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Fiscal policy and regional output volatility: Evidence from Russia

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Abstract

This paper investigates the relationship between fiscal policy and output volatility in Russian regions between 2000 and 2009. System GMM estimation techniques are used to account for potential endogeneity between output volatility and fiscal developments. Our main finding is that fiscal activism, proxied by various measures of discretionary fiscal policy, contributes to output volatility and so induces macroeconomic instability at the regional level in Russia. This result corroborates previous studies using cross-country data. To reduce business cycle fluctuations, it would be necessary to curtail pro-cyclical fiscal activism at the regional level, e.g. via fiscal rules and sound institutions of fiscal federalism.

JEL Codes: E32, E62, R11.

Keywords: output volatility, automatic stabilizers, discretionary fiscal policy, dynamic panel models, Russia

Markus Eller, Oesterreichische Nationalbank, Foreign Research Division, Otto-Wagner-Platz 3, A-1090 Vienna, Austria. Email: markus.eller@oenb.at.

Jarko Fidrmuc, Austrian Institute of Economic Research Vienna, Comenius University Bratislava and Zeppelin University Friedrichshafen, Department of Economics, Am Seemoser Horn 20, D-88045 Friedrichshafen, Germany. Email: jarko.fidrmuc@zu.de and jarko.fidrmuc@wifo.ac.at.

Zuzana Fungáčová, Bank of Finland Institute for Economies in Transition (BOFIT), Snellmaninaukio, PO Box 160, FI-00101 Helsinki, Finland. Email: zuzana.fungacova@bof.fi.

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1 Introduction

Emerging markets tend to experience higher output volatility than do developed economies (Debrun and Kapoor, 2010). Higher output volatility is shown to be connected to lower private investment (Aizenman and Marion, 1999) and to slower long-run economic growth (e.g. Ramey and Ramey, 1995; Imbs, 2007; Furceri, 2010)[1]. Hegerty (2012) recently confirmed for several transition economies that volatility significantly reduces output growth. Therefore, the analysis of factors that aggravate or dampen output volatility has important policy implications for emerging markets.

Given the lack of empirical evidence explaining output volatility in emerging markets, this paper investigates the determinants of output volatility by employing a rich panel dataset on Russian regions covering the period 2000-2009. Russia is one of the largest emerging markets, and its economy is dependent on the performance of a few key industries, which makes it susceptible to macroeconomic instabilities (EBRD, 2012), as evidenced by the fact that Russia has been repeatedly hit by economic and financial crises. Our focus on Russian regions is timely for several reasons. First, while there are plenty of cross-country analyses of output volatility, very few papers have analyzed the determinants of output volatility at the subnational level (the most notable exceptions are Fatás and Mihov, 2001, for US states and Cheng, 2010, for Chinese provinces). Second, the overall institutional frameworks for the Russian regions are very similar, which enables us to work with a reasonably homogeneous panel, and yet output volatility varies enough to guarantee satisfactory degrees of freedom for the estimations.

This paper underlines the importance of fiscal policy in explaining output volatility. Output volatility has substantial effects on income and unemployment, as well as on the overall well-being of the local population. Thus fiscal policy is often aimed at reducing output volatility. The impact of fiscal policy as a shock absorber or shock inducer is a long-standing issue that has not yet been elaborated in detail for subnational entities. Besides the impact of automatic stabilizers, we are particularly interested in whether "fiscal activism", i.e. the active use of discretionary fiscal policy measures, enlarges or dampens output fluctuations. To the best of our knowledge, there is no paper that investigates the impact of discretionary fiscal policy on output volatility in Russian regions. We fill this gap in the literature by conducting a dynamic panel analysis of a detailed data set on output

[1] Blackburn (1999) however shows that stabilization policy can reduce long-run economic growth.

and selected fiscal, financial and other economic indicators. Our most important finding is that fiscal activism contributes to output volatility and so induces macroeconomic instability in Russian regions.

The remainder of this paper is structured as follows. Section 2 reviews the literature on the determinants of output volatility, paying special attention to the impact of fiscal policy. Section 3 describes our dataset on Russian regions, defines output volatility and introduces our metrics for discretionary fiscal policy. Section 4 presents cross-sectional estimates, dynamic panel estimates (system GMM) and related robustness checks. The last section concludes.

2 Literature review

Our research contributes to several different strands of existing literature. The first one investigates fiscal policy determinants of output volatility. Whether or not fiscal policy is able to contribute to macroeconomic stabilization or whether it actually amplifies business-cycle fluctuations has been discussed frequently in this literature. Broadly speaking, one can distinguish two categories of fiscal instruments: automatic stabilizers and discretionary fiscal policy measures.

Automatic stabilizers comprise public spending and revenues of a countercyclical or acyclical nature. Deroose, Larch and Schaechter (2008, p. 13) argue that “it is predominantly the differences in size of governments that impact how strong automatic stabilizers are”, as a temporary output decline does not induce lay-offs of public sector employees, a stoppage of public infrastructure projects, or the closing of schools and hospitals. In line with this reasoning, most empirical investigations of output volatility have included government size as a control variable, approximated by government expenditures or government consumption as a share of GDP. There is ample evidence for the expected negative correlation between output volatility and government size (e.g. Galí, 1994; Fatás and Mihov, 2001; Andrés et al., 2008; Evrensel, 2010). However, the relationship between government size and volatility is apparently more complex. First, the correlation changes considerably over time, as highlighted by Karras and Song (1996) and Debrun et al. (2008). Moreover, nonlinearities seem to be at work. Debrun et al. (2008) show, for a sample of OECD countries, that little extra stability can be gained by expanding public expenditure beyond 40 percent of GDP. Crespo Cuaresma et al. (2011) find that the business cycle smoothing effect vanishes for countries with large governments, so that output volatility may actually increase. Finally, the stabilizing effect of government is is usually found for advanced OECD countries but not for developing countries (Debrun and Kapoor, 2010).

With the seminal paper of Fatás and Mihov (2003) the literature began to argue that different types of fiscal policy have different impacts on output volatility. More specifically, *discretionary fiscal policy measures* (e.g. changes in the government’s budget balance which cannot be attributed to automatic stabilizers) can destabilize the economy if they are implemented procyclically or entail economic distortions. Fatás and Mihov (2003) investigate a large cross-section of 91 countries for the period 1960-2000 and come to three important findings. First, more volatile discretionary fiscal policy increases output volatility. Second, volatility of output induced by discretionary changes in fiscal policy substantially constrains economic growth. Third, the existence of political constraints (e.g. a large number of veto points in the government) helps to reduce the frequency of discretionary fiscal policy measures. The destabilizing effect of discretionary fiscal policy has been confirmed by other scholars, e.g. by Ahmed and Suardi (2009) and Debrun and Kapoor (2010). The latter – pointing to the quality of political institutions – emphasize that discretionary fiscal policy boosts output volatility more in developing than in high-income OECD countries.

In order to uncover the impact of fiscal policy on business cycle volatility, one needs to control for other factors that might influence volatility. First, a more developed financial sector, being better able to screen borrowers, is expected to identify viable projects and to allocate funding only to these projects with lower failure probabilities. In this way a more developed financial sector should contribute to the reduction of credit market imperfections and thus reduce business cycle fluctuations. The empirical literature in general provides evidence that countries with more developed financial systems have smoother business cycles (e.g. Ferreira Da Silva, 2002; Denizer et al., 2002; Raddatz, 2006). Beck et al. (2006), on the other hand, do not find a significant relationship between the development of financial intermediaries and volatility of output growth for a large sample of countries. Another group of studies that focus on developed markets includes some that distinguish between different parts of the financial system. These studies support the view that developed stock markets are associated with lower output volatility (Huizinga and Zhu, 2006; Fidrmuc and Scharler, 2013).

Furthermore, the relationship between trade openness and overall volatility is found to be positive (di Giovanni and Levchenko, 2009); political instability tends to increase volatility (Dutt and Mitra, 2008); geography and institutions also play a role, as remote countries are more likely to experience greater volatility in output growth (Malik and Temple, 2009); and remittance flows have a negative effect on output growth volatility (Chami et al., 2012). Finally, Fountas and Karanasos (2007) find mixed evidence regarding the relationship between inflation and output growth volatility. We consider oil resources and inflation as additional determinants of output volatility.

Our research also adds to the literature on Russian regions. We are not aware of papers that have yet analyzed the impact of discretionary fiscal policy on regional output volatility in Russia. Regional government spending plays apparently an important role in Russia. Tables 1 and A.1 show that regional government size ranges between 15 and 30 percent of gross regional product (GRP) and accounts on average for about 20 percent of GRP. Kwon and Spilimbergo (2005) are probably closest to us in terms of the research question. They investigate whether regional fiscal policies and federal transfers to regions have helped to mitigate regional shocks in Russia. Their results indicate that regional income shocks can be largely attributed to regional governments' pro-cyclical spending, suggesting that the way (discretionary) fiscal measures are implemented is important for explaining output fluctuations in Russia. Instead of explaining output volatility, the focus in the literature has been on regional differences in economic growth in Russia. For instance, Berkowitz and DeJong (2003) find that in the 1990s regional differences in price liberalization policies were positively related to growth, whereas since 2000 the emergence of bank-issued credit has been an important engine of regional growth (Berkowitz and DeJong, 2011). Another strand of the literature studies the link between fiscal decentralization and various economic outcome variables. Desai et al. (2003) conclude that tax retention (a proxy for fiscal autonomy) had a significant positive effect on the recovery of industrial output in the Russian regions in the 1990s. Freinkman and Plekhanov (2010) analyze the relationship between fiscal decentralization and quality of public services, and show that in Russia the former has a positive effect on education results and the quality of municipal utilities provision.

3 Data description

3.1 Output volatility

To study the determinants of output volatility, we collect an annual panel data set for Russian regions covering the period from 2000 to 2009. We do so for the following reasons. First, Ahrend (2012) identifies a break in the causal mix of regional economic growth in Russia: before the 1998 crisis initial conditions played a huge role; afterwards political and economic reform variables joined the mix.[2] Second, some of the variables were not satisfactorily available before 2000. Third, the chosen time period captures rather satisfactorily a full business cycle as it includes both the boom and the downturn during the recent crisis. Out of 83 Russian regions we exclude some of them because they are significant outliers, war regions or autonomous regions[3] below oblast level and end up with over 660 observations for 74 regions. Our primary data source is the Russian Federation Federal State Statistics Service, Rosstat. Financial indicator data originate from the Central Bank of the Russian Federation. In some cases we use the data that were collected from these original sources and stored in the CEIC Russia Premium Database.

Whereas the previous literature focusing on developed economies most often uses the standard deviation of real GDP growth rate, our preferred metric of output volatility is based on industrial production. Real GDP growth is less appropriate for regional analysis because gross regional product (GRP) data are usually available only at annual frequency, with short time series. Moreover, by calculating an annual volatility measure based on real monthly figures, we employ a more precise estimate of output volatility that takes account of within-year variation.[4]

To account for growth differences across regions, we follow Klomp and de Haan (2009) and opt for the *relative* standard deviation, i.e. we divide the standard deviation by average industrial production.[5] Klomp and de Haan (2009) make note of several limitations of the simple standard deviation indicator, which was used frequently in the previous lit-

[2] Notably, regions with more reform-oriented governors and active privatization policies have enjoyed more robust growth.
[3] We do neither include autonomous regions nor several Caucasus regions that are affected by military conflicts (Chechnya, Ingushetia, Ossetia, and Dagestan). We also exclude Kalmykia due to insufficient data quality and outliers.
[4] Moreover we do not lose one year of observations, as would be the case if we used annual GRP growth rates.
[5] We do not use industrial production per capita because industrial production is available only as indices.

erature. Most importantly, the simple standard deviation is not independent of the mean of the data, i.e. regions with higher average economic growth rates would in general also have larger variances. We define our volatility indicator as

$$vol_{it} = \frac{\sqrt{\frac{1}{12}\sum_{k=1}^{12}\left(\log\left(IP_{itk}\right) - \overline{\log\left(IP_{it}\right)}\right)^2}}{\overline{\log\left(IP_{it}\right)}} \quad (1)$$

where *IP* is the index of real industrial production (previous month equals to 100)[6] in region *i*, year *t* and month *k*. We deflate nominal data by producer prices. For the computation of vol_{it}, we use the logarithm of industrial production to dampen the impact of data outliers. We do not apply any seasonal adjustment of monthly industrial production figures; not only because our time series are generally short and have some outliers but also because of the fact that the seasonal adjustment (if, e.g., the Tramo-Seats procedure is applied) tends to smoothen the time series in an unreasonably strong manner. It is therefore questionable whether all the variance lost when the seasonal adjustment is applied can really be attributed to seasonal factors.

The obvious caveat of our preferred measure of output volatility is that it does not include the other sectors of the economy. To address this issue, we use an alternative, time-varying indicator of output volatility in the robustness analysis, which focuses on fluctuations in real per capita GRP growth as a metric for macroeconomic volatility. We follow Morgan et al. (2004), Kalemli-Ozcan et al. (2010) and Fidrmuc and Scharler (2013) and estimate the panel regression

$$\Delta\log(GRP_{it}) = \alpha_i + \lambda_t + u_{it}^{GRP} \quad (2)$$

where *GRP* is regional real per capita GRP and α_i and λ_t denote regional and time fixed effects. We use the absolute values of estimated residuals from this regression to calculate regional and time-specific volatility shocks:

$$vol_{it}^{GRP} = \left|\hat{u}_{it}^{GRP}\right|. \quad (3)$$

[6] As average real industrial growth in Russia was relatively low, reaching only about 3 percent, we prefer monthly indices of industrial production to growth rates. This reflects the fact that the relative standard deviation includes the average growth performance in the denominator. Division by numbers close to zero artificially increases the reported output volatility for regions with low growth.

Since this measure varies across regions and across time, we are able to exploit the panel structure of the data. In this sense, this approach differs from most of the empirical literature on output volatility, which analyzes either only the cross-sectional variability in a large number of countries (e.g. Fatás and Mihov, 2003; Mobarak, 2005; Evrensel, 2010) or the cross-sectional and time variation by calculating business cycle volatility over subperiods (e.g. Klomp and de Haan, 2009; Yang, 2010). As a caveat, we note that this residual measure of volatility is sensitive to single region-specific or time-specific events, which could occur relatively often at the regional level.

Figure 1 Output volatility (*vol* and vol^{GRP}) in Russian regions, 2000-2009

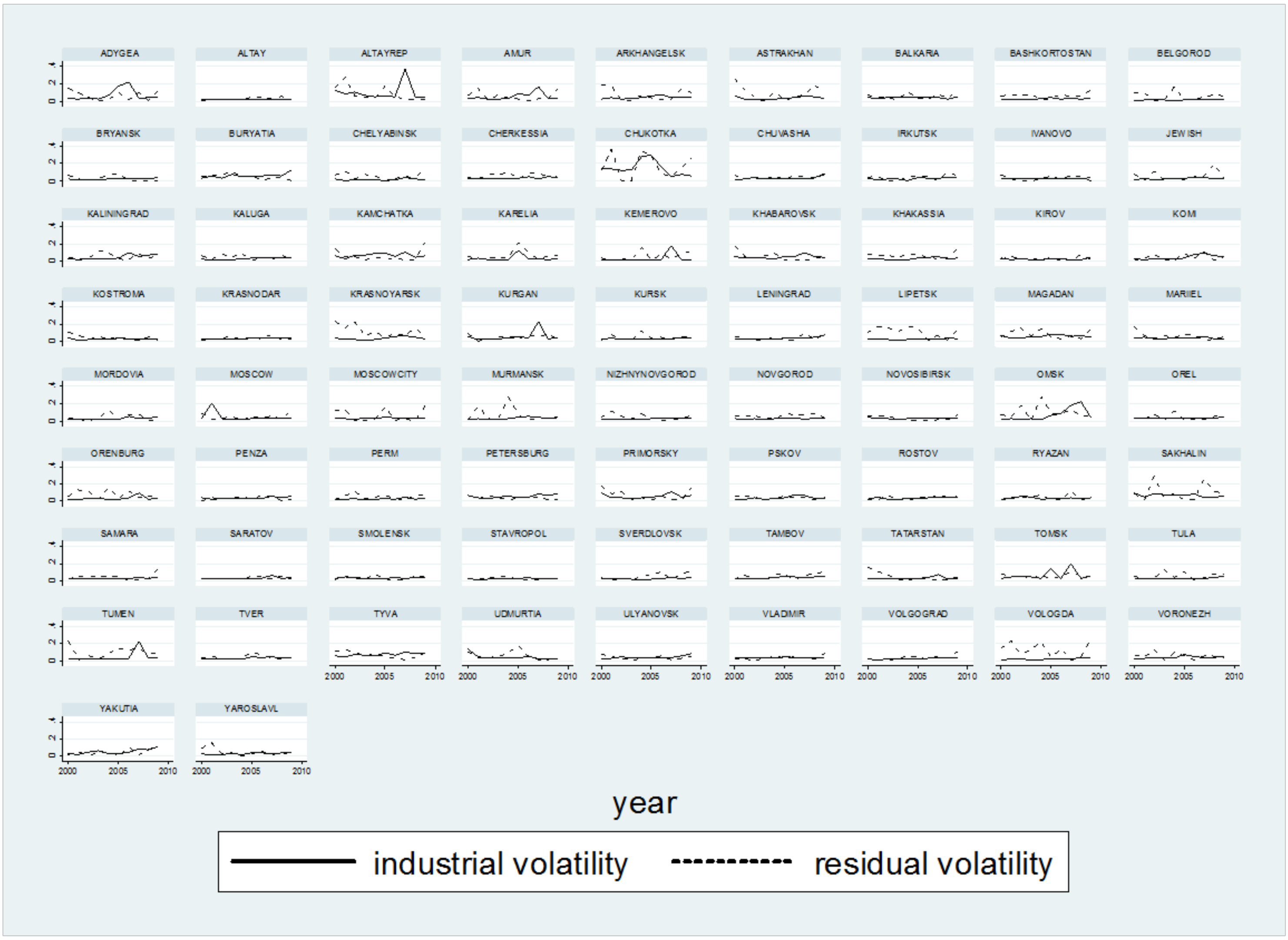


Figure 1 demonstrates that there is generally little difference between our industrial-output volatility metric and the residual measure of GRP volatility. Their correlation is over 0.5 for regional 10-year averages (0.2 for pooled data) and statistically significant at the 1 percent level. Both measures vary considerably across regions, whereby the heterogeneity was larger at the beginning of the sample. Both series show a slight upward trend and thus increased volatility during the financial crisis in 2009. For this reason, we include the impact of the financial crisis in our sensitivity analysis.

3.2 Explanatory variables

Given the focus of this paper, we first define the fiscal variables to be included as regressors. In line with the literature reviewed in Section 2, we distinguish between automatic stabilizers and discretionary fiscal policy. Automatic stabilizers are approximated by regional government size, calculated as the share of regional government expenditures in GRP (in logs): $\log(g_{it}) = \log{(G_{it}/GRP_{it})}$. Defining discretionary fiscal policy is less straightforward, and so we resort to a variety of metrics. Loosely speaking, a discretionary policy change can be understood as any deviation from a policy that was considered optimal yesterday but which is not appropriate for today's conditions. Blanchard (1993) defines a discretionary change in policy as the difference between actual policy and the policy that would prevail under the previous year's macroeconomic conditions. Buti and van den Noord (2004) classify a discretionary change as any deviation from a "neutral" fiscal policy stance. Fatás and Mihov (2003) see discretionary fiscal policy as the change in detrended regional government spending unexplained by past regional government spending or by current macroeconomic conditions.

Our first measure of discretionary fiscal policy follows Fatás and Mihov (2003). In particular, we estimate the following panel regression:

$$\Delta\log(g_{it}) = \beta_1\Delta\log(g_{it-1}) + \beta_2\Delta\log(GRP_{it}) + \beta_3\Delta\log(P_{it}) + \beta_4(\Delta\log(P_{it}))^2 + \beta_5 trend + \gamma_i + u_{it}^g, \quad (4)$$

where g_{it} stands for the regional government expenditures in region i at time t, the explanatory variables include lagged regional government expenditures, contemporaneous GRP growth (GRP_{it}), inflation (P_{it})and squared inflation, and a linear trend. Moreover, we include regional fixed effects, γ_i, and time effects, θ_t. As in equation (3), we define discretionary fiscal policy as the absolute value of the residual u_{it} from the equation

$$fp_{it}^{discr} = \left|\hat{u}_{it}^{g}\right|. \tag{5}$$

The second measure of discretionary fiscal policy is the change in budget balance which cannot be attributed to automatic stabilizers. In order to remove the automatic stabilizer part from the budget balance, we use the cyclically adjusted budget balance, *cab*[7]:

$$cab_{it} = bb_{it} - cc_{it}, \tag{6}$$

where *bb* denotes the headline budget balance and *cc* the cyclical component (all variables enter as shares of GRP). The cyclical component *cc* is usually calculated as $e \times y^{gap}$, whereby *e* represents the sensitivity of *bb* with respect to the output gap, y^{gap} (see Debrun and Kapoor, 2010). The parameter *e* captures budgetary elasticities weighted by revenue shares (*R*) and expenditures (*G*) in output (*Y*): $e = e^R - e^G = m^R \times R/Y - m^G \times G/Y$. *m* denotes the elasticity of revenue or expenditures with respect to output changes. Assuming that $m^R = 1$ and $m^G = 0$ (as e.g. suggested by cross-country evidence provided in Eller, 2009) yields $e = R/Y = rev$. In our empirical analysis we thus use $cab_{it} = bb_{it} - rev_{it} y_{it}^{gap}$ and its change to proxy discretionary fiscal policy.[8] Note that this indicator may be negative (deficit). Therefore, we cannot form the log of this indicator and include it as a percentage in the subsequent analysis.

We can also take a broader view and so define regional discretionary fiscal policy as any region-specific deviation from federal-level trends. Accordingly, our third measure of discretionary fiscal policy is the absolute deviation of regional government spending in a given region (g_{it}) from that in Russia as a whole (g_t^{ru}):

[7] Debrun and Kapoor (2010) distinguish between "cyclical fiscal policy", i.e. any systematic response of the *cab* to the business cycle, and "exogenous discretionary fiscal policy", i.e. any response of the *cab* unrelated to current macroeconomic conditions. The separation of these different dimensions makes sense in theory but is empirically subject to model and parameter uncertainty. We prefer to classify any change in the cyclically adjusted balance as discretionary fiscal policy, whether due to the business cycle (e.g. a stimulus package) or due to other factors (e.g. elections).

[8] We calculate the output gap as the residual in a fixed-effect regression of GRP growth on trend and squared trend: $\Delta \log(y_{it}) = \alpha_i + \beta_{1i} trend_{it} + \beta_{2i} trend_{it}^2 + y_{it}^{gap}$.

$$grdif_{it} = |\log(g_{it}) - \log(g_t^{ru})|. \tag{7}$$

While equation (5) already captures the volatility of discretionary fiscal policy, *cab* and *grdif* characterize the level of discretionary fiscal policy. In order to examine the impact of a change in discretionary fiscal policy, our empirical analysis also uses first differences of *cab* and *grdif*. In the same vein, we experiment with the absolute first difference of the logged government to GRP ratio, which can serve as a proxy for discretionary policy deviations if it changes mostly because of discretionary spending categories (rather than automatic stabilizer categories).

Figure 2 Regional government expenditures (log(*G/GRP*)) and discretionary expenditures (fp^{discr}) in Russian regions, 2000-2009

Figure 3 Cyclically adjusted budget balance (*cab*) in Russian regions, 2000-2009

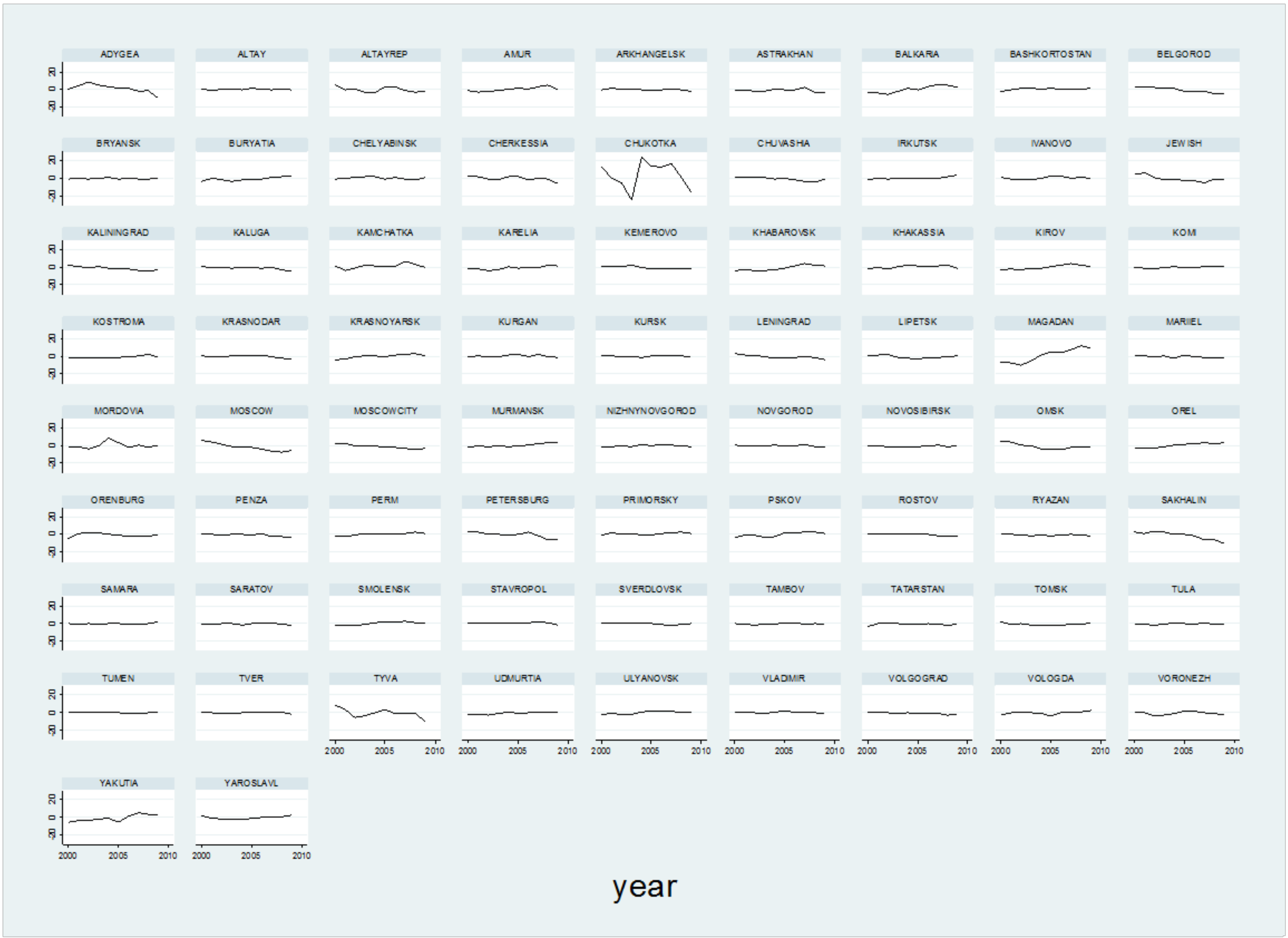
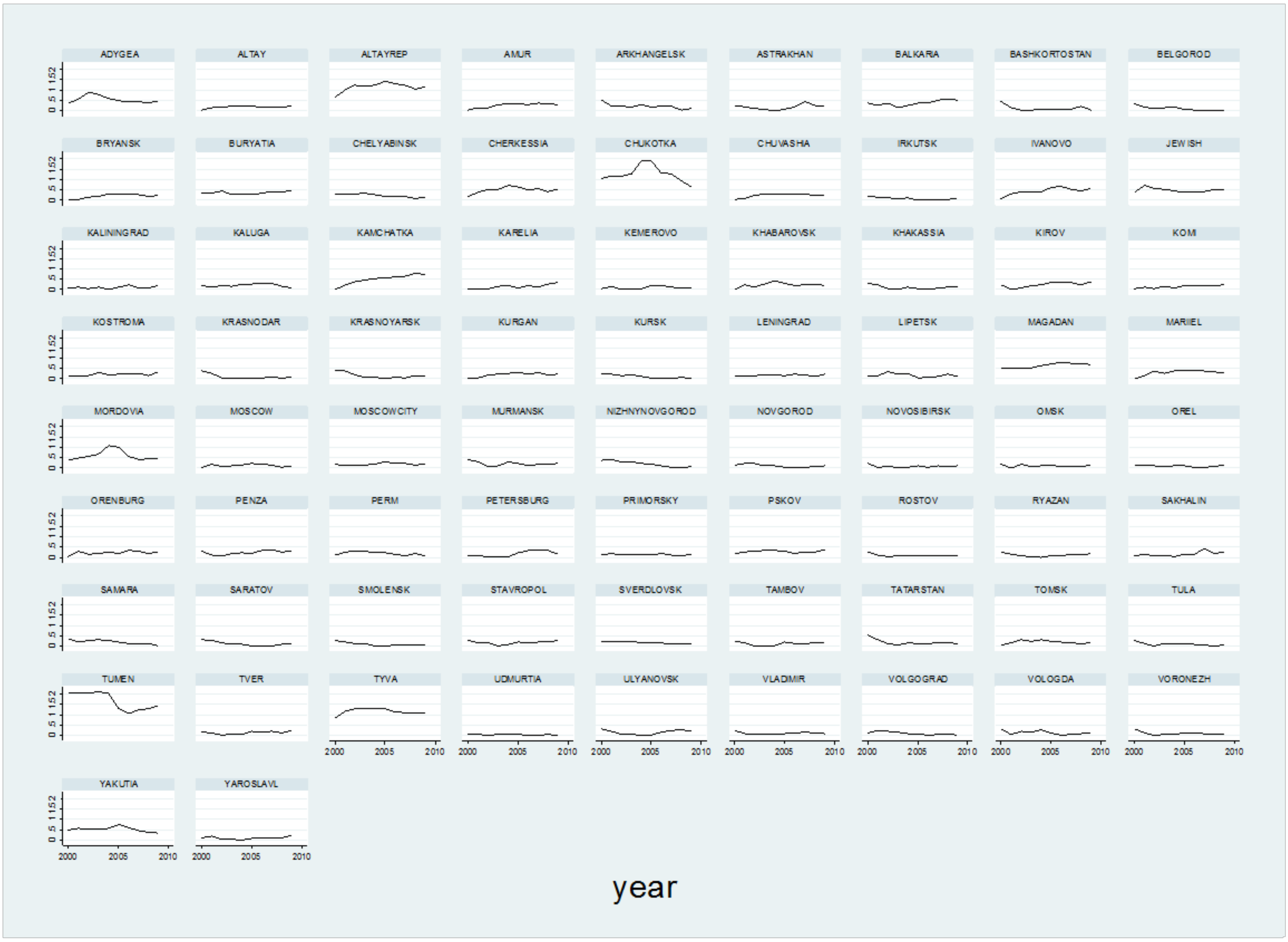


Figure 4 Deviation of Regional government expenditures from national average (*grdif*) in Russian regions, 2000-2009



To sum up, we use $\log(g_{it})$ to proxy automatic stabilizers and fp_{it}^{discr}, cab_{it}, Δcab_{it}, $grdif_{it}$, $\Delta grdif_{it}$ and $|\Delta\log(g_{it})|$ to measure respectively discretionary fiscal policy or changes in discretionary fiscal policy. Moreover, in the panel regressions we include time-specific effects to capture the trends of federal-level fiscal policy and the oil price (P_t^{oil}), which can be considered a proxy for oil revenues of the federal government.

We also control for other non-fiscal factors that might influence output volatility. To select the proper control variables, we follow the general rationale of Klomp and de Haan (2009) and include variables that represent both the extent to which a region is hit by external shocks as well as its ability to absorb internal and external shocks. The first group of control variables includes the trade openness of a particular region (measured by the ratio of the sum of its exports and imports vis-à-vis non-CIS countries to its GRP, T_{it}^{noncis}/GRP_{it}) and a dummy variable indicating whether the region produces any oil and/or gas (D_i^{oil})[9], as regions dependent on these commodities might have more volatile output levels. The “absorption capacity” of a region is reflected by the inclusion of control variables accounting for financial sector development and inflation. As the Russian financial system is bank-based, we rely mainly on metrics that describe the development of Russian banks, namely the GRP-shares of total deposits (D_{it}) and total loans (L_{it}) for each region. Our inflation measure is based on the consumer price index excluding food products ($CPI_{it}^{nonfood}$).[10] This metric of core inflation was selected in order to exclude short-term price fluctuations. Moreover, it helps us to avoid possible endogeneity problems as we use CPI to compute real GRP. Detailed summary statistics and definitions of all variables can be found in Table 1. The means of selected variables by regions can be found in Table A.1.

[9] Our dummy variable is created based on the information from Rosstat that ranks regions according to the amount of oil/gas they produce. The dummy variable equals 1 if they produce at least some oil/gas. We have also experimented with an alternative definition where only the 15 regions with the highest production of oil/gas had a dummy variable equal to 1 but this has not influenced our main results.
[10] Our results do not change if the headline CPI is used instead.

Table 1 Descriptive statistics

Variable	Definition	Obs	Mean	Std.Dev.	Min	Max
vol_{it}	Relative standard deviation of monthly real industrial production	740	0.036	0.034	0.006	0.377
vol_{it}^{GRP}	Residual measure of GRP volatility (in absolute value)	740	0.055	0.053	0.000	0.377
G_{it}/GRP_{it}	Government expenditures as share of GRP	888	0.209	0.100	0.022	1.164
fp_{it}^{discr}	Volatility of discretionary government expenditures (in absolute value)	740	0.084	0.076	0.000	0.705
cab_{it}	Cyclically adjusted budget balance	888	-0.212	2.955	-24.960	24.584
Δcab_{it}	First difference of cab_{it}	814	-0.047	3.025	-19.480	49.544
$grdif_{it}$	Deviation of regional government expenditures from national average	888	1.378	0.760	1.000	8.178
$\Delta grdif_{it}$	First difference of $grdif_{it}$	814	1.098	0.102	1.000	2.092
$\exp\lvert\Delta\log(G_{it}/GRP_{it})\rvert$	Difference of government expenditures as share of GRP (in absolute value)	814	1.112	0.107	1.000	2.008
D_{it}/GRP_{it}	Total deposits as share of GRP	734	0.148	0.079	0.004	0.840
L_{it}/GRP_{it}	Total loans as share of GRP	740	0.218	0.147	0.014	0.892
$CPI_{it}^{nonfood}$	Consumer price index, excluding food products	814	12.966	10.540	0.400	61.100
T_{it}^{noncis}/GRP_{it}	Exports plus imports to non-CIS countries as share of GRP	740	1.547	7.520	0.012	107.011
P_t^{oil}	Price of crude oil, Urals CIF Baltic, USD per barrel	740	47.077	22.701	23.091	93.950
D_i^{oil}	Dummy indicating whether the region produces to a considerable extent oil and/or gas	888	0.365	0.482	0.000	1.000
$D_i^{oil} \times P_t^{oil}$	Interaction term of energy dummy and oil price	740	17.177	26.501	0.000	93.950

4 Methodology and estimation results

4.1 Cross-sectional evidence

In order to support comparability with earlier papers (e.g. Fatás and Mihov, 2003 or Mobarak, 2005), we start with the estimation of a cross-sectional equation that includes averaged data for the period between 2000 and 2009. Given that we use ten-years averages of all indicators, the cross-sectional coefficients can be seen to reflect long-run relationships between output volatility and its determinants. Our benchmark regression equation is specified as

$$vol_i = \alpha + \beta \log(FP_i) + \sum_{k=1}^{K} \gamma_k \log(X_{ki}) + \varepsilon_i \quad (8)$$

where vol_i is either the average relative standard deviation of industrial production, as defined in equation (1), or the residual measure of GRP volatility according to (3), and the FP_i are the seven alternative regional fiscal policy indicators described above. Furthermore, we include several control variables, denoted by X_i, which account for financial sector development, trade openness and inflation, as well as a dummy variable indicating whether the region produces any oil and/or gas. Note that all explanatory variables are expressed in logs, to dampen the potential impact of outliers in our dataset. Similarly, the dependent variable, *vol*, is computed using the logs of industrial production for the same reason.

Tables 2 and 3 present the OLS estimation of equation (8) for 74 Russian regions. Regional government size, our proxy for automatic stabilizers, is non-negatively correlated with output volatility. In the case of industrial output volatility (Table 2), we find a positive and significant correlation, whereas for the residual measure of GRP volatility (Table 3) regional government size is not statistically significant. This evidence is in line with the results of Debrun and Kapoor (2010) who show that the volatility-dampening impact of government size does not obtain for all countries in their sample. In line with our results, they show that the stabilizing role of government size can be found for OECD countries but not for developing countries. The positive correlation of regional government size and output volatility in Russian regions could also indicate that a bigger government in a country like Russia, where the institutional environment is generally weaker in comparison to developed economies, could create larger destabilizing fiscal shocks (see the reasoning in Debrun and Kapoor, 2010), which outweigh the volatility-dampening effect of automatic stabilizers.

Besides regional government size, most of our measures of discretionary fiscal policy are associated with increased output volatility. In the case of the residual measure of GRP volatility, five of six discretionary fiscal policy variables get a statistically significant positive sign, while for industrial output volatility this applies to three of six variables.

Looking at the control variables, there is some indication of a volatility-dampening impact for financial sector development. All other control variables (including a dummy for oil/gas producing regions) remain insignificant.

Altogether, our cross-section results imply that fiscal variables are important determinants of long-run output volatility, whereby a larger regional government and fiscal activism tend to be associated with increased long-run output volatility.

Table 2 Determinants of output volatility and industrial production volatility, cross-section results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\log(D_i/GRP_i)$	-0.006	-0.004	-0.002	-0.010*	-0.010**	-0.002	-0.003	-0.004
	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
$\log(CPI_i^{nonfood})$	0.006	-0.007	-0.005	-0.009	0.004	-0.007	-0.009	-0.002
	(0.016)	(0.014)	(0.013)	(0.016)	(0.018)	(0.013)	(0.013)	(0.015)
$\log(T_i^{noncis}/GRP_i)$	0.001	0.003*	0.001	0.003	0.002	0.002	0.002	0.003
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
D_i^{oil}	0.006*	-0.002	0.004	0.001	-0.000	0.000	-0.003	-0.002
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
$\log(G_i/GRP_i)$	0.032*		0.026***					
	(0.016)		(0.009)					
fp_i^{discr}		0.324**	0.254**					
		(0.151)	(0.106)					
cab_i				0.014				
				(0.010)				
Δcab_i					-0.006			
					(0.007)			
$grdif_i$						0.041*		
						(0.023)		
$\Delta grdif_i$							0.358**	
							(0.151)	
$\lvert\Delta\log(G_i/GRP_i)\rvert$								0.271
								(0.180)
Constant	0.061	0.021	0.065*	0.044	0.009	0.041	0.024	0.009
	(0.048)	(0.035)	(0.036)	(0.039)	(0.040)	(0.032)	(0.032)	(0.038)
Observations	74	74	74	74	74	74	74	74
R^2	0.356	0.331	0.495	0.250	0.109	0.342	0.365	0.237

Note: Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 3 Determinants of output volatility and GRP volatility, cross-section results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\log(D_i/GRP_i)$	-0.017**	-0.011*	-0.012	-0.016**	-0.017***	-0.010	-0.007	-0.009
	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
$\log(CPI_i^{nonfood})$	0.002	-0.011	-0.012	-0.016	-0.001	-0.009	-0.019	-0.010
	(0.026)	(0.023)	(0.023)	(0.026)	(0.025)	(0.024)	(0.020)	(0.022)
$\log(T_i^{noncis}/GRP_i)$	-0.001	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
D_i^{oil}	0.001	-0.002	-0.002	0.002	-0.000	0.000	-0.004	-0.003
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
$\log(G_i/GRP_i)$	0.005		-0.003					
	(0.019)		(0.010)					
fp_i^{discr}		0.333**	0.342**					
		(0.156)	(0.142)					
cab_i				0.017*				
				(0.009)				
Δcab_i					-0.008			
					(0.008)			
$grdif_i$						0.037*		
						(0.019)		
$\Delta grdif_i$							0.494***	
							(0.121)	
$\|\Delta \log(G_i/GRP_i)\|$								0.379**
								(0.166)
Constant	0.020	0.030	0.025	0.061	0.021	0.046	0.040	0.020
	(0.060)	(0.054)	(0.053)	(0.062)	(0.057)	(0.056)	(0.045)	(0.054)
Observations	74	74	74	74	74	74	74	74
R^2	0.091	0.245	0.247	0.228	0.112	0.218	0.410	0.264

Note: Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

4.2 Dynamic panel estimations

While the cross-section regressions uncover the long-run dependencies among the variables, they do not take into account the time dimension. Moreover, we need to consider possible reverse causality and endogeneity problems. Fiscal variables may be endogenous in our estimations, e.g. due to reversed causality. For instance, Rodrik (1998) argues that very volatile economies may opt for larger governments to function as insurance against cyclical shocks.[11] Several authors accounted for the potential endogeneity of government size by applying instrumental variable estimation techniques (e.g., Fatás and Mihov, 2003; Debrun and Kapoor, 2010). Yet another important concern is that adverse economic shocks, assumed to increase the volatility of business cycles, are usually highly persistent and affect economic developments for several years. We control for dynamic properties of our data by estimating a dynamic panel model:

$$vol_{it} = \alpha_i + \rho vol_{i,t-1} + \beta \log(FP_{it}) + \sum_{k=1}^{K} \gamma_k \log(X_{kit}) + \lambda_t + \varepsilon_{it} \quad (9)$$

In the estimations of (9) we apply the one-step system GMM estimator according to Arellano and Bover (1995) and Blundell and Bond (1998), which enables one to tackle the problem of endogeneity. We use one lag of the output volatility indicator and instrument all the regressors. As internal instruments, we use one lag of each of the endogenous variables. Time effects λ_t are included as exogenous variables. The set of control variables, X_{it}, includes again financial sector development, trade openness and inflation. We also include the oil price as well as its interaction with the regional oil/gas production dummy.

Table 4 shows that output volatility exhibits significant persistence. The lagged dependent variable is significant and its value is close to 0.2. The appropriateness of our identification strategy is confirmed by the residual tests. The Arellano-Bond test of residual autocorrelation of second order indicates that the dynamic panel models are sufficient to cover the autocorrelation of the residuals. The Hansen *J*-test of over-identifying restrictions fails to reject the null hypothesis of no correlation between instruments and the error term in the second-stage estimation, which confirms instrument exogeneity.

[11] This mechanism could be less important for regional government size because it is largely due to national regulations.

As regards the impact of fiscal indicators, the cross-section results are largely confirmed by the dynamic panel estimates. All the six discretionary fiscal policy indicators have a positive impact on output volatility and are at least marginally significant. The estimated coefficient for regional government size, log (G_{it}/GRP_{it}), still has a positive sign but is only weakly significant and even insignificant when it is included together with the volatility of discretionary government expenditures, fp_{it}^{discr}. This result is identical to that of Fatás and Mihov (2003) and may indicate that regional government size, when included on its own, captures part of the effects of discretionary spending categories (given that total regional government spending also covers spending due to discretionary fiscal policy actions). A noteworthy issue in this context is the concern that regional expenditures may not suffice as a proxy for the overall effect of government expenditures at the regional level because federal government expenditures are not considered. Even if the Russian regions do not enjoy full fiscal autonomy, the share of consolidated regional expenditures in total expenditures reached about 45 percent of GRP in the pre-crisis period (Alexeev and Weber, 2013). Nevertheless, it can be argued that several federal expenditure categories (e.g. unemployment and social benefits) function as automatic stabilizers at the regional level. We implicitly use federal expenditures for the estimation of the deviation of regional government expenditures from the national average, *grdif*. Therefore, due to possible multicollinearity, we decided not to include them in the regressions. However, recall that we control in the dynamic panel regression for the oil price and time effects, which should account to a certain extent for the impact of the federal budget.

Although the estimated coefficients of the discretionary fiscal policy variables are statistically significant, they cannot be interpreted as elasticities, because it is not the case that both sides of the equation are expressed in logarithmic units. The economic effect can be derived from the interdependence of variables relative to their standard deviations. In particular, the increase in the volatility of discretionary regional government spending, fp_{it}^{discr} by one standard deviation (0.076) increases output volatility by the product of its coefficient and the standard deviation of the volatility indicator (see Table 1 for descriptive statistics), that is, $0.110 \times 0.076 = 0.008$, which corresponds to nearly a quarter of the standard deviation of output volatility ($0.008 / 0.034 = 0.235$). And this is only the contemporaneous effect. We have to consider also the dynamic characters of the estimated equation and the long-run effects, which are given by the factor of $1 / (1 - \rho)$, where ρ is the autoregressive parameter in equation (9), 0.222 for fp_{it}^{discr}. Thus, the long run effects (in absolute terms) are larger by a factor of about 1.2. This means that in the long run the share of standard deviation of output volatility explained by fiscal variables increases to 31 percent for fp_{it}^{discr}. These effects are clearly significant also from an economic perspective.

Moreover, our results tend to confirm that the oil price has a dampening effect on output volatility. The oil-producing regions are not more dependent on the oil price than are other Russian regions, reflecting the fact that the oil and gas revenues are assigned to the federal budget. This underlines the importance of federal-level fiscal policy. A higher oil price means that the federal government can use additional revenues for output stabilization. Financial sector development also has volatility-dampening, but insignificant, effects.[12] This is not in line with most of the literature that investigates the influence of financial sector development on output volatility. Nevertheless, significant effects of financial development are often found in studies on developed markets (Fidrmuc and Scharler, 2013) or for large cross-country samples that include both developed and emerging markets (Raddatz, 2006) in which developed countries prevail. Moreover, some studies, e.g. Beck et al. (2006), find only weak evidence that financial intermediaries dampen the effect of terms of trade volatility. Similarly, Bekaert et al. (2006) document a relatively weak volatility impact of equity market liberalization in emerging market economies. Finally, trade openness and inflation do not seem to have a significant impact on output volatility.

[12] Note that in our baseline estimation we use the share of deposits in regional GRP as a proxy for financial sector development, because households are likely to put savings to local banks, while they can apply for loans from banks located in other regions. Guriev and Vakulenko (2012) also show that local investment is often not financed by local savings.

Table 4 Determinants of output volatility, panel results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
vol_{it-1}	0.172**	0.222*	0.188*	0.208**	0.271*	0.139	0.224*	0.231**
	(0.085)	(0.122)	(0.098)	(0.098)	(0.145)	(0.091)	(0.123)	(0.115)
$\log(D_{it}/GRP_{it})$	0.008	-0.002	0.000	-0.008*	-0.005	0.007	-0.001	0.002
	(0.008)	(0.008)	(0.008)	(0.005)	(0.005)	(0.009)	(0.006)	(0.007)
$\log(CPI_{it}^{nonfood})$	0.008	0.003	0.003	-0.006	0.005	0.007	-0.001	0.009
	(0.016)	(0.013)	(0.013)	(0.012)	(0.015)	(0.018)	(0.012)	(0.013)
$\log(T_{it}^{noncis}/GRP_{it})$	-0.000	0.001	-0.001	-0.001	-0.000	-0.001	-0.000	0.000
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$\log(P_t^{oil})$	-0.005	-0.022***	-0.014	-0.036***	-0.026***	-0.007	-0.021***	-0.015**
	(0.011)	(0.007)	(0.011)	(0.008)	(0.006)	(0.008)	(0.006)	(0.007)
$D_i^{oil} \times \log(P_t^{oil})$	0.003	-0.005*	-0.001	-0.005	-0.007	-0.006	-0.005*	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
$\log(G_{it}/GRP_{it})$	0.047*		0.029					
	(0.025)		(0.024)					
fp_{it}^{discr}		0.110***	0.064**					
		(0.032)	(0.031)					
cab_{it}				0.004***				
				(0.001)				
Δcab_{it}					0.002***			
					(0.001)			
$grdif_{it}$						0.046*		
						(0.026)		
$\Delta grdif_{it}$							0.088*	
							(0.046)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.129***
								(0.032)
Constant	0.113**	0.114***	0.125***	0.193***	0.130***	0.054	0.119***	0.070*
	(0.048)	(0.040)	(0.036)	(0.049)	(0.038)	(0.063)	(0.037)	(0.042)
Observations	662	662	662	662	662	662	662	662
Number of regions	74	74	74	74	74	74	74	74
Hansen *p*-val	0.569	0.799	0.932	0.539	0.869	0.794	0.818	0.883
AR1 *p*-value	0.001	0.002	0.001	0.001	0.003	0.001	0.002	0.001
AR2 *p*-value	0.160	0.235	0.215	0.288	0.225	0.124	0.226	0.305

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

4.3 Robustness analysis

We check the sensitivity of our analysis in several ways. First, we include the share of total regional loans instead of deposits as a proxy for the level of financial sector development (Table 5). The estimated coefficients for total loans are slightly larger than for deposits, but the significance of results remains rather weak. The results for the fiscal variables are comparable to the benchmark regression although the coefficients are in general a bit smaller and not always significant (e.g. the deviation of regional government expenditures from the national average, $grdif_{it}$). When both regional government size and fp_{it}^{discr} are included, the latter is no longer significant and the former is only weakly significant. The results for the control variables remain essentially unchanged.

In the second robustness check we exclude Moscow and St Petersburg (including their surrounding regions, Moscow oblast and Leningrad oblast) from the estimations because they are the largest urban, administrative and financial centers in Russia and so could drive our main results. Table 6 shows that the results for this subsample remain unchanged. The specification including both regional government size and fp_{it}^{discr} is the single exception, as both indicators now become insignificant.

Other Russian regions are dominated by agriculture or mining industry, which can bias the results especially if volatility of industrial production is considered. Therefore, we exclude regions[13] with considerably low shares of industry (less than 10 percent of GRP) in Table 7. Similar to the previous robustness checks, the results remain nearly unchanged.

In another set of estimations (Table 8), we exclude more distant regions with relatively large government size situated in Siberia and North Caucasus from our sample to check whether the benchmark results hold when we focus on the core Russian regions. The signs and significance of the estimated coefficients for the measures of discretionary fiscal policy corroborate the benchmark results. We observe that the coefficient for trade with non-CIS countries becomes negative and marginally significant. We excluded the relatively closed regions, and thus a larger degree of trade openness is apparently associated with less output volatility. Analogously to di Giovanni and Levchenko (2009), regions that are

[13] These regions include Tumen, Sakha (Yakutia), Sakhalin, Tyva, Altay, Magadan, Amur, Kamchatka, Primorskiy krai, and Komi (ordered by the share of industrial production). The threshold of industrial shares was selected by visual inspection of the data. In particular, the GRP-shares of industrial production change rather continuously above 10 percent. Several non-agricultural regions have also GRP-shares of industry above 10 percent, e.g. Moscow.

more open to trade are less highly correlated with the rest of the Russian economy, an effect that apparently acts to reduce output volatility.

The results for fiscal indicators could be driven by specific regions that have easier access to budgetary means (soft budget constraints). Therefore, we conduct another robustness check in which we exclude the oil and gas regions (Table 9), to uncover the importance of the energy revenues for discretionary fiscal policy. Indeed, the coefficients for all fiscal variables are larger and more precisely estimated. Fiscal variables thus seem to have stronger impacts on volatility in the non-oil regions. The oil price also remains significant in this specification, which confirms again a high degree of redistribution of oil revenues.

In Table 10 we report our results for the subsample that excludes the period of the financial crisis (years 2008 and 2009), as it was more volatile than the previous period. Actually, we can see that regional government size becomes insignificant and fp_{it}^{discr} only marginally significant, but the effects of the remaining fiscal variables remain largely unchanged. More importantly, the oil price is found to have positive effects on output volatility before the financial crisis. This implies that oil revenues had destabilizing effects before 2008. By contrast, the relatively high oil prices[14] may have helped to stabilize the Russian economy during the recent financial turmoil.

Finally, we again use the alternative residual measure of GRP volatility as the dependent variable (Table 11). In contrast to the benchmark results, regional government size is insignificant but remains positive. All the various indicators for discretionary fiscal policy strongly matter and confirm the volatility-increasing impact of fiscal activism.

Overall, our benchmark results prove to be robust to different specifications of output volatility, different definitions of financial sector development, different regional subsamples, and different observation periods.

[14] The oil price peaked in 2008, having risen from 23 USD per barrel in 2000 to 94 USD in 2008 and 61 USD in 2009. On average, oil prices were nearly twice as high in 2008 and 2009 as they were in 2000 - 2007.

Table 5 Determinants of output volatility, robustness analysis, loans instead of deposits

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
vol_{it-1}	0.161*	0.224*	0.178*	0.239**	0.281*	0.139	0.225*	0.218*
	(0.092)	(0.126)	(0.101)	(0.113)	(0.144)	(0.092)	(0.126)	(0.119)
$\log\,(L_{it}/GRP_{it})$	-0.017	-0.021	-0.024*	-0.022*	-0.019	-0.003	-0.020	-0.014
	(0.012)	(0.014)	(0.014)	(0.013)	(0.012)	(0.012)	(0.014)	(0.011)
$\log\,(CPI_{it}^{nonfood})$	-0.002	0.000	-0.002	0.006	0.011	0.000	-0.000	0.006
	(0.014)	(0.016)	(0.016)	(0.015)	(0.019)	(0.015)	(0.015)	(0.015)
$\log\,(T_{it}^{noncis}/GRP_{it})$	0.000	0.003	0.001	0.001	0.001	-0.001	0.002	0.002
	(0.003)	(0.004)	(0.003)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
$\log\,(P_t^{oil})$	-0.011	-0.020***	-0.013	-0.023***	-0.019***	-0.013**	-0.018***	-0.015***
	(0.007)	(0.006)	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$D_i^{oil} \times \log\,(P_t^{oil})$	-0.001	-0.006*	-0.003	-0.009**	-0.009**	-0.006	-0.007**	-0.004
	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
$\log\,(G_{it}/GRP_{it})$	0.040**		0.032*					
	(0.019)		(0.018)					
fp_{it}^{discr}		0.092**	0.029					
		(0.042)	(0.042)					
cab_{it}				0.003***				
				(0.001)				
Δcab_{it}					0.002**			
					(0.001)			
$grdif_{it}$						0.041		
						(0.025)		
$\Delta grdif_{it}$							0.067	
							(0.042)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.114***
								(0.030)
Constant	0.127***	0.100**	0.117***	0.107**	0.079	0.083	0.094*	0.067
	(0.038)	(0.048)	(0.041)	(0.049)	(0.054)	(0.053)	(0.051)	(0.051)
Observations	666	666	666	666	666	666	666	666
Number of regions	74	74	74	74	74	74	74	74
Hansen *p*-val	0.530	0.683	0.982	0.788	0.742	0.771	0.943	0.707
AR1 *p*-value	0.001	0.003	0.001	0.002	0.003	0.001	0.002	0.002
AR2 *p*-value	0.279	0.343	0.301	0.164	0.190	0.289	0.316	0.478

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 6 Determinants of output volatility, robustness analysis, excluding Moscow and St. Petersburg

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
vol_{it-1}	0.182**	0.248**	0.206**	0.241**	0.298**	0.149	0.249**	0.250**
	(0.089)	(0.124)	(0.100)	(0.098)	(0.146)	(0.094)	(0.125)	(0.117)
$\log(D_{it}/GRP_{it})$	0.008	-0.002	-0.000	-0.007*	-0.003	0.006	0.000	0.000
	(0.008)	(0.008)	(0.008)	(0.004)	(0.006)	(0.009)	(0.007)	(0.007)
$\log(CPI_{it}^{nonfood})$	0.004	0.003	0.001	-0.000	0.003	0.005	0.000	0.011
	(0.014)	(0.012)	(0.012)	(0.012)	(0.013)	(0.018)	(0.011)	(0.011)
$\log(T_{it}^{noncis}/GRP_{it})$	-0.000	0.001	-0.001	-0.000	-0.000	-0.001	0.000	0.000
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$\log(P_t^{oil})$	-0.006	-0.022***	-0.015	-0.035***	-0.026***	-0.008	-0.021***	-0.016**
	(0.010)	(0.006)	(0.011)	(0.009)	(0.006)	(0.008)	(0.006)	(0.006)
$D_i^{oil} \times \log(P_t^{oil})$	0.003	-0.005*	-0.001	-0.004	-0.006	-0.005	-0.004	-0.003
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.002)
$\log(G_{it}/GRP_{it})$	0.045*		0.030					
	(0.024)		(0.025)					
fp_{it}^{discr}		0.083**	0.048					
		(0.038)	(0.034)					
cab_{it}				0.004**				
				(0.001)				
Δcab_{it}					0.002***			
					(0.001)			
$grdif_{it}$						0.045*		
						(0.025)		
$\Delta grdif_{it}$							0.066	
							(0.052)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.112***
								(0.035)
Constant	0.121***	0.116***	0.130***	0.175***	0.136***	0.058	0.118***	0.066*
	(0.041)	(0.031)	(0.030)	(0.052)	(0.031)	(0.059)	(0.031)	(0.034)
Observations	626	626	626	626	626	626	626	626
Number of regions	70	70	70	70	70	70	70	70
Hansen *p*-val	0.703	0.789	0.990	0.809	0.967	0.810	0.786	0.799
AR1 *p*-value	0.001	0.002	0.001	0.001	0.003	0.001	0.002	0.001
AR2 *p*-value	0.131	0.144	0.133	0.173	0.151	0.101	0.133	0.221

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 7 Determinants of output volatility, robustness analysis, excluding non-industrial regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
vol_{it-1}	0.172*	0.259*	0.170*	0.250**	0.335**	0.151	0.270**	0.284**
	(0.090)	(0.135)	(0.103)	(0.103)	(0.152)	(0.095)	(0.123)	(0.130)
$\log(D_{it}/GRP_{it})$	0.009	0.007	0.007	-0.006	-0.001	0.011*	0.008	0.005
	(0.007)	(0.008)	(0.007)	(0.005)	(0.004)	(0.006)	(0.008)	(0.007)
$\log(CPI_{it}^{nonfood})$	-0.016	-0.008	-0.020	-0.007	0.001	-0.003	0.001	-0.005
	(0.015)	(0.012)	(0.015)	(0.011)	(0.012)	(0.017)	(0.012)	(0.010)
$\log(T_{it}^{noncis}/GRP_{it})$	-0.004	0.001	-0.003	0.001	0.000	-0.004*	0.001	-0.000
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
$\log(P_t^{oil})$	-0.005	-0.021***	-0.009	-0.039***	-0.025***	-0.008	-0.012	-0.019***
	(0.011)	(0.008)	(0.011)	(0.009)	(0.008)	(0.008)	(0.008)	(0.007)
$D_i^{oil} \times \log(P_t^{oil})$	0.003	-0.001	0.001	-0.001	-0.004	0.002	-0.001	-0.003
	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)
$\log(G_{it}/GRP_{it})$	0.062**		0.052**					
	(0.025)		(0.024)					
fp_{it}^{discr}		0.127***	0.053**					
		(0.038)	(0.027)					
cab_{it}				0.005***				
				(0.001)				
Δcab_{it}					0.002***			
					(0.001)			
$grdif_{it}$						0.077***		
						(0.024)		
$\Delta grdif_{it}$							0.136***	
							(0.035)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.097***
								(0.036)
Constant	0.185***	0.141***	0.195***	0.207***	0.138***	0.064	0.076*	0.123***
	(0.048)	(0.036)	(0.045)	(0.044)	(0.035)	(0.050)	(0.040)	(0.031)
Observations	573	573	573	573	573	573	573	573
Number of regions	64	64	64	64	64	64	64	64
Hansen *p*-val	0.911	0.994	0.994	0.844	0.990	0.846	0.984	0.899
AR1 *p*-value	0.004	0.007	0.004	0.005	0.009	0.004	0.005	0.006
AR2 *p*-value	0.370	0.150	0.355	0.548	0.294	0.325	0.176	0.153

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 8 Determinants of output volatility, robustness analysis, excluding Siberia and North Caucasus

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
vol_{it-1}	0.276***	0.362***	0.296***	0.307***	0.396***	0.297***	0.381***	0.366***
	(0.070)	(0.103)	(0.068)	(0.096)	(0.142)	(0.072)	(0.110)	(0.100)
$\log(D_{it}/GRP_{it})$	0.007	-0.002	-0.002	-0.001	-0.006	0.014	0.003	0.002
	(0.007)	(0.009)	(0.008)	(0.005)	(0.004)	(0.012)	(0.007)	(0.009)
$\log(CPI_{it}^{nonfood})$	0.008	0.003	0.002	0.005	0.018	0.001	0.009	0.012
	(0.013)	(0.011)	(0.009)	(0.012)	(0.012)	(0.018)	(0.009)	(0.011)
$\log(T_{it}^{noncis}/GRP_{it})$	-0.005*	-0.006*	-0.005**	-0.006*	-0.006*	-0.004	-0.005*	-0.007*
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)
$\log(P_t^{oil})$	-0.011	-0.026***	-0.020*	-0.031***	-0.027***	-0.014	-0.021***	-0.017*
	(0.008)	(0.008)	(0.011)	(0.007)	(0.006)	(0.009)	(0.008)	(0.009)
$D_i^{oil} \times \log(P_t^{oil})$	0.002	-0.004	-0.001	-0.002	-0.004*	-0.004	-0.003**	-0.003
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
$\log(G_{it}/GRP_{it})$	0.041*		0.026					
	(0.023)		(0.019)					
fp_{it}^{discr}		0.149***	0.087***					
		(0.024)	(0.019)					
cab_{it}				0.003***				
				(0.001)				
Δcab_{it}					0.003***			
					(0.000)			
$grdif_{it}$						0.036		
						(0.027)		
$\Delta grdif_{it}$							0.106***	
							(0.032)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.142***
								(0.034)
Constant	0.120**	0.113***	0.136***	0.143***	0.086**	0.096	0.086*	0.053
	(0.058)	(0.043)	(0.035)	(0.050)	(0.041)	(0.075)	(0.044)	(0.051)
Observations	537	537	537	537	537	537	537	537
Number of regions	60	60	60	60	60	60	60	60
Hansen *p*-val	0.943	0.994	1.000	0.961	0.968	0.988	0.991	0.985
AR1 *p*-value	0.006	0.001	0.002	0.001	0.004	0.003	0.001	0.001
AR2 *p*-value	0.238	0.928	0.994	0.686	0.501	0.103	0.567	0.763

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 9 Determinants of output volatility, robustness analysis, excluding oil regions

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
vol_{it-1}	0.078	0.195	0.067	0.224	0.328	0.087	0.230	0.235
	(0.091)	(0.181)	(0.091)	(0.144)	(0.209)	(0.088)	(0.184)	(0.189)
$\log{(D_{it}/GRP_{it})}$	0.019**	0.008	0.018**	-0.002	-0.009**	0.017*	0.003	0.010
	(0.009)	(0.007)	(0.008)	(0.004)	(0.004)	(0.009)	(0.006)	(0.007)
$\log{(CPI_{it}^{nonfood})}$	-0.008	-0.004	-0.006	-0.030**	-0.000	-0.001	0.010	0.004
	(0.014)	(0.010)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)	(0.011)
$\log{(T_{it}^{noncis}/GRP_{it})}$	-0.000	0.004	0.000	0.002	0.001	-0.000	0.004	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
$\log{(P_t^{oil})}$	0.000	-0.025***	-0.001	-0.047***	-0.039***	-0.007	-0.022***	-0.018**
	(0.011)	(0.008)	(0.011)	(0.010)	(0.008)	(0.009)	(0.008)	(0.008)
$\log{(G_{it}/GRP_{it})}$	0.066***		0.061***					
	(0.023)		(0.022)					
fp_{it}^{discr}		0.152***	0.044**					
		(0.045)	(0.020)					
cab_{it}				0.004***				
				(0.001)				
Δcab_{it}					0.002***			
					(0.000)			
$grdif_{it}$						0.072***		
						(0.023)		
$\Delta grdif_{it}$							0.111**	
							(0.053)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.120***
								(0.036)
Constant	0.176***	0.157***	0.165***	0.300***	0.181***	0.074	0.102**	0.107**
	(0.058)	(0.043)	(0.052)	(0.060)	(0.046)	(0.061)	(0.050)	(0.045)
Observations	419	419	419	419	419	419	419	419
Number of regions	47	47	47	47	47	47	47	47
Hansen *p*-val	0.997	0.997	1.000	1.000	0.998	0.998	0.999	0.999
AR1 *p*-value	0.010	0.022	0.010	0.016	0.023	0.008	0.021	0.018
AR2 *p*-value	0.645	0.021	0.601	0.404	0.032	0.603	0.127	0.110

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 10 Determinants of output volatility, robustness analysis, excluding financial crisis (2008-2009)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
vol_{it-1}	0.307***	0.423***	0.373***	0.373***	0.471***	0.315***	0.424***	0.421***
	(0.094)	(0.138)	(0.125)	(0.121)	(0.136)	(0.110)	(0.132)	(0.121)
$\log(D_{it}/GRP_{it})$	0.011	0.001	0.002	-0.005	0.001	0.010	0.003	0.004
	(0.008)	(0.008)	(0.007)	(0.006)	(0.007)	(0.009)	(0.006)	(0.007)
$\log(CPI_{it}^{nonfood})$	0.005	-0.001	-0.005	-0.004	0.010	0.004	-0.005	0.005
	(0.014)	(0.011)	(0.014)	(0.012)	(0.015)	(0.017)	(0.012)	(0.011)
$\log(T_{it}^{noncis}/GRP_{it})$	0.000	0.002	0.000	0.001	0.003	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
$\log(P_t^{oil})$	0.086	0.128**	0.123*	0.131**	0.114*	0.105	0.141**	0.114*
	(0.063)	(0.059)	(0.068)	(0.060)	(0.063)	(0.070)	(0.063)	(0.063)
$D_i^{oil} \times \log(P_t^{oil})$	0.007	-0.004	-0.001	-0.004	-0.005	-0.004	-0.003	-0.000
	(0.006)	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)
$\log(G_{it}/GRP_{it})$	0.043		0.017					
	(0.027)		(0.027)					
fp_{it}^{discr}		0.079*	0.062*					
		(0.046)	(0.036)					
cab_{it}				0.004**				
				(0.002)				
Δcab_{it}					0.004***			
					(0.001)			
$grdif_{it}$						0.040		
						(0.025)		
$\Delta grdif_{it}$							0.074**	
							(0.035)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.103***
								(0.029)
Constant	-0.251	-0.496**	-0.440	-0.506**	-0.453*	-0.394	-0.542**	-0.454*
	(0.287)	(0.244)	(0.305)	(0.245)	(0.260)	(0.269)	(0.260)	(0.253)
Observations	514	514	514	514	514	514	514	514
Number of regions	74	74	74	74	74	74	74	74
Hansen *p*-val	0.217	0.420	0.273	0.065	0.301	0.268	0.224	0.345
AR1 *p*-value	0.015	0.018	0.014	0.017	0.020	0.020	0.013	0.011
AR2 *p*-value	0.908	0.623	0.732	0.788	0.946	0.465	0.799	0.899

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 11 Determinants of output volatility, robustness analysis, residual measure of GRP volatility

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
vol_{it-1}^{GDP}	0.071	0.068	0.066	0.083	0.134	0.060	0.042	0.084
	(0.046)	(0.061)	(0.043)	(0.056)	(0.092)	(0.042)	(0.068)	(0.070)
$\log(D_{it}/GRP_{it})$	-0.002	-0.003	-0.005	-0.011	-0.009	0.000	-0.004	-0.003
	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.007)	(0.009)	(0.009)
$\log(CPI_{it}^{nonfood})$	0.029	0.037	0.036	0.022	0.036	0.009	0.044	0.039
	(0.031)	(0.039)	(0.026)	(0.037)	(0.025)	(0.034)	(0.028)	(0.037)
$\log(T_{it}^{noncis}/GRP_{it})$	0.001	0.002	-0.001	0.000	0.001	0.000	0.005	0.003
	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
$\log(P_t^{oil})$	-0.043*	-0.048**	-0.046**	-0.062**	-0.050**	-0.051**	-0.045**	-0.043*
	(0.023)	(0.022)	(0.021)	(0.027)	(0.021)	(0.022)	(0.021)	(0.024)
$D_i^{oil} \times \log(P_t^{oil})$	0.013**	0.004	0.006*	0.001	0.000	0.007	0.006	0.005
	(0.006)	(0.004)	(0.003)	(0.004)	(0.005)	(0.006)	(0.004)	(0.004)
$\log(G_{it}/GRP_{it})$	0.045		0.017					
	(0.031)		(0.028)					
fp_{it}^{discr}		0.144**	0.133***					
		(0.065)	(0.051)					
cab_{it}				0.004***				
				(0.002)				
Δcab_{it}					0.003***			
					(0.001)			
$grdif_{it}$						0.060**		
						(0.028)		
$\Delta grdif_{it}$							0.295***	
							(0.052)	
$\lvert\Delta\log(G_{it}/GRP_{it})\rvert$								0.242***
								(0.068)
Constant	0.220	0.163	0.174	0.259	0.177	0.231	0.121	0.122
	(0.160)	(0.167)	(0.138)	(0.182)	(0.125)	(0.157)	(0.134)	(0.174)
Observations	662	662	662	662	662	662	662	662
Number of regions	74	74	74	74	74	74	74	74
Hansen *p*-val	0.773	0.705	0.980	0.854	0.752	0.873	0.908	0.597
AR1 *p*-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR2 *p*-value	0.135	0.211	0.206	0.086	0.070	0.086	0.234	0.167

Note: Time effects not reported. Robust standard errors in parentheses, ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

5 Conclusion

We analyze in this paper the determinants of output volatility in Russia. The framework of a single country allows us to concentrate on region-specific factors, since the overall economic policy developments (including monetary and financial issues) are the same for all regions and can be omitted from the analysis. This approach corroborates previous studies that use cross-country data, especially for the OECD countries.

We employ a detailed data set on Russian regions for the period between 2000 and 2009. We compare two metrics of output volatility, our preferred one based on monthly real industrial production and a residual measure of GRP volatility. We concentrate on the relationship between fiscal policy and output volatility, accounting for potential endogeneity.

We present several findings which may have policy implications not only for Russia but also for emerging markets in general. First, fiscal policy is found to be a shock inducer rather than a shock absorber in Russia. Discretionary fiscal policy (robustly across various definitions) contributes to output volatility at the regional level in Russia. This finding is largely in line with the previous literature, which was mainly based on cross-country samples for OECD countries. We also find that a larger regional government size does not in fact dampen output fluctuations; it can even be associated with larger output volatility. This result indicates that bigger regional governments in a weak institutional environment might create larger destabilizing fiscal shocks that outweigh the volatility-dampening effect of automatic stabilizers.

Second, we find only weak evidence that financial sector development dampens output fluctuations. A possible reason is that the financial sector in Russia is still comparatively underdeveloped. Moreover, regional differences in financial development may be less important as firms can directly access financial institutions in the main financial centers of the country (Moscow and St. Petersburg).

Third, the impact of oil revenues changes over time. Oil revenues due to higher oil prices reduced output volatility over the whole period. However, we get the opposite results if the period of the financial crisis is excluded, indicating that high oil prices contributed to the overheating of the economy before 2008. It might be that oil revenues had very specific effects during the financial crisis, as relatively high oil prices helped to constrain the impact of the financial turmoil. Moreover, our sensitivity analysis shows that all regions are similarly affected by the oil price, which indicates a high degree of redistribution of oil revenues.

Overall, our results show that fiscal activism contributes to output volatility and thus induces macroeconomic instability at the regional level in Russia. To reduce business cycle fluctuations in Russia, it would be necessary to curtail pro-cyclical fiscal activism at the regional level (see Kwon and Spilimbergo, 2005), e.g. by appropriate fiscal rules, sound fiscal federalism institutions, and an institutionalized control mechanism that enforces budget balancing at the regional level. A crucial challenge in this context remains the issue of how to reconcile the cyclicality of discretionary fiscal measures with that of automatic stabilizers.

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Table A.1 Means of selected variables by region

Region code	Federal district	Industrial volatility vol	Res. GRP volatility vol^{GRP}	Reg. gov. size G/GRP	Discr. fisc. policy fp^{discr}	Cycl. adj. balance cab	Reg. gov. deviation $grdif$	Deposit share D/GRP
Belgorod Region	CF	0.015	0.061	0.161	0.084	-0.999	1.150	0.151
Bryansk Region	CF	0.025	0.031	0.203	0.058	-0.256	1.219	0.151
Vladimir Region	CF	0.027	0.031	0.183	0.079	0.050	1.102	0.185
Voronezh Region	CF	0.033	0.051	0.174	0.069	-0.650	1.094	0.217
Ivanovo Region	CF	0.026	0.032	0.268	0.102	-0.224	1.504	0.211
Kaluga Region	CF	0.028	0.044	0.210	0.090	-0.505	1.202	0.174
Kostroma Region	CF	0.020	0.035	0.209	0.100	-1.256	1.214	0.160
Kursk Region	CF	0.022	0.041	0.166	0.088	-0.128	1.103	0.129
Lipetsk Region	CF	0.016	0.105	0.154	0.085	0.152	1.171	0.106
Moscow Region	CF	0.045	0.048	0.199	0.050	-0.876	1.115	0.171
Orel Region	CF	0.029	0.038	0.191	0.054	-0.184	1.099	0.138
Ryazan Region	CF	0.030	0.036	0.178	0.078	-0.420	1.112	0.161
Smolensk Region	CF	0.028	0.030	0.163	0.049	-0.129	1.135	0.159
Tambov Region	CF	0.034	0.049	0.181	0.064	-0.072	1.127	0.135
Tver Region	CF	0.025	0.035	0.183	0.065	-0.305	1.134	0.124
Tula Region	CF	0.025	0.054	0.173	0.062	-0.272	1.122	0.174
Yaroslavl Region	CF	0.024	0.043	0.185	0.052	-0.463	1.102	0.175
City of Moscow	CF	0.029	0.063	0.148	0.091	-0.256	1.208	0.386
Republic of Karelia	NW	0.029	0.065	0.203	0.064	-0.865	1.137	0.106
Republic of Komi	NW	0.041	0.042	0.159	0.073	-0.442	1.145	0.111
Arkhangelsk Region	NW	0.045	0.077	0.140	0.097	-0.225	1.280	0.095
Vologda Region	NW	0.018	0.127	0.159	0.060	-0.202	1.146	0.154
Kaliningrad Region	NW	0.043	0.054	0.195	0.081	-0.317	1.108	0.206
Leningrad Region	NW	0.029	0.033	0.155	0.046	0.037	1.163	0.057
Murmansk Region	NW	0.029	0.066	0.168	0.133	-0.199	1.192	0.145
Novgorod Region	NW	0.023	0.053	0.166	0.061	-0.240	1.113	0.102
Pskov Region	NW	0.031	0.035	0.225	0.072	0.067	1.261	0.129
City of St Petersburg	NW	0.050	0.032	0.204	0.075	0.269	1.148	0.304
Republic of Adygea	SF	0.071	0.064	0.307	0.130	0.001	1.719	0.151
Krasnodar Territory	SF	0.025	0.030	0.158	0.075	-0.069	1.133	0.172
Astrakhan Region	SF	0.035	0.097	0.185	0.095	-0.696	1.204	0.142
Volgograd Region	SF	0.018	0.035	0.160	0.049	-0.436	1.121	0.135
Rostov Region	SF	0.029	0.031	0.169	0.060	0.038	1.103	0.159
Rep.of Kabardino Balkaria	NK	0.040	0.061	0.274	0.093	-0.266	1.534	0.050
Rep. Karachaevo Cherkessia	NK	0.034	0.062	0.285	0.095	-0.304	1.592	0.038
Stavropol Territory	NK	0.019	0.020	0.184	0.084	0.135	1.204	0.216

Table A.1 Continued

Region	Federal district	Industrial volatility vol	Res. GRP volatility vol^{GRP}	Reg. gov. size G/GRP	Discr. fisc. policy fp^{discr}	Cycl. adj. balance cab	Reg. gov. deviation $grdif$	Deposit share D/GRP
Republic of Bashkortostan	VR	0.026	0.064	0.190	0.124	0.311	1.192	0.133
Republic of Marii El	VR	0.033	0.056	0.227	0.077	-0.375	1.289	0.119
Republic of Mordovia	VR	0.023	0.036	0.312	0.124	-0.238	1.744	0.130
Republic of Tatarstan	VR	0.026	0.044	0.201	0.139	-0.160	1.244	0.143
Republic of Udmurtia	VR	0.040	0.056	0.178	0.031	-0.411	1.043	0.110
Republic of Chuvashia	VR	0.032	0.045	0.217	0.070	-0.535	1.225	0.135
Perm Territory	VR	0.019	0.046	0.147	0.082	0.417	1.215	0.134
Kirov Region	VR	0.023	0.026	0.207	0.061	-0.210	1.235	0.148
Nizhny Novgorod Region	VR	0.020	0.043	0.152	0.071	-0.504	1.188	0.185
Orenburg Region	VR	0.027	0.072	0.151	0.111	-0.459	1.210	0.100
Penza Region	VR	0.029	0.028	0.197	0.094	-0.356	1.223	0.164
Samara Region	VR	0.021	0.044	0.143	0.064	-0.155	1.252	0.172
Saratov Region	VR	0.025	0.029	0.168	0.067	-0.398	1.121	0.163
Ulyanovsk Region	VR	0.035	0.032	0.180	0.116	-0.154	1.149	0.141
Kurgan Region	UF	0.048	0.043	0.205	0.084	0.219	1.198	0.096
Sverdlovsk Region	UF	0.021	0.048	0.149	0.047	0.014	1.200	0.172
Tumen Region	UF	0.037	0.095	0.033	0.182	0.023	5.447	0.079
Chelyabinsk Region	UF	0.016	0.062	0.144	0.062	0.310	1.241	0.133
Republic of Altay	SB	0.101	0.086	0.506	0.144	-0.709	2.832	0.044
Republic of Buryatia	SB	0.062	0.051	0.241	0.133	-0.261	1.351	0.084
Republic of Tyva	SB	0.067	0.065	0.518	0.135	0.255	2.898	0.057
Republic of Khakassia	SB	0.028	0.067	0.173	0.072	0.071	1.125	0.068
Altay Territory	SB	0.022	0.027	0.216	0.049	0.042	1.207	0.141
Krasnoyarsk Territory	SB	0.029	0.115	0.157	0.059	0.057	1.194	0.084
Irkutsk Region	SB	0.029	0.042	0.161	0.055	-0.210	1.123	0.113
Kemerovo Region	SB	0.028	0.054	0.190	0.081	-0.255	1.105	0.119
Novosibirsk Region	SB	0.028	0.031	0.174	0.065	-0.586	1.111	0.155
Omsk Region	SB	0.067	0.099	0.175	0.111	-0.784	1.103	0.123
Tomsk Region	SB	0.061	0.054	0.150	0.066	-0.619	1.204	0.107
Republic of Sakha (Yakutia)	FE	0.048	0.044	0.291	0.078	-1.986	1.629	0.078
Kamchatka Territory	FE	0.066	0.058	0.268	0.085	0.016	1.522	0.117
Primorsky Territory	FE	0.052	0.062	0.194	0.079	0.317	1.101	0.165
Khabarovsk Territory	FE	0.047	0.048	0.218	0.080	-0.885	1.220	0.180
Amur Region	FE	0.053	0.058	0.223	0.055	-0.437	1.279	0.106
Magadan Region	FE	0.054	0.080	0.320	0.045	-0.875	1.791	0.212
Sakhalin Region	FE	0.062	0.096	0.161	0.096	-0.129	1.146	0.052
Jewish Autonomous Region	FE	0.030	0.059	0.279	0.148	0.877	1.565	0.042
Chukotka Area	FE	0.147	0.172	0.607	0.220	3.591	3.397	0.130

Note: CF - Central Federal District, NW - North Western Federal District, SF - Southern Federal District, NK - North-Kaukasus Federal District, VR- Volga Region Federal District, UF- Ural Federal District, SB - Siberian Federal District, FE - Far East Federal District.

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