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INTERREGIONAL INSURANCE AND REDISTRIBUTION IN THE RUSSIAN FEDERATION

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Abstract. The paper examines interregional insurance and redistribution of fiscal system in the Russian Federation during period 1995-2004. Three closely related models, several panel data techniques, and different variable specifications are used to check for the robustness of results. We find that the interregional insurance scheme compensates 20-35% – depending on the method, model and accounting – of a shock to the regional gross product. Estimates are more in line with the earlier estimates obtained for European countries (20-40%) compared to those of US and Canada (10-20%). The earlier literature reports also strong evidence that variation in the estimates is caused by different accounting choices. We do not find clear support for this result in the Russian case.

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1. Introduction

According to Oates (1999), in the fiscal federalism literature three roles for intergovernmental transfers are emphasized: internalization of spill over benefits over jurisdictions, fiscal equalization across jurisdictions, and an improved overall tax system. The discussion on lack of automatic stabilizers in the EMU emphasizes another role for intergovernmental transfers, i.e. stabilizing idiosyncratic regional shocks. Regional stabilization can appear in various forms. Typically interregional labour mobility softens economic shocks. As the exchange rate adjustment is lost in the EMU and the European wide labour mobility is weak and prices sticky, EU redistribution policy might act as an interregional insurance that works also as a stabilization tool.

The natural question is that why the countries do not insure themselves through national or international capital markets. Concerning the EMU member countries this is a legitimate question but in federations such as Russia, the member regions face notable impediments for access to capital markets. Furthermore, even if there was complete access to capital markets, there are still economic incentives for a region to participate in a federation wide insurance scheme carried out through the fiscal system of federation. Von Hagen (1998) argues that especially if the self-insuring region is small, it might face higher borrowing than lending rates making fiscal based insurance scheme preferable.

Empirical interregional insurance literature before Mélitz and Zumer (2002) did not have a consistent and unified approach[1]. They – owing a lot to Bayoumi and Masson (1995) – took a major step towards creating a unified approach for estimating interregional insurance and redistribution. They constructed a rather general framework with several estimation techniques and accounting choices for the dependent variable. They concluded that the variation in estimates found in the previous literature can largely be explained by different accounting choices.

The aim of this paper is to estimate the magnitude of interregional insurance and redistribution in Russia by extending the Mélitz and Zumer (2002) approach. Our dynamic model includes budget revenues and first lag of federal transfers (the dependent variable) as regressors in addition to the standard gross regional product. The estimated magnitude of redistribution embedded in the

[1] A good example of this is the variety of names used in the literature for the subject: regional stabilization, fiscal insurance, interregional risk sharing, intranational insurance and interstate insurance. Here we will refer to it as interregional insurance.

Russian fiscal system is 13-15%. The estimated magnitude of insurance – defined as the change in federal net transfers in the case of transitory shock to regional gross product – in Russia is between 20-35% depending on estimation method, model and accounting used. Some of our results suggest that the federal transfers have been in fact destabilizing. We do not find unambiguous support for the Mélitz' and Zumer's result of accounting as the main source of variation in the estimates.

This paper will proceed as follows. In Section 2. we present shortly the issues discussed in the theoretical literature of interregional insurance and review some of previous empirical literature. Section 3. presents and discusses the regression models and techniques. It also reports the estimation results. Section 4 concludes the paper. Some additional results are found in the Appendices.

2. Previous literature

Several theoretical and empirical papers have been written on interregional insurance. Most of the research started in the 1990s. It is first useful to review some of the discussion in the theoretical literature (see also von Hagen 1998 and Vigneault 2000).

2.1. Theoretical literature

The themes of relevant theoretical literature can be roughly divided into three partly overlapping categories: information and incentives issues, political economy issues, and macroeconomic issues. As an example of the first category, Persson and Tabellini (1996a) modelled the moral hazard problems on an interregional insurance scheme where the federation wide risk-sharing may induce local policies that increase local risk. Another example is Lockwood (1999) who considers information asymmetry which can realize in two ways. The central government can observe either the physical output of a public good or the revenue raised by the regional governments. His main results are that transfers induce qualitative distortion in the public good supply that varies depending on the source of the shock and oversupply (rather than undersupply) of the public good is very possible. Secondly, in the presence of interregional spillovers, it turns out that the public good supply is subject to two-way distortion in such a way that in the regions where the demand for the stochastic public good is highest (lowest) the public good is oversupplied (undersupplied).

Concerning the political economy issues, the discussion includes themes mainly concerned with the design of the insurance scheme. For example, the timing of voting vis-à-vis policy actions and the nature of the tax system have high significance considering the theoretical results of an optimal insurance scheme. The complexity of the issue is visible in Lockwood's (1999) paper. He finds that in his model (with Cobb-Douglas preferences and spillovers absent), if regions differ in incomes and face lump-sum taxes, the interregional insurance system results to an undersupply of the public good whereas a system of distortionary taxes results to oversupply. Persson and Tabellini (1996b) assume that regions have different risk characteristics and argue that efficient risk-sharing involves full insurance but requires a risk premium to be paid by the riskier region to the less risky region. This would be implemented through a combination of region-dependent and region-independent transfers. They show that full insurance along with efficient risk premium can be obtained through Nash bargain (or unanimity vote) among agents representing each region whereas majority voting in each region separately does not produce efficient equilibrium.

An interesting theoretical political economy discussion, motivated by the EMU, is the distinction between *interregional* transfers and *intertemporal* transfers (*stabilization*[2]). This distinction is highlighted by Fatás (1998) and Bayoumi and Masson (1998). The fundamental issue here is the nature of fiscal stabilization, i.e. whether it is implemented across regions or across time. Regions can provide insurance to their citizens by running countercyclical budgets. However, interregional transfers are provided by the federal level as a redistribution of income between the regions. The main concern here is the Ricardian equivalence- hypothesis. Intertemporal transfers are subjected to the Ricardian equivalence since they have to be paid back from the future budgets (assuming that government expenditures remain unchanged in cyclical fluctuations) and – if we are in a perfect Ricardian world – transfers lose their effectiveness because they have no effect on output or consumers' welfare. Purely interregional transfers on the other hand avoid the Ricardian equivalence effect because consumers are not worried about increased future liabilities since the transfers are funded from the income of the better off regions. Thus, as Fatás (ibid.) concludes, interregional transfers are more efficient than intertemporal ones and hence better for provision of regional insurance. This argument also provides one justification for federal-based insurance

[2] Fatás use of term *stabilization* can be confusing. Some authors, such as Büttner (1999), use the term stabilization in the sense which interregional insurance is used in this paper, whereas its meaning is different in Fatás (1998).

scheme since residents of a self-insuring region borrowing from capital markets expect the loans to be paid in the future with higher taxes.

Fatás (1998) has analyzed the interaction between interregional insurance and the Ricardian equivalence further. Suppose one region of the federation goes into recession and incomes of other regions and expenditures remain unchanged. As a result, the federal budget goes into deficit. This creates expectations for future tax liabilities for all regions to cover the current federal deficit, which results into some degree of Ricardian equivalence. Thus, an interregional insurance scheme where a pool of money is collected from taxes and redistributed across regions on an equalizing basis is not necessarily free from the offsetting effect of the Ricardian equivalence. There is necessarily some degree of insurance in the system – assuming some level of idiosyncrasy – as the region in recession has to pay only its share of future increase in tax payments which is notably smaller than the current foregone tax incomes caused by the recession. But also the intertemporal stabilization effect is present as the region receives a postponement for the necessity of balancing its budget today thanks to the insurance scheme. The insurance and stabilization, in the sense that Fatás is using them, are difficult to distinguish unambiguously in empirical work. Furthermore, the Ricardian effect is mitigated if the consumers do not fully internalize the future tax payments.

Finally, we shortly present some of the macroeconomic considerations related to interregional insurance. Even though an interregional insurance scheme is designed to bring stability in the economies of individual regions, the scheme itself might develop – both positive and negative – implications affecting the whole federation level. Sala-i-Martin and Sachs (1991) argue that the federally provided interregional insurance scheme has been an important reason why the fixed exchange regime existing within the United States has survived without extensive problems. They also address the need for the EMU for a similar arrangement. Sanguinetti and Tommasi (2004) concern the potential negative implications. They focus on a macroeconomic trade-off related to federal fiscal arrangements, i.e. the trade-off between providing interregional insurance and providing sufficient incentives for aggregate fiscal discipline. The key assumption is that the realized regional income is unobserved to the federal government. Sanguinetti and Tommasi show that the economy can be subjected to the tragedy of fiscal commons through excessive sub-national spending and lower level provision of federal public good such as macroeconomic stability. Von Hagen (1998) constructs a simple model in which interregional insurance is provided through rules-based transfer scheme aimed at reducing income differences between the regions. He shows how the insurance scheme conflict between national and regional stabilization can emerge, and how the effectiveness of monetary policy can improve or reduce depending on it.

2.2. Previous empirical literature

Next we focus on empirical results and methods used in previous studies (see also von Hagen 1998, Mélitz and Zumer 2002, and Vigneault 2000). We overview in somewhat details the debate related to empirics of interregional insurance. We will first present the research carried out with the US data which has deserved the most attention. The methods and results are summarized in Table 1. After that we will present research conducted on other countries – summarized in Table 2 – and lastly we discuss the system and earlier literature of interregional insurance in Russia.

The MacDougall Report (European Commission, 1977) on viable EMU initiated the empirical discussion on interregional insurance by presenting estimates for interregional insurance and redistribution. Due to its poor methodology, we will not reproduce here the report's estimates (see von Hagen 1998). After the MacDougall Report it took almost fifteen years before the next paper on the subject was published. This was the study of Sala-i-Martin and Sachs (1991). It has become one of the most influential and debated paper in the field. The empirical methods had improved dramatically from the time of the MacDougall Report. Sala-i-Martin and Sachs (1991) used 3SLS-method with two separate equations to analyse the shock absorption of federal taxes and transfers in the US. They obtained an estimate for the combined insurance effect of taxes and transfers around 33-40% for a shock on regional personal incomes. In their analysis the redistributive role of these money flows were taken into account only implicitly.

Very soon von Hagen (1992) published his estimates along with criticism on Sala-i-Martin's and Sachs' (1991) work. His criticism was that they did not distinguish between permanent and transitory shocks i.e. between redistribution and insurance. Von Hagen's approach was to run Sala-i-Martin's and Sachs' regression in first differences using state gross products as the dependent variable. His estimate for the insurance effect was considerably lower, approximately 10% whereas his estimate for redistribution was actually a bit higher. Fatás (1998) brought a new perspective to the discussion. It was the problem of difference between *insurance* and *stabilization* discussed above. According to Fatás (1998, see also von Hagen 1998) von Hagen's (1992) approach manages to avoid this problem whereas Sala-i-Martin's and Sachs' (1991) does not. This could explain the notable difference in the estimates.

The approaches of Fatás (1998) as well as Athanasoulis and van Wincoop (1998 and 2001) are similar but quite exceptional in relation to the rest of empirical literature. Fatás defines and analyses interregional insurance as the reduction of volatility (standard deviation) in permanent regional income. Athanasoulis and van Wincooop measure the interregional risk sharing by analysing the reduction in standard deviation of state specific income growth uncertainty obtained through federal fiscal policy (and financial markets). Both studies obtain similar estimates for insurance that are more in line with von Hagen (1992) than with Sala-i-Martin and Sachs (1991). Fatás and Athanasoulis and van Wincoop were, however, not the first to approach the estimation through the standard deviation. In their influential paper Asdrubali et al. (1996) constructed their estimable equations by decomposing the period-by-period cross sectional variance of gross state product into smoothed and unsmoothed parts. The former was determined by capital markets, credit markets,

Table 1: Estimates and estimation methods for interregional insurance and redistribution in the United States[a]

Author	**Method for estimating Insurance**	**Insurance effect, %**	**Redistribution, %**
Sala-i-Martin and Sachs (1991)	3SLS	33-40	
von Hagen (1992)	1st difference OLS for stabilization, level OLS for redistribution	10	47
Goodhart and Smith (1993)	Same as von Hagen (1992)	13	15
Pisani-Ferry et al.(1993)	Simulation	17	
Bayoumi and Masson (1995)[a]	3SLS	7-30	7-22
Asdrubali et al. (1996)	GLS	13	
Fatás (1998)	Standard deviation analysis	11	
del Negro (1998)[b]	i.i.d., AR(1), VAR(1), trend specifications	20-30	
Obstfeld and Peri (1998)	Bivariate VAR	10	19
Athanasoulis and van Wincoop (2001)	Standard deviation analysis	14	
Mélitz and Zumer (2002)[a]	Level OLS, 1st difference, dynamic GMM	4-27	7-21

a. The given estimates of Bayoumi and Masson (1995) and Mélitz and Zumer (2002) vary depending on the broadness of the measure for net intergovernmental transfers used method and for the latter also on the estimation method used.

b. del Negro (1998) measures risk sharing with respect to shocks to the overall level of wealth rather than to the current income.

and federal government. They obtain a result that a total of 75 per cents of the shocks to gross state products were smoothed and federal government's share was 13 percentage points.

Bayoumi and Masson (1995) agree von Hagen's (1992) view on the importance of distinguishing between redistribution and insurance, and test the two with separate equations (cross-sectional and time series, respectively). Bayoumi and Masson (ibid.) were first to use the disposable value of regional (personal) incomes as the dependent variable instead of transfers explicitly. They were also the first to emphasize the *accounting* phenomena. The term was used by Mélitz and Zumer (2002, M-Z from here onwards) for the extent of federal money flows included when constructing the variable. The more equalizing money flows are included in the regression, i.e. the wider the definition of transfers is, the bigger insurance effect we should obtain. Bayoumi and Masson obtain estimates for insurance varying from almost von Hagen (1992) to Sala-i-Martin and Sachs (1991), depending on the width of included flows. Also Asdrubali et al. (1996) studied the insurance role of separate federal flows and concluded that most of the federal shock smoothing was carried out through direct federal transfers to individuals (excluding unemployment benefits).

The biggest contribution of M-Z is that they seem to be able to explain most of the differences of the estimates in the interregional insurance literature. They test for interregional insurance with three different estimation techniques – level OLS, first differences and dynamic GMM – for four different countries. However, their main argument is that the difference in insurance estimates obtained in previous studies lies strictly on accounting. In their estimations, different methods produce a dispersion of about five percentage points while different accounting selections produce a dispersion of some 15 percentage points. Thus the selection of the personal incomes or gross product as the regressor plays the crucial role. According to M-Z, both specifications are correct but only in proper context, which may require corresponding adjustment of selected federal transfers, i.e. the dependent variable. If we choose personal incomes, we should include all federal transfers to the residents. However, if we choose gross regional product (GRP), we should also include all transfers to lower level governments and firms because residents receive benefits also from these instances. Furthermore, M-Z note that it is likely that lower estimates for insurance are obtained when using GRP rather than personal incomes since GRP per capita figures are considerably larger than personal income figures. M-Z reject the critique posed by von Hagen (1992) to Sala-i-Martin and Sachs (1991). M-Z note that they obtain similar results regardless of level or first difference regression for Sala-i-Martin and Sachs data. Thus the difference lies in different accounting, as Sala-i-Martin and Sachs used regional personal incomes and von Hagen used GRP. M-Z reject also, on account of their empirics, the critique of Fatás (1998) concerning deficit spending by the federal government.

Some additional criticism, not-discussed by M-Z, is also found. del Negro's (1998) appraisal is quite fundamental concerning the whole approach to interregional insurance. He argues that if individuals and regional governments are able to borrow and lend, then shocks to the expected present value of lifetime resources rather than shocks to current income affect agent's decisions and welfare. Thus, risk-sharing should also be analyzed empirically against shocks to wealth rather than to current income. His estimates for interregional insurance in the US were approximately 20-30 per cents, somewhat higher than other studies' estimates on the average.

Finally, von Hagen and Hepp (2000) tested interregional insurance and found that the equalization scheme in Germany, so called *Finanzausgleich*, provides hardly any smoothing to transitory shocks against GRP and also only little redistribution compared to other countries. However, the scheme smoothes more than half on transitory shocks to regional per capita *tax collection* around the federal average. Furthermore, it produces more than full redistribution for regions with tax collections below the federal average. Von Hagen and Hepp address the importance of distinguishing between insurance aimed at the private sector and the one aimed at regional budgets. Besides von Hagen and Hepp, this part of the accounting issue is addressed only by Kadotchnikov (2003)[3]. It has some importance as in many countries, e.g. in Russia, the equalization system is designed to smooth tax capacity. It is noteworthy that these both studies do not address the problem of endogeneity which is more likely to incur when regional tax incomes, rather than regional gross incomes, are used as the "shock variable".

Besides US and Germany, estimations for interregional insurance have been conducted with data for Canada, France, UK and Italy. International comparison of the estimates is difficult due to different kinds of equalization schemes, which complicates the selection of proper accounting for international comparability. However the estimates for insurance in these countries seem to fall approximately in the range of 10-20 percents with the exception of Germany. Concerning

[3] It is also shortly mentioned in Vigneault (2002) when referring to von Hagen and Hepp (2000).

redistribution, there is more variation. The rather low estimates for Italy by Obstfeld and Peri (1998) are probably due to accounting as the authors had to limit their analysis only on social insurance flows that provide rather partial picture of total equalizing fiscal flows. This argument is supported by the results of Decressin (1999) who uses broader measure of equalizing fiscal flows, with similar methods, and obtained clearly higher estimates for Italy. Decressin uses probably the broadest measure of all studies as he includes into the equalizing flows also the central government's investments and expenditures on consumption in the regions. Decressin justifies his approach by the fact that in many countries public expenditures have relatively important role in regional economies, and that e.g. public sector wages – that are clearly countercyclical due to their rigidness – are paid from these expenditure flows

Table 2: Estimates for interregional insurance and redistribution in other countries

Author	**Method for estimating Insurance**	**Insurance effect, %**	**Redistribution, %**
Canada			
Goodhart and Smith (1993)	See table 1	12-19	
Bayoumi and Masson (1995)	See table 1	3-17	2-39
Obstfeld and Peri (1998)	See table 1	13	53
Mélitz and Zumer (2002)	See table 1	4-21	3-24
France			
Pisany-Ferry et al. (1993)	See table 1	37	
Mélitz and Zumer (2002)	See table 1	17-19	38
Germany			
Pisany-Ferry et al. (1993)	See table 1	34-42	
von Hagen and Hepp (2000)[a]	Fixed effects OLS	3.4, 56	8.2, 114
Italy			
Obstfeld and Peri (1998)	See table 1	3	8
Decressin (1999)[b]	Bivariate VAR	5; 20-30	20; 30-35
UK			
Goodhart and Smith (1993)	See table 1	21	
Mélitz and Zumer (2002)	See table 1	21-26	26

a. The first figure relates to a regression of transfers on regional incomes whereas the second relates to regression on regional tax revenues.
b. Depending on broadness of the measure.

2.2. The system and previous empirical literature of interregional insurance in Russia

In the early years of Russia's transition there was no legislation that stated any explicit arrangements for intergovernmental transfers. The role of transfers was supplanted in the Soviet

Union time and in the early years of transition by a complex, negotiation-based tax sharing system between the federal and sub-national governments. A major disadvantage of the system was that it tried to address two tasks – balancing both vertical and horizontal imbalances[4] – with a single policy tool i.e. the tax sharing rate. These rates were chosen to balance the revenue division between the sub-national and the federal governments, and in addition, to reduce fiscal disparities among the regions (Wallich 1994). According to Martinez-Vazques and Boex (2001) this bargaining based and non-transparent system – characteristic to whole Russian fiscal system of the time – exposed it to bad incentives and soft budget constraints.

A notable step towards the better was taken in 1994 when the part of the transfers aimed at reducing horizontal instability was subjected to formula-based mechanism, so called Fund for Financial Support of Regions (FFSR), which was and is funded from VAT collections. The rest of the transfers remained as non-transparent and usually ad hoc based lump-sum subventions prone to political manipulation and pressure. Initially the FFSR determined the allocation by classifying the regions in need of support as those that had below the average (per capita) revenues in a base year. In addition, regions with insufficient funds for financing their expenditure needs still after the support would get supplementary financial aid. The FFSR formula was later improved by simplifying it, and using better proxies for fiscal capacity and expenditure needs than the actual amounts of a base year (see e.g. Makushkin et al. 2001 for through description on the FFSR).

The FFSR was intended to be the sole funnel of support between the centre and the regions. In reality a lot of funds were allocated through more informal channels during almost the whole decade (Solanko and Tekoniemi 2002), and in some years other types of transfers exceeded the amount of the FFSR (Martinez-Vazques and Boex 2001). Total amount of money allocated to the fund was decided in the annual federal budget. However the funding rule changed virtually every year. There have been several adjustments to the allocation rule of the FFSR and clear progress in mitigating the bad incentives present in the original system. Although the FFSR is currently the most important channel for distributing equalizing funds, the share of the non-transparent mutual settlements flows is still notable.

[4] Vertical imbalance refers to the difference between regional mandates and funds available for their implementation. Horizontal imbalance refers to a situation where there are different revenue endowments or capabilities of revenue collection across sub-national governments.

To our knowledge, the Russian Federation is the first – and thus far only – non-OECD and/or transition country of which any research on interregional insurance has been conducted. Furthermore, only one research has been carried out on Russia (Kadotchnikov et al. 2003) although there are numerous studies of other aspects of the Russian fiscal federalism (see e.g. Zhuravskaya, 2000 and Le Houerou and Rutkowski, 1996). The lack of research on this field concerning the transitional economies is understandable as we are only now beginning to have sufficiently long and sufficiently reliable data for these countries.

Kadotchnikov et al. (ibid.)[5] studied the impact of three different insurance flow measures on changes in GRP and budget revenues in Russia in 1994-2001. These flows are aggregate transfers[6], aggregate tax revenues rendered to the federal level, and net federal tax as a difference between the two. They use three different model specifications and estimate the insurance in pairs of years rather than as a panel data. They justify this approach on time varying coefficients which could be indeed the case concerning Russia's turbulent transition.

Their estimates suggest that there was virtually no redistribution across regional GRPs through the fiscal system till 1996. They explain this by the fact that in the early years of transition the amount of federal transfers to regions depended on jointly planned regional budgets for the next period rather than the fiscal state of the region. For 1998-2001 they obtain significant estimates for GRP redistribution ranging approximately from 10-17 percents for the tax rendered to federal level measure. Concerning tax revenue redistribution through federal transfers, they find significant redistributive effect in 1994-1999 ranging from 10-47 percents. They explain the statistically non-existent relation in 2000-2001 with newly introduced principles of intergovernmental transfer allocation. The amount of federal transfer allocation for 2000 was calculated in 1999 according to pre-crisis 1997 statistics and in 2001 fiscal and budget reforms aimed at distributing federal transfers according to expenditure needs rather than tax capacity. However, redistribution of budget revenues through federal was significant for whole estimation period with redistribution effect varying from 50 up to almost 80%.

Concerning GRP insurance through fiscal flows, authors failed to find any clear tendency in the estimation period. They conclude that the fiscal system was not used as an insurance against GRP

[5] The Russian version of their paper, available at www.iet.ru, is by far more comprehensive.
[6] Kadotchnikov et al. use a term grant-in-aid for federal non-repayable transfers.

shocks. However, the insurance effect of federal taxes on regional budget revenues appeared to be persistent and vary from 25 up to 93 percent with very high explanatory power. Quite interestingly, unlike federal taxes the federal transfers failed to show any significant stabilizing effect on regional budget revenues excluding the very end of the period. This result raises an interesting question. If the transfers were, generally speaking, not targeted for GRP or budget revenue stabilization, then what has determined their allocation throughout the transition? This result contradicts previous literature which has found a stabilizing effect of transfers either for GRP shocks (majority of previous studies) or for budget revenue shocks (e.g. von Hagen and Hepp 2000).

3. Estimating interregional insurance in the Russian federation

In this paper we are able to extend the Kadotchnikov et al. (2003) estimation period (1994-2001) to 1995-2004 (see data description in Appendix A). Contrary to Kadotchnikov et al., we will drop year 1994 as it contains still considerable data unreliability. Unfortunately, our results are not directly comparable with Kadotchnikov et al. as they report annual estimates whereas here we analyse the whole period as one with panel data methods and we are using a narrower selection of variables.

Here we follow the approach adopted in Mélitz and Zumer (M-Z, 2002), i.e. use different panel data methods and different accounting measures. We extend the estimation methods used by M-Z. However, we unfortunately cannot perform as comprehensive accounting analysis due to data limitations. We will first present the basic model by M-Z and our results with the Russian data and then introduce simple but justified augmentations to their model.

3.1. The basic model

M-Z proposed a general equation from which they derive the separate equations for interregional insurance and redistribution. They adopted the definitions of insurance and redistribution by Bayoumi and Masson (1995) and Obstfeld and Peri (1998), and combined them in a single equation. Consider a model

$$(3.1) \qquad Y_{it} = \alpha_d + \beta_D \overline{X}_i + \beta_S (X_{it} - \overline{X}_i) + \varepsilon_{it} \qquad (i = 1, 2, \ldots, M \quad t = 1, 2, \ldots, T)$$

where X_{it} is the gross regional product per capita (GRP) divided by the national average; Y_{it} – also a percentage figure – is the disposable value of X_{it} after adding net federal transfers (which can be either positive or negative) from the fiscal system[7], $\overline{X}_i$ is the average of X for region i over the whole time period. Due to considerable differences between regional inflation rates in Russia, dividing the annual data by the national averages will not remove the inflation completely. Thus the Russian data was also deflated with region specific consumer price inflation to constant prices of year 1995[8]. Equation (3.1) can now be decomposed into two parts:

(3.2) $$\overline{Y}_i = \alpha_d + \beta_D \overline{X}_i + \eta_i$$

(3.3) $$Y_{it} - \overline{Y}_i = \beta_S (X_{it} - \overline{X}_i) + \mu_{it}$$

These two equations add up to Eq. 3.1) as $\varepsilon_{it} = \mu_{it} + \eta_i$. Parameter β_D will produce an estimate for regional redistribution since it is related to permanent regional product (the average) whereas β_S is related to transitory regional product (deviation from the average). Finally, M-Z depart from assumption of strictly contemporary insurance suggested by equations (3.2) and (3.3) and argue that a dynamic model with lagged influences is more fitting:

(3.4) $$Y_{it} - \overline{Y}_i = \sum_{j=0}^{L} \beta_{-j} (X_{it} - \overline{X}_i) + \mu_{it}$$

where L is the number of lags. In their paper, M-Z have included lags from four to five depending on the country under scrutiny. However, with the Russian data, we have to content with considerably shorter lags due to the relatively short data set. Due to the short data set, we will take the approach of including one lag in the basic model and two to three in the augmented model. As is shown later on, depart from purely contemporary insurance has significance concerning the estimates with the Russian data.

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[7] Net transfers are calculated by adding up transfers from federal to regional level and deducting from these the money rendered from the regional to the federal level. Note that if we want to assess the direct effect of GRP on net transfers (say, Z) we have to do a transformation of coefficient from β to (β-1). This is due to the fact that Y is defined as Y = X+Z, thus the regression for the direct effect would have the form Z=(β -1)X + μ following from the specification X+Z= βX + μ.

[8] Dividing by national average has, however, one country specific advantage. It will remove any potential problems caused by the 1998 monetary reform in Russia when three zeros were removed from all monetary figures.

The M-Z model is somewhat non-standard concerning dynamic models as the starting point is a model in which the independent variable is deducted by its region specific mean. The aim of this approach is to distinguish two concurrent but separate influences on regional income and not to remove any regional fixed affects contrary to possible first impressions. The first influence reflects the change in the average income over the whole period. This is the redistribution effect (equation 3.2). The second one reflects changes in transitory income compared to the average income. This relates to insurance (equations 3.3 and 3.4). Basically we are assuming (although not explicitly stated in M-Z) that the policy maker compares region's income development to its long run average in order to determine the possible financial aid. This would require an assumption of rational expectations of the policy maker for the long run average income.

Furthermore, using more sophisticated methods will require moving to first differences. Through first differencing equation (3.3) we will in arrive to a regression equation

$$\Delta Y_{it} = d_i + \beta_S \Delta X_{it} + v_{it} . \qquad (3.5)$$

Note that we would get this model also from the more standard equation when *L=0*

$$Y_{it} = \alpha_i + \sum_{j=o}^{L} \beta_j X_{i,t-j} + e_{it} .$$

This is due to the fact first differencing the equation will remove all region fixed effects as well as the averages. Here we will use the popular estimating technique for dynamic models which alleviates the potential problem of endogeneity with the X variables. This approach was proposed by Arellano and Bond (1991)[9] and it is a GMM-based dynamic panel data method utilizing the orthogonality conditions between the *differences* of residuals and lagged values of the endogenous variables. Thus the results are obtained via difference model estimations. M-Z were the first to use this technique for interregional insurance estimation. However, it is important to note that the model of M-Z will not produce same results with the Arellano-Bond technique as the standard equation. This is due to the fact that although the estimated equation is the same in both cases after first differencing, the instruments used are different. Lagged deviations from the averages are used in

[9] Although the time period in our study still rather short compared to e.g. Mélitz and Zumer (2002), Bond (2002) argues that the Arellano-Bond estimation technique used in Mélitz and Zumer (ibid.) and also here is especially suitable for panel data of relatively short time and relatively large amount of individuals.

(3.5) and lagged levels in standard equation. We tested for both approached with the Russian data and obtained differences of some 1-3 percentage points. However, the test statistics for residual AR(1)- and AR(2)- process as well as the Hansen's test for overidentified restrictions were clearly better when using the M-Z specification (Eq. 3.4). Thus we depart from the standard equation model here.

In addition to the Arellano-Bond estimation we will also use – following the approach of M-Z – level OLS (Sala-i-Martin and Sachs 1991) and first differenced OLS (von Hagen 1992) to check how the estimation technique affects the estimates for interregional insurance. M-Z concluded that the estimation technique appears to be less important source of variation in estimates than the accounting choice of the federal net transfers, at least concerning the data for US and Canada.

3.2 Results for the basic model with Russian data

Table 3 reports the results for interregional redistribution and insurance of replicating the M-Z regression with Russian data. Our narrowest accounting choice for federal net transfers is taxes (and other compulsory payments) rendered from the regional to the federal government. A wider choice is to include federal non-repayable transfers to the region in net transfers. The widest choice includes also the net of budget loans. The third one is based on the claim by Makushkin et al. (2001). They argue that budget loans are in reality one type of federal financial aid to Russian regions. According to our knowledge, budget loans' role in interregional insurance and redistribution has not been tested before. Contrary to reporting style of M-Z the redistributing or stabilizing effect is presented with a negative sign following the intuitive logic that lower GRP leads to higher net transfers and vice versa.

The results show that the redistributive effect is clearly present in the Russian fiscal system with some 12-15 per cent magnitude. Interestingly, however, the results suggest that while taxes to federal government have been equalizing, the federal transfers have been in fact un-equalizing as the redistributive effect diminishes when federal transfers are added into the net transfers. Thus, the logic of bigger equalizing and stabilizing effects following broader accounting - working nicely in M-Z - does not hold here. In fact, Kadotchnikov et al. (2003) and von Hagen and Hepp (2000) obtained similar counter-intuitive results with Russian and German data. Another noteworthy fact

Table 3: Interregional redistribution and insurance of gross regional product in Russia

	Redistribution, Eq. (3.2)		Stabilization: Level, Eq. (3.3)		Stabilization: First differences Eq. (3.5)[c]	
	(β_D-1)	R^2	(β_S-1)	R^2	(β_S-1)	R^2
Rendered taxes	-0.148*** (31.06)[a]	0.987 [0.690][b]	-0.320*** (9.82)	0.700 [0.341]	-0.190*** (11.38)	0.801 [0.224]
Rendered taxes and transfers	-0.126*** (18.8)	0.972 [0.418]	-0.370*** (8.57)	0.485 [0.246]	-0.196*** (11.56)	0.718 [0.254]
Rendered taxes, transfers and loans	-0.126*** (18.6)	0.971 [0.410]	-0.379*** (8.40)	0.466 [0.245]	-0.215*** (11.59)	0.701 [0.270]

	Stabilization: Dynamic A-B[d] Eq. (3.4)		A-B test for AR(1): z-value, (p-value)	A-B test for AR(2): z-value, (p-value)	Hansen test, χ^2-value, (p-value)	Number of instruments/ number of groups
	β^e_{-j}	$\Sigma\beta_{-j}$ $(Pr > \chi^2)$				
Rendered taxes	β_0=-0.397*** (6.76) β_{-1}=-0.04 (-0.78)	-0.437 (0.000)	-1.44 (0.150)	-1.32 (0.187)	46.30 (0.078)	36/79
Rendered taxes and transfers	β_0=-0.365*** (7.56) β_{-1}=-0.082 (-1.63)	-0.447 (0.000)	-0.83 (0.408)	-1.30 (0.194)	49.54 (0.041)	36/79
Rendered taxes, transfers and loans	β_0=-0.372*** (7.52) β_{-1}=-0.085* (-1.68)	-0.457 (0.000)	-0.52 (0.601)	-1.19 (0.234)	47.26 (0.065)	36/79

Significance levels are denoted by asterisks: *, **, *** denote significance at 10, 5, 1 % level, respectively.

a. In the parentheses of regressions for equations 3.1, 3.2 and 3.3 are t-values based on heteroskedasticity robust standard errors.

b. The figures in the brackets are the R^2 when net transfers were used as dependent variable instead of disposable value of X. The disposable value tends to give very high R-squared due to the construction of the variables. Otherwise the results between the two variable specifications were identical for this table.

c. Regional constants are not reported and none of them was significant. Regressions produce only small differences in estimates whether or not the regional constants were included.

d. In the Arellano-Bond regression the more efficient two step method is reported instead of one step. It is robust to heteroskedastic and serially correlated standard errors. The downward bias of the standard errors in the two step method is corrected with Windmeijer's (2005) finite sample correction. Furthermore, the difference in the results between the two approaches was very small.

e. Necessary transformation (β-1) for overall insurance effect summation has already been done for the reported figure. M-Z report the insurance effect with a positive sign but here we take the approach as reporting it with its actual sign (negative) in the regression. The interpretation of the insurance coefficient is, naturally, the same in both approaches.

is that budget loans seem to posses no redistributive role. Concerning the insurance effect, on the other hand, we find the expected logic of accounting width to hold. Also the budget loans appear to have a stabilizing effect as argued by Makushkin et al. (2001). While M-Z found only small differences between the results in levels and first differenced regression, we report notable difference in the results between these two estimation techniques. In level regressions we find some 32-38% insurance effect while first difference regression produces effect around 20%. Due to definition of the dependent variable as a disposable value of the independent variable, the values for R^2 are generally unrealistically high (as was in M-Z). The R^2 for regressions with net transfers explicitly as the dependent variable (as e.g. in von Hagen, 1992), are visible in the table in brackets. They were generally clearly lower than in case of regression with disposable X as the dependent variable. Also t-statistics were considerably smaller. The estimates as such were naturally the same with both definitions[10].

Concerning the dynamic model, Table 3. clearly shows some rejecting test statistics. This is despite the fact that we report here the most efficient specification of X_{it} which treats it as a predetermined variable. Note that as AR(1)-test assumes the null hypothesis of absence of first order autocorrelation in residuals, we would typically expect to obtain p-values far from zero. However if the residuals in levels are uncorrelated, we would expect error term AR(1) to be significant as the estimation is based on first differences. On this setting the AR(2) –residual test values are more important. For corrected specification p-values of AR(2) tests must be far from zero. Similarly we would expect p-values far from zero for the Hansen test if the instruments are correctly specified, i.e. uncorrelated with the residuals. However, Table 3. reports p-values below 0.10 indicating that instrument choice has not been proper one. In the dynamic model, the coefficients for X_{it} are close to that in the levels model. When we add the coefficient of $X_{i,t-1}$ the combined insurance effects grows to around 45%. The logic of wider accounting seems to hold also for the dynamic A-B model.

[10] As M-Z note in their paper, the choice between net transfers and disposable value of GRP is of little importance considering the results also in the dynamic model. This is natural as the difference is merely algebraic, i.e. we can restore the estimate for insurance in case of net transfers from the disposable GRP model by deducting unity from the coefficient of current X. Concerning the dynamic model, the lagged coefficients can be used as such. But, as we will show, the situation is not so straightforward in the augmented model.

To sum-up, when we replicate the M-Z regressions with Russian data we arrive to some contradictory results. First, there are considerable differences between the estimates from three methods varying some 20 percentage points between first differences and dynamic models. The latter could be unreliable because lack of proper instruments. Secondly, the logic of wider accounting does not hold in the redistribution case. We will show below that the accounting logic fails also with insurance in the augmented models. This failure could be a result of Russian peculiarities. Note that the Russian transfer system is designed to equalize tax capacity – as is the German system – not regional incomes per se. In addition, several researchers in the Russian fiscal federalism literature claim that that the redistribution of federal transfers has been plagued by political motives[11]. These aspects would, naturally, cause biases in regressing transfers on economic variables.

3.3. Augmented models and estimation results

Next we test with Arellano-Bond method two model extensions for sake of robustness, fiscal reasoning and country specific factors. First modification adds first lag of the dependent variable in the model as an explanatory variable. Inclusion of lagged *Y* as an explanatory variable is often justified in economic terms and proves to be the case also here. Longer lags of *Y* turned out to be statistically insignificant. Consider the model of M-Z with an addition of lagged *Y* deducted by the region's whole period average of *Y*.

$$(3.6) \qquad Y_{it} = \alpha_d + \phi(Y_{i,t-1} - \overline{Y}_i) + \beta_D \overline{X}_i + \beta_S (X_{it} - \overline{X}_i) + \varepsilon_{it} .$$

Applying similar manipulations as in the original model, we will get new equation for estimating interregional insurance. Whereas equation for redistribution remains the same, Equation (3.5) for insurance now becomes[12]

[11] See e.g. Popov (2002) and Treisman (1998).

[12] In this specification we have to be careful when switching between definitions of the dependent variable (net transfers versus disposable GRP). If we denote net transfers with Z (+ or -), and thus Y=X+Z we get from Equation 3.7) that:

$$Z_{it} - \overline{Z} = \varphi(Z_{i,t-1} - \overline{Z}_i) + (\beta - 1)(X_{it} - \overline{X}_i) + (\beta_{-1} + \varphi)(X_{i,t-1} - \overline{X}_i) + \sum_{j=2}^{L} \beta_{-j}(X_{i,t-j} - \overline{X}_i) + u_{it} .$$

Thus, transforming from disposable GRP (Y) to net transfers Z requires deducting unity from β and adding the coefficient of lagged Y, φ, to β_{-1}. Coefficients for lag two and greater of X can be used as such.

$$(3.7) \qquad Y_{it} - \overline{Y}_i = \phi(Y_{i,t-1} - \overline{Y}_i) + \sum_{j=0}^{L} \beta_{-j}(X_{it} - \overline{X}_i) + \mu_{it}\,.$$

The second modification is to include current budget expenditures (divided by *GDP*) *E* minus its average as a regressor:

$$(3.8) \qquad Y_{it} - \overline{Y}_i = \phi(Y_{i,t-1} - \overline{Y}_i) + \lambda(E_{it} - \overline{E}_i) + \sum_{j=0}^{L} \beta_{-j}(X_{i,t-j} - \overline{X}_i) + \mu_{it}\,.$$

This addition is justified especially in the Russian case where federal transfers are allocated through a formula comparing region's "tax potential" and "expenditure needs". This addition does not, however, change the interpretation of interregional redistribution and insurance, i.e. the reaction of net transfers on permanent and temporary deviations of regional incomes from the long run average. Thus, adding the regional expenditures as a regressor serves as a robust check and it also gives us a sense of budget expenditure's magnitude and significance in determining the federal transfers' allocation.

Table 4: Augmented model with first lag of Y and one to two lags of X^a, (Eq. 3.7)

	Stabilization: Dynamic A-B, Eq. (3.7)		A-B test for AR(1): z-value, (p-value)	A-B test for AR(2): z-value, (p-value)	Hansen test, χ^2-value, (p-value)	Number of instruments/ no. of groups
One *X* lag	$\Sigma\beta_{-j}$=	φ=				
Rendered taxes	-0.195	+0.655*** (8.61)	2.10 (0.036)	0.13 (0.900)	78.14 (0.349)	77/79
Rendered taxes and transfers	-0.255	+0.470*** (9.27)	1.82 (0.069)	0.55 (0.584)	78.56 (0.336)	77/79
Rendered taxes, transfers and loans	-0.270	+0.458*** (9.16)	1.95 (0.051)	0.35 (0.726)	77.87 (0.357)	77/79
Two *X* lags	$\Sigma\beta_{-j}$=	φ=				
Rendered taxes	-0.256	+0.596*** (7.60)	2.09 (0.037)	0.84 (0.402)	75.53 (0.198)	70/79
Rendered taxes and transfers	-0.222	+0.645*** (11.97)	1.94 (0.053)	0.81 (0.416)	77.39 (0.159)	70/79
Rendered taxes, transfers and loans	-0.220	+0.664*** (13.03)	1.96 (0.051)	0.61 (0.545)	76.94 (0.168)	70/79

a. *Y* is net transfers and predetermined, *X* is exogenous.

Table 4. presents the basic regression results for equation (3.7) with two lags of X_{it}. Compared to dynamic M-Z replication in Table 3, the insurance estimates are now clearly lower, around 20-25% and close to the first difference model estimates. Interestingly the logic of wider accounting works with one lag but not with two. Actually there it works in the opposite direction. It is also important to note that the total insurance effect does not increase with the amount of included lags. The test statistics can be regarded as fairly good. The coefficients for Y_{t-1} are highly significant and positive which means that positive net transfers of previous period would produce positive net transfers in the consecutive period. This could relate to state dependence, i.e. that there are stable donor and recipient regions in the fiscal system. Indeed, this seems to be the case with the Russian data[13].

Next we will report the results for the second augmented model of equation (3.8) where also regional budget expenditures appear as a regressor. Budget expenditures are treated as endogenous since there is considerable danger of endogeneity embedded in the Russian transfer scheme. Table 5. shows insurance estimates ranging from 25 to 36% which are a bit higher than in the first augmented model but lower than in the M-Z replication. Again the test statistics are at satisfactory levels. The accounting logic holds for one lag model whereas for two and three lag models it seems that taxes and budget loans have stabilizing effect whereas federal transfers have destabilizing effect.

Regarding the lag of *Y* we find similar but somewhat higher estimates than in Table 4. and no clear accounting logic. The expenditure coefficients are highly significant and of expected sign. A higher expenditure needs are supported by higher federal fiscal flow. Interestingly, here the accounting logic works with two *X* lags but not with one. The variation in the estimates for first lag of *Y* is larger compared to dispersion in the insurance estimates.

A noteworthy result in Table 5. is that when we add transfers and loans into the net transfers of our first lag model, the budget expenditures become insignificant. This might be due to multi-collinearity. The same phenomenon is not, however, visible in two or three lag models. Appendix B reports the same regressions as in Table 5. but with disposable GRP as the dependent variable. The test statistics are partly better for the disposable GRP specification and the estimates with two and

[13] Approximately 50 out of 79 regions in the data were either stable donors or recipients over the whole time horizon and clear majority of these were recipients.

three lags some 5 percentage points smaller. Also individual coefficients for current and lagged GRPs and their significance for Tables 4. and 5. are reported in Appendix B. Although the difference is rather small, it is interesting since M-Z found that choosing between disposable GRP and net transfers as regressand had no notable influence on the results.

Table 5: Augmented model with current expenditures, first lag of Y and one to three lags of X as regressors[a] (Eq. 3.8)

	Stabilization: Dynamic A-B Eq. (3.8)			A-B test for AR(1): z-value, (p-value)	A-B test for AR(2): z-value, (p-value)	Hansen test, χ^2-value, (p-value)	Number of instruments/ no. of groups
One X lag	$\Sigma\beta_{-j}$=	φ=	λ=				
Rendered taxes	-0.271	+0.709*** (10.74)	+0.280*** (10.24)	2.21 (0.027)	0.49 (0.624)	75.16 (0.440)	78/79
Rendered taxes and transfers	-0.330	+0.459*** (7.24)	+0.183 (1.33)	1.71 (0.088)	0.58 (0.560)	78.66 (0.334)	78/79
Rendered taxes, transfers and loans	-0.346	+0.446*** (7.16)	+0.170 (1.17)	1.74 (0.082)	0.39 (0.697)	77.68 (0.362)	78/79
Two X lags	$\Sigma\beta_{-j}$=	φ=	λ=				
Rendered taxes	-0.295	+0.677*** (10.52)	+0.327*** (9.63)	1.91 (0.056)	1.03 (0.303)	77.05 (0.291)	76/79
Rendered taxes and transfers	-0.255	+0.707*** (19.02)	+0.333*** (5.53)	1.73 (0.083)	1.11 (0.267)	76.81 (0.298)	76/79
Rendered taxes, transfers and loans	-0.259	+0.721*** (19.52)	+0.329*** (6.09)	1.87 (0.061)	0.84 (0.403)	76.91 (0.295)	76/79
Three X lags	$\Sigma\beta_{-j}$=	φ=	λ=				
Rendered taxes	-0.364	+0.639*** (6.86)	+0.344*** (5.76)	1.19 (0.236)	0.19 (0.853)	74.60 (0.394)	78/79
Rendered taxes and transfers	-0.323	+0.690*** (7.76)	+0.384*** (10.67)	1.23 (0.220)	0.56 (0.574)	77.62 (0.304)	78/79
Rendered taxes, transfers and loans	-0.335	+0.674*** (7.47)	+0.346*** (8.65)	1.39 (0.164)	0.26 (0.796)	76.33 (0.341)	78/79

a. *Y* is net transfers and predetermined, *X* is predetermined, *E* is endogenous

4. Conclusions

The paper focused on estimating interregional insurance and redistribution provided by the Russian fiscal system. Many econometric studies for interregional insurance have been made for European and North-American countries but this was only the second for Russia. We used the approach used by Mélitz and Zumer (2002). We also tested some simple but justified augmentations to their model. The main result of Mélitz and Zumer was that substantial differences in estimation results of previous studies were due to differences in accounting choices rather than in the estimation techniques. Concerning our replicate of their methods would clearly suggest the opposite, i.e. that the estimation method causes most variation – some 20 percentage points – whereas the width of accounting causes at most five percentage point variation. However, the dynamic model used by Mélitz and Zumer produces some poor test values in our case. Relatively short time horizon and the consequent lack of instruments partly explain these results.

More efficient results were obtained when first lag of the dependent variable and budget expenditures are included as regressors. Our most efficient results suggest that the insurance effect in Russia lies within the range of 20-35% between different estimation techniques and models. Also the estimates obtained with simple OLS techniques fall within this range. Estimates are more in line with the estimates obtained for European countries (20-40%) than those for the US and Canada (10-20%). It is hard to find any systematic cause - such as accounting - to explain the differences in the Russian estimates. However, one factor – left untouched by Mélitz and Zumer – seems to be responsible for at least part of the variation in the dynamic model estimates. This is the amount of GRP lags included as regressors. However we observe that there is considerable variation in the estimates between different techniques, which would suggest that the estimation technique has importance at least for the results. But at the same time the estimates obtained with different techniques fall into this – admittedly large – range while no systematic cause behind the variation is evident.

Concerning accounting differences we were unable to do as through inspection as Mélitz and Zumer did, but the differences in our estimates between different accounting choices were at most 7-8 percentage points whereas Mélitz and Zumer obtained differences up to 20 percentage points. It is however impossible to robustly compare the two studies due to different fiscal system in Russia, and in US and Canada. Despite of this, we argue that accounting plays smaller role for Russia than in US and Canada. An interesting result concerning accounting was that the robust logic of wider accounting and larger insurance visible in Mélitz and Zumer was not unambiguous in the Russian case. This would suggest that federal transfers in Russia have actually destabilizing or un-equalizing nature in Russia, which has been suggested already in earlier fiscal federalism literature, or that they are used in some other purpose such as equalizing regional budget revenue differences.

It is important to bear in mind that empirical work concerning Russia is prone to more uncertainties than those with OECD countries. One possible reason for our somewhat unstable results (e.g. change in the signs of individual GRP coefficients in the dynamic models) is not necessarily a problem in the quality of data but due to turbulent nature of Russia's transition. Interesting further applications would be to test for insurance in different time periods as there have been considerable differences in e.g. president Yeltsin's and president Putin's fiscal policy. Testing for shocks to budget incomes as in von Hagen and Hepp (2000) might be important as it captures the design od some transfer systems better. Furthermore, testing for shocks to regional personal income would also be useful and give us more tools to compare the Russian interregional insurance scheme internationally.

Appendix A: The data

First of all, we are very grateful and highly indebted to the researchers of Moscow Institute for the Economy in Transition who were kind enough to provide us with the raw fiscal data for 1995-1999 which was used also in Kadotchnikov et al. (2003). The rest of the raw data is obtained from Russia's Ministry of Finance and National Statistical Committee (Rosstat).

In constructing the net transfers measure, we tried to operate on a level as general as possible to reduce accounting uncertainties since the Russian budget reporting varies somewhat over the transition period. The summation of the following budget classes were used in constructing the net federal transfers data:

1. Taxes and other compulsory payments rendered to the federal government appeared as a negative flow in the net transfers.
2. Non-repayable payments from the federal budget (including FFSR transfers, subsidies, subventions and resources transferred under mutual settlement schemes) were used as a measure for federal transfers whenever it was possible. In years when this budget class was not published, we used the budget class Non-repayable transfers from budget of other levels.
3. The net of budget loans (positive or negative) taken from and repaid to federal budget was used in the widest accounting measure. Also in this case, in some years we had to use the more obscure Budget loans from budgets of other levels.

Major shortcoming is inability to include custom duty incomes, which are a major income source for many regions but statistics for them are unavailable. Also budget flows related to national defence are unavailable. Seventy nine of Russia's eighty nine regions were included in the regressions. However, the data for the nine autonomous regions of Russia were embedded in the data under the respective administrative unit, e.g. the figures of Nenets autonomous regions is embedded in the data of Arkhangelsk region under which the Nenets region administratively belongs. This is due to the fact that GRP data for these autonomous regions is published only from year 2000 onwards. Only the Chechen Republic was dropped from the data due to highly unreliable and/or missing data.

Appendix B: More detailed results

Table B1: Individual coefficients and their significance for $\Sigma\beta_{-j}$ for Table 4.

	Lags	β	β_{-1}	β_{-2}
Rendered taxes	One:	-0.250***	+0.056	
		(2.96)[a]	(1.36)	
	Two:	-0.370***	+0.077	+0.038
		(3.65)	(1.43)	(0.93)
Rendered taxes and transfers	One:	-0.266***	+0.012	
		(3.31)	(0.33)	
	Two:	-0.325***	+0.067	+0.036
		(3.78)	(1.25)	(1.18)
Rendered taxes, transfers and loans	One:	-0.284***	+0.014	
		(3.55)	(0.40)	
	Two:	-0.336***	+0.078	+0.038
		(3.85)	(1.32)	(1.41)

a. Here and in the following tables the z-values are in the parentheses.

Table B2: Individual coefficients and their significance for $\Sigma\beta_{-j}$ for Table 5.

	Lags	β[a]	β_{-1}	β_{-2}	β_{-3}
Rendered taxes	One:	-0.335***	+0.065		
		(2.88)	(1.16)		
	Two:	-0.349***	-0.038	+0.092**	
		(2.93)	(0.67)	(2.01)	
	Three:	-0.394***	-0.035	+0.014	+0.051
		(2.81)	(0.50)	(0.53)	(0.72)
Rendered taxes and transfers	One:	-0.329***	-0.001		
		(3.52)	(0.02)		
	Two:	-0.304***	-0.033	+0.082***	
		(3.11)	(0.58)	(2.80)	
	Three:	-0.349***	-0.033	-0.006	+0.065
		(3.23)	(0.49)	(0.24)	(0.98)
Rendered taxes, transfers and loans	One:	-0.348***	+0.002		
		(3.80)	(0.05)		
	Two:	-0.328***	-0.010	+0.079***	
		(3.46)	(0.858)	(3.09)	
	Three:	-.365***	-0.0167	-0.028	+0.075
		(3.46)	(0.23)	(1.40)	(1.21)

Table B3: Augmented model with current expenditures, first lag of Y and one to three lags of X as regressors[a] (Eq. 3.8)

	Stabilization: Dynamic A-B Eq. (3.8)			A-B test for AR(1): z-value, (p-value)	A-B test for AR(2): z-value, (p-value)	Hansen test, χ^2-value, (p-value)	Number of instruments/ no. of groups
One X lag	$\Sigma\beta_{-j}=$	$\varphi=$	$\lambda=$				
Rendered taxes	-0.271	+0.709*** (10.74)	+0.280*** (10.24)	2.21 (0.027)	0.49 (0.624)	75.16 (0.440)	78/79
Rendered taxes and transfers	-0.330	+0.459*** (7.24)	+0.183 (1.33)	1.71 (0.088)	0.58 (0.560)	78.66 (0.334)	78/79
Rendered taxes, transfers and loans	-0.346	+0.446*** (7.16)	+0.170 (1.17)	1.74 (0.082)	0.39 (0.697)	77.68 (0.362)	78/79
Two X lags	$\Sigma\beta_{-j}=$	$\varphi=$	$\lambda=$				
Rendered taxes	-0.245	+0.714*** (14.21)	+0.299*** (7.04)	2.13 (0.033)	0.56 (0.577)	74.88 (0.354)	76/79
Rendered taxes and transfers	-0.220	+0.725*** (21.47)	+0.303*** (4.69)	1.81 (0.070)	0.76 (0.448)	77.27 (0.285)	76/79
Rendered taxes, transfers and loans	-0.225	+0.752*** (21.03)	+0.320*** (5.08)	1.86 (0.062)	0.56 (0.574)	77.21 (0.287)	76/79
Three X lags	$\Sigma\beta_{-j}=$	$\varphi=$	$\lambda=$				
Rendered taxes	-0.293	+0.703*** (9.33)	+0.336*** (6.08)	1.41 (0.157)	0.24 (0.810)	72.43 (0.464)	78/79
Rendered taxes and transfers	-0.247	+0.763*** (7.98)	+0.376*** (8.63)	1.40 (0.161)	0.54 (0.590)	77.34 (0.312)	78/79
Rendered taxes, transfers and loans	-0.245	+0.755*** (9.24)	+0.345*** (9.43)	1.56 (0.118)	0.36 (0.716)	77.68 (0.303)	78/79

a. Y is disposable GRP and predetermined**,** X (GRP) is predetermined, E is endogenous

Table B4: Individual coefficients and their significance for $\Sigma\beta_{-j}$ for Table B3.[a]

	Lags	β	β_{-1}	β_{-2}	β_{-3}
Rendered taxes	One:	-0.335***	+0.065***		
		(5.71)	(7.64)		
	Two:	-0.346***	+0.053***	+0.048	
		(5.83)	(9.82)	(1.06)	
	Three:	-0.385***	+0.042***	+0.021	+0.029
		(4.65)	(12.62)	(0.57)	(0.45)
Rendered taxes and transfers	One:	-0.329***	-0.001***		
		(7.16)	(5.22)		
	Two:	-0.304***	+0.044***	+0.040	
		(7.88)	(13.18)	(1.31)	
	Three:	-0.343***	+0.039***	+0.013	+0.044
		(6.62)	(13.45)	(0.47)	(0.64)
Rendered taxes, transfers and loans	One:	-0.348***	+0.002***		
		(7.11)	(5.18)		
	Two:	-0.323***	+0.051***	+0.046	
		(7.45)	(13.69)	(1.72)	
	Three:	-0.352***	+0.050***	+0.012	+0.046
		(6.36)	(16.76)	(0.49)	(0.67)

a. In this table the relevant transformations for β_t and its lags for the summation of insurance coefficients are already made for the reported figures, i.e. $\beta = (\beta\text{-}1)$ and $\beta_{-1} = (\beta_{-1}+\varphi)$. See footnote 12.

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