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Simulations with a regional dynamic general equilibrium model

Philippe Monfort, Simone Salotti

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WHERE DOES THE EU COHESION POLICY PRODUCE ITS IMPACT?

Simulations with a regional dynamic general equilibrium model

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ABSTRACT

In this paper, we investigate the macroeconomic effects of the 2007–2013 cohesion policy investments in the EU. First, we present a detailed overview of the EU budget and of the contributions of the Member States for the specific policy under scrutiny. Then, we use a dynamic spatial general equilibrium model to assess the overall impact of the policy both in the short run and in the long run. Finally, we focus on the spatial spillovers generated by the policy programmes and we highlight a number of policy-relevant findings with regard to the debate over the financing of the policy and the divide between its net contributors and net beneficiaries. Our main findings suggest that cohesion policy programmes had a positive and significant impact on the economies of the EU Member States and regions, particularly in the poorest regions of the EU. Spatial spillovers imply that the progammes implemented in the main beneficiaries of the policy also benefit its main contributors. For some of these Member States, spillovers even constitute the main source of benefits from cohesion policy.

Keywords: Cohesion Policy, general equilibrium, spatial spillovers.

JEL code: C53, E62, O30, O41.

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1. INTRODUCTION

According to the Treaty on European Union, the objective of the EU cohesion policy is to strengthen economic, social and territorial cohesion, notably by reducing disparities in the levels of development between regions. Accordingly, cohesion policy supports interventions aimed at enhancing the structure of the regional economies, fosters social inclusion and promotes sustainable development.

The EU allocates considerable financial means to cohesion policy. Today, it is the second largest item in the budget, after the common agricultural policy, being allocated around EUR 355 billion for the 2014–2020 programming period, around one third of the multiannual financial framework.

Cohesion policy is supposed to support the process of convergence, through which the less developed EU countries and regions catch up with the more developed ones. Thus, it devotes most of its resources to the former group of regions. At the same time, the EU budget is largely financed by the contributions of the Member States, which are proportionate to their gross national income (GNI). As a result, cohesion policy implies a transfer of resources from the richest to the poorest EU Member States and regions, which is an expression of European solidarity.

This partly explains why cohesion policy is one of the most debated and evaluated policies of the EU. While some Member States are net beneficiaries of the policy, others are net contributors, and the policy is constantly scrutinised regarding the use of the funds and its capacity to deliver results. This has led to a vast literature trying to assess the impact of the policy and its value for money with a wide variety of techniques, including various econometric analyses, theory-based evaluations and counterfactual impact evaluations (see, for instance, Fratesi and Wishlade, 2017).

A question keeps coming back in the discussions on how the benefits and the costs of the policy are shared among the Member States: what are the returns to the net contributors from the policy interventions in the net beneficiaries? Cohesion policy is likely to produce important spatial spillovers, with the programmes implemented in a given region having an impact in the rest of the EU. For instance, the economic activity generated by the interventions in the net beneficiaries may lead to an increase in disposable income and, therefore, in imports, some of which could originate from the net contributors. Interventions also increase the competitiveness of the recipients, thereby affecting the spatial distribution of business and factors of production (capital and workers) throughout EU territories. This type of mechanism can have a considerable impact on the costs–benefits balance of the policy and, as a result, the net contribution or benefits of the Member States cannot be properly assessed by simply looking at the amounts they pour into, and receive from, the community budget.

However, quantifying such indirect effects of the policy is not a simple task and only a few analytical instruments can actually provide credible estimates. In this paper, we use a spatial dynamic computable general equilibrium model called RHOMOLO to analyse the spillovers associated with the EU cohesion policy for the 2007–2013 programming period. We particularly focus on the extent to which the benefits of the interventions implemented in the net beneficiaries spread out to the net contributors. The results of the modelling simulations suggest that, in the medium to long run, there are substantial benefits originating in the regions targeted by the policy, which spread to the rest of the EU. This makes the interventions beneficial even for the territories that contribute the most to the financing of the interventions themselves.

The remainder of the paper is organised as follows. Section 2 sets the scene regarding the EU budget and the contributions of the Member States to cohesion policy, mainly using information from the programming period 2007–2013, on which the analysis is based. Section 3 provides a brief description of RHOMOLO while Section 4 explains how cohesion policy interventions are factored into the model as policy shocks. Section 5 discusses the results of the simulations and Section 6 provides a conclusion.

2. THE EU BUDGET AND THE CONTRIBUTION OF THE MEMBER STATES

Most of the EU budget comes from traditional own resources and national contributions. The former consist of duties and levies, while the latter mostly consist of value added tax (VAT)-based and GNI-based national contributions.

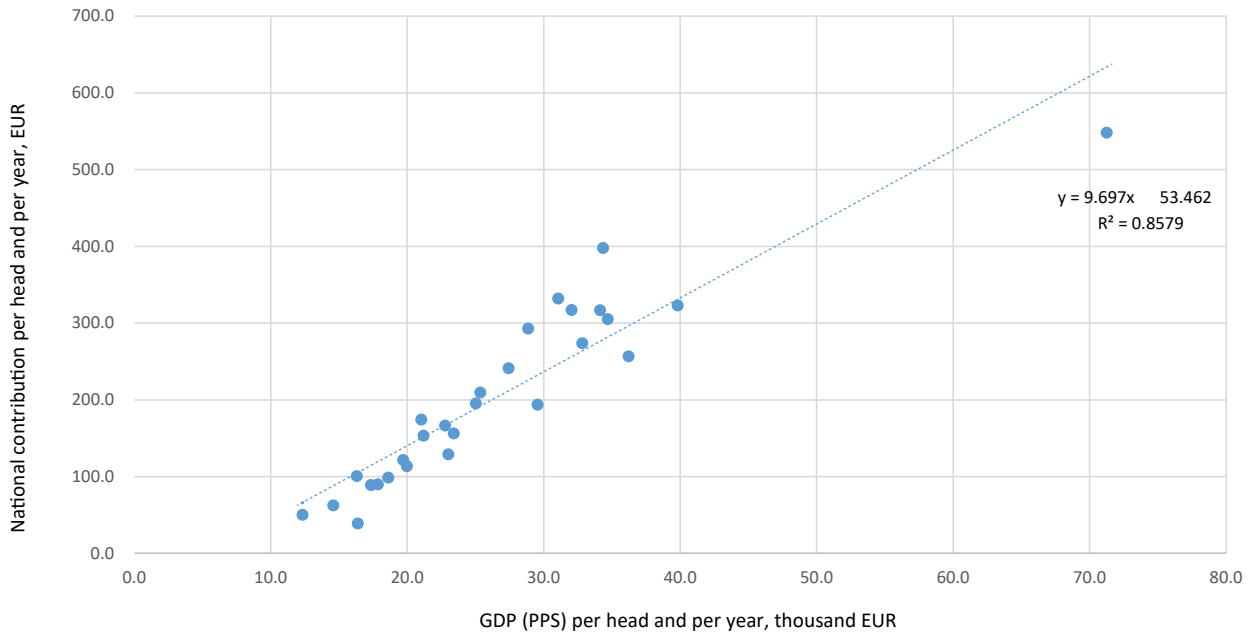
Duties and levies included in the traditional own resources are mainly sugar levies ([1]) and customs duties on imports from outside the EU. The Member States are responsible for the collection of these resources and they retain 20 % of the traditional own resources paid to the EU budget to compensate for the collection costs.

The VAT-based national contribution is a percentage of the VAT base of each Member States which, for both the 2007–2013 and the 2014–2020 multiannual financial frameworks, corresponded to a call rate of 0.30 % of the national VAT base. The GNI-based national contribution corresponds to a call rate applied to the GNI of each Member State, calculated to provide the revenue necessary to cover expenditure in excess of the other revenues, thereby ensuring that the annual EU budget is always balanced. The rates vary accordingly from one financial year to another, and various mechanisms exist to correct financial contributions considered as excessive for some Member States ([2]).

The national contributions represent by far the largest source of revenue of the EU budget. Between 2007 and 2017, national contributions amounted to 79 % of the total financing on average (12 % accruing to the VAT-based contribution and 67 % to the GNI-based resource). The biggest EU economies contribute more to the community budget than the smallest ones due to the correlation of these contributions with GNI (by design). During the 2007–2017 period, Germany, France, Italy and Spain represented, respectively, 20.1 %, 17.5 %, 13.2 % and 8.9 % of the total national contributions.

Given these characteristics, the EU budget is redistributive, both on the revenue and expenditure sides. As highlighted by Figures 2.1 and 2.2, there is a strong correlation between Member States' gross domestic product (GDP) per capita and their contribution to the operating expenditure of the community budget ([3]). On the contrary, operating expenditure per capita is negatively correlated to GDP per capita, although not as significantly ([4]).

Figure 2.1: National contribution to operating expenditure per capita vs GDP per capita (yearly average 2007–2017)



Source: Own calculations based on European Commission data.

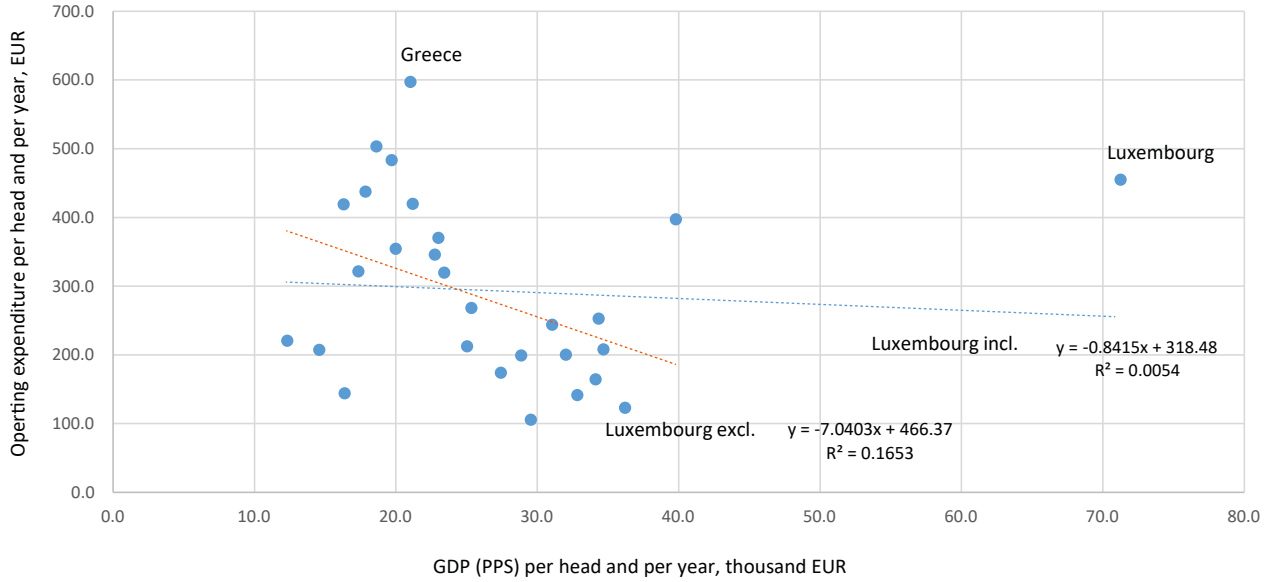
1 The sugar quota system ended by the marketing year 2016/2017 (30 September 2017) which implies that Member States paid the sugar production tax and the surplus levy to the EU for the last time in March 2017 and June 2018.

2 These correspond to the United Kingdom rebate, a reduction of the national contribution for Austria, Denmark, the Netherlands and Sweden and a reduction of the VAT call rates for Germany, the Netherlands and Sweden.

3 The operating expenditure excludes the administration costs. These are concentrated in the Member States hosting the EU institutions and hence introduce a bias in the geographical distribution of expenditure. The national contributions to the operating expenditure are calculated as the national contribution multiplied by the share of operating expenditure over total expenditure in each Member State.

4 However, this result is strongly influenced by Luxembourg, which stands as an outlier. When excluding this country from the analysis, the negative relationship between GDP per capita and operating expenditure becomes much clearer and more significant.

Figure 2.2: Operating expenditure per capita vs GDP per capita (yearly average 2007–2017)

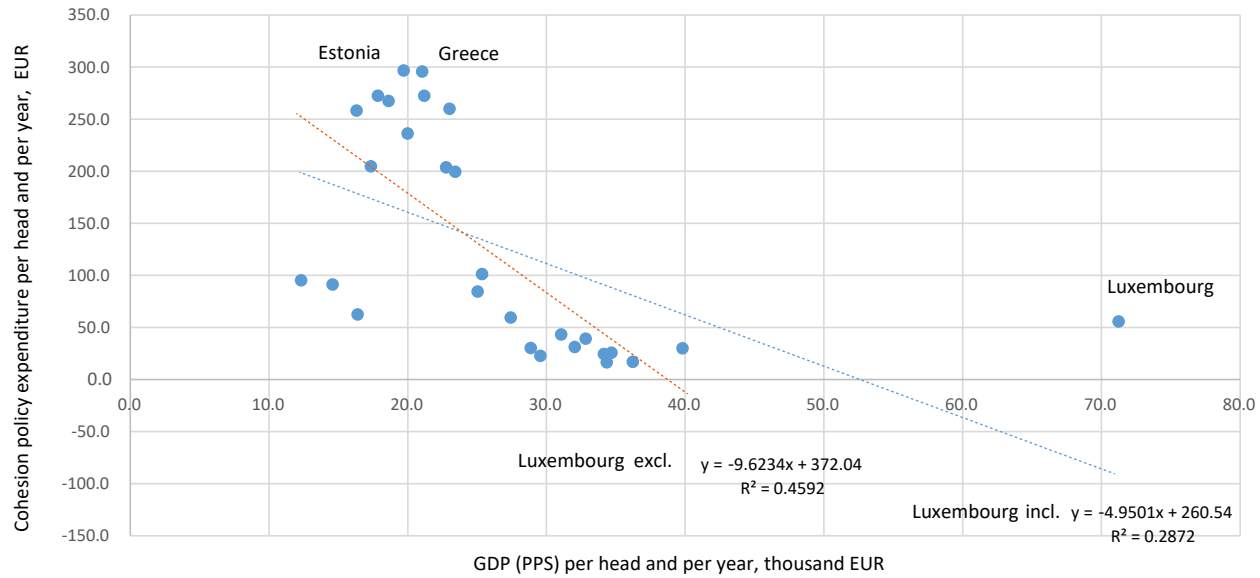


Source: Own calculations based on European Commission data.

In contrast, the correlation between cohesion policy expenditure and GDP per capita is much stronger (Figure 2.3). This reflects the legal basis of the policy to reduce development gaps in the EU, which operationally implies that the funding is concentrated in the less developed Member States and regions of the EU.

The operating budgetary balance is the difference between the national contribution to the operating expenditure and these expenditures in each Member State. The community budget being at equilibrium, the balance at the EU level is zero. The amount of funding redistributed then corresponds to the sum

Figure 2.3: Cohesion policy expenditure per capita vs GDP per capita (yearly average 2007–2017)



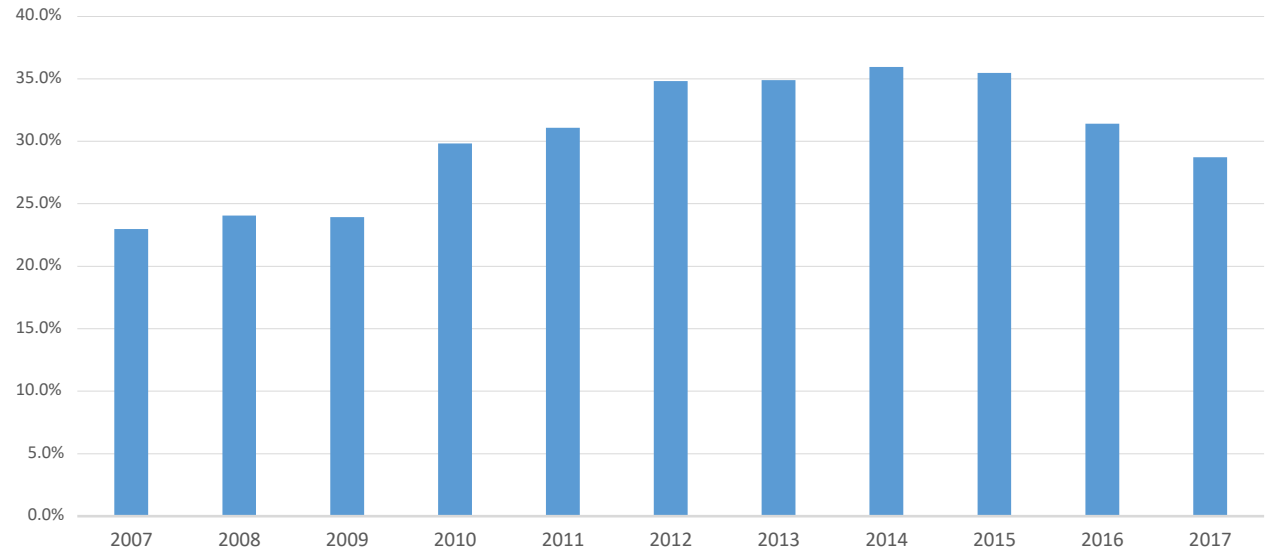
Source: Own calculations based on European Commission data.

of the positive national balances (which corresponds to the absolute value of the sum of the negative balances). Between 2007 and 2017, redistribution among Member States ranged between 23.0 % and 35.9 % of operating expenditure, with an average of 30.3 % for the whole period, as shown in Figure 2.4.

Cohesion policy plays a key role in the redistribution implemented through the EU budget. The balance between the contribution of the Member States to cohesion policy ([5]) and cohesion policy expenditure is shown in Figure 2.5 below ([6]).

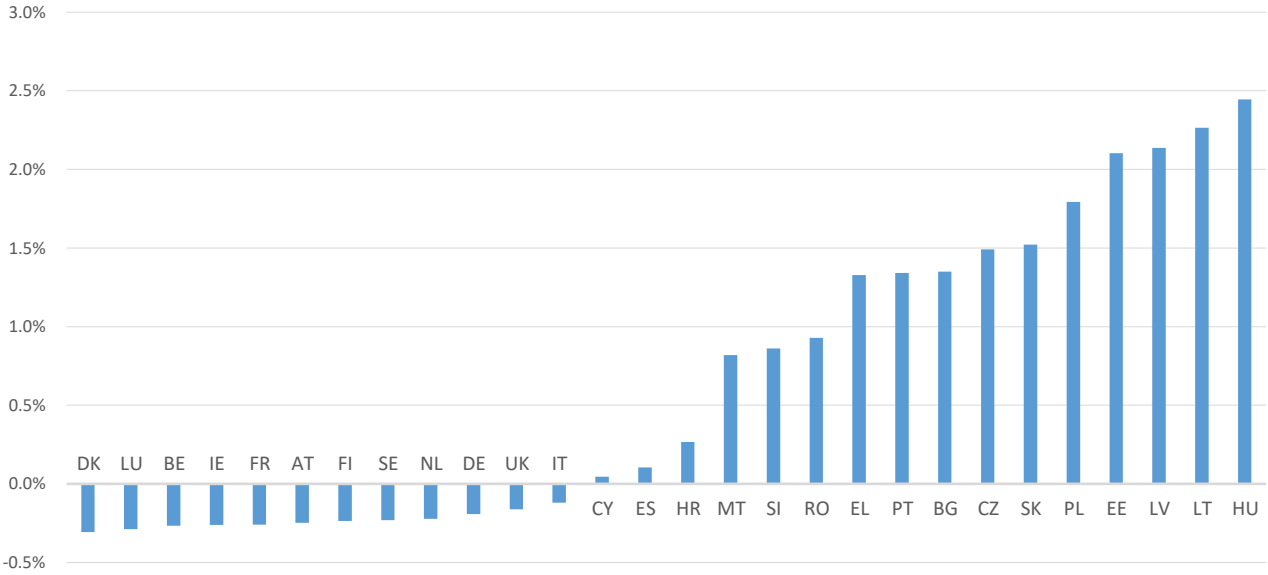
On average, between 2007 and 2017, almost EUR 22 billion was redistributed each year via cohesion funding, which corresponds to 64.2 % of the total amount redistributed through the EU budget.

Figure 2.4: Redistribution through the EU budget as % of operating expenditure



Source: Own calculations based on European Commission data.

Figure 2.5: Cohesion policy balance (average 2007–2017, % of GNI)



Source: Own calculations based on European Commission data.

[5] The contribution of the Member States to cohesion policy corresponds to the national contribution multiplied by the share of cohesion policy in the operating expenditure.

[6] In fact, the Member States for which the balance is positive are those eligible for the cohesion fund for 2007–2013.

However, EU budget national contributions and expenditures are not the only source of redistribution linked to cohesion policy. Indeed, not only do the programmes produce their impact in the countries where they are implemented, but they also affect the rest of the EU due to the many spillovers generated by this type of policy. The sources of these spillovers are numerous. Notably, they stem from the fact that the net recipient countries are often small open economies with narrow industrial bases, where many goods or services critical for the implementation of cohesion policy programmes are not produced domestically. Thus, the implementation of the programmes generates demand for these goods and services which can only be satisfied via imports, notably from other countries and regions of the EU. The induced process of development also triggers demand for imports of a wide range of goods and services from their main, and more advanced, trading partners.

One additional spillover source lies in the research and development (R & D) investments: the effects of an innovation hardly remain confined to a specific territory since other regions can benefit through processes of imitation or technological externalities (Bottazzi and Peri, 2003). Finally, some of these spillovers may also be negative. Cohesion policy investments boost the competitiveness of the beneficiaries, which can then gain market shares at the expense of the others.

In this paper, we investigate the redistribution linked to cohesion policy by taking into account the spatial spillovers generated by the policy, with a particular focus on the net recipient and net contributor Member States and regions. In order to do so, we use a spatial dynamic general equilibrium model called RHOMOLO which allows us to disentangle the effects and transmission mechanisms of cohesion policy via a scenario analysis.

3. A CONDENSED DESCRIPTION OF THE RHOMOLO MODEL

In this section, we outline the main equations of the RHOMOLO model to help the reader identify the key drivers and determinants of the spatial outcomes generated by it. More details on the model can be found in Lecca et al. (2018). In this paper, we use a version with an updated treatment of transport costs based on Persyn et al. (2020).

The model represents a decentralised market economy based on the assumption that producers maximise their profits and consumers maximise the utility derived from their consumption, with market prices adjusting endogenously to keep supply and demand balanced in all markets.

The domestic economy consists of the 267 endogenous NUTS 2 regions ([7]). The rest of the world is an exogenous external sector. The model includes the following 10 NACE rev.2 economic sectors: agriculture, forestry and fishing; energy; manufacturing; construction; trade and transport; information and communication; financial activities; R & D; public administration; and other services. Firms operate under a monopolistic competition framework à la Dixit and Stiglitz (1977) in all sectors except for agriculture, public administration and other services in which perfect competition is assumed.

The aggregate consumption level is directly related to the disposable income. Households consume all the final goods available in the economy and love of variety is assumed by adopting a consumption function with constant elasticity of substitution (CES). Government expenditure comprises current spending on goods and services and net transfers to households and firms. Government revenues are generated by labour and capital income taxes, and indirect taxes on production. The cost of cohesion policy is modelled via a contribution of each Member State proportional to its GDP financed by lump sum taxes.

The firms' production technology is represented by a multilevel CES function combining value added and intermediate inputs, net of fixed costs. Total factor productivity is modelled via a conventional Hicks neutral technical change parameter. Public capital enters the production function as an unpaid factor of production for which congestion effects are taken into account, as in Edwards (1990), Turnovsky and Fisher (1995) and Fisher and Turnovsky (1998).

Goods and services can either be sold in the domestic economy or exported to other regions. At the same time, firms and consumers can purchase inputs within the region or from external markets. We use a single Armington nest that differentiates between domestic and imported goods and does not differentiate between imports from within the country or within the EU. In terms of prices, a Dixit-Stiglitz formulation of the markup is adopted for the firm-level product differentiation with elasticities of substitution that are equal for all firms and products in the model. Furthermore the markup does not depend on the market shares, therefore a single region sells products to all the other regions at the same fob (first on board) price, even if consumers in the importing regions can observe different cif (cost, insurance and freight) prices. The latter include iceberg transport costs (Krugman, 1991), which are obtained by applying a linear approximation of the results of the transport model by Persyn et al. (2020).

The RHOMOLO model incorporates imperfect competition into the labour market. We assume a flexible framework that allows one to switch from a wage curve to a Philips curve. In this analysis, we have used a static wage curve wherein the real wage is solely affected by the unemployment rate.

Private investments are modelled according to the neoclassical firm's profit maximisation theory (maximising the present value of firms). The aggregated level of investments is defined as the gap between a desired level of private capital and its actual level, adjusted by depreciation. Thus, the investment capital ratio is a function of the rate of return to capital and the user cost of capital, allowing the capital stock to reach its desired level smoothly over time. This is a typical accelerator model à la Jorgenson and Stephenson (1969) and it is consistent with the capital adjustment rules of Uzawa (1969). The user cost of capital is a function of the interest rate, the depreciation rate, the investment price index and an exogenous risk premium. In the long run, changes in capital returns in all regions should equalise, which means that the allocation of investments between regions is driven by the differences between regional and EU average return, ensuring capital flow mobility between regions. The EU is assumed to be a price-taker on the world financial market, which determines the level of the interest rate.

All shift and share parameters are calibrated to reproduce the base year data represented by the interregional Social Accounting Matrices (SAMs) for the year 2013, constructed by Thissen et al. (2019). The choice of the year 2013 for the calibration is based on data availability, as it is the most recent year for which regional SAMs can be built with a sufficient degree of reliability.

The structural parameters of RHOMOLO are either borrowed from the literature or estimated econometrically. The parameters related to the elasticities of substitution both on the consumer and on the producer side are either based on similar models or derived from the econometric literature. Typically, we assume a rather low elasticity of substitution in

[7] The French outermost regions are not included in the analysis due to data availability issues and the fact that the very long distance between them and the rest of the EU would cause technical difficulties for the model to solve.

production (0.4), a relatively higher elasticity of substitution in consumption (1.2) and a high elasticity for trade between regions (4.0), since regions are typically small and rely on external markets to satisfy a substantial part of their demand. The interest rate (faced by producers, consumers and investors) is set at 0.04, while the rate of depreciation applied to the private capital equates to 0.15 (that of public capita is set at 0.05). As for the wage curve parameterisation, we typically consider a long-run wage curve, assuming that the unemployment parameter is equal to 0.1 (Nijkamp and Poot, 2005).

The model calibration process assumes that the economies are initially in steady-state equilibrium. This means that the capital stock is calibrated to allow depreciation to be fully covered by investments. The steady-state equilibrium calibration implies that the data observed should provide unbiased information about preferences and technologies in each region and therefore relative magnitudes should not vary in the baseline scenario. We assume that there is no natural population change and we do not make any assumptions about the economic growth of regions due to external factors. Further details on the calibration and parameterisation of the model can be found in Lecca et al. (2018).

4. MODELLING COHESION POLICY INVESTMENTS

4.1. COHESION POLICY FUNDING

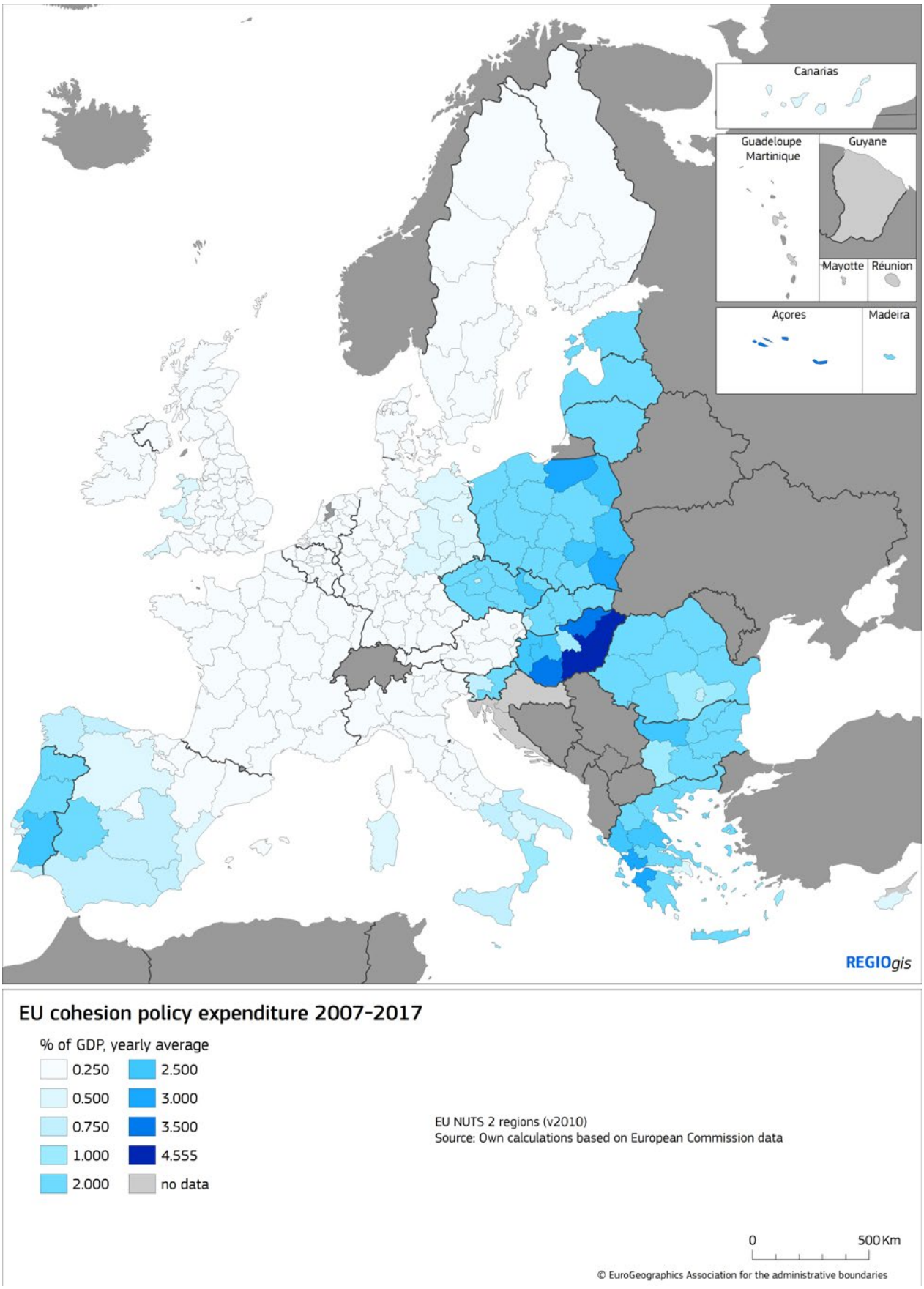
In this analysis, we focus on the programmes funded by the European Regional Development Fund (ERDF), the Cohesion Fund (CF) and the European Social Fund (ESF) during the 2007–2013 programming period, for which we have data on actual expenditure. Given the N + 3 rule ([8]), interventions were actually implemented between 2007 and 2017 and amounted in total to almost EUR 320 billion.

The interventions funded during this period were broken down into 86 categories of expenditure for monitoring purposes. Spending data for the ERDF and CF by year and by categories were provided at the NUTS 2 level by Work Package 13 of the ex post evaluation for 2007–2013 (European Commission, 2015). For the ESF, data at the regional level are not available and the amounts at the national level have been distributed across NUTS 2 regions in proportion to their population.

Resources mobilised by cohesion policy tend to be invested in the less developed parts of the EU. As highlighted by Figure 4.1, which shows the amount invested as a percentage of regional GDP, the policy channelled considerable resources to central and eastern European regions, and to a number of southern European regions, particularly in Greece and Portugal. For instance, between 2007 and 2017, cohesion policy expenditure corresponded on average to about 3.3 % of GDP in Região Autónoma dos Açores (PT20), 4.6 % in Észak-Alföld (HU32) and 4.2 % in Dél-Alföld (HU33). For more developed regions, investments were much more limited, as in Inner London – West (UKI1) or Luxembourg (LU00), where cohesion policy expenditure corresponded on average to around 0.01 % of GDP.

[8] Member States' cohesion policy allocations are divided into annual amounts that must be spent within 2 or 3 years, depending on the country. This rule is known as the 'N + 2 or N + 3' rule, with N being the start year when the money is allocated.

Figure 4.1: EU cohesion policy expenditure 2007–2017, EU NUTS 2 regions (% of GDP, yearly average)



4.2. TRANSLATING ACTUAL EXPENDITURES INTO MODEL SHOCKS

In order to introduce cohesion policy in the model, we grouped the 86 categories of expenditure into the following six fields of interventions: transport infrastructure investments (TRNSP); other infrastructures (INFR); investments in human capital (HC); investments in research and innovation (RTD); aid to the private sector (AIS); and technical assistance (TA). We used a model shock to simulate each category with an appropriate economic transmission mechanism, except for the AIS and INFR categories, which are associated with more than one model shock due to the specific nature of these interventions.

Table 4.1 illustrates the combinations of model shocks used for each of the six fields of intervention listed above, together with some brief explanations of the associated economic mechanisms at work both in the short and in the long run. The list of the 86 spending categories of expenditure and their tags is reported in the appendix.

As explained above, the 2007–2013 cohesion policy programmes were actually implemented between 2007 and 2017. We therefore simulated the interventions over a period of 11 years, according to country-specific time profiles based on the data provided by Work Package 13 of the ex post evaluation for 2007–2013 (European Commission, 2015). Table 4.2 shows the time profile for expenditure at EU level, highlighting the fact that most of the money was spent in the middle of the period.

Table 4.1: Description of the model shocks by field of intervention

Field of intervention	Code	Model shock	Short-run (demand side) effects	Long-run (supply side) effects
Transport infrastructures	TRNSP	TRNSP	Increase in government consumption	Decrease in transportation costs
Other infrastructures	INFR	IG G	Increase in public investment Increase in government consumption	Increase in the stock of public capital
Human capital	HC	HC	Increase in government consumption	Increase in labour productivity (all types of labour)
Research and development	RTD	RTD	Stimulates private investment in R & D	Increase in total factor productivity (TFP)
Aid to private sector	AIS	RPREMK G	Reduction in risk premium stimulating private investment Increase in government consumption	Increase in the stock of private capital
Technical assistance	TA	G	Increase in government consumption	

Source: Own modelling assumptions based on the composition of the 2007–2013 cohesion policy expenditure categories.

Table 4.2: Time profile of expenditure

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Share of total expenditure	2.1 %	3.5 %	9.0 %	10.4 %	12.4 %	13.2 %	15.7 %	15.4 %	12.7 %	5 %	0.8 %

Source: European Commission.

4.3. A BRIEF DESCRIPTION OF THE ECONOMIC MECHANISMS AT WORK FOR EACH FIELD OF INTERVENTION

- **Transport infrastructures (TRNSP).** The resources allocated to transport infrastructure are assumed to generate temporary effects through increases in government consumption to account for the purchase of goods and services required to build the actual infrastructures. The associated long-run effect is simulated through a reduction in bilateral transport cost. The estimated reduction in costs due to cohesion policy investments is calculated with the Persyn et al. (2020) transport model and a linear approximation of it is included in RHOMOLO to simulate the general equilibrium effects generated via lower trade costs and, therefore, trade flows changes.

- **Other infrastructures (INFR).** Regional investments in non-transport infrastructures are typically related to electricity network improvements, water treatment and waste management. These are modelled and implemented in RHOMOLO as public capital-enhancing investments (IG) when associated with industrial processes (for example, 'energy efficiency investments'), and as a government consumption (G) to account for the purchase of construction services and materials when aimed at enhancing the quality of life (for example, 'promotion of clean urban transport'). Public capital-enhancing investments are implemented as an exogenous increase in the public investment augmenting the amount of the public capital stock, which enters the production function of the model as an unpaid factor, as explained in Section 3.

- **Investment in human capital (HC).** The implementation of human capital policies is modelled in RHOMOLO through a series of steps. First, in the short run, all the HC expenditures are modelled as government current expenditure. Then, to model the long-run productivity-enhancing effects of the policy, we calculate the additional school year equivalents of training that can be purchased with the cohesion policy investment in human capital in each region and for each labour skill group (low, medium and high). This allows to compute the change in school years embedded in the labour force due to cohesion policy. Following QUEST and the empirical literature on Mincer-type regressions (see e.g. Card, 2001), labour efficiency is assumed to increase by 7 % for each additional school year gained. This parameter is assumed to be identical between all countries and regions. To account for differences in educational quality between countries, we lower the return to education by the education efficiency index.

- A key piece of the required information is the cost per pupil of different levels of schooling, which is obtained from Eurostat. These data are used as an estimate of how much one year of additional training would cost to train one worker in each of the three skill groups. We take one year of the tertiary-level education as the cost of training for all skill levels, because the majority of the cohesion policy investment in the human capital aims at training workers. The last piece of information we use is employment per NUTS 2 region by skill level, obtained from Eurostat.

- **Research and development (RTD).** This expenditure is implemented in RHOMOLO through a temporary increase in private investment stimulated by a reduction in risk premium (which in turn affects the user cost of capital) to reflect the firms' investments in R & D activities. The permanent effects associated with this policy are simulated through a total factor productivity (TFP) improvement. In order to translate the money injection into TFP shocks in RHOMOLO, we use a simple accounting approach wherein the amount of investments in RTD directly augments the total output in the economy via an elasticity estimated with a model à la Kancs and Siliverstovs (2016). The elasticity depends positively on the R & D intensity of each region, a piece of data that we retrieved from Eurostat.

- **Aid to private sector (AIS)**. Regional governments also use cohesion policy to support investors who want to engage in risky activities with a high potential for fostering economic growth and employment. These interventions are modelled either as increases in government consumption (G) or as a reduction of the usage cost of capital. This stimulates private investments and therefore accelerates the accumulation of physical capital by the private sector, which positively affects productivity in the long run.

- **Technical assistance**. **(TA)** The impact of this shock on the economy is modelled with an increase in public current expenditure (G) to account for purchases of goods and services associated with the transfer of resources, with no direct long-run effects.

The mapping of expenditure categories into the fields of intervention reported in the appendix determines the policy mix of each Member State, that is, the distribution of cohesion funding among the various fields of interventions (Table 4.3).

At EU level, the highest share of payments goes to infrastructure (24.4 %) and transport (23.8 %), followed by support for the development of human capital (21.9 %). The share of the first two fields is generally much higher in the Member States that joined the EU after 2004, while in the EU-15 (Member States that were in the EU before 2004), investments in RTD, human capital and aid to the private sector are predominant.

Table 4.3: Distribution of funds per field of intervention (% of the total expenditure)

	RTD	AIS	TRNSP	INFR	HC	TA	Total
AT	22.5	25.5	0.1	4.9	42.9	4.1	100
BE	12.4	26.4	2.7	5.0	51.5	2.0	100
BG	3.5	14.4	29.3	30.5	15.2	7.0	100
CY	5.9	32.8	17.5	20.7	18.3	4.8	100
CZ	11.5	13.2	30.0	28.0	13.8	3.5	100
DE	18.0	20.6	12.5	10.2	36.3	2.4	100
DK	26.1	19.3	0.0	2.8	48.4	3.4	100
EE	15.8	10.3	21.1	42.2	9.9	0.7	100
EL	4.3	18.9	27.3	25.5	21.0	3.1	100
ES	12.7	11.3	29.2	22.0	22.4	2.4	100
FI	23.1	20.2	4.6	8.3	39.7	4.1	100
FR	19.8	13.1	4.2	19.6	39.8	3.5	100
HU	4.1	17.8	24.7	35.7	13.2	4.4	100
IE	15.3	11.0	14.0	9.5	49.9	0.3	100
IT	20.1	15.4	13.6	22.2	24.7	4.0	100
LT	11.2	11.6	24.6	36.2	12.2	4.2	100
LU	24.1	3.0	0.0	21.5	48.6	2.7	100
LV	15.4	9.8	25.8	34.3	12.2	2.5	100
MT	7.0	15.6	16.9	45.3	11.6	3.6	100
NL	19.7	17.6	2.2	5.6	52.8	2.0	100
PL	12.1	9.9	36.4	23.8	14.5	3.4	100
PT	16.2	12.3	8.0	28.6	31.9	3.0	100
RO	4.4	12.2	33.0	28.1	16.5	5.9	100
SE	21.4	21.9	9.0	4.7	40.9	2.1	100
SI	18.8	13.2	19.7	30.0	15.8	2.6	100
SK	8.1	8.9	29.9	37.1	11.9	4.1	100
UK	15.5	23.7	3.8	9.3	46.2	1.5	100
EU	**12.4**	**14.0**	**23.8**	**24.5**	**21.9**	**3.4**	**100**

Source: Own calculations based on European Commission data.

5. RESULTS

5.1. IMPACT OF THE 2007–2013 PROGRAMMES

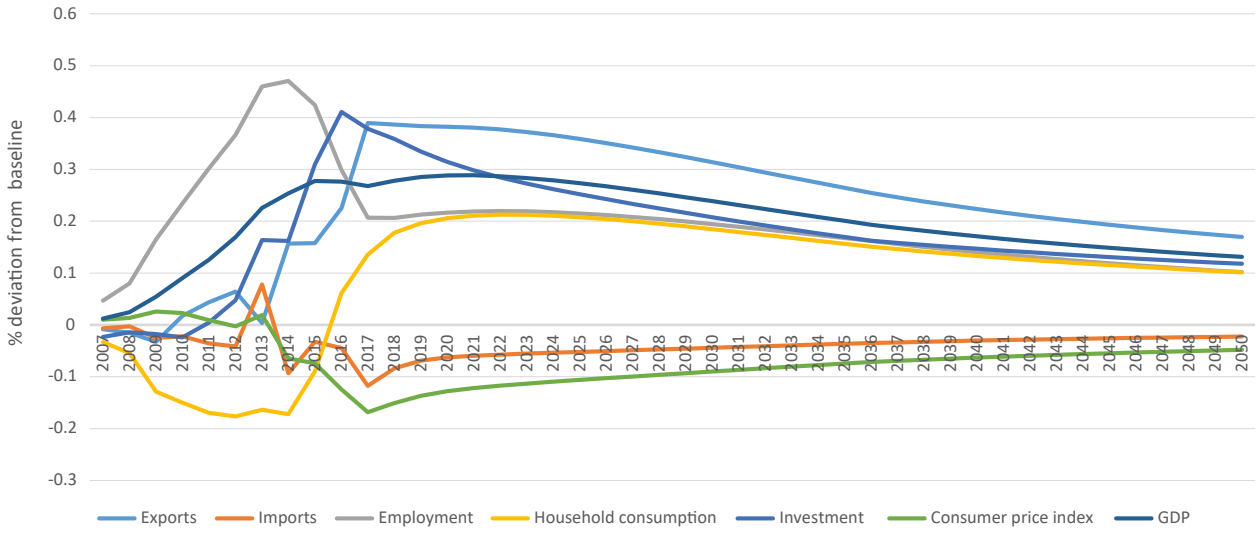
This subsection reports the results based on a scenario simulating the full cohesion policy package both on the spending and on the financing side. Results are expressed as deviations from a hypothetical (baseline) scenario in which no cohesion policy is implemented, thus allowing us to interpret the results as the 'pure' impact of the policy.

Figure 5.1 reports the impact of the policy on some key macroeconomic variables over time. In the short run, a substantial part of the impact stems from the increase in demand, which is partly crowded out by increases in prices. This is particularly the case during the early stage of the implementation period when supply side effects are quasi-absent. In the medium to long run, the productivity-enhancing effects of cohesion policy investments materialise and output increases, leaving room for GDP to increase free of inflationary pressures. The impact of the interventions remains long after the termination of the programmes, which is to be expected from a policy that is meant to improve the structure of the economies via long-term effects on productivity, labour supply and transport costs.

Another interesting finding highlighted by Figure 5.1 is that the policy leads to improvements in the trade balance as soon as supply-side effects kick in. The structure-enhancing effects of the policy result in EU firms becoming more competitive, therefore gaining shares on extra-EU markets.

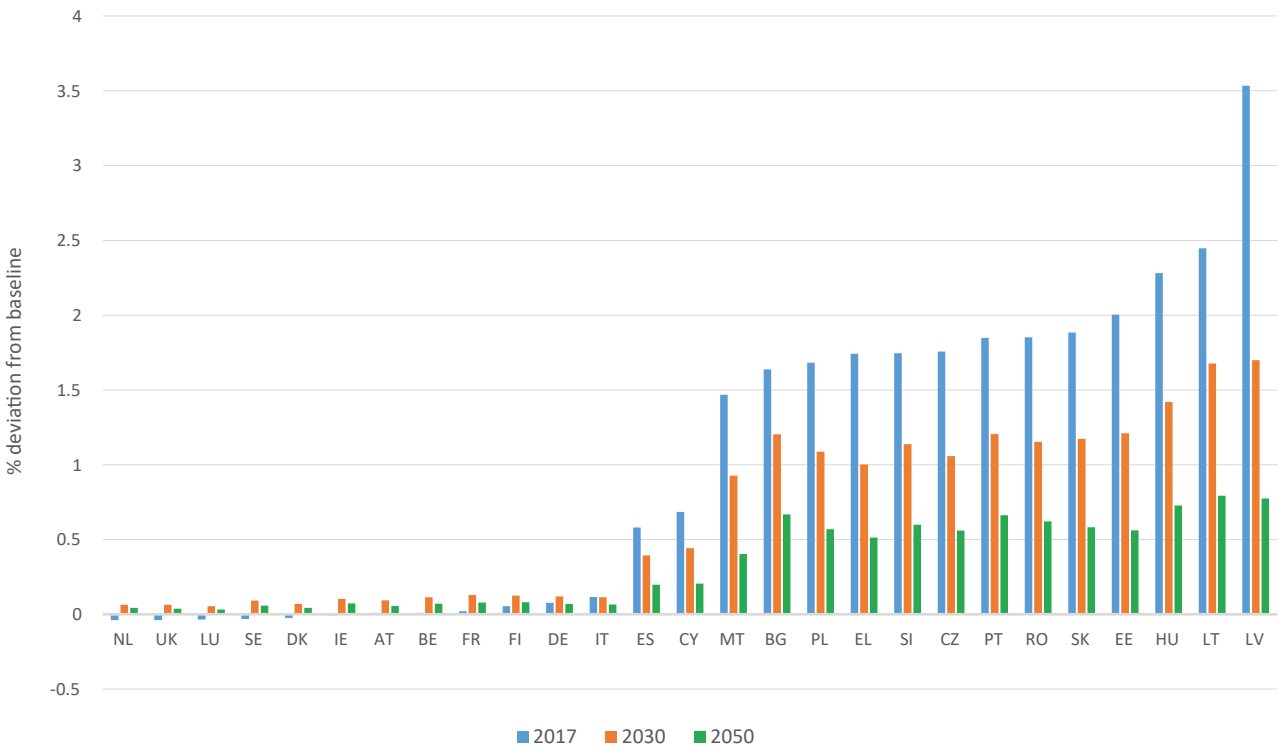
According to the simulations, EU GDP at the end of the implementation period (2017) is almost 0.3 % higher as a result of cohesion policy interventions. The annual impact then stabilises and around 2022/2023 starts decreasing due to the depreciation of the new stocks generated by these investments, although at a rather low pace. In 2030 and in 2050, the impact of the policy on GDP is still at + 0.24 % and + 0.13 %, respectively.

Figure 5.1: Impact of 2007–2013 programmes at EU level



Source: RHOMOLO simulations

Figure 5.2: GDP impact of 2007–2013 programmes at Member State level



Source: RHOMOLO simulations

The impact strongly varies from one country to another, and it is higher for the main beneficiaries of the policy (see Figure 5.2). For example, at the end of the implementation period in 2017, GDP in Latvia is 3.5 % higher thanks to cohesion policy investments, while in Lithuania and Hungary it is about 2.5 % and 2.3 % higher, respectively. The impact is much smaller in the EU-15 Member States. This is due to (i) cohesion policy spending being generally low relative to the size of the economies and (ii) most of these countries being net contributors to the policy. In the short run, the impact is even negative in some Member States where the costs of financing the policy (which corresponds to a transfer of resources out of the domestic economy) outweigh its benefits, at least initially.

However, in the medium and long run, the impact of the policy strengthens and becomes positive for all Member States. After the end of the implementation period, the programmes are terminated and therefore no longer generate costs even though their benefits are still present. This is particularly true for the more developed Member States, where investments tend to be relatively more concentrated in the fields of R & D and human capital, intervention fields which produce most of their effects long after their implementation. Moreover, spatial spillovers fully materialise and tend to redistribute these benefits among Member States, in particular from the less developed (where most of the direct effects of the policy take place) to the more developed ones.

The spatial distribution shows even more variation at the regional level. Figures 5.3 and 5.4 show the impact of the policy on the GDP of NUTS 2 regions in 2017 and 2030, respectively. Cohesion policy is a 'spatially targeted' policy, which implies that both the intensity of aid and the policy mix differ from one region to another, even within the same Member State. The impact of the policy also depends on the economic and social environment in which it is applied. The same policy mix can potentially have quite different consequences whether implemented in a mostly rural region where agriculture accounts for a substantial share of GDP or in an urban region specialised in the service industry.

The impact on GDP is positive and significant both in 2017 and in 2030 in the regions targeted by cohesion policy. At the end of the implementation period, GDP in Dél-Alföld (HU33, Hungary) is more than 4.0 % higher than in a hypothetical scenario without cohesion policy. The impact is also high in some regions of southern Europe, such as Dytiki Ellada (EL63, Greece) or Alentejo (PT18, Portugal), where it is 3.6 % and 3.5 % higher than in the no-policy scenario, respectively. Once again, the impact in some of the more developed regions can be negative in the short run but turns positive after the end of the implementation period. By 2030, the cumulated impact per euro is greater than 1 for all regions, which means that the policy produces positive returns everywhere.

Figure 5.3: Impact of 2007–2013 cohesion policy on regional GDP, all EU regions, 2017

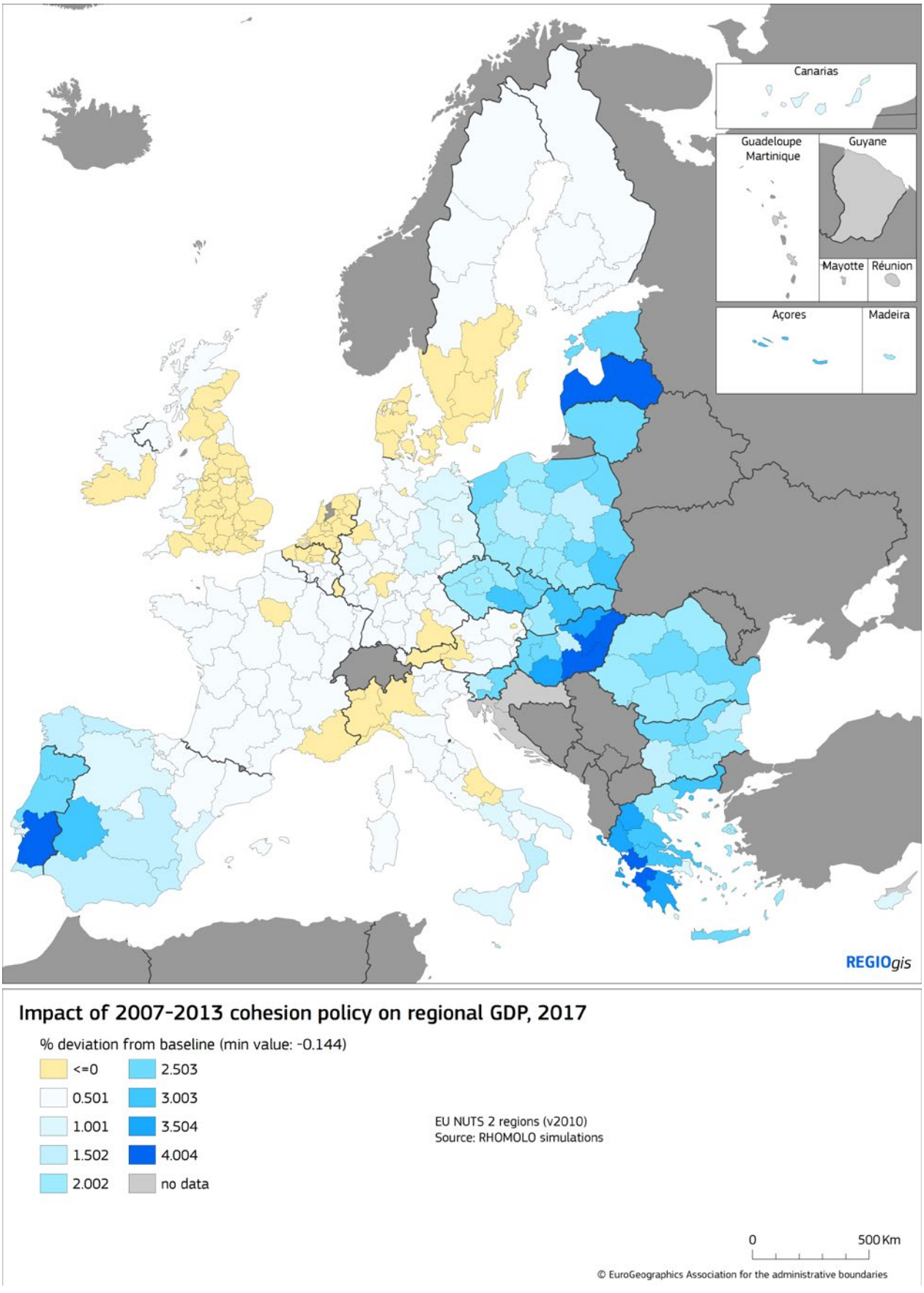
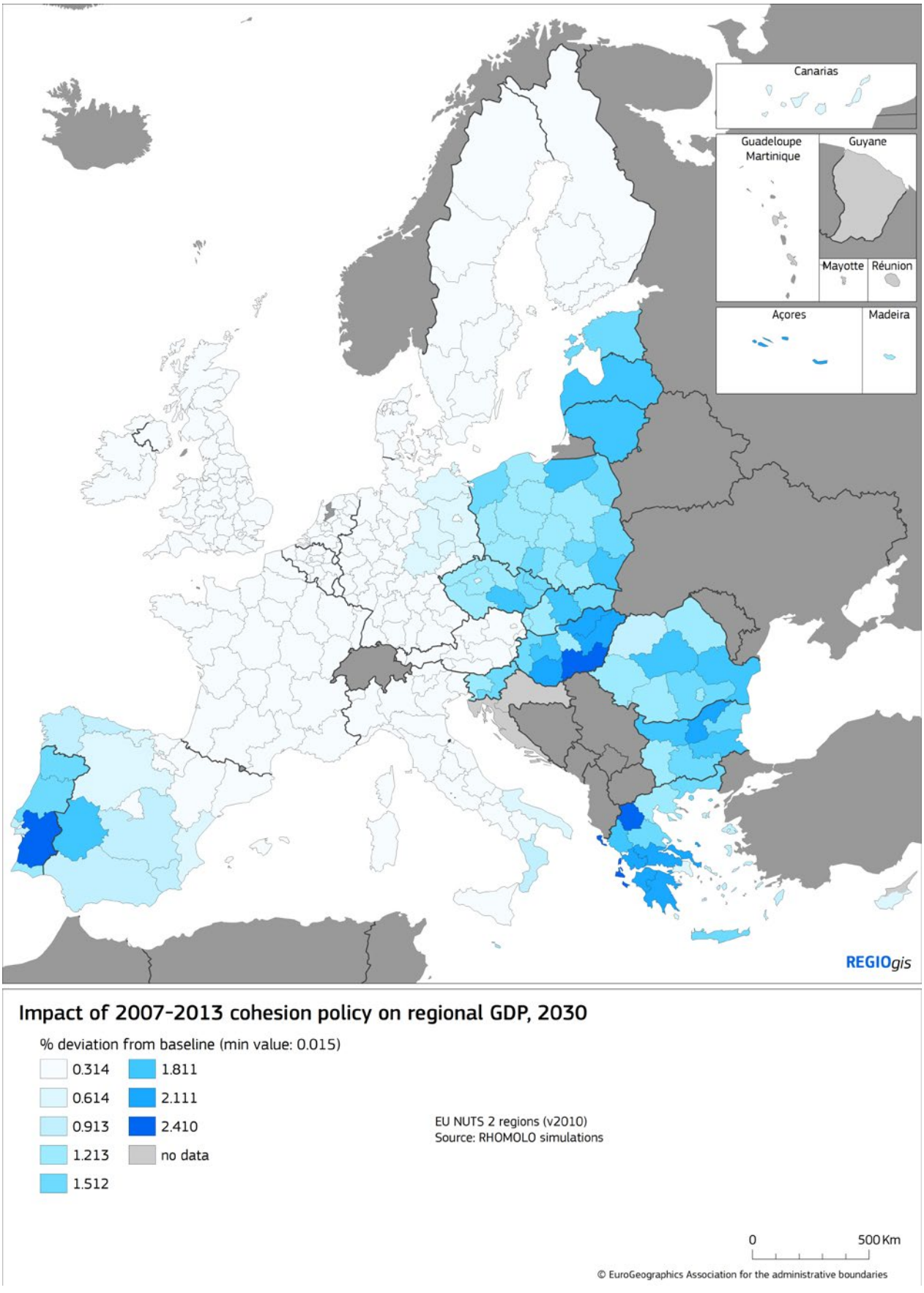
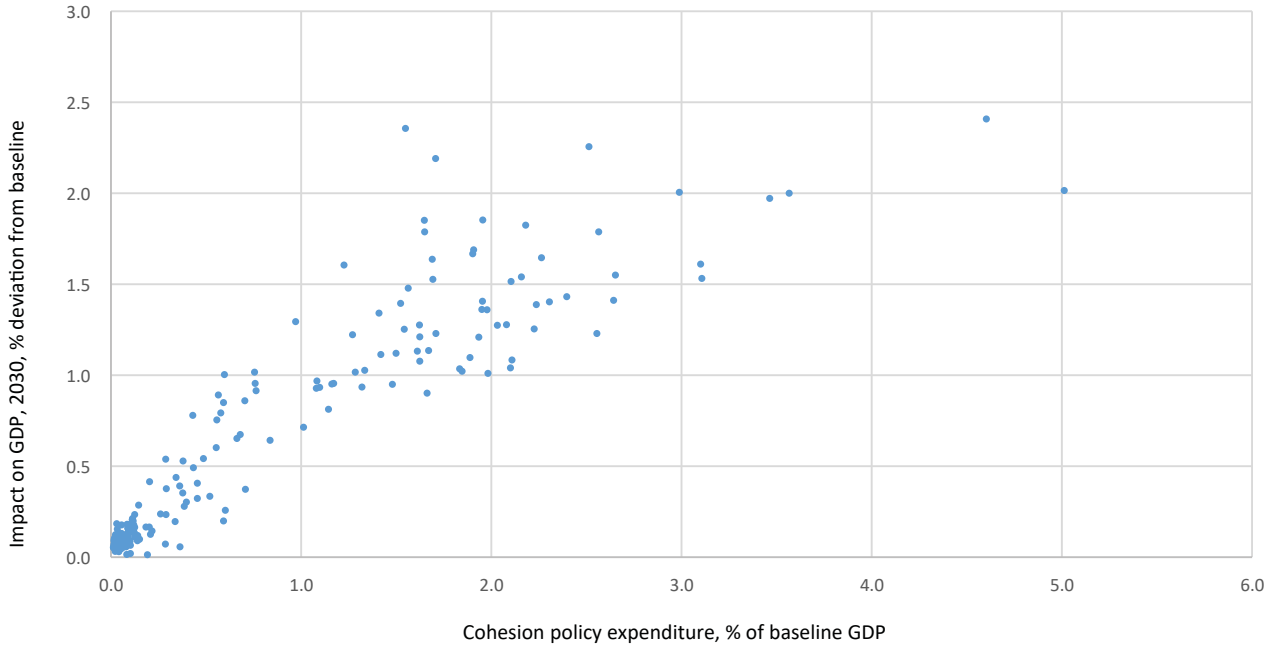


Figure 5.4: Impact of 2007–2013 cohesion policy on regional GDP, all EU regions, 2030



Finally, there is generally a strong positive relationship between the amount of cohesion funds invested in a region and the magnitude of the policy impact (Figure 5.5). Since the targeted regions are typically those whose GDP per capita is below the EU average, this suggests that there is a negative relationship between GDP per capita and policy impact. Thus, cohesion policy produces its most significant results in the less developed regions, which is in line with the mandate enshrined in the treaty of reducing disparity in the EU.

Figure 5.5: Correlation between cohesion policy spending and GDP impact in 2030



Source: RHOMOLO simulations

5.2. SPILLOVERS

As explained in Section 2, cohesion policy interventions affect the performance of the Member State or region where they are implemented, but their impact is also likely to spill over into the other countries or regions of the EU. In this section, we use RHOMOLO to investigate the importance of the spillovers generated by the 2007–2013 programmes.

To do so, we first divide Member States into two groups. The first one consists of those that, on average between 2007 and 2017, have a positive cohesion policy balance, as defined in Section 2. In fact, these countries correspond to those eligible for the cohesion fund for that period and we will refer to them as the cohesion countries (CCs). The other group is the rest of the EU and will be referred to as the non-cohesion countries (NCCs). Table 5.1 below lists the Member States pertaining to each group and reports their cohesion policy balance.

TIt would be impossible to disentangle the direct effect of cohesion policy on a region from the indirect effect coming from elsewhere in the EU by simply looking at the actual investments data. However, economic modelling can be used to quantify the two effects separately. To isolate the spillover effects of the policy, we rely on two additional scenarios: one in which we only consider cohesion policy investments taking place in the CCs, and one in which we only consider those taking place in the NCCs. For each scenario (as well as for the full policy scenario illustrated in Section 5.1), we can identify the impact at EU level, at group level and at country level ([9]).

The impact for each group can be broken down as follows: $I^{CC} = i^{CC}_{CC} + i^{CC}_{NCC}$ and $I^{NCC} = i^{NCC}_{NCC} + i^{NCC}_{CC}$, where I^{j} $(j = CC, NCC)$ designates the total impact of the policy on group j and $i^{x}_{j}(x = CC, NCC)$ designates the direct impact of the policy (when $j = x$) and the spillover stemming from the programmes implemented elsewhere (when $j \neq x$). Figure 5.6 shows the magnitude of spillover effects over time $(i^{NCC}_{CC} + i^{CC}_{NCC})$ in comparison to the total impact of the policy at EU level $(I^{NCC} + I^{CC})$.

During the implementation period, spillovers are negative, due to the fact that NCCs have to raise taxes in order to finance the programmes implemented in the CCs. However, once the implementation period is over, this negative impact disappears and the spillovers rapidly become positive in both groups of countries. By 2030, around 16 % of the total policy impact in the EU is actually due to spillovers, meaning that cohesion policy is a positive sum game in the long run and generates cross-fertilisation of the Member States' economies.

This can be further illustrated by focusing on the NCCs that are the net contributors to the policy. Figure 5.7 shows the total impact of the policy on NCCs' GDP and the spillover stemming from the programmes implemented in the CCs over time.

At the beginning of the period, the impact on the NCCs economies is negative, as the positive effects of cohesion policy investments implemented there are unable to offset the negative impact of the taxes levied to finance the policy (a substantial share of which is actually implemented in the CCs).

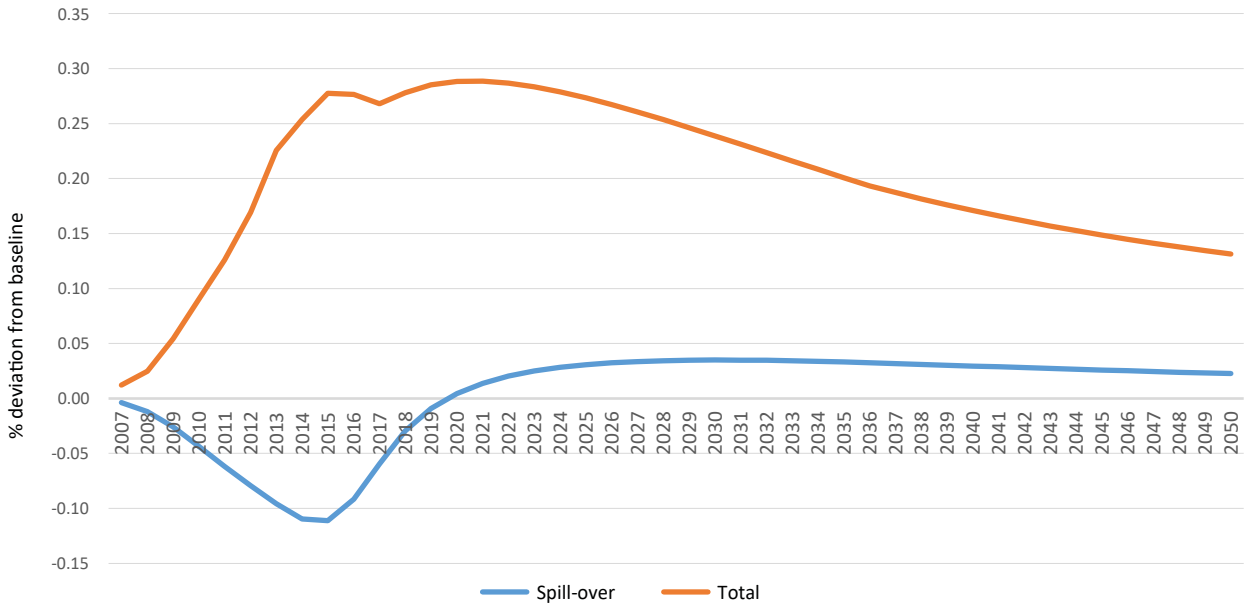
Table 5.1: Cohesion and non-cohesion countries

Countries	Cohesion policy balance, average 2007–2017, % of GNI	Group	Countries	Cohesion policy balance, average 2007–2017, % of GNI	Group
DK	0.3 %	NCCs	CY	0.0 %	CCs
LU	0.3 %	NCCs	ES	0.1 %	CCs
BE	0.3 %	NCCs	HR	0.3 %	CCs
IE	0.3 %	NCCs	MT	0.8 %	CCs
FR	0.3 %	NCCs	SI	0.9 %	CCs
AT	0.2 %	NCCs	RO	0.9 %	CCs
FI	0.2 %	NCCs	EL	1.3 %	CCs
SE	0.2 %	NCCs	PT	1.3 %	CCs
NL	0.2 %	NCCs	BG	1.4 %	CCs
DE	0.2 %	NCCs	CZ	1.5 %	CCs
UK	0.2 %	NCCs	SK	1.5 %	CCs
IT	0.1 %	NCCs	PL	1.8 %	CCs
			EE	2.1 %	CCs
			LV	2.1 %	CCs
			LT	2.3 %	CCs
			HU	2.4 %	CCs

Source: Own calculations based on European Commission data.

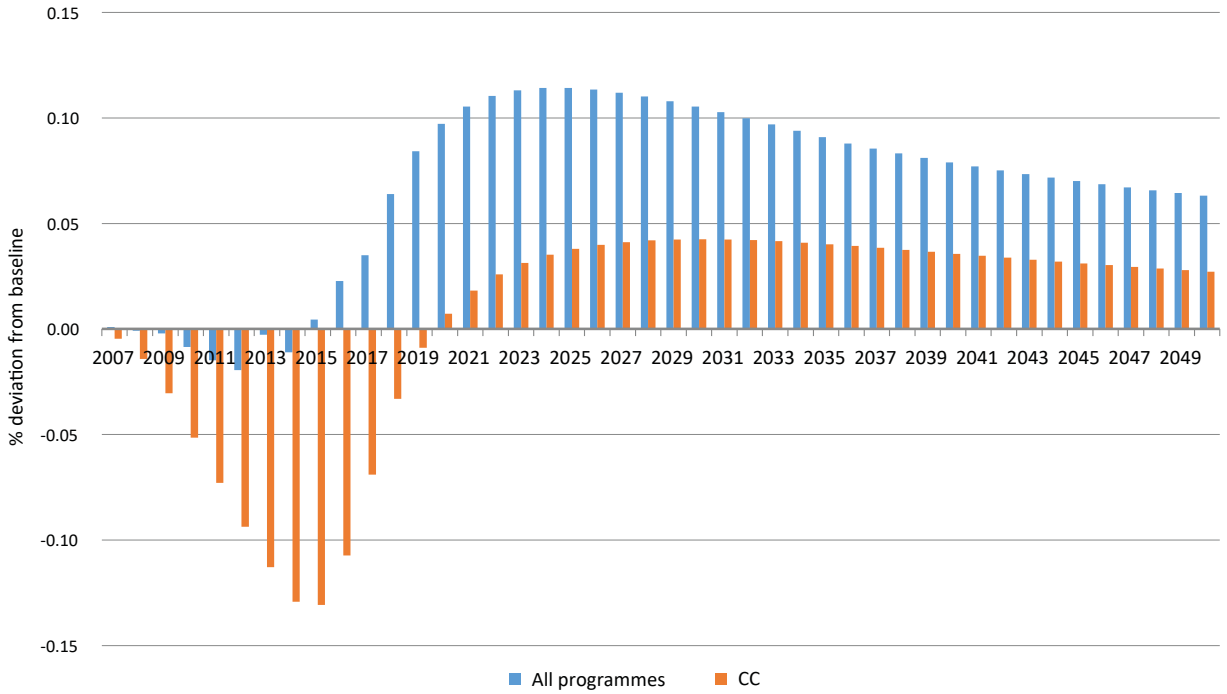
[9] The model provides results at the regional level as well, but we do not use them in this analysis.

Figure 5.6: Total cohesion policy impact and spillovers on EU GDP, 2007–2050



Source: RHOMOLO simulations

Figure 5.7: Total impact on NCCs' GDP and spillovers from CCs programmes, 2007–2050



Source: RHOMOLO simulations

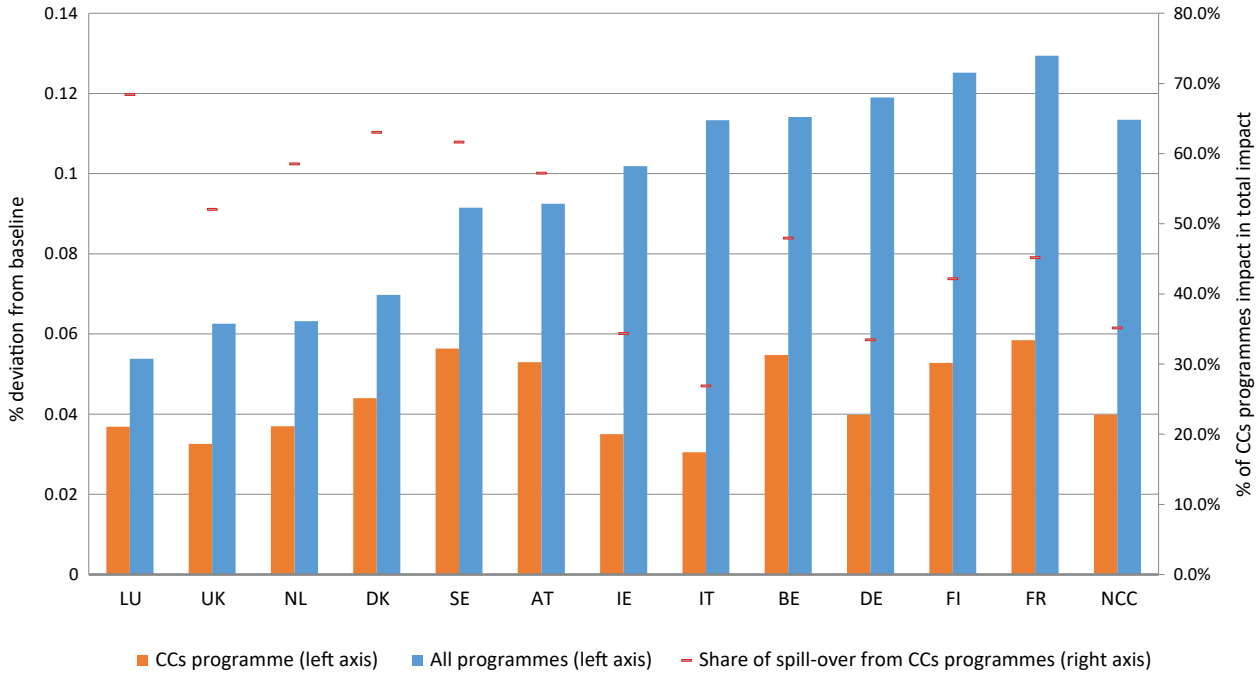
However, after 2017, the positive impact on the CCs increases and spills over to the NCCs. By 2030, more than 30 % of the policy's impact on the NCCs corresponds to spillovers originating in the CCs. This share continues to grow in the long run as the impact of the NCCs programmes decays, reaching more than 45 % in 2040.

NCCs do not all benefit from these spillovers in the same manner. For a given country, the magnitude of the spillover depends on its specific contribution to the financing of the CCs programmes, as well as on other factors, such as the trade links (and in particular its exports) with the CCs countries. This depends on the openness of the economy to international trade and on the location of the country within the EU.

Figure 5.8 shows the total GDP impact of the policy for each NCC in 2030 as well as the spillover coming from the CCs. Notice that, by 2030, the spillovers are no longer affected by the contribution to the financing of the policy.

In some NCCs, most of the impact of cohesion policy actually stems from the programmes implemented in the CCs. The share of these spillovers is particularly high in countries that trade extensively with CCs partners, like Austria, where more than 57 % of the policy impact consists of spillovers, or France, where this share is above 45 %. Clearly, that share is large in highly developed and very open economies where the domestic programmes are rather modest, like Luxembourg (69 %), Denmark (64 %) or the Netherlands (59 %). On the other hand, the share of spillover is smaller in countries like Germany (36 %) or Italy (27 %) due to some of their regions receiving substantial cohesion policy investments.

Figure 5.8: Total impact on NCCs' GDP and spillovers from CCs, 2030



Source: RHOMOLO simulations

6. CONCLUSION

Cohesion policy is a key instrument of the EU, used to reinforce the economies of the Member States and their regions, and to reduce territorial disparities. As such, it is a direct expression of the principle of solidarity enshrined in the EU treaties from the onset.

Cohesion policy is by far the most important channel through which the EU redistributes wealth within the Union. Its resources are highly concentrated on the less developed Member States and regions. Since the national contributions to the financing of the policy are highly correlated to GNI, almost 64 % of the redistribution of funds taking place via the EU budget is actually due to cohesion policy.

However, this is not the only form of redistribution linked to the policy. Interventions implemented in a given region or country have different kinds of effects in the rest of the EU. These spillover effects need to be taken into account when assessing the redistribution linked to cohesion policy at the macroeconomic level. In this paper, we have used RHOMOLO, a spatial dynamic general equilibrium model, to analyse this question and provide an estimate of the importance of spillovers in the total impact of the policy on the economies of the Member States. The main findings are the following:

- Between 2007 and 2017, cohesion policy programmes had a positive and significant impact on the economies of the EU Member States and regions. The impact is higher in the main beneficiaries, but in the long run, it is also positive in more developed countries and regions in spite of the fact that they are net contributors to the policy.

- In general, the impact is much higher in the poorest regions of the EU, which suggests that cohesion policy fulfils its objective of reducing regional disparities.

- Spillovers account for a substantial share of the total impact of the policy. In the long run, around 15 % of the impact on EU GDP stems from international spillovers, which suggests that cohesion policy is a positive sum game and generates cross-fertilisation of Member States' economies.

- Spillovers are particularly important for the main contributors to the policy. In the long run, more than 45 % of the impact in the countries not eligible for the cohesion fund come from countries benefiting from this fund. For some Member States, spillovers constitute the main source of benefits from cohesion policy. This is particularly true in the countries for which the main beneficiaries are a major destination of their exports or in countries where cohesion policy programmes are small.

REFERENCES

Bottazzi, L. and Peri, G. (2003), 'Innovation and spillovers in regions: Evidence from European patent data', *European Economic Review*, Vol. 47, No 4, pp. 687–710.

Dixit, A. and Stiglitz, J. (1977), 'Monopolistic competition and optimum product diversity', *American Economic Review*, Vol. 67, No 3, pp. 297–308.

Edwards, J.H.Y. (1990), 'Congestion function specification and the "publicness" of local public goods', *Journal of Urban Economics*, Vol. 27, No 1, pp. 80–96.

European Commission (2014), *European Union Public Finance*, fifth edition, Luxembourg, Publications Office of the European Union.

European Commission (2015), '*Ex post* evaluation of cohesion policy programmes 2007–2013 financed by the ERDF and the cohesion fund', *Work Package 13: Geography of Expenditure*, Luxembourg, Publications Office of the European Union.

Fisher, W.H. and Turnovsky, S.J. (1998), 'Public investment, congestion, and private capital accumulation', *The Economic Journal*, Vol. 108, No 447, pp. 399–413.

Fratesi, U. and Wishlade, F.G. (2017), 'The impact of European cohesion policy in different contexts,', *Regional Studies*, Vol. 51, No 6, pp. 817–821.

Jorgenson, D.W. and Stephenson, J.A. (1969), 'Issues in the development of the neoclassical theory of investment behaviour', *The Review of Economics and Statistics*, Vol. 51, No 3, pp. 346–353.

Krugman, P. (1991), *Geography and Trade*, MIT Press, Cambridge, Massachusetts.

Lecca, P., Barbero, J., Christensen, M.A., Conte, A., Di Comite, F., Diaz-Lanchas, J., Diukanova, O., Mandras, G., Persyn, D. and Sakkas, S. (2018), 'RHOMOLO V3: A spatial modelling framework', EUR 29229 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-85886-4, doi:10.2760/671622, JRC111861.

Nijkamp, P. and Poot, J. (2005), 'The last word on the wage curve?', *Journal of Economic Surveys*, Vol. 19, No 3, pp. 421–450.

Persyn, D., Díaz-Lanchas, J. and Barbero, J. (2020), 'Estimating road transport costs between and within European Union regions', *Transport Policy* online, doi.org/10.1016/j.tranpol.2020.04.006

Thissen M., Husby, T., Ivanova, O. and Mandras, G. (2019), 'European NUTS 2 regions: construction of interregional trade-linked supply and use tables with consistent transport flows', *JRC Working Papers on Territorial Modelling and Analysis* No 1/2019, European Commission, Seville, JRC115439.

Turnovsky, S.J. and Fisher, W.H. (1995), 'The composition of government expenditure and its consequences for macroeconomic performance', *Journal of Economic Dynamics and Control*, Vol. 19, No 4, pp. 747–786.

Uzawa, H. (1969), 'The preference and Penrose effect in a two-class model of economic growth', *Journal of Political Economy*, Vol. 77, No 4, pp. 628–652.

APPENDIX

Table A.1: Cohesion policy spending categories and associated model shocks

Category No.	Category	Field of intervention	Model shock
01	R&TD activities in research centres	RTD	RTD
02	R&TD infrastructure and centres of competence	RTD	RTD
03	Technology transfer and improvement of cooperation networks	RTD	RTD
04	Assistance to R&TD	RTD	RTD
05	Advanced support services for firms and groups of firms	AIS	G
06	Assistance to SMEs for the promotion of environmentally-friendly technologies	AIS	G
07	Investment in firms directly linked to research and innovation	RTD	RTD
08	Other investment in firms	AIS	RPREMK
09	Other measures to stimulate research and innovation	RTD	RTD
10	Telephone infrastructures (including broadband networks)	INFR	IG
11	Information and communication technologies	INFR	IG
12	Information and communication technologies (TEN-ICT)	INFR	IG
13	Services and applications for citizens (e-health, e-government)	INFR	IG
14	Services and applications for SMEs (e-commerce)	INFR	IG
15	Other measures for improving access to ICT	INFR	IG
16	Railways	TRNSP	TRNSP
17	Railways (TEN-T)	TRNSP	TRNSP
18	Mobile rail assets	TRNSP	TRNSP
19	Mobile rail assets (TEN-T)	TRNSP	TRNSP
20	Motorways	TRNSP	TRNSP
21	Motorways (TEN-T)	TRNSP	TRNSP
22	National roads	TRNSP	TRNSP
23	Regional/local roads	TRNSP	TRNSP
24	Cycle tracks	TRNSP	TRNSP
25	Urban transport	TRNSP	TRNSP
26	Multimodal transport	TRNSP	TRNSP
27	Multimodal transport (TEN-T)	TRNSP	TRNSP
28	Intelligent transport systems	TRNSP	TRNSP
29	Airports	TRNSP	TRNSP
30	Ports	TRNSP	TRNSP
31	Inland waterways (regional and local)	TRNSP	TRNSP
32	Inland waterways (TEN-T)	TRNSP	TRNSP
33	Electricity	INFR	IG
34	Electricity (TEN-E)	INFR	IG
35	Natural gas	INFR	IG

Category No.	Category	Field of intervention	Model shock
36	Natural gas (TEN-E)	INFR	IG
37	Petroleum products	INFR	IG
38	Petroleum products (TEN-E)	INFR	IG
39	Renewable energy: wind	INFR	IG
40	Renewable energy: solar	INFR	IG
41	Renewable energy: biomass	INFR	IG
42	Renewable energy: hydroelectric, geothermal and other	INFR	IG
43	Energy efficiency, co-generation, energy management	INFR	IG
44	Management of household and industrial waste	INFR	IG
45	Management and distribution of water (drink water)	INFR	IG
46	Water treatment (waste water)	INFR	IG
47	Air quality	INFR	IG
48	Integrated prevention and pollution control	INFR	IG
49	Mitigation and adaption to climate change	INFR	IG
50	Rehabilitation of industrial sites and contaminated land	INFR	IG
51	Promotion of biodiversity and nature protection	INFR	G
52	Promotion of clean urban transport	INFR	G
53	Risk prevention	INFR	G
54	Other measures to preserve the environment and prevent risks	INFR	G
55	Promotion of natural assets	AIS	G
56	Protection and development of natural heritage	AIS	G
57	Other assistance to improve tourist services	AIS	G
58	Protection and preservation of the cultural heritage	AIS	G
59	Development of cultural infrastructure	AIS	G
60	Other assistance to improve cultural services	AIS	G
61	Integrated projects for urban and rural regeneration	AIS	G
62	Development of life-long learning systems	HC	HC
63	Design of innovative work organisation	HC	HC
64	Development of special services for employment in restructuring sectors	HC	HC
65	Modernisation and strengthening labour market institutions	HC	HC
66	Implementing active and preventive measures on the labour market	HC	HC
67	Measures encouraging active ageing and prolonging working lives	HC	HC
68	Support for self-employment and business start-up	HC	HC
69	Measures to improve participation of women to labour market	HC	HC
70	Specific action to increase migrants' participation in employment	HC	HC
71	Pathways to integration of disadvantaged people	HC	HC
72	Design, introduction and implementing of reforms in education	HC	HC
73	Measures to increase participation in education and training	HC	HC
74	Developing human potential in the field of research and innovation	HC	HC

Category No.	Category	Field of intervention	Model shock
75	Education infrastructure	INFR	IG
76	Health infrastructure	INFR	IG
77	Childcare infrastructure	INFR	IG
78	Housing infrastructure	INFR	IG
79	Other social infrastructure	INFR	G
80	Promoting the partnerships, pacts and networking	TA	G
81	Mechanisms for improving good policy and programmes	TA	G
82	Compensation of additional costs due to accessibility deficit	TA	G
83	Specific action to compensate additional costs due to market size	TA	G
84	Support to compensate additional costs due to climate conditions	TA	G
85	Preparation, implementation, monitoring and inspection	TA	G
86	Evaluation and studies; information and communication	TA	G

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