The Economic Effects of Interregional Redistribution of Resources: the Case of Khabarovsk Territory

A Isaev

1Economic Research Institute, 680042, Tikhookeanskaya 153, Khabarovsk, Russian Federation

E-mail: isaev@ecrin.ru

Abstract. Interregional transfers are the tool for redistributing financial resources in national economy. Increase in transfers to the region affects the supply of freely provided public goods by residents. The study investigates the effects of changes in the volume of federal transfers on key variables of the regional economy using a two-regional computable general equilibrium model. A key feature of the used Groenewold-Hagger-Madden model is the behavior of regional governments, which optimize expenditures on public goods in such a way as to maximize the utility function of households within their jurisdiction. The latter are perfectly mobile between regions and consume private and public goods under budgetary constraints. The model is calibrated for a particular region, Khabarovsk Territory, and the rest of the nation. It is shown that a sharp increase in federal transfers to the regional budget leads to a significant inflow of labor resources to the region, but only to insignificant changes in the welfare, wages and per capita consumption of households. Regional government will change tax rates in such a way that a reduction in their spending will offset the increase in consumption of public goods through transfers. Several multipliers for key regional variables with respect to tax rate are calculated.

1. Introduction

In federal states the central government plays an important role in the financial resources redistribution between regions. Regional differences in income generated, tax base, expenditure obligations of regional authorities determine the importance of the redistribution of finances between them. One way of stimulating regional growth and development is public investment, the primary purpose of which is to create public goods. Another way is to provide financial assistance to the regions in the form of intergovernmental transfers. In theory, the aim of financial redistributing through intergovernmental transfers is to stimulate regional government spending on goods and services, eliminate tax imbalances, and reduce interregional inequality.

Unlike the Pareto-optimal redistribution of budgetary funds in proportion to the region’s contribution to the GDP, regions with high costs of providing public services and having difficulties with generating their revenues, usually receive larger federal grants per capita than other regions. This approach to redistribution is based on the principle of horizontal equality, when citizens should have equal access to public goods and services, regardless of their location. At the same time, when decisions on the allocation of financial resources to the regions are politically determined, the transfers can increase economic inequality of the regions.
The Russian regions are characterized by a high degree of socio-economic differentiation, which requires large-scale redistribution of budget funds between them (see [1], [2], [3]). In addition, the last decade has been marked by the centralization of interregional financial flows. As a result, there was an increase of the federal center share in the consolidated budget revenues of the Russian Federation, followed by an increase in the volume of centrally redistributed funds.

After the financial crisis of 2009, the government took measures to change fiscal policy and the allocation of budget funds, mainly aimed at increasing the revenue of regional budgets. The crisis also revealed the shortcomings of the intergovernmental transfer system. The central government was not always able to adequately assess the socio-economic priorities of the regions. As a result, the efficiency of distributed funds decreased.

A specific feature of the transfer policy in Russia is the equalizing of per capita regional budgets [4]. In such circumstances, the financial maneuvers of the regional authorities to optimize the revenue and expenditure parts of regional budgets are limited in order to improve the welfare of their residents.

The aim of this study is to assess the implications of budget transfer policies for the region’s economy and the welfare of its residents on the basis of a two-regional computable general equilibrium model with federal and regional governments. The question is to assess the extent and direction of the changes depending on the size of the federal transfer under the assumption that the regional government behaves as an optimizing agent. Model calibration is carried out on statistical data for two regions, one of which is the Khabarovsk Territory, and the second represents the rest of the national economy.

2. Fiscal federalism and the consolidated budget of Khabarovsk territory

The basic model of fiscal federalism involves the establishment of such a level of regional taxes that ensures the provision of an optimal level of public goods to residents. Russia has some features of budgetary relations in which these basic principles are not implemented. The federal government sets boundaries within which regional tax rates can vary. The government also sets the minimum range of services that should be provided to residents of each region. If the region’s tax revenues are not able to provide this level of services, the federal center provides financial assistance.

Intergovernmental transfers are an instrument of state fiscal policy, the purpose of which is to redistribute financial resources from economically more prosperous regions to less prosperous ones. There is a stabilization aspect of federal financial assistance to the regions, which consists in changing the amount of allocated funds depending on fluctuations in tax revenues to the regional budget [5]. Another approach (see [6], [7]) to the problem of fiscal federalism considers federal grants as a way of transferring powers to regions in order to improve the provision of public services to the residents. Local governments act as agents that maximize the utility functions of residents, given resource constraints and restrictions on the size of transfers. At the same time, the main tool with which the regional government can operate is the local tax rate that determines the amount of regional budget revenue [8], [9].

The nominal income of the consolidated budget of the Khabarovsk Territory for 2010-2016 was determined to a large extent by the dynamics of transfers from the federal budget. The level of budget subsidies in the Khabarovsk Territory is close to the national average. The share of transfers in the revenue structure of the regional budget in 2016 was 16.7 per cent. Among the regions of the Far East only Sakhalin and Primorsky Territory had a lower share of transfers in their budgets (3.5 per cent and 15.4 per cent respectively).

The expenditure structure of the Khabarovsk Territory budget is quite stable. The largest share (about 60 per cent) is social spending. At the same time the share of expenses on housing services decreased from 12.5 per cent in 2010 to 7.4 per cent in 2016. It should be noted that in 2010-2011 the regional budget was in surplus. In 2014 the deficit amounted to 15.4 per cent, but decreased to 4.6 per cent in 2016.

Thus, the main direction of expenditures of the regional budget is providing the residents with public goods. A relevant question is to what extent changes in government spending affect the welfare
of the residents and other important regional economic variables. Since the region is a part of the national economy, the variation of the volume of public goods provided affects not only the welfare of residents, but also their motivation to change location. Moreover, this indirectly affects the motivation of residents of other regions, thereby causing migration flows. These relationships can be traced within the framework of the general equilibrium approach. A regional computable general equilibrium model is a convenient tool for studying such issues (see [10], [11], [12] for example).

3. General equilibrium model with two regions

The model is a two-stage system, similar to that described in [13]. At the first stage households and firms maximize their target functions based on set of restrictions, exogenous tax rates and federal transfers. At the second stage the regional government choose the regional tax rate in order to maximize the welfare of its residents given the tax rate in the second region.

The preferences of representative household of ith region are characterized by the linearly homogeneous Cobb-Douglas utility function $U_i$:

$$U_i=\beta_i C_i^{\alpha_i} G_i^{\phi_i}$$

where $C_i$ and $G_i$ denote per household consumption of private and public good respectively.

Each household offers to firm one unit of labor $L_i$. Household income is the sum of nominal wage $W_i$ and firm profit $\pi_i$. The source of income is located in the same region $i$. There are no savings and investment in the model. Denoting price of the private good by $P$, the budget constraint facing household is:

$$P_i C_i = \pi_i + W_i$$

(2)

It is assumed that only one representative firm operates in each region. There is no mobility of firms between regions. In contrast, households are mobile between regions.

Firm’s output $Y_i$ produced using labor as only variable factor. The production function is characterized by a decreasing marginal product of labor:

$$Y_i = L_i^\alpha_i$$

(3)

Firms operate in perfectly competitive product and factor markets. Output and employment are chosen to maximize the profit function:

$$\Pi_i = P_i Y_i - W_i L_i (1 + T_i)$$

(4)

where $T_i$ is the payroll tax rate imposed by region’s $i$ government. The specificity of the model is that all taxes levied on firms are regional.

Maximizing (4) with respect to $L_i$ we obtain the first-order condition:

$$P_i \alpha_i L_i^{\alpha_i - 1} = W_i (1 + T_i)$$

(5)

The regional government purchases part of the firm’s output $GR_i$ from tax revenues. Regional governments are supposed to balance their budgets so that:

$$P_i L_i GR_i = T_i W_i L_i$$

(6)

The federal government does not collect taxes, but carries out an inter-regional redistribution of part of $GR$ purchased by regional governments. It takes part of the goods from the government of one region for transfer to households in another region. Like regional governments the federal government balances its budget:

$$L_i GF_1 = L_2 GF_2$$

(7)

where $GF_i$ is the amount of goods supplied by the federal government to household in region $i$. This amount can be positive or negative. The total number of goods provided freely by the government to representative household in region $i$ is:

$$G_i = GR_i + GF_i > 0$$

(8)

The national labor supply $L$ is fixed and exogenously given, but households are perfectly mobile between regions. Migration arises as a response to the differences in nominal wages among two regions. Equilibrium is set when the difference disappears:

$$W_1 = W_2$$

(9)
Interregional trade is not considered in the model. All goods produced in the region are consumed there. Equilibrium condition on the commodity markets of each region is set as:

\[ Y_i = L_i (C_i + GR_i) \]  \tag{10}

All profits are distributed among households in the same region and are thus a local form of rent.

Finally, the tax rate \( T_i \) is chosen by the government of region \( i \) in such a way as to maximize the household utility function \( U_i \). The tax rate of the neighboring region is taken as given. The first-order condition for this maximization problem is:

\[ \gamma_i C_i^{\gamma_i - 1} G_i^\delta_i \frac{\partial C_i}{\partial T_i} + \delta_i C_i^\gamma_i G_i^{\delta_i - 1} \frac{\partial G_i}{\partial T_i} = 0 \]  \tag{11}

Combining equations (3) and (4) the individual demand function for \( C_i \) can be written as:

\[ C_i = L_i^{\alpha_i - 1} \cdot \frac{W_i T_i}{P_i} \]  \tag{12}

Finally, the equilibrium condition of the commodity markets (10) using the production function (3) is transformed into:

\[ L_i^{\alpha_i - 1} = C_i + GR_i \]  \tag{13}

Thus, the system of equations (5)-(9), (11) and (13) along with fixed national labor supply condition constitute a model with 13 endogenous variables: \( C_i, L_i, P_i, W_i, T_i, GR_i, GF_i \). It is assumed that the federal government uses \( GF_i \) as a control variable. The second exogenous value is the national labor supply \( L \). Since there is no interregional trade, the price changing mechanism in absent in the model. The number of endogenous variables can be reduced by setting the price levels \( P_i \) to one.

4. Parameters estimation and numerical solution of the model

Model (5)-(13) is a system of nonlinear equations. Numerical solution of the model is complicated both in terms of specification and interpretation of the results. It is possible to simplify its solution significantly by transforming the model using log-linearization of the equations. The model is transformed from non-linear in levels of variables to linear in rates of change of variables. The numerical solution of linear model will result in relative changes in endogenous variables as a result of changes in exogenous variables.

The modified model (see [14] for details) represents a linear system with 11 endogenous variables \( c_i, l_i, w_i, t_i, gr_i, gf_i \) and two exogenous variables \( g_i \) and \( l \), where \( x_i = dX_i/X_i \).

The model also contains parameters \( \alpha_i, \gamma_i, \delta_i \), which can be estimated from statistical data, taking into account the restrictions imposed by the model.

The parameter of the production function \( \alpha_i \) can be calculated based on equations (5) and (13):

\[ \alpha_i = \frac{W_i (1 + T_i)}{C_i + GR_i} \]  \tag{14}

Regarding the parameters of the utility function \( \gamma_i \) and \( \delta_i \) it can be shown (see [13]) that specific values of these parameters does not affect the calculated values of endogenous variables. Values for \( C_i, GR_i, GF_i, W_i, L_i \) are selected from the available statistical information. Tax rate values are estimated as:

\[ T_i = GR_i / W_i \]  \tag{15}

Since the model does not contain investment and trade, the regional output \( Y_i \) is not identical to the gross regional product, but represents the sum of \( C_i \) and \( GR_i \).

Unlike testable partial equilibrium models, general equilibrium models are a purely theoretical construct, an empirical verification of which is impossible (see [15], [16]). The main problem is to maintain a balance between the realism of the initial data and their consistency with the theoretical premises of the model.

The average values of the corresponding aggregates for 2015-2016 were used as initial data. Khabarovsk Territory acts as Region 1, and Region 2 is the rest of national economy. Employment level is taken for the number of households \( L_i \). Wage \( W_i \) refers to the nominal average annual salary
minus the regional cost of living. The value of consumption of private goods $C_i$ is taken to be identical to the cost of purchasing goods and services minus the expenses of pensioners.

Obviously not all goods purchased by residents are produced in the region. However, in the absence of interregional trade in the model, the retail sector plays the role of local producer of imported goods. $GR_i$ is defined as regional budget revenues minus federal transfers. Accordingly, the sum of $C_i$ and $GR_i$ is equivalent to the regional output $Y_i$. Nominal values of final consumption are adjusted by the real price indices reflecting price disparities between regions. The regional cost of a fixed set of consumer goods and services is taken as an index.

Finally, the value of the public good $GF_i$ is calculated as:

$$GF_i = MGF_i - MGF_{L_i}$$  \hspace{1cm} (16)

where $MGF_i$ is the amount of federal transfers to region $i$.

Estimated data-base is represented in table 1. All original figures are taken from Regions of Russia Statistical Yearbook.

| Table 1. Data-base. |
|---------------------|
|                     |
| $C_i \cdot L_i$ (RUR m) | $GR_i \cdot L_i$ (RUR m) | $GF_i \cdot L_i$ (RUR m) | $W$ (RUR x1000) number x1000 | $L$ (number) x1000 | $Y_i \cdot L_i$ (RUR m) |
|---------------------|
| Region 1            |
| 305418              |
| 63048               |
| 1659                |
| 300.8               |
| 688.5               |
| 368466              |
| Region 2            |
| 3436219             |
| 7955091             |
| -1659               |
| 300.5               |
| 71556.6             |
| 42317210            |

To carry out the calculations, it is necessary to set a change for the value of $GF_i$ by choosing a nonzero value of $gf_i$ (per worker). The study simulates an increase in the average per capita transfer to Region 1 by an amount equal to 10 per cent of the average annual per capita transfer for all Russian regions in 2015-2016. This value is estimated at 21,802 rubles per worker. Accordingly, a 10 per cent increase is 2180 rubles. Thus the value of $gf_i$ is taken so as to guarantee an increase in $GF_i$ by this amount. For the Khabarovsk Territory this would be equivalent to an increase in the actual level of federal transfer by 2.3 times.

Table 2 presents the simulation results for $gf_i = 131.4$ per cent. Estimates are based on the assumption that wage inequality between regions is a stimulus for inter-regional migration. The table shows that the equilibrium condition is satisfied, which in terms of growth rates takes the form $w_1 = w_2$.

| Table 2. Simulation results for exogenous $gf_i$ change. |
|--------------------------------------------------------|
| Percentage change                                      |
| Region 1 | Region 2 |
|----------|----------|
| $c$      | -0.280   | 0.004   |
| $t$      | 3.272    | -0.031  |
| $w$      | 0.001    | 0.001   |
| $t$      | -3.746   | 0.031   |
| $gr$     | -3.745   | 0.032   |
| $g$      | -0.280   | 0.004   |
| $y$      | 2.399    | -0.022  |
| $u$      | -0.280   | 0.004   |
| $\Delta L$ (number) | 22 529 | -22 529 |

The regional government tries to maintain a balance in household consumption of private and public goods. As a respond to a sharp increase of $GF$ the regional government will reduce its spending by adjusting the tax rate, as can be seen from the table. As the regional budget is balanced, government spending is reduced in proportion to the reduction of the tax rate by 3.7 per cent, but to a
slightly lesser extent as a result of the growth of the tax base \( WL \). The latter increases both due to growth of wage rate and positive migration.

In contrast, regional government spending in the rest of the economy will increase due to reduced federal transfers. In general, the reaction of regional governments is such that they compensate for the increase in public goods consumption by households by reducing purchases from regional firms. Changes in the growth rate of consumption of private good, public good and household utility in the region are the same.

It follows that the effect of a reduction in regional government spending as a result of increased transfers can be predicted through a change in consumption of private goods. Despite the growth of wage rate there is a decrease in consumption of private good in Region 1. The reason is that profits per worker have decreased.

5. The multipliers

Taking parameter \( a \) identical for all regions, some multipliers for endogenous variables with respect to tax rate for Region 1 can be derived from the model. It can be shown (see [17]) that the multiplier for \( L_1 \) with respect to \( T_1 \) takes the form:

\[
\frac{\partial L_1}{\partial T_1} = L_1 \beta \left[ 1 + \left( \frac{1}{1+T_2} \right)^{\beta^2} \left( 1+\frac{T_1}{1+T_2} \right)^{\beta-1} \left( \frac{1}{1+T_2} \right) \right]
\]  

(17)

where \( \beta = 1/(\alpha - 1) < 0 \). This fact indicates that the employment multiplier in Region 1 in relation to the tax rate in the same region is negative. From (3) it follows that a rise in \( T_1 \) reduces not only employment but also output in Region 1.

The multiplier for \( W_1 \) with respect to \( T_1 \) is given by the following expression:

\[
\frac{\partial W_1}{\partial T_1} = -a(\alpha - 1) \left( L_1 - L_1 \right)^{\alpha - 2} \frac{\partial L_1}{\partial T_1}
\]  

(18)

The sign of the multiplier is again negative. It follows from (17) and the restriction on \( a \). It means the rise of the tax rate in Region 1 depresses wage rates in both regions.

The effect of a change in the \( T_1 \) on \( G_1 \) follows from the corresponding multiplier:

\[
\frac{\partial G_1}{\partial T_1} = aL_1^a \frac{\partial L_1}{\partial T_1} \frac{1}{(1+T_1)^2} \left[ 1 + \frac{\alpha}{1+T_1} \frac{\partial L_1}{\partial T_1} \right]
\]  

(19)

The second term in (19) is negative, but the first one is positive. Consequently, the sign of the multiplier of \( G_1 \) with respect to \( T_1 \) is indeterminate.

Finally, the effect of tax change on consumption expenditure by households is determined as:

\[
\frac{\partial C_1}{\partial T_1} = -aL_1^a \frac{\partial L_1}{\partial T_1} \frac{1}{(1+T_1)^2} \left[ 1 + \frac{\alpha(1-\alpha)T_1}{1+T_1} \right] \frac{\partial L_1}{\partial T_1}
\]  

(20)

which is negative.

Multipliers values for Khabarovsk Territory are presented in table 3.

**Table 3. Multipliers for Khabarovsk Territory.**

| Multiplier   | Value     |
|--------------|-----------|
| \( \frac{\partial L_1}{\partial T_1} \) | -45319.5  |
| \( \frac{\partial W_1}{\partial T_1} \) | -0.003    |
| \( \frac{\partial G_1}{\partial T_1} \) | -667.2    |
| \( \frac{\partial C_1}{\partial T_1} \) | -3675.8   |

Tax rate increase is aimed at redistributing a given volume of output from \( C \) to \( G \). At the same time it reduces the wage rate, causing labor to migrate to the Region 2. Output decline in Region 1 reduces consumption of both private and public goods by households in the region. There are spillover effects...
in Region 2 of the tax raise in Region 1. Employment rises as a result of migration, but wages are reduced.

6. Conclusion
Using a two-regional computable general equilibrium model, the regional effects of federal transfers were analyzed for the Khabarovsk Territory and the rest of Russia. The model is based on the assumption that regional governments determine tax rates and spending policies within their jurisdictions in such a way as to maximize the utility of a representative household in the region. Each regional government based its actions, taking the actions of the federal and other regional governments as given. The behavior of the regional government can be seen as a search for Nash equilibrium in a non-cooperative game.

It can be concluded that a significant increase in the volume of regional transfers to the region can lead to a significant redistribution of labor resources, but will have a weak effect on household welfare both in the recipient region and in the national economy as a whole. The effect on per capita consumption and wages will also be negligible. It should be noted that the scale of migration is significantly affected by the assumption of perfect labor mobility.

The motivation of the federal government is to increase the consumption of public goods by households in one region at the expense of households in another region. In turn, regional governments optimize their spending on providing households with public goods in order to balance their utility functions.

The study assesses the scale and direction of changes in key economic variables in response to an increase in federal transfers. As further research in this area, a model may be modified to reflect other motives of the federal government’s behavior. For example, federal policy may be targeted at increased regional fiscal capacity instead of improving welfare of households (which is identical to the reduction of interregional socio-economic inequalities). It can significantly change both the behavior of households and enterprises.

References
[1] Bakhtizin A, Bukhvald E, Kolchugina A 2016 Alignment of Regions in Russia: Illusions of the Program and Reality of the Economy The Bulletin of the Institute of Economics of the Russian Academy of Sciences 1 76-91
[2] Kotlyarov M, Sidorova E, Tatarkin D 2009 Tax Federalism in the System of Stimulating Regional Self-development: from Theory to Implementation Finances and Credit 37 2-7
[3] Yushkov A 2015 Fiscal Decentralization and Regional Economic Growth: Theory, Empirics, and the Russian Experience Russian Journal of Economics 1 404-418
[4] Klistorin V 2011 Modern Russian Federalism: Political and Fiscal Problems Region: Economy and Sociology 4 39-50
[5] Kadochnikov P, Sinelnikov-Murylev S, Trunin I, Chetverikov S 2003 Regional Income Redistribution within the Framework of Russia’s Intergovernmental Relations Questions of Economics 10 77-93
[6] Boadway R, Flatters F 1982 Efficiency and Equalization Payments in a Federal System of Government: A Synthesis and Extension of Recent Results The Canadian Journal of Economics 15 613-633
[7] Oates W 1999 An Essay on Fiscal Federalism Journal of Economic Literature 37 1120-1149
[8] Gordon R 1983 An Optimal Taxation Approach to Fiscal Federalism The Quarterly Journal of Economics 98 567-586
[9] Epple D, Romer T 1991 Mobility and Redistribution Journal of Political Economy 99 828-858
[10] Wildasin D 1988 Nash Equilibria in Models of Fiscal Competition Journal of Public Economics 32 229-240
[11] Wildasin D 1994 Income Redistribution and Migration Canadian Journal of Economics 27 637-656
[12] Wildasin D 1997 Income Distribution and Redistribution within Federations *Annales D’Économie et de Statistique* **45** 291-313

[13] Groenewold N, Hagger A, Madden J 2003 Interregional Transfers: A Political-Economy CGE Approach *Papers in Regional Science* **82** 535-554

[14] Isaev A 2019 Effects of Interregional Redistribution of Financial Resources: a General Equilibrium Approach *Economy of Region* **15** 618-630

[15] Bewley T 2007 *General Equilibrium, Overlapping Generations Models, and Optimal Growth Theory* (Cambridge and London: Harvard University Press)

[16] Partridge M, Rickman D 2010 Computable General Equilibrium (CGE) Modelling for Regional Economic Development Analysis *Regional Studies* **44** 1311-1328

[17] Groenewold N, Hagger A, Madden J 2001 Competitive Federalism: A Political-Economy General Equilibrium Approach *Economics Discussion / Working Papers* 01-10