increasing with lower unemployment is consistent with the implications of the Phillips curve. When unemployment is rising, workers are more concerned with jobs than with wages, constraining wage claims. Also, a larger pool of employable workers allows employers to moderate their wage offers.

4.4.8 GDP Deflator

Equation 8:

$$\Delta py_t = -1.121_{(0.118)} - 0.416 py_{t-1} + 0.203 w_{t-1} + 0.062_{(0.009)} [pceu_{t-1} + poilrub_{t-1}] + 0.102_{(0.02)} \Delta poilrub_t + 0.384_{(0.06)} \Delta py_{t-1}$$

The GDP deflator (py) depends on wages, international prices (pceu), oil prices and the exchange rate in the long run. International prices are proxied by the CPI for the euro area, as the euro area is the dominating trading partner. The effect of wages is relatively strong, indicating that an increase in domestic factor costs has a greater impact on inflation than an increase in international factor costs. The oil price effect lends weight to the argument that energy prices in Russia have a significant influence on product prices. Long-run homogeneity in wages and foreign prices is close, but not statistically significant and therefore not imposed by restriction. This is a common finding, and does not appear to pose any problems in simulations on the model. The equation also includes an impact effect of a shock to the oil price and a positive autoregressive term (Δpy).

4.4.9 Consumer prices

Equation 9:

$$\Delta pc_t = -1.112_{(0.195)} - 0.313_{(0.055)} pc_{t-1} + 0.121 [w_{t-1} + pceu_{t-1}] + 0.027_{(0.036)} poilrub_{t-1} + 0.505 \Delta pc_{t-1}$$

Consumer prices (pc) depend on wages, international prices, the exchange rate and the oil price in the long run. Notice that there is a smaller effect of the oil price and a larger effect of international prices compared to what is the case for the GDP deflator, reflecting a higher share of consumer goods in the CPI basket. This difference is illustrated in section 6 where the impact of changes to the oil price is greater on the GDP deflator than on consumer prices. Long-run homogeneity in the oil price and foreign prices is close, but not statistically significant and therefore not imposed by the means of restrictions. The equation also contains a positive autoregressive term (Δpc).

4.4.10 Government expenditure

Equation 10:

$$\Delta ge_t = 0.215_{(0.318)} - 0.132_{(0.054)} ge_{t-1} + 0.038_{(0.011)} poilrub_{t-1} + 0.26_{(0.096)} \Delta ge_{t-3}$$

Government expenditure (ge) is determined by the oil price measured in rubles in the long run. The estimated coefficient of the equilibrium correction term of -0.13 implies a relatively slow adjustment of government revenues in the event of a shock in the oil price. The equation also contains positive autoregressive effects from ge.

4.4.11 Government revenue

Equation 11:

$$\Delta gr_t = 0.301_{(0.226)} - 0.129_{(0.052)} gr_{t-1} + 0.06_{(0.01)} poilrub_{t-1} + 0.657_{(0.154)} \Delta y_t$$

Government revenues (gr) depend on the oil price in the long run, with short-run effects of GDP. The estimated coefficient of the equilibrium correction term of -0.13 is similar to the corresponding coefficient in equation 10, and likewise implies relatively slow adjustment of government expenditure in the event of a shock in the oil price. A 1 per cent increase in the oil price yields an increase of almost 0.5 per cent in government revenues in the long run, indicating a firm success of the state capturing a large share of oil windfall profits. Furthermore, a raise in the oil price increases government revenues by more than it increases government expenditure, implying that rising oil prices yield a positive net effect on the fiscal budget. This is illustrated in section 6.

4.4.12 Interest rate

Equation 12:

$$\begin{aligned} \Delta R_t = & 0.04 - 0.637 R_{t-1} + 0.182 \Delta pc_t - 0.508 U_{t-1} - 0.179 \Delta pc_{t-1} \\ & \quad (0.023) \quad (0.112) \quad (0.062) \quad (0.347) \quad (0.063) \\ & - 0.078 \Delta pc_{t-2} - 1.5 \Delta U_t - 1.069 \Delta U_{t-3} \\ & \quad (0.025) \quad (0.592) \quad (0.592) \end{aligned}$$

Equation 12⁸ may be interpreted as a reaction function for the nominal interest rate, suggesting that the Russian central bank (CBR) is leaning against the wind by responding to higher inflation and lower unemployment by tightening monetary policy. Thus, higher oil prices induce the CBR to adjust interest rates in order to dampen inflationary pressures. The estimated coefficient of the equilibrium correction term is 0.64, implying rapid adjustment in the nominal interest rate to shocks in the unemployment rate and inflation.

There are short-run effects of inflation and the unemployment rate. The estimated short-run effects of the unemployment rate are substantially greater than the long-run counterpart. Accordingly, the nominal interest rate responds quickly and with overshooting to shocks in the unemployment rate. The estimated short-run effects of inflation are negative. These terms contribute to improve the statistical properties of the equation, but also make the adjustment process of the interest rate less smooth in the model after a shock in inflation, as it will cause the interest rate to move in opposite directions in the short and the long run.

4.4.13 Exchange rate

Equation 13:

$$\Delta \text{rubusd}_t = 1.251 - 0.311 \text{rubusd}_{t-1} - 0.058 \text{poil}_{t-1} - 0.065 \Delta \text{poil}_t - 0.269 \Delta R_t - 0.123 \Delta \text{rubusd}_{t-2}$$

(0.161) (0.04) (0.009) (0.03) (0.087) (0.038)

The ruble/usd exchange rate is a function of the oil price in the long run. An increase in the oil price leads to a stronger ruble. There is also an impact effect of the oil price, and short-run effects of the interest rate and the exchange rate.

⁸ Bear in mind that all variables in this equation are defined as rates with no logarithmic transformation. Thus, the coefficient estimates of inflation and the nominal interest rate are interpreted as semi elasticities. A permanent one *percentage point* increase in the unemployment rate (inflation) leads to a 0.80 (0.29) *percentage point* reduction (increase) in the nominal interest rate in the long run.

5 Fit

In this chapter, we assess how well the simulated model fits with actual Russian economic developments over the period 1999Q1 to 2008Q1.

Model evaluation is often based on forecasting properties and ability to reproduce history. When comparing predicted future values of endogenous variables with actual outcome, prediction errors are not only caused by the model, but also by exogenous variables. Furthermore, one has to wait for the future to become history, making data available, to enable comparison of predicted and realized values of endogenous variables. These problems can be avoided by making forecasts for a historical period. Then the “correct” exogenous variables are available, and only the model is to blame for forecast errors, not erroneous assumptions about the future paths of exogenous variables. A stringent evaluation is to test the model “out of sample”. In this case the model is tested for a historical period, but after the estimation period. If the test is performed “in sample” the estimated coefficients reflects information from the forecast period and the test is not valid. However, when testing the model out of sample another problem occurs: the model cannot be estimated using the full sample. Giving up the last observations in the data set for evaluation purposes implies a loss to estimation. A limited period of viable data is available for the Russian economy. All available information is therefore utilized in the estimation, and we are left with an in sample evaluation as the best alternative available in practice. When simulated data is compared to historical data within the estimation period, it is rather a description of how the model tracks/fits historical data than a test of forecasting properties. However, it is hard to imagine a model having good forecasting properties if it is not able to reproduce history in a realistic manner.

To assess the model, we check its ability to track the actual development of the endogenous variables. Dynamic simulation starts in 1999Q1, after the 1998 crisis and within the estimation period of the exchange rate and interest rate equations. Dynamic simulation enables examination of model performance when used to forecast many periods into “the future”. Forecasts from previous periods – and not actual historical data – are used when assigning values to the lagged endogenous terms in the model. The results illustrate model performance as if we in 1999 had used the model to forecast the next 9 years, assuming we had known the correct paths for the exogenous variables. Stochastic Monte Carlo simulation is used to provide a measure of uncertainty in the results, by adding error bounds of plus/minus two standard deviations to the predictions. **Error! Reference source not found.** displays actual and fitted values of the dependent variable including error bounds. The simulation exercise reveals good tracking abilities for all variables, which indicate good overall model stability.

6 Changing the oil price

The model can be simulated under different assumptions for the exogenous variables. The outcome of these simulations is transparent and traceable. In this section we apply two counterfactual paths for the oil price, solving the model in a high and low oil price scenario over the nine-year sample 1999 Q1 to 2008 Q1. This exercise elucidates to what extent the oil price increase of the 2000s has contributed to Russia’s economic growth in this period. The alternative oil price

scenarios also serve as illustrations of model properties, e.g. the different channels through which the oil price influences the Russian economy. The model is simulated with endogenous monetary and fiscal policy.⁹

At the outset of the simulation period the oil price stood at a record low USD 11.3/bbl. The oil price gained USD 15 through 1999 and another USD 5 in 2000. Through the course of 2001–2002 prices hovered around USD 25–30. What is referred to as the oil price boom in this paper started in 2003 Q2, when prices climbed uninterrupted from USD 26 to USD 51 after two years and on to USD 97 in 2008 Q1. Beyond our sample the oil price grew another USD 25/bbl in 2008 Q2 before it crashed.

6.1 Mean Reversion Oil Price Scenario

The increase in oil prices has been substantial and arguably unexpected among policy makers at the outset of our simulation period. Pindyck (1999) argued in an influential article that oil prices exhibited reversion to a stochastically fluctuating trend that represents evolution of long-run marginal cost. According to his forecast the oil price in the period 2000–2010 should revert to a long-run level of USD⁽¹⁹⁶⁷⁾ 4.5/bbl or USD⁽²⁰⁰⁰⁾ 23/bbl. Similar price expectations prevailed in Russia into the 2000s (Gurvich, 2004). We therefore start by solving the model under the assumption that these expectations were fulfilled, such that prices stay at USD⁽²⁰⁰⁰⁾ 23/bbl throughout the simulation period. This hypothetical development is illustrated against the actual oil price Figure 6.1. Hypothetical and actual oil prices are quite similar up to 2003 Q2. To improve interpretability, we therefore allow the hypothetical and actual values to differ after this point only.

Model simulation along this oil price scenario sheds light on the question: How would the Russian economy have performed had it not been for the sustained oil price boom witnessed up until July 2008? Among Russia-focused researchers this is a question of much debate. Particularly because the debate is often coupled with an evaluation of President and Prime Minister Vladimir Putin’s “semi-authoritarian” economic model as is the case in McFaul and Stoner-Weiss (2008). Our analysis is partial in the sense that the USD oil price is the only exogenous variable that is changed. It is a common assumption that the oil price boom has been fuelled by fast-growing international demand, particularly in China. In our alternative scenarios international demand as well as international prices are treated exogenously and not changed. The fact that monetary and fiscal policy, the exchange rate, and oil revenues and expenditure are endogenously determined in the model contributes to realism in the results.

⁹ The model is simulated with historical residuals to ensure that the difference between the actual and the alternative scenario reflects only the effects of the change in the oil price, and not model errors.

Figure 6.1: Oil Price, actual and Mean Reversion Scenario

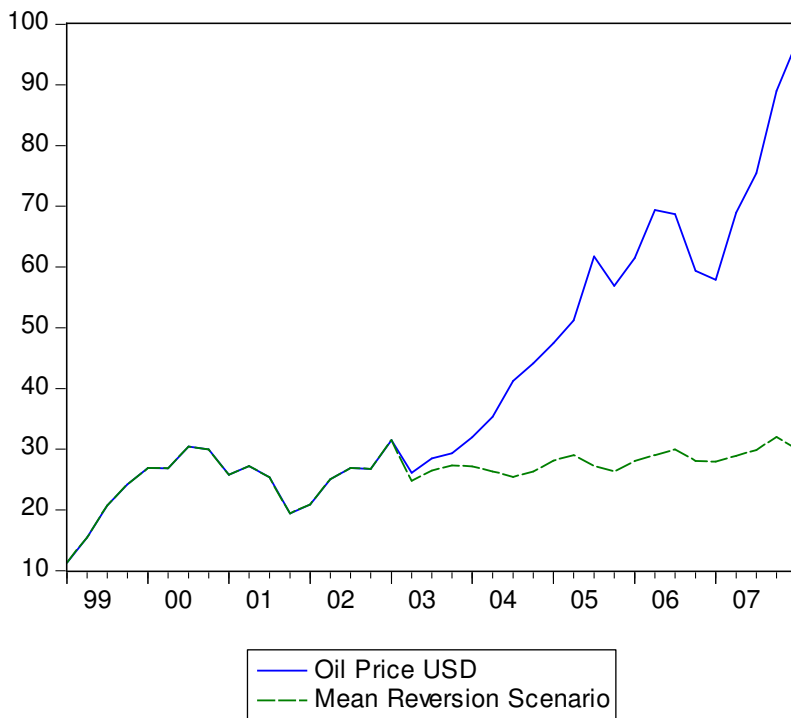
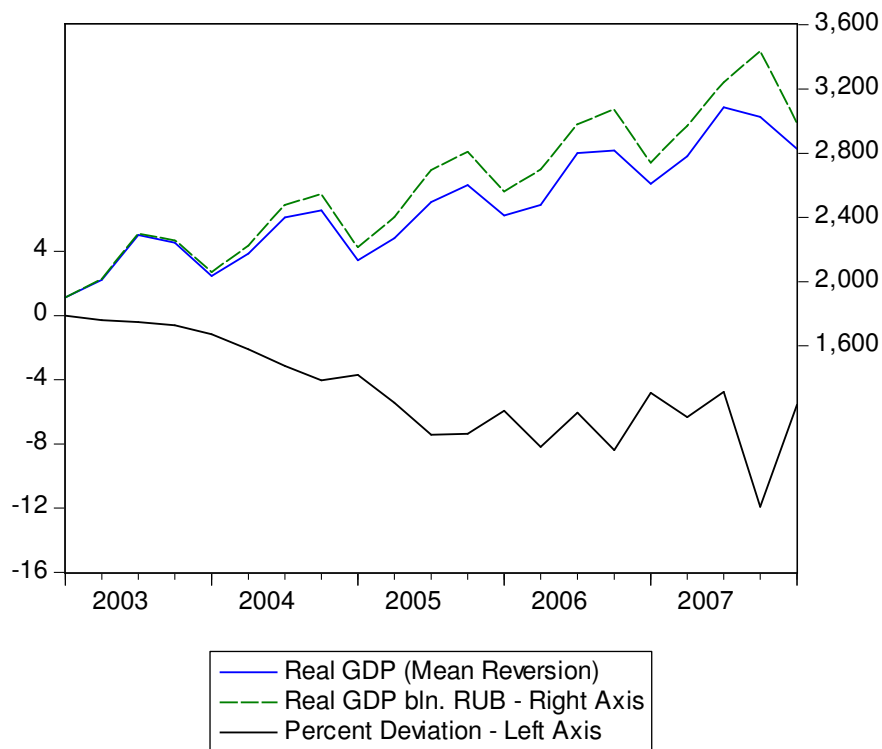


Figure 6.2 compares real GDP under the mean reversion scenario with the observed development of the same variable. Simulated GDP starts developing along a lower path immediately as hypothetical and actual oil prices diverge. The gap between actual and simulated GDP grows throughout the simulation period as oil price divergence increases. At the end of the simulation period, GDP is 6–7 per cent lower in the mean reversion oil price scenario.

Figure 6.2: GDP, actual and Mean Reversion Scenario



Lower oil prices have a direct, negative effect on oil exports, government revenue and expenditure as well as consumer and producer prices, and cause the ruble to depreciate. Lower oil prices affect GDP through a negative effect on consumption, which depends on disposable income, which in turn is increasing in oil prices. Investments are affected negatively through lower GDP. Public consumption and investment rely positively on oil prices through their positive relation to government expenditure, which in turn is under direct positive influence of the oil price. Oil exports are reduced, bringing about a direct negative effect on GDP through the export channel.

Negative effects of lower oil prices are countered somewhat through the stabilizing properties of imports and non-oil exports. Imports are subdued through lower domestic demand, while non-oil exports experience a positive effect through depreciation of the ruble and lower domestic inflation.

The gap between actual and simulated GDP stabilizes somewhat toward the end of the sample. This can be attributed to the CBR lowering the interest rate by approximately 2 percentage points in the short term as a response to lower economic growth and lower inflation. Lower interest rates yield a ruble depreciation, increasing net exports.

Error! Reference source not found. contains the simulated and actual evolution of the GDP deflator, ruble–dollar exchange rate, non-oil and oil exports as well as money market rate and real wage. **Error! Reference source not found.** contains graphic illustrations of all endogenous solutions in the mean reversion scenario.

Simulated inflation departs from observed values immediately and inflation divergence increases unabated throughout the simulation period. The effect of curbed inflation is reinforced through the wage channel as lower GDP has a positive effect on unemployment and accordingly a negative effect on wage

growth. Simulated wages stay close to par with observed values initially, but depart decisively in early 2005. The gap between actual and simulated values increases throughout the simulation period as high observed oil prices lead to accelerated wage growth. A lower oil price causes the ruble to depreciate. At the end of the simulation period the simulated ruble is some 15 per cent weaker than actual observations.

Non-oil exports increase on observed values as slower domestic inflation and weaker nominal ruble bring about real exchange rate depreciation. The gap trajectory is, however, marked by ups and downs. This is likely related to the equivocal nature of the exchange rate relative to inflation resulting in short-run fluctuations. Non-oil exports end approximately 10 per cent higher than observed values. Oil exports increase along with observed values over the first half of the simulation period, but where actual exports recover from a 2004 dip, simulated values continue to decrease and end up 20 per cent lower than actual values. This may indicate that Russia's maintained level of oil production would not be viable if not for the substantial increase in the oil price. Our simulation thereby lends indicative support to the claim that Russian oil production has reached a peak and can be expected to decline in the future unless prices grow.

Figure 6.3: Mean Reversion Selected Variables

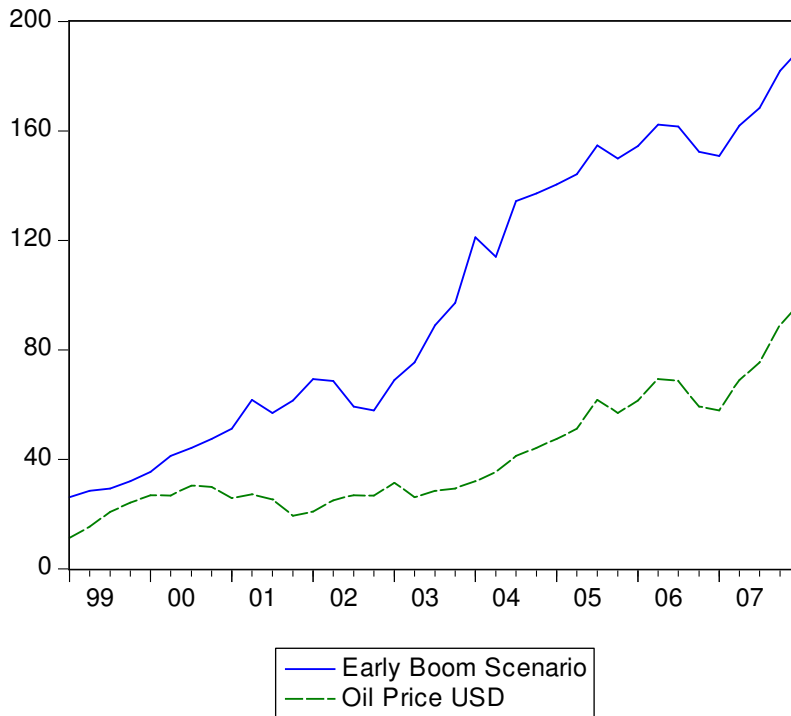


6.2 Early Boom Scenario

A different question is how the Russian economy would have performed should the oil price boom have occurred at the outset of our simulation period in 1999 rather than in 2003. Accordingly, we run the model using a hypothetical oil price

series where the observations for 2003 Q2 and onwards are shifted back in time to start in 1999 Q1. Thus the oil price boom starts 18 periods earlier and culminates in 2004 Q2 with the value observed in 2008 Q1. For the rest of the simulation period, we keep a constant difference between the hypothetical and the observed oil price, see Figure 6.4.

Figure 6.4: Oil Price, actual and Early Boom Scenario



In the early boom scenario simulated GDP grows faster than actual observations until mid-sample when the gap between simulated and actual GDP starts to close, going from 24 per cent to 12 per cent above actual observations at sample end, see Figure 6.5. At first, a higher oil price leads to higher oil exports and -income, paving the way for increasing public consumption and investment. Higher real disposable income fuels household consumption. After five years, however, the gap between actual and simulated GDP is reduced. The oil price gap increases until mid-sample only. Thereafter the price gap remains constant. Thus the scenario oil price is growing in parallel with the actual oil price from 2004 Q2, providing no additional stimulus to the economy over public budgets from this point. Oil exports also grow relatively slow from here on. Lower growth in real disposable income brings down growth in household consumption, and private investments are hampered by weaker overall economic development.

A stronger nominal exchange rate and higher inflation impairs non-oil exports through a real appreciation of the ruble. Strong growth in domestic demand leads to high import growth, dampened somewhat towards the end of the simulation period in accordance with the relatively weaker performance of the overall economy.

Figure 6.5: GDP, actual and Early Boom Scenario

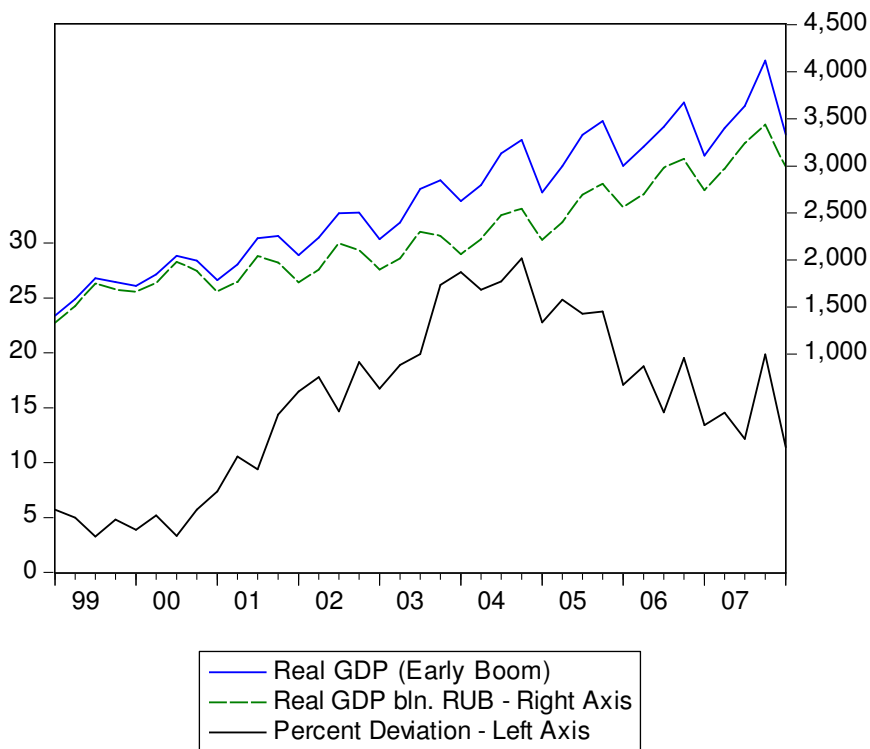


Figure 6.6 illustrates the evolution of selected variables under the early boom scenario. For reference, the solutions for all endogenous variables are provided in **Error! Reference source not found.**

The simulated GDP deflator grows faster than its observed counterpart for most of the simulation period, but as the oil price gap stabilizes the same happens to the GDP deflator gap. The exchange rate depreciates less initially and starts appreciating earlier compared to the actual trajectory. The gap closes somewhat over the last three years, with no new impulses from the oil price and falling interest rates. At the end of the simulation period the ruble is 14 per cent stronger than the observed value.

Figure 6.6: *Early Boom Scenario Selected Variables*



7 Summary

Russia is occasionally surpassing Saudi Arabia as the world's number one oil producer and exporter. Oil revenues make a significant share of Russia's exports and foreign trade turnover as well as government earnings. The demise of the Soviet Union and Russia's recovery in the 2000's have been accompanied by falling and rising oil prices respectively. Prior to the 2009 economic crisis Russia's average GDP growth since 2001 has been in excess of 7 per cent and thus among the strongest in the world. At the same time Russia has seen an increased role of the state while market institutions remain underdeveloped. This has led critics of the Russian regime, and in part the current President Dmitry Medvedev to claim that Russia's boom has largely been facilitated by unprecedented oil price growth.

To shed light on these issues we have estimated a macro econometric model of the Russian economy tailored to answering the question of Russia's oil price dependence. The model has good statistical properties and explains history well for most variables.

We apply the model to assess the degree of oil price dependency of the Russian economy. The two scenario simulations discussed above are based on two alternative paths of the oil price. Under the first scenario the real oil price does not increase after 2003, in contrast to the sky-rocketing development we actually observed. Under the second scenario the 2003 oil price boom commences in 1999 rather than in 2003. The simulations indicate that the oil price has been of considerable importance to the Russian economy over the last decade. However, according to the model, the Russian economy exhibits significant growth capabilities also in the absence of growth in the oil price. Thus the model suggests that Russian economic performance in general is not as oil price dependent as commonly anticipated.

Furthermore, according to the model, an increase in the oil price yields a real appreciation of the ruble, leading to reduced exports in line with the Dutch Disease hypothesis.

The alternative scenarios were chosen to provide grounds for a discussion of how the Russian economy actually would have performed should oil prices have evolved in a different way. The scenarios are chosen with an eye to realism in the sense that they should be easy to relate to the actual development of the oil price. The two alternative paths for the oil price are not symmetric, which complicates scenario comparison. Nevertheless, we argue that our choice is justified as we shed light on issues that are of direct concern to most Russia analysts. For the interested reader **Error! Reference source not found.** contains model solutions for a 100 per cent permanent increase as well as a symmetric decrease in oil prices. These more stylized simulations forego some realism in order to make the model more easily interpretable.

Notwithstanding the advances in this paper, several issues are left in need of further research. Rather than using its own interest rates the Russian central bank has operated a money targeting program aimed at providing the economy with sufficient liquidity subject to constraining inflation and concerns for rapid ruble appreciation. We know little about how money supply affects interest rates and accompanying transmission effects into inflation. Nevertheless, we find empirical

evidence for modelling monetary policy as the RCB “leaning against the wind”, tightening monetary policy – represented by the money market interest rate – in the face of increasing inflation and falling unemployment. Keeping in mind these uncertainties and the omission of one of the target variables (money supply), more detailed modelling of Russian monetary policy might provide important insights and add precision to model forecasts.

The Russian society as well as the economy, including fiscal and monetary policy, has been in constant development throughout the data period. This makes identifying stable relationships a challenging task. One important example is the change in exchange rate regime following the 1998 default, allowing us to model the exchange rate from 1999 only.

With reference to the discussion above, a prime goal for Russian monetary authorities is a western style transfer to free float of the ruble and inflation targeting using the interest rate. When it comes to fiscal policy, our model does not include a specific spending rule for petroleum revenues. Rather, government expenditure is modelled based on observed behaviour over the estimation sample. Model simulation illustrates how government spending increases slower than government revenues following a positive shift in the oil price, allowing significant amounts to be transferred to the Reserve and National Wealth Funds.

References

Alekseev, A., Tordyeva, N. and Yudaeva, K. (2003): Estimation of Russia's trade policy options with the help of the Computable General Equilibrium Model, *CEFIR Working papers*, #42, 2003

Armington, P. S. (1969): "A theory of demand for products distinguished by place of production", *IMF Staff papers* 16, No. 1, 159-176

Aune, F. R., Glomsrød, S., Lindholt, K. and Rosendal, K. E. (2005): "Are high oil prices profitable for OPEC in the long run?" *Discussion Papers* 416, Statistics Norway

Barrell, R., K. Dury and D. Holland (2001): "Macro-models and the medium term - The NIESR experience with NiGEM", *National Institute of Economic and Social Research, Preliminary*,
http://ecomod.net/conferences/ecomod2001/papers_web/Barrell_Bruss4.PDF

Bernanke, B. S., M. Gertler and M. Watson (1997): "Systematic monetary policy and the effect of oil price shocks". *Brooking papers on economic activity* 1:91:157

Boug, P., Dyvi, Y., Johansen, P. R. and Naug, B. E. (2002): "MODAG – En makroøkonomisk model for norsk økonomi (MODAG – A macro economic modell for the Norwegian economy)", *Social and Economic Studies* 108, Statistics Norway

Davidson, J. E. H., D. F. Hendry, F. Srba and Yeo (1978): "Econometric modeling of the aggregate time series relationships between consumers' expenditure and income in the United Kingdom", *Economic Journal* 88, 661-692

Econ Pöyry (2008): "Virkninger av høye oljepriser", *Econ Pöyry Rapport* No 2008-112

EEG (2009): *Key Economic Indicators*, Economic Expert Group, Available at <http://www.eeg.ru/pages/123>, accessed 2009-11-09

Fair, R. C. (2004): "Estimating how the macro economy works", *Harvard University Press*

Gaidar, Y. (2007): "The Soviet Collapse: Grain and Oil", *American Enterprise Institute for Public Policy Research*, April

Granger, C. W. J. and Jeon, Y. (2007): "Evaluation of global models", *Economic Modelling* 24, 980-989.

Gurvich, E. T. (2004): "Makroekonomicheskaya otsenka poli rossiyskogo neftegazogo sektora", *Voprosy ekonomiki* 10.

Hendry, D.F. and J.A. Doornik (2001): “Modelling Dynamic Systems using PcGive” Volume II, Timberlake Consultants LTD, London.

IEA (2004): “Analysis of high oil prices on the global economy”, http://www.iea.org/textbase/papers/2004/high_oil_prices.pdf.

Jackson, P.M and Razak, S. (2008): “Russia’s Future Oil Capacity – Slowing Growth and the Confluence of Risks”, CERA Private Report, April

Jensen, J., Rutherford, T. F. and Tarr, D. G. (2004): “The Impacts of Liberalizing Barriers to Foreign Direct Investments in Services: The Case of Russian Accession to the World Trade Organization”, *World Bank, Working Paper*, WPS3391

Johansen, P. R. and Magnussen, K. A. (1996): “The implementation model: a macroeconomic model for Saudi Arabia”, Documents, Statistics Norway.

Johansen, S. (1988): Statistical Analysis of Cointegration Vectors, *Journal of Economic Dynamics and Control* 12, 231-254.

Kerkelä, L. (2004): Distortion costs and effects of price liberalization in Russian energy markets: ACGE analysis, *BOFIT, Discussion Papers 2004-No.2*

Korvald, H. M. (2006): “Økonomiske konsekvenser av økt oljepris for euroområdet: En empirisk undersøkelse”, Department of Economics, University of Oslo.

Laxton, D., Isard, P., Faruqee, H., Prasad, E. and Turtelboom, B. (1998): “MULTIMOD Mark III The Core Dynamic and Steady-State Models”, IMF Occasional Paper No. 164.

Marquez, J. (2002): “Estimating Trade Elasticities”, Kluwer Academic Publishers.

Merlevede, B., Schoors, K. and van Aarle, B. (2007): “Russia From Bust to Boom and back: Oil Price, Dutch Disease and Stabilisation Fund”, *Comparative Economic Studies*, 51, 213-241.

Notten, G. and Crombrugghe, D. (2006): “Poverty and Consumption Smoothing in Russia”, Working Paper no 004, Maastricht Graduate School of Governance.

Nymoén, R. (2008): “Forecasts for the Norwegian economy 2008q1-2011q4”, http://folk.uio.no/rnymoen/namforecast_mar08.pdf

(see also <http://folk.uio.no/rnymoen/NAM/index.html>).

Dalgaard, T., Christophe, A. and Richardson, P. (2001): “Standard Shocks in the OECD Interlink Model” OECD Economics Department Working Papers 306.

Pindyck, R. S. (1999): “The Long-Run Evolution of Energy Prices”, *The Energy Journal* 20, No. 2.

Rautava, J. (2004): The role of oil prices and the real exchange rate in Russia's economy - a cointegration approach, *Journal of Comparative Economics* **32(2004)**, 315-327

Robinson, D. O. (2003): “Public Expenditure Reform”, in David Owen and David O. Robinson, *Russia Rebounds*, IMF, 2003.

Rutherford, T., Tarr, D. and Shepotylo, O. (2005): The Impact on Russian of WTO Accession and The Doha Agenda: The importance of liberalization of barriers against foreign direct investment in services for growth and poverty reduction, *World Bank, Working Paper*, WPS3725.

Sagen, E. and M. Tsygankova (2006): Russian Natural Gas Exports to Europe. Effects of Russian gas market reforms and the rising market power of Gazprom, Discussion Papers No. 445, Statistics Norway.

Spatafora, N. and Stavrev, E. (2003): ”The Real Exchange Rate in a Commodity Exporting Country: the Case of Russia”, Working Paper 03/93, IMF, Washington.

Sulamaa, P. and Mika Widgren (2004): EU-Enlargement and Beyond: A Simulation Study on EU and Russian Integration, *Empirica* **31**, 307-323.

Taylor, J. B. (2001): “The Role of the Exchange Rate in Monetary-Policy Rules”, *AEA Papers and Proceedings*, Volume 91(2), pp 263-267.

UN LINK, <http://www.un.org/esa/policy/link/index.html>

Van Wijnbergen, S. (1984): “The ‘Dutch Disease’: A Disease After All?”, *The Economic Journal* 94 373:41.

WB (2008): “Russian Economic Report”, *World Bank in Russia*, No 16