

CGE Evaluation of Fiscal Equalization Schemes

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Abstract

A multi-regional dynamic CGE model RHOMOLO was employed to evaluate the potential impact of alternative fiscal equalization schemes on interregional growth and convergence in the EU.

We simulated the expenditure and revenue equalization policies where the allocation of intergovernmental equalization transfers tackles the type of inequality that is addressed by each policy intervention.

The results suggested that expenditure equalisation is the only policy that promotes regional convergence, therefore it should be prioritized in countries with significant interregional disparities. Revenue equalisation produced much stronger policy impacts than expenditure equalization. The pattern of policy effects generated by elimination of fiscal imbalances at both revenue and expenditure side was similar to that of revenue equalization but of the reduced strengths.

Reinvestment of tax income into the mechanisms that widen tax base in periphery regions should be the key element of revenue equalization policies as it permits to moderate interregional divergence.

For all scenarios, the most opposite impacts were observed in countries with substantial interregional fiscal disparities on revenue and expenditure side such as Italy, Greece, Spain, Ireland and France.

Model results certify that fiscal equalization policies should be evaluated with spatial models that capture inter-regional impacts, as positive country-level impacts can conceal growing regional divergence.

Key words: computable general equilibrium model, fiscal equalization, government transfers, regional convergence

JEL Classification: R13, C68, H73, E62

Introduction

There is considerable momentum in the world towards increasing the degree of fiscal decentralization. Central governments have greater revenue raising power over subnational governments, while the latter have advantages in providing place-tailored public services. A problem associated with decentralisation is possible emergence of regional disparities if regions within the same country differ in revenue-raising capacities, costs and needs for government services, as point out Beramendi (2007) and Stegarescu (2009).

Many ex-post econometric studies certified that fiscal decentralization tended to be associated with a general reduction in territorial disparities (Sacchi and Salotti, 2014, Shankar and Shah, 2003, Rodríguez-Pose and Gill, 2005, Rodríguez-Pose and Ezcurra, 2010). However, recent empirical research qualifies this general result, showing that decentralization can promote significant regional convergence in wealthier countries, and increase regional inequalities in developing and emerging economies, depending on government quality (Kyriacou et al., 2013), existing disparities and fiscal redistribution systems (Lessman, 2012).

In overcoming regional inequalities, many OECD countries introduced fiscal equalization arrangements with objective to empower subnational governments to provide their citizens with similar sets of public services at comparable tax rates. There is a wide variety of equalisation schemes across countries. Many countries have “incomplete” form of decentralisation that involves only the transfer of expenditure responsibilities to subnational governments, without the corresponding transfer of revenue responsibilities (Bird and Smart, 2002, Dafflon and Vaillancourt, 2002). In order to close horizontal imbalances, central government distribute intergovernmental equalization transfers. The size and allocation principle normally corresponds to the type of inequality that is addressed by a given policy, i.e. differences in revenue or in cost (OECD, 2007).

Albeit, numerous studies were dedicated to the empirical evaluation of already executed fiscal decentralisation policies, the ex-ante evaluation remains scarce.

Based on a regional computable general equilibrium (CGE) model for Australia, Groenewold and Hagger (2005, 2003) found that intergovernmental transfers have significant welfare effects, inducing migration from the donor region to the recipient region.

Computer simulations with the regional CGE model for the UK of Foreman-Peck and Zhou (2019) discouraged decentralization of taxation to the same extent as decentralization of public spending, since limited tax devolution could trigger substantial tax revenue and value added spillovers from migration on the devolved economy.

Rutherford T.F. and Törmä H. (2010) conducted simulations with the regional CGE model for Finland which shown that differentiation of the employers' social security contributions and value-added taxes could be effective regional instrument to restrain out-migration and unemployment.

Employing a regional CGE model for Colombia, Haddad et al. (2018) demonstrated that distribution of interregional transfers proportionally to the number of people impoverished or proportionally to the horizontal equity gaps, improves regional inequality but affects growth; distribution according to the regional population shares increases regional disparities but yields gains in national growth.

To extend the ex-ante impact assessment, a devolved economy submodule was introduced in the dynamic multi-regional dynamic CGE model RHOMOLO (Lecca et al., 2018).

The RHOMOLO model covers all NUTS2 regions of the EU, that permits to feature the inter-regional disparities within each Member State, and to model a wide range of fiscal equalization policies that are implemented both at the national and regional levels, capturing both direct and cross-border spillover effects.

As fiscal devolution presents new opportunities for economic governance in the EU, this paper seeks to identify the regional, national and EU-wide impacts of revenue and expenditure equalization policies.

The paper is structured as follows. Section 1 presents a non-technical description of the current structure of RHOMOLO. Section 2 outlines model scenarios. In section 3 the results of computer simulations with RHOMOLO are presented and discussed. Section 4 concludes the study with policy recommendations

1 Non-technical description of the RHOMOLO model

Regional CGEs have been acknowledged as the key instruments to examine geographic features of economic activity (e.g., factor mobility, transport and transaction costs, regional price differentials) that influence the speed and extent of economic development. These models allow for geographical disaggregation of country-wide policy impacts and for evaluation of policies that are implemented at a regional level. Model's results help to identify the territories where the benefits or losses will be concentrated, and to clarify which impacts can be attributed to a specific policy interventions, and which were attained due to spillover effects. This helps to identify priority areas for investment and policy interventions and to provide a basis for comparing net welfare benefits with prospective investment costs.

To provide scientific support to EU policymaking under the Cohesion Policy toolkit, the RHOMOLO model was constructed under the Regional Modelling project of JRC-IPTS on behalf of DG REGIO (Lecca et al, 2018).

RHOMOLO was calibrated to the regionalized Social Accounting Matrixes (SAMs) of NUTS2¹ regions, since they are the basic regions for the application of regional policies, Eurostat (2006).

In RHOMOLO all regions are inter-connected with the trade and factor flows. Trade decisions are modelled in line with Armington's (1969) approach. The EU regions are treated as small open economies that accept non-EU prices as given; this assumption is consistent with the regional scope of the model. In this context EU's external relations involve only one non-EU trading partner that is represented by the ROW aggregate. Because of the detailed representation of spatial interactions, the model captures both the direct effects of policy interventions and spillover effects that affect economies of other regions.

Goods in RHOMOLO are consumed by households, governments and sectors. Since high spatial dimensionality of RHOMOLO requires much time and computer power to perform simulations, the current model version includes only 10 sectors, such as Agriculture, Forestry and Fishing (A), Energy Sector (B_D_E), Manufacturing (C), Construction (F), Trade and Transport (G_I), Information and Communication (J), Financial Activities (K-L), Scientific and Technical Activities (M_N), Public Services (O-Q), Other Services (R-U).

As usual in CGE models, taxes in RHOMOLO are determined in ad-valorem fashion, so that a tax at a given rate determines the fractional increase in the corresponding price level.

The model can run under the alternative settings, such as perfect or imperfect (Cournot, Bertrand or monopolistic) competition, perfect or imperfect factor mobility, autonomous or return-optimised investments, and Phillips-type, wage curve or flexible wage labour market.

Though the labour supply is fixed at the EU level, workers can migrate between regions within the skill level (low, medium, high). The migration is governed by expected differences in the real income and probability to be employed in a given region.

In order to accommodate the heterogeneity of EU member states in terms of fiscal decentralization on revenue and expenditure sides, and to feature locational effects of public spending, a devolved economy submodule was introduced to RHOMOLO. We modelled provision of public services in NUTS2 regions by national (state) and regional governments, featuring the degree of fiscal power that they exercise, and represented financial flows between the governments. Expenditure of national governments was characterized with a two-level constant elasticity of substitution (CES) aggregate over regions within a country and sectors within a region. Spending of regional governments was modelled as CES aggregate over sectors in a region.

It should be noted that not all the NUTS2 regions have their own public administration. In a number of regions local authorities operate at the lower than NUTS2 levels. Nonetheless, since RHOMOLO is calibrated to the NUTS2 level data, the subnational governments are treated as aggregates of local governments at the lower levels. The Eurostat data (EU Commission, 2018) were used to split the accounts between the national and subnational governments.

2 Model Scenarios

The goal set in this paper is to uncover the regional impacts of cost and revenue equalization policies before they are executed, where no ex-post empirical evaluation is possible. Because of its high regional dimension, the RHOMOLO model permits evaluation of redistribution effects within each country, thus exposing the potential trade-offs between regional equity and policy efficiency.

Consequently we investigate the economic impacts of achieving by 2050 expenditure and revenue equalization in per capita terms in each EU member state. All policy goals are accomplished gradually, and the size of intergovernmental equalization transfers is tailored to smooth policy transition of governments with below average public spending, above average tax burden or fiscal imbalance (in per capita terms).

Under the first scenario, named *Expenditure equalization*, the inter-regional differences in public spending per-capita were nulled by 2050. To support the regions with below the average per capita public expenditures, the intergovernmental transfers are distributed inversely proportionally to the per capita public spending in each region.

Under the second scenario, named *Revenue equalization*, the inter-regional differences in per-capita tax revenues were eliminated by 2050. To narrow the fiscal gap, the intergovernmental transfers were distributed proportionally to regional per capita tax burden.

This scheme is likely to generate surplus tax revenues in countries with strong fiscal inequality. At the same time, it can affect regions with revenue-raising disabilities by increasing their tax rates and not tax bases.

¹ European Nomenclature of Territorial Units for Statistics at the level two

In order analyse a policy mechanism that widens tax bases, under the revenue equalization scheme, we simulated an additional case of reinvesting surplus tax revenues into total factor productivity (TFP) enhancing activities in less developed regions. According to model results, surplus tax revenues generated in Greece, Italy, Spain, Bulgaria, Check Republic, Hungary, Poland, Slovakia and the UK were allocated proportionally to the GDP of LDR of these countries. The link between R&D investments and TFP improvements was taken from econometric estimates of Kancs and Siliverstovs (2016). The values of TFP improvements that entered RHOMOLO as model shock are provided in the Figure A. 1.

Under the third scenario, named *Expenditure and revenue equalization*, the per capita public expenditures and tax burden were equalized at subnational level. The intergovernmental transfers were distributed proportionally to the regional per-capita fiscal imbalance. Logically, regions with non-negative fiscal balance received zero transfers. This grant allocation serves as an adaptation mechanism for the regions with significant fiscal imbalances.

The following formula allows to gradually equalizing model shocks over the model horizon:

$$x_{t+1} = x_t + \frac{t-1}{T} (X_t - x_t),$$

where t – a year of dynamic simulation during the policy intervention phase;

T – lengths of the policy intervention phase;

x_t – model parameter that is subject to equalization shock in year t ;

X_t – a subnational average of x_t in year t .

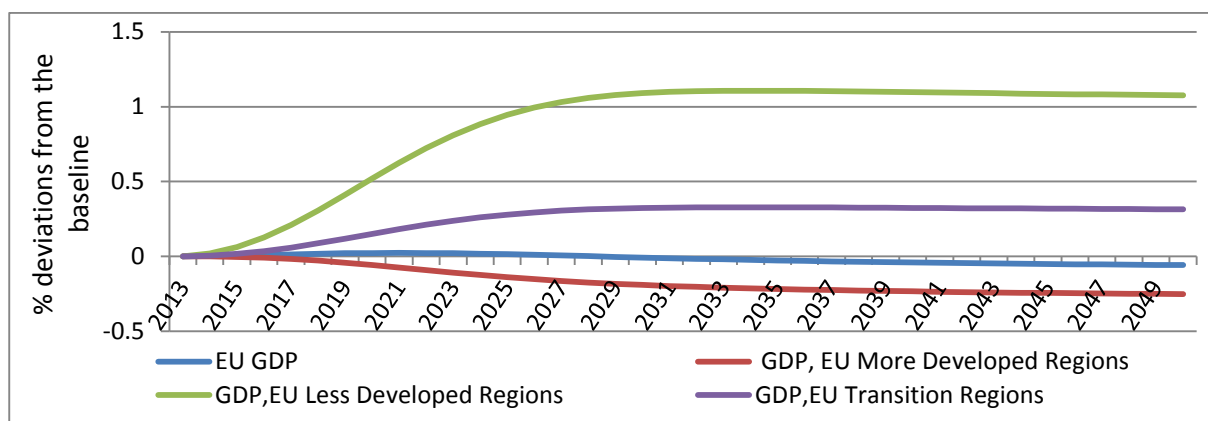
It should be mentioned that not all EU member states have simultaneously less developed (LDR), transition (TR) and more developed regions (MDR). In view of the EU regional convergence priorities, further analysis is focused on this ranking.

3 Evaluation of Alternative Fiscal Equalisation Schemes

Results of computer simulations with the RHOMOLO model demonstrate that although all fiscal equalization schemes have little impact on the EU GDP, their effects on regional convergence differ drastically.

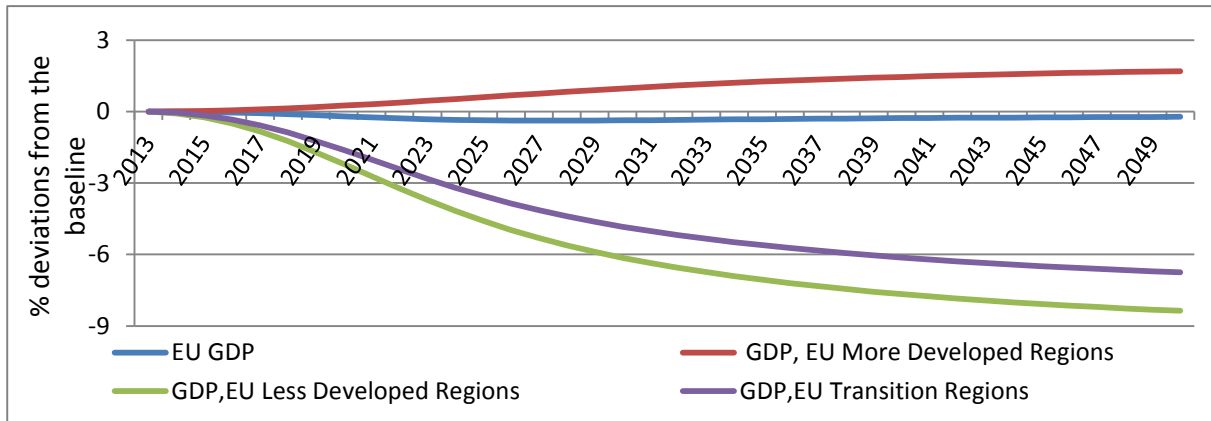
Figure 1 shows that equalisation of per-capita public spending has positive impact on LDR and TR, as it pushes their GDP up to 1.08% and 0.32% correspondingly, simultaneously lowering GDP of MDR by 0.25%, relative to the baseline projections.

Figure 1 Impact of equalization of the per-capita provision of public services on real GDP in the EU (% changes from baseline)



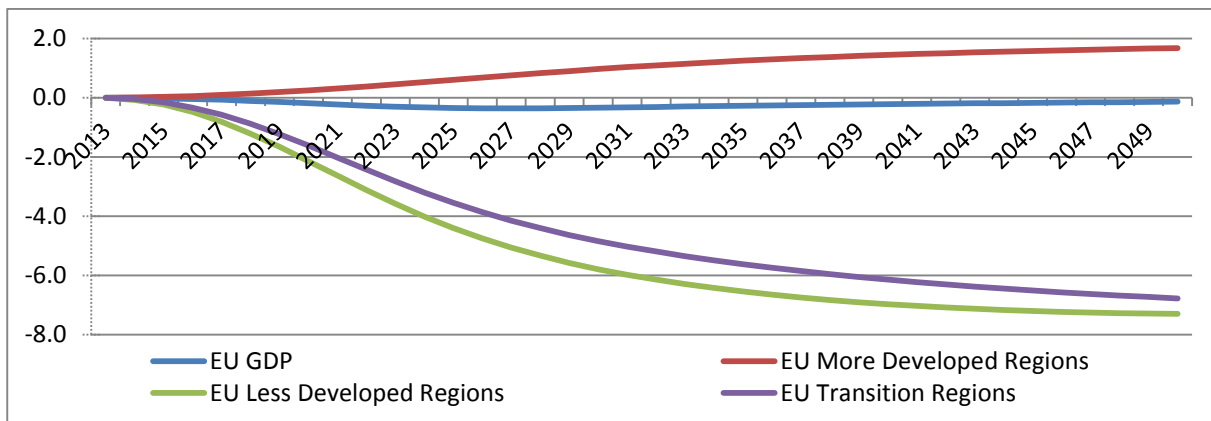
Revenue equalization without revenue rebate causes by 2050 up to 6.75% and 8.37% drop in GDP of TR and LDR, correspondingly, while raising GDP of MDR up to 1.69%, Figure 2 a).

Figure 2 Impact of equalization of per capita tax revenues on real GDP in the EU (% changes from baseline)



a)

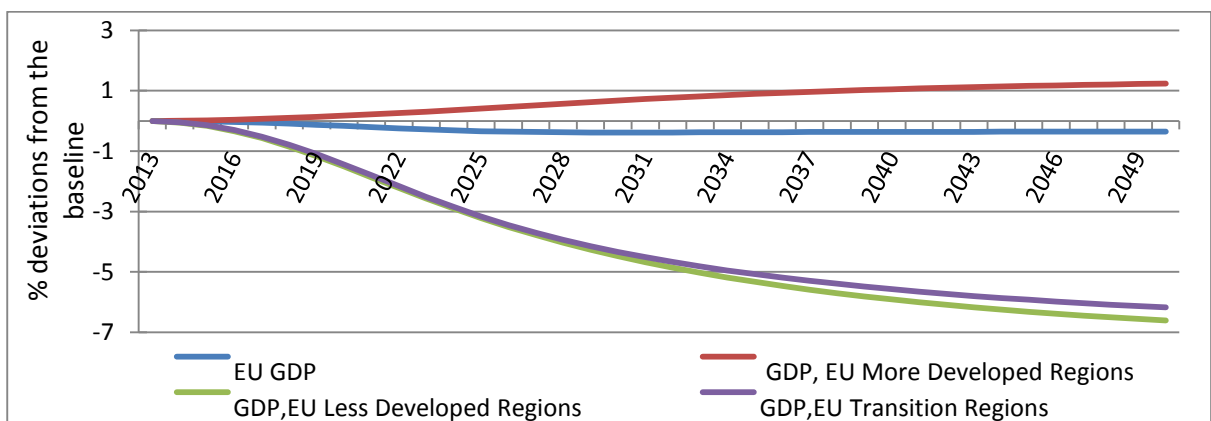
Re-investment of surplus revenues gained through tax equalization into TFP improvements moderates the negative impacts on LDR. This scheme reduces GDP losses in LDR to -7.31%, while causing marginal changes to GDP of TR (-6.78%) and MDR (1.67%) comparing with the case of tax equalization without rebate, Figure 2 b).



b)

Nullification of per capita fiscal imbalances reduces the gap between TR and LDR bringing the GDP of TR down to 6.17% and GDP of LDR down to 6.7%. At the same time, it raises the GDP of the MDR up to 1.23%, Figure 3.

Figure 3 Impact of elimination of fiscal imbalances on both revenue and expenditure side on real GDP in the EU (% changes from baseline)



At the EU level model scenarios produce nearly identical impacts, Figure 1- Figure 3. Nevertheless, they generate very diverse effects on individual EU member states, as shows Table A.1 in the Annex. What strikes is that all policy interventions have positive impacts on Italy, and negative-on Belgium, Croatia,

Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Poland, Slovakia, Slovenia, Sweden, and Spain. Even though, model shocks were not applied to the countries that consist of one NUTS2 region, Estonia, Latvia, Lithuania, Luxembourg, Cyprus and Malta are affected by policy spillovers from other regions. On the whole, propagation of spillover effects largely depends on strengths of a policy shock and economic inter-connectedness of regions. Revenue equalization with tax rebate into the TFP improvements in LDR causes GDP growth in the maximum amount of countries. In contrast, expenditure equalization has the narrowest range of the weakest mostly negative impacts among all model scenarios (see Table A.1).

Country-level results would encourage equalization at both revenue and expenditure side with reinvestment of tax revenues into widening the tax base in periphery regions, as this scheme would have positive impact on GDP in the most of the EU member states.

However, analysis of regional impacts can reveal potential trade-offs between regional equity and policy efficiency. The GIS maps of NUTS2 regions (Figure A. 2– Figure A. 5) show both the direct and spillover effects of alternative fiscal equalization schemes on GDP, employment and migration.

These figures demonstrate that the scenarios of revenues and expenditure equalization produce very distinct regional effects, since the former boosts the divergence and the latter promotes convergence among the NUTS2 regions.

Expenditure equalization has the smallest interval of regional impacts among all the other policy interventions. The GDP changes lay in the interval of (-1.44–5.08%), employment (-2.23%–6.67%) and migration (-1.9%–5%), see Figure A. 2. It is the only scenario that favours periphery regions that generally receive low public expenditure. Expenditure equalization acts as a pure demand shock, stimulating production and, therefore employment and migration to the poorer regions.

Revenue equalization without subsequent reinvestment of surplus tax revenues provokes the strongest among the rest of scenarios changes in regional GDP (-29.57%–14.08%), employment (-38.86%–18.31%) and migration (-21.68%–12.23%), see Figure A. 3. Since richer regions generally have higher tax incidence, this policy intervention redistributes the tax burden from the core to periphery and affects the poorer economies. At a country level this scenario gives a boost to the GDP of Italy, Romania, Netherlands, Austria and Portugal (see Table A.1). However, this growth is largely achieved through growth in richer regions, see Figure A. 3. Inequality between MDR and LDR is especially noticeable in Italy, Greece, Spain, and France. On the other hand, Eastern European countries with a predominance of LDR display quite moderate range of impacts, see Figure A. 3.

Results of modelling confirm that widening of tax bases in LDR through TFP improvements flattened the impacts of revenue equalization. Due to both direct and spillover effects, this policy mechanism had positive effects on the maximum among all scenarios number of countries, Table A.2 and Figure A. 4. On the whole, the strength of direct policy impacts depends on the amount of reallocated tax revenues, and thus, intensity of TFP shock, and also on significance of LDR in country's economy.

Model's results certify that revenue equalisation has much stronger impacts than the expenditure equalization. This explains why the pattern of policy impacts generated by elimination of fiscal imbalances both at revenue and expenditure side were quite similar to the revenue equalization however, of reduced strengths, see Figure A. 2–Figure A. 5.

When fiscal imbalances are eliminated, the negative shock of increased tax burden outweighs the positive shock of increased public expenditure, which has negative impacts on poorer regions and positive impacts on richer regions. The overall impacts on GDP, employment and migration vary within (-24.87%–12.09%), (-31.71%–18.19%) and (-17.17%–11.05%), correspondingly. As it follows from Table A.3, expenditure and revenue equalization promotes GDP growth in Italy, Portugal and Netherlands, but only richer regions contribute to this growth (see Figure A. 5). If accompanied with tax revenue rebates, this scheme would increase GDP in the maximum amount of EU member states.

In general, revenue equalization and elimination of fiscal imbalances favour the metropolitan areas and large financial and business centres, since their tax burden is lowered due to the policy implementation. For all scenarios the most opposite impacts were observed in the countries with substantial inter-regional fiscal disparities on revenue and expenditure side, such as Italy, Greece, Spain, Ireland, and France (Figure A. 2–Figure A. 5).

Summary

Fiscal equalisation presents new opportunities for economic governance in the EU. However, governments are usually confronted with trade-off between efficiency and equity when designing fiscal policies.

To predict possible outcomes of such policies, this paper evaluates the regional impacts of revenue and expenditure equalization schemes.

It was found that although producing very insignificant impacts at the EU level, fiscal equalization schemes have very distinct impacts on countries and regions.

For all scenarios the most opposite regional impacts were observed in countries with substantial inter-regional fiscal disparities on revenue and expenditure side, such as Italy, Greece, Spain, Ireland, and France.

Given that generally, poorer regions receive lower public expenditure, equalization of per capita public expenditure is the only scenario that reduced inter-regional disparities.

Because of higher tax incidence in richer regions, revenue equalisation redistributed tax burden from the core to periphery. However, reinvestment of surplus tax revenues into factor productivity enhancing activities in less developed regions flattened inter-regional disparities.

Overall, revenue equalisation has visibly stronger impacts on regional economies than expenditure equalization. That explains why elimination of both revenue and expenditure imbalances produced the pattern of policy effects similar to revenue equalization scenario, but of reduced strength.

The main conclusion is that fiscal equalization policies should be evaluated with multi-regional models that expose distributional impacts of policy interventions. Expenditure equalization should be prioritised in the countries with significant inter-regional inequalities. Revenue equalization should be combined with an effective mechanism that widens tax base in periphery regions.

The fiscal devolution submodule, developed for RHOMOLO, can be employed for evaluation of fiscal decentralisation schemes different from considered in this paper. Vertical and horizontal equalization are the obvious examples; these are policies in which inter-regional impact is very important, and which can be evaluated via spatial CGE models.

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Annex

List of Abbreviations

CES	Constant elasticity of substitution
CGE	Computable general equilibrium model
LDR	Less developed regions
MDR	More developed regions
NUTS	Nomenclature of Territorial Units for Statistics
SAM	Social Accounting Matrix
TFP	Total factor productivity
TR	Transition regions

Figure A. 1 **TFP improvements in LDR regions due to the surplus revenue rebate**

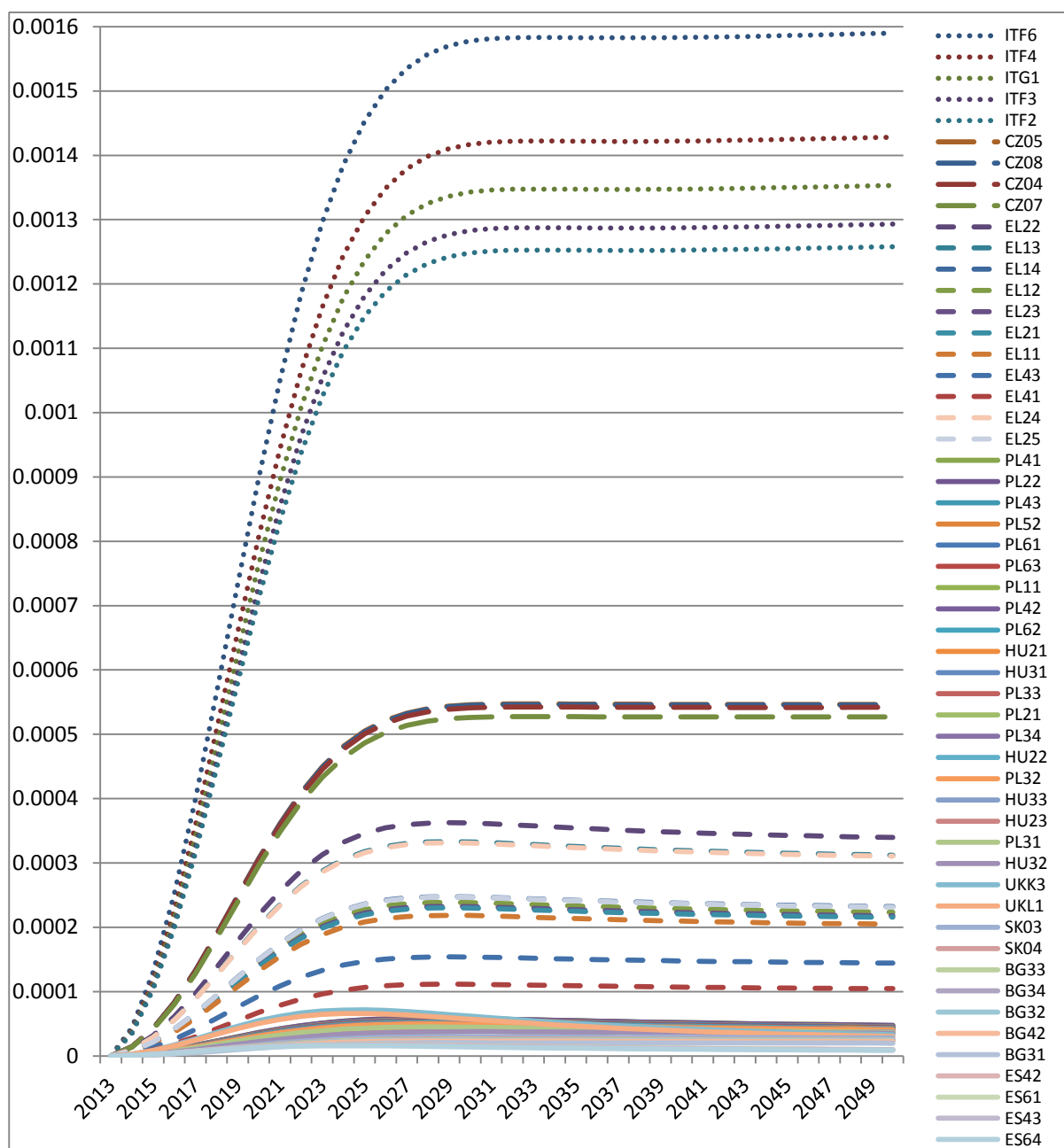


Table A. 1 Impact of fiscal equalization policies on real GDP in the EU member states, 2050 (% changes from baseline)

	Equalization of the per-capita provision of public services	Equalization of per capita tax revenues		Elimination of fiscal imbalances
		No reinvestment of tax revenues	Re-investment of revenues gained through tax equalization into TFP enhancing activities in LDR	
Austria	-0.192	0.227	0.226	-0.001
Belgium	-0.239	-0.509	-0.491	-0.693
Bulgaria	-0.214	-0.070	0.025	-0.276
Cyprus	-0.095	0.330	0.323	0.203
Check Republic	-0.260	-0.248	0.999	-0.611
Germany	-0.091	-0.948	-0.934	-1.077
Denmark	-0.402	-0.376	-0.355	-0.455
Estonia	-0.078	0.060	0.061	-0.056
Greece	-0.053	-0.144	0.364	-0.234
Spain	-0.054	-0.202	-0.201	-0.323
Finland	-0.093	-2.677	-2.647	-3.938
France	-0.140	-0.752	-0.720	-0.710
Croatia	-0.117	-0.058	-0.031	-0.165
Hungary	-0.240	-1.089	-0.958	-1.352
Ireland	-0.122	-1.274	-1.270	-1.436
Italy	0.356	2.397	2.748	2.368
Lithuania	-0.130	-0.435	-0.406	-0.533
Luxembourg	-0.125	1.636	1.625	1.416
Latvia	-0.111	-0.127	-0.036	-0.099
Malta	-0.172	0.217	0.251	0.064
Netherlands	-0.185	0.345	0.345	0.053
Poland	-0.190	-0.509	-0.312	-0.717
Portugal	-0.103	0.123	0.138	0.005
Romania	-0.413	0.254	0.296	-0.097
Sweden	-0.247	-0.181	-0.160	-0.185
Slovenia	-0.194	-0.050	-0.013	-0.283
Slovakia	-0.185	-0.663	-0.592	-0.893
United Kingdom	0.022	-0.666	-0.653	-0.824

Figure A. 2 Impacts of equalization of the per-capita provision of public services on NUTS 2 regions, 2050 (% from baseline)

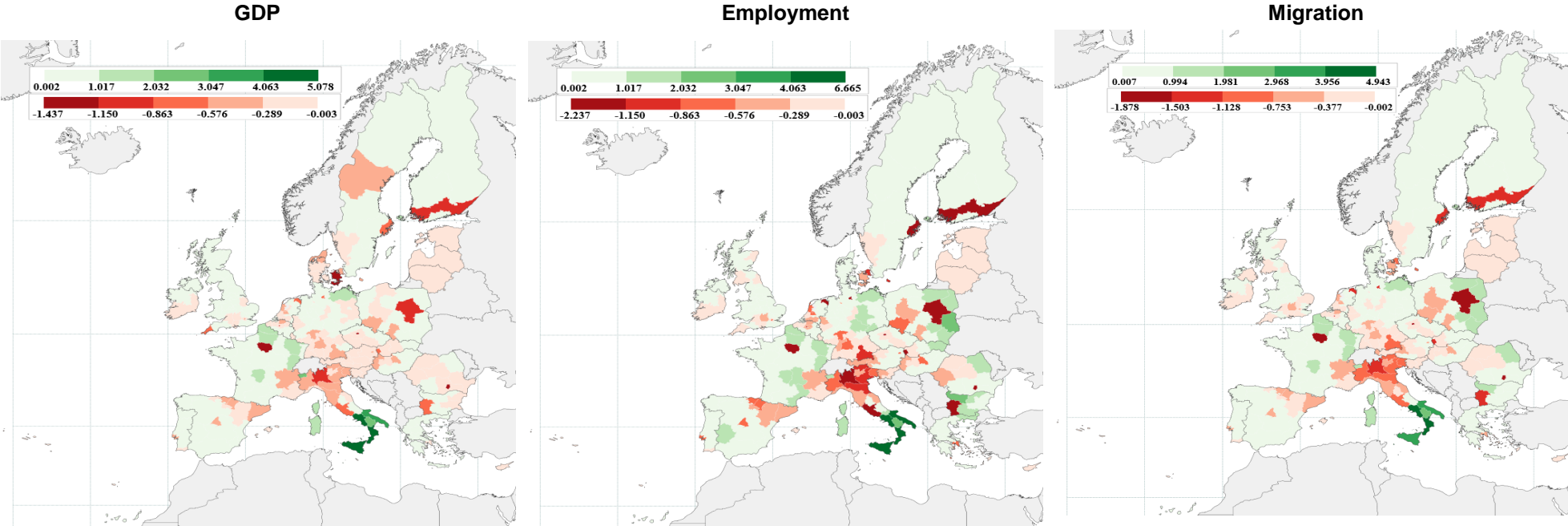


Figure A. 3 Impacts of equalization of per capita tax income without reinvestment tax revenues on NUTS 2 regions, 2050 (% from baseline)

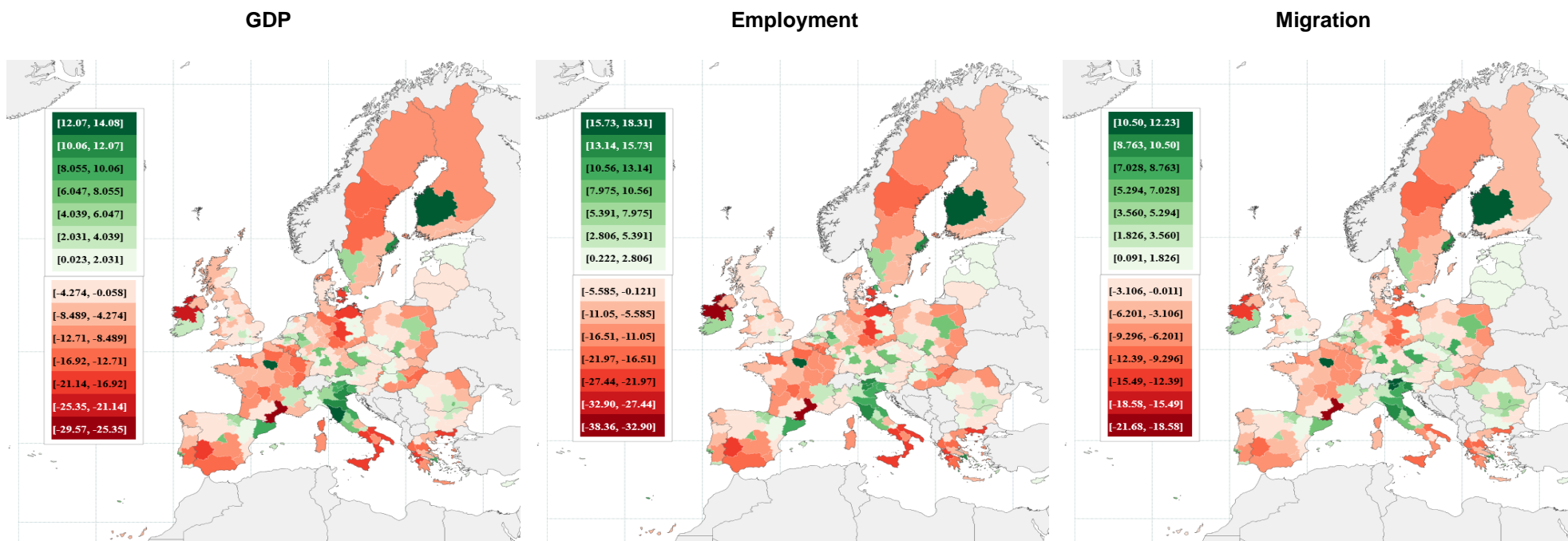


Figure A. 4 Impacts of equalization of per capita tax income with subsequent reinvestment of surplus tax revenues to TFP-enhancing activities in LDR on NUTS 2 regions, 2050 (% from baseline)

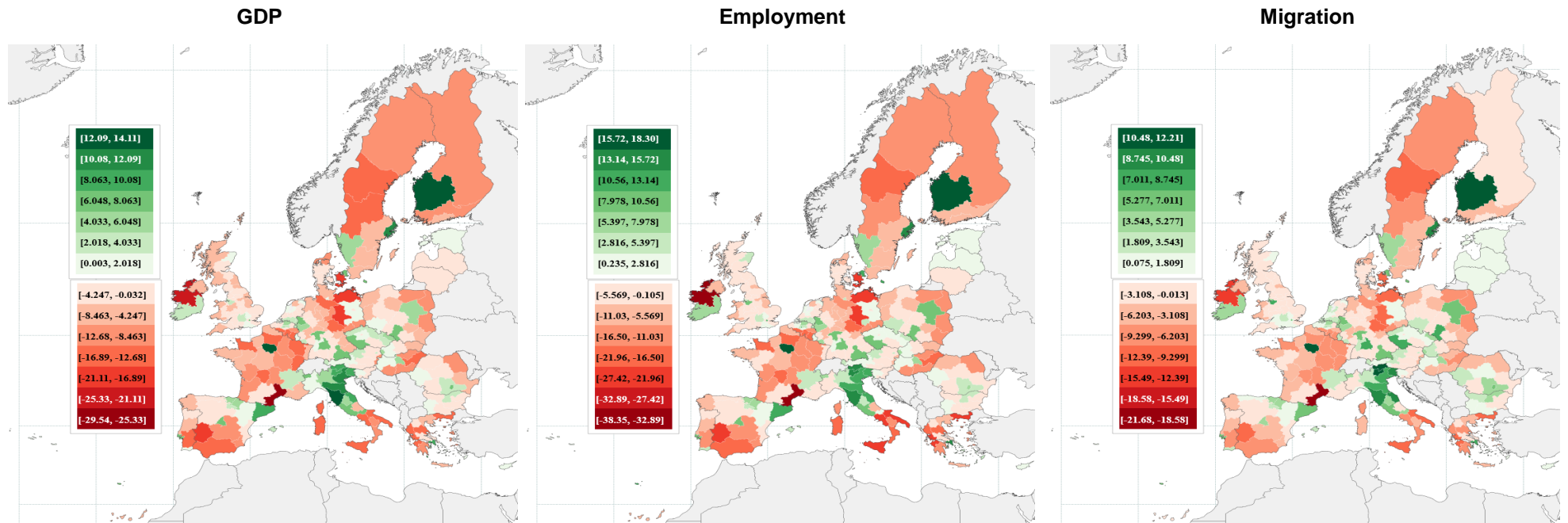


Figure A. 5 Impacts of elimination of fiscal imbalances on NUTS 2 regions, 2050 (% from baseline)

