The impact of cohesion policy 2007-2013: model simulations with RHOMOLO

SUMMARY OF SIMULATION RESULTS

WORK PACKAGE 14b

Ex post evaluation of Cohesion Policy programmes 2007-2013, focusing on the European Regional Development Fund (ERDF) and the Cohesion Fund (CF)

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The impact of cohesion policy: an ex-post evaluation of the 2007-2013 programming period based on RHOMOLO

1. Introduction

This note complements the one analysing the impact of cohesion and rural development policies based on QUEST by reporting the results obtained with RHOMOLO, the dynamic spatial general equilibrium model RHOMOLO developed by DG REGIO and DG JRC[1]. The model's specifications are fully aligned with QUEST which ensures that the channels through which the policies are assumed to deliver their results are to a large extent of similar nature. However, compared to that model which produces results at the national level, RHOMOLO brings additional information on several aspects:

- RHOMOLO produces results at the level of the EU NUTS 2 regions. It is therefore particularly well suited for the analysis of cohesion policy as it allows to take into account the variations in aid intensity which exists within the Member States benefiting from the policies;

- The model incorporates several elements borrowed from economic geography. In particular, it takes a number of spill-over effects into account which allows capturing the fact that interventions have implemented in a particular region also have an impact in other regions. Such spill-over effects are due to interregional trade linkages as well as to the spatial dissemination of technology though well-known processes of diffusion and imitation;

- The model distinguishes investment in transport infrastructure from the other investment in infrastructure. Such investments are indeed assumed to reduce transport costs inside and between the regions concerned which makes the model capable of simulating the specific impact of this type of interventions. Improvement in transport infrastructure implies that regions have a better access to the EU markets and hence which allows increasing their exports and hence boosts the level of economic activity. Enhanced accessibility also means a reduction in the price of imported intermediate goods and of consumption which contributes to reduce firms' production costs and increase real income of households.

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[1] For more details on RHOMOLO, see Brandsma A., Kancs, D., Monfort Ph. and A. Rillaers (2013), " RHOMOLO: A Dynamic Spatial General Equilibrium Model for Assessing the Impact of Cohesion Policy", REGIO Working Paper 01/2013.

2. Scope of the analysis

The analysis covers the interventions supported by the European Regional Development Fund (ERDF), the Cohesion Fund (CF) and the European Social Fund (ESF) under the 2007-2013 programming period. Interventions were implemented between 2007 and 2015 and led to expenditure amounting to more than €300 billion.

The methodology for breaking down the expenditure for the ERDF and CF by year and by categories is the same as for the analysis based on QUEST, except that the figures provided at the NUTS 2 level by Work Package 13[2] of the ex-post evaluation 2007-2013 have been used instead. 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 pro rata their population.

Resources mobilised by cohesion policy tend to concentrate in the less developed parts of the Union. Over the period 2007-2015, around 60% of the expenditure corresponds to programmes implemented in less developed regions (GDP per capita < 75% of EU average - 65 regions) received around 60% while in the transition (GDP per capita between 75% and 90% - 51 regions) and more developed (GDP per capita > 90% - 151 regions) regions, cohesion policy investment correspond to respectively 14% and 27%.

The contribution of cohesion policy funds is also more important to the economies of the less developed regions as illustrated by the figure below which shows expenditure as a share of GDP for the three groups of regions.

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[2] Work Package 13 "Geography of Expenditure" provides an estimated breakdown of allocations and expenditure by priority themes at NUTS2 levels for years 2013 and 2014.

Figure 1: ERDF, CF and ESF expenditure 2007-2015, More developed, transition and less developed regions (% of GDP)
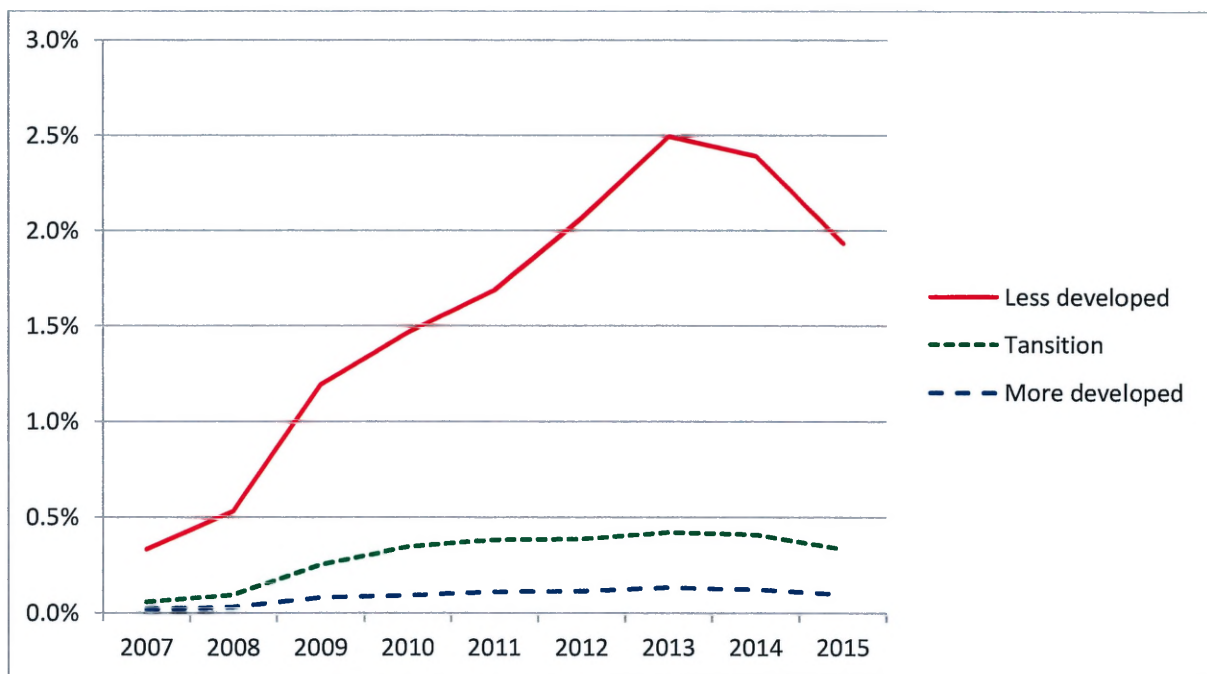
Source: DG REGIO.

While the allocation of the cohesion policy funds is uneven across the three groups of regions, the time profile of investment is rather similar among the three groups of regions, with expenditure peaking in 2013 and then slightly declining in the following periods.

As highlighted by table 1, the variation in the spatial distribution of expenditure is even more apparent when looking at the level of regions. The main beneficiaries are Mazowieckie (PL12), Andalucia (ES61) and Norte (PT11) where cohesion policy investment amounts to respectively €10.1 billion, €8.2 billion and 7.6 billion. At the other end of the spectrum, expenditure in Zeeland (NL34), Valle d'Aosta/Vallée d'Aoste (ITC2) or Åland (FI20) amount to €37.2 million, €32.3 million and €5.6 million respectively. As a share of their GDP, the regions where cohesion policy finds contribute most are Região Autónoma dos Açores (PT20), Észak-Alföld (HU32) and Dél-Alföld (HU33) where, at their maximum, investments corresponded respectively to 8.9%, 8.3% and 8.0% of GDP. For more developed regions, the contribution of cohesion policy funds is much smaller, as in Inner London - West (UKI1) or Luxemburg (LU00) for which cohesion policy expenditure corresponds to around 0.01% of GDP.
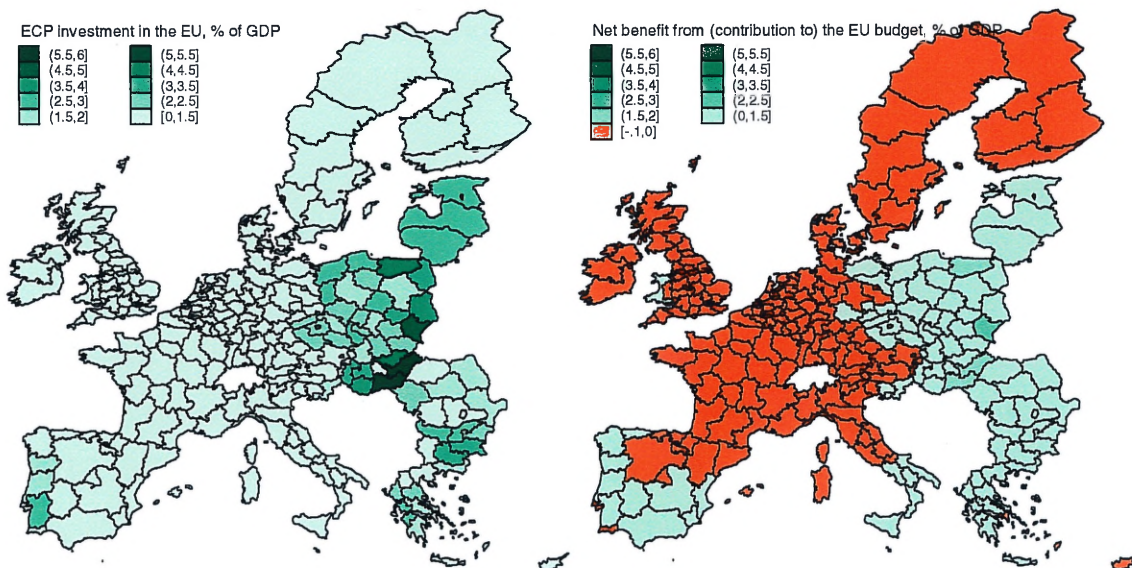
Table 1: Cohesion policy expenditure, millions of euros and as % of GDP

| Mio euros, 2007-2015 | | | | % of GDP, average 2007-2015 | | | |
Top 10		Bottom 10		Top 10		Bottom 10	
PL12	10.070,86	UKM5	56,98	HU32	4,9%	DK04	0,02%
ES61	8.178,17	BE34	52,36	HU33	4,7%	NL33	0,02%
PT11	7.555,44	LU00	47,96	PT20	4,0%	NL31	0,02%
PL22	6.755,50	AT32	45,72	HU31	3,9%	UKJ1	0,02%
LT00	6.436,72	BE31	45,08	PL32	3,5%	AT13	0,02%
PT16	5.039,80	NL23	40,61	HU23	3,4%	SE11	0,02%
PL51	4.984,15	AT34	40,42	PL62	3,4%	NL32	0,02%
PL21	4.787,65	NL34	37,18	HU21	2,9%	DK01	0,02%
HU10	4.744,11	ITC2	32,31	HU22	2,8%	UKI1	0,01%
PL32	4.613,32	FI20	5,60	GR23	2,8%	LU00	0,01%

Source: DG REGIO.

The spatial distribution of expenditure is illustrated by Map 1 which shows cohesion policy expenditure as a % of GDP (average 2007-2015) for the EU NUTS 2 regions. Relative to size of their economies, the policy channels a considerable amount of resources in Central and Eastern Europe regions as well as in a number Southern Europe regions, particularly in Greece and Portugal.

Map 1: Cohesion policy expenditure, as % of GDP, average 2007-2015


Source: DG REGIO.

3. The macroeconomic impact of cohesion policy 2007-2015

For the simulations, cohesion policy expenditure have been regrouped into the five fields of interventions already used for QUEST. In addition, the policy shocks are introduced in the model through the same channel as for QUEST. The exception is investments in transport

infrastructure which, in the case of RHOMOLO, are translated into reduction of transport costs in and between the regions where the interventions take place.

The Map below shows the impact at the NUTS 2 level for the EU-27 while the table reports the 10 regions for which the impact of the policy is the highest and the 10 regions for which it is the smallest.

Map 2: Cohesion policy, impact on GDP 2015 and 2023, % deviation of baseline
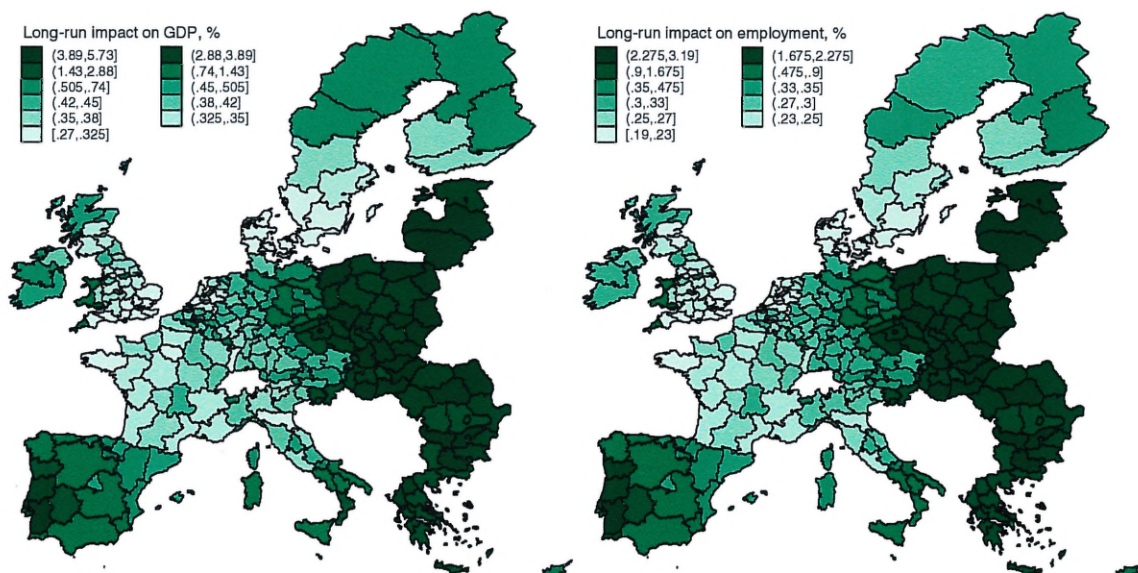
Source: RHOMOLO.

Table 2: Cohesion policy impact on GDP, 2015 and 2023, % deviation from baseline

2015				2023			
Top 10		Bottom 10		Top 10		Bottom 10	
HU33	9.4	UKH1	0.0	SK03	5.9	UKH3	0.18
HU32	8.5	UKJ3	0.0	HU33	5.9	UKK2	0.18
HU23	7.8	UKH2	0.0	SK04	5.9	UKH1	0.18
HU31	7.8	ITC4	0.0	HU32	5.3	UKJ3	0.18
SK03	7.4	UKJ1	0.0	BG32	5.3	UKJ2	0.17
PL32	7.1	UKJ4	0.0	HU23	5.2	UKJ4	0.17
PL34	7.1	UKJ2	0.0	HU31	5.1	DK03	0.17
LT00	7.1	UKI2	0.0	LT00	4.8	UKI2	0.17
PL62	7.1	FR10	0.0	BG31	4.7	DK04	0.17
SK04	7.0	ITD5	0.0	PL62	4.7	DK02	0.16

Source: RHOMOLO.

According to the simulations, the impact of cohesion policy is positive and significant, particularly in the regions which are the main beneficiaries. By the end of the programming

period, GDP in Dél-Alföld (HU33), Észak-Alföld (HU32) and Dél-Dunántúl (HU23) is respectively 9.4%, 8.5% and 7.8% higher than in a scenario without cohesion policy.

The impact of cohesion policy strongly varies around the national average. For instance, in the case of Hungary, the results of the simulations with QUEST indicate an impact of 5.3% in Hungary for 2015 (note that the aggregation of the regional results of RHOMOLO for Hungary leads to an impact at national level of 4.9% in 2015). At the regional level, the impact on GDP spans from 2.4% in the capital city region of Közép-Magyarország (HU 10) to 9.4% in Dél-Alföld. The analysis of cohesion policy must therefore be conducted at the regional level in order to fully capture its impact of the EU economies.

In regions of more developed Member States, the impact is smaller but remains positive in spite of the fact that these regions are net contributors to the policy. This is particularly true in the long run (interventions implemented in these regions usually take time to produce their full impact). In 2023, the smallest impact is found in Sjælland (DK02) but still correspond to around 0.3% of GDP.

In the most Member States, there is in general a strong negative relationship between GDP per head and the magnitude of the impact. This suggests that within each Member States, it is in the less developed regions that cohesion policy has produced its most important results, which is in line with the mandate enshrined in the Treaty of reducing disparities in the EU.

The impact in terms of employment generally follows the same pattern. As shown in table 3, it is positive and quite significant in the main beneficiaries regions. In Stredné Slovensko (SK03), Východné Slovensko (SK04) and Észak-Alföld (HU33) employment in 2023 is respectively 2.2%, 2.2% and 2.0% higher following the implementation of the cohesion policy programmes[3]. As for GDP, the impact is smaller in the regions of the more developed

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[3] The impact in 2015 is negative for a number of regions. This is due to the fact that each year intervention in the field of human capital are assumed to train a number of workers which are subtracted from the labour force. During the implementation of the programmes, these interventions can therefore trigger a temporary decrease in employment, as part of the labour force is supposedly unavailable while training. Each year, the newly trained from last year are added back to the labour force and the average productivity is increased. In some regions, and given that cohesion policy expenditure is increasing steadily over time, this short-run labour supply effect may dominate the increase in the labour productivity in the last years. This masks the unambiguous positive effect from the years after 2015, where there is no more short-run labour supply effect and only a level effect on productivity. Consequently, results for the years after the end of the programmes are generally used for reporting.

Member States but remains positive. At the EU level, the impact on employment is at most 0.3% above baseline which represents around 670.000 jobs.

Table 3: Cohesion policy impact on employment, 2015 and 2023, % deviation from baseline

| 2015				2023			
Top 10		Bottom 10		Top 10		Bottom 10	
SK03	2.84	ITD4	-0.10	SK03	2.21	UKH2	0.11
SK04	2.53	ITE3	-0.10	SK04	2.18	DK04	0.10
PL32	2.45	ITD3	-0.10	HU33	1.97	DK03	0.10
PL31	2.35	FR10	-0.10	BG32	1.90	UKK2	0.10
PL62	2.29	ITC4	-0.11	LT00	1.84	UKH3	0.10
BG32	2.25	ITD5	-0.14	HU32	1.82	UKH1	0.10
PL34	2.24	PT30	-0.27	LV00	1.81	UKI2	0.10
BG42	2.22	PT17	-0.52	PL42	1.79	UKJ4	0.10
LT00	2.19	RO32	-0.54	HU23	1.78	UKJ2	0.10
PL33	2.13	PT15	-0.58	PL32	1.78	DK02	0.09

Source: RHOMOLO.

Note that these results are obtained under a specification of the labour market close to the one adopted for QUEST and which is quite conservative (the labour market is represented by a Philip's curve where changes in the real wage are negatively affected by unemployment). Under an alternative specification (the labour market is represented by a wage curve where the level of real wage is negatively affected by unemployment) calibrated with parameters values corresponding at standards in the literature, the impact in terms of employment is bigger. Under such specification, the impact on employment rises to 5.7% in Podkarpackie (PL32), 5.6% Dél-Alföld (HU33) and 5.4% in Warmińsko-Mazurskie (PL62). At the EU-27 level, cohesion policy contributed to increase employment by 1.1% at most (in 2016) which corresponds to some 2.4 million jobs.

4. Impact of improving accessibility within EU

Expenditure in the field of transport infrastructure represents around 24% of the total expenditure. The geographical distribution of the expenditure shown in map 3 below reveals that it mostly takes place in less developed regions, notably in Central and Eastern Europe as well as in Spain, Greece, Southern Italy and Portugal.

Map 3: Cohesion policy expenditure in transport infrastructure, as % of GDP, average 2007-2015
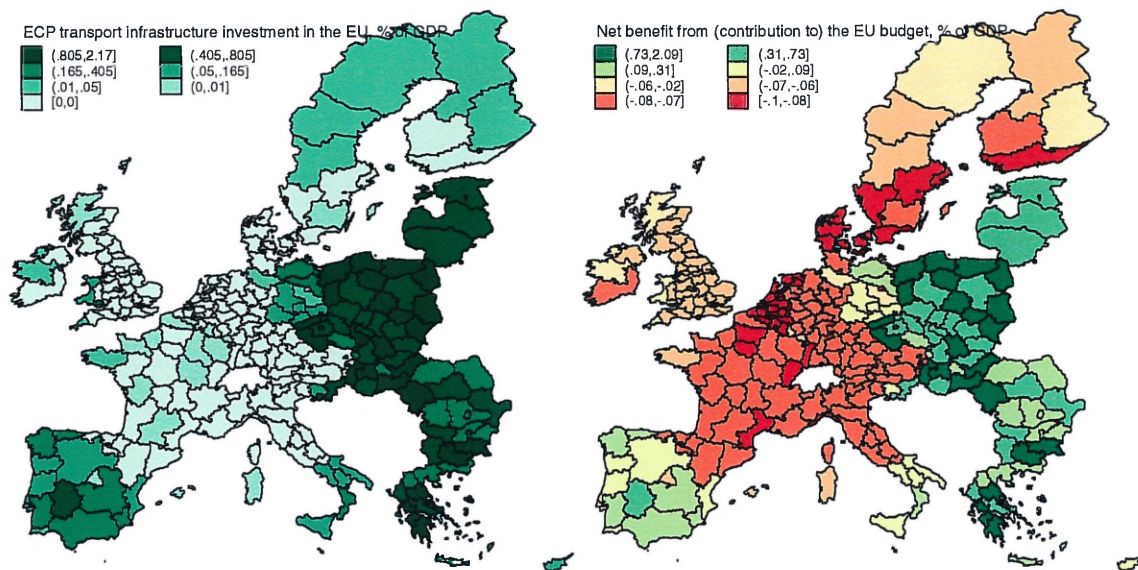
Source: DG REGIO.

As mentioned above, cohesion policy expenditure related to transport infrastructure has been translated into a reduction of bilateral transportation costs between and within NUTS2 regions. Transport infrastructure investments are simulated as a reduction in transportation costs which in turn increases the competitiveness of the regions concerned but also increase their exposure to competition of the other regions. Map 4 below shows the impact of investment in transport infrastructure for the EU-27 NUTS 2 regions.

Map 4: Impact of investment in transport infrastructure on GDP, 2015 and 2023, % deviation from baseline
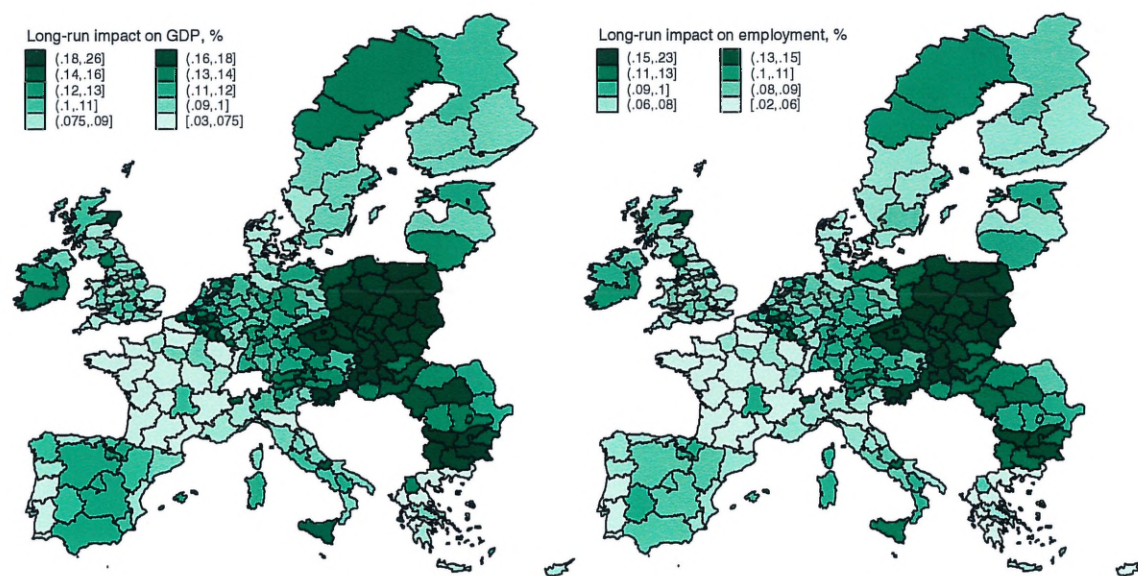
Source: RHOMOLO

At the end of the programming period (2015), the impact of investment in transport is high for the regions where investments in transport infrastructure are significant. It is smaller for regions where this field of intervention is not a priority and it is even negative in a limited number of regions (19 out of the 268 regions incorporated in the model).

However, in the medium to long run (e.g. 2023) the impact becomes positive for all regions. This suggests that the improvement of transport infrastructure, although increasing competition among EU regions, does not lead to a zero-sum game where some regions benefit from the investment, at the detriment of the others. Investment in transport infrastructure actually improves the EU network which produces gains throughout the whole Union. The table below shows the top 10 regions where the impact is the highest and the bottom 10 where it is the lowest.

Table 4: Impact of investment in transport infrastructure on GDP, 2015 and 2023, % deviation from baseline

Impact on GDP 2015				Impact on GDP 2023			
Top 10		Bottom 10		Top 10		Bottom 10	
PL32	2.33	FR81	-0.01	PL32	0.28	FR22	0.04
PL62	1.96	FR41	-0.01	PL62	0.26	FR53	0.04
GR23	1.63	FR24	-0.02	RO12	0.23	FR62	0.04
HU32	1.54	FR51	-0.02	RO42	0.22	FR41	0.04
RO42	1.54	ITD5	-0.02	BG34	0.21	FR52	0.04
PL31	1.53	FR30	-0.02	PL31	0.20	FR81	0.04
BG34	1.51	FR10	-0.02	PL63	0.20	FR30	0.04
CZ03	1.37	UKI2	-0.02	PL11	0.20	FR61	0.04
HU33	1.32	FR22	-0.02	PL12	0.19	GR12	0.04
PL34	1.29	FR61	-0.03	PL51	0.19	PT18	0.03

Source: RHOMOLO

In 2023, the highest impacts are in Podkarpackie (PL32), Warmińsko-Mazurskie (PL62) and Vest (RO42). Those regions invest considerable amounts in transport infrastructure (more than €2.2 billion or 3.1% of GDP, €1.5 billion or 2.2% of GDP and €1.2 billion or 1.8% of GDP respectively). Interestingly, the impact of transport investment is rather low in two categories of regions: regions for which the level of investment is low, - e.g. Aquitaine (FR61) where investments in transport represent around 0.02% of GDP - and regions where investment are more substantial but which are at exenterated and distant from the core of the

EU. This is for instance the case of Alentejo (PT18) where investments in transport represent 0.4% of GDP but which is located at the Atlantic edge of the Union.

The geographical pattern of the impact can be explained as follows. Investment in transport infrastructure has a direct demand effect (captured in the model by an increase in public consumption) which is likely to materialise mainly in the region where it takes place. In addition, it also contributes to reduce transport costs between regions and hence improve the whole EU network which can potentially benefit to the other regions of the Union. In order to represent such a mechanism in the model, region-specific expenditures are translated into region-pair-specific reduction in trade costs. The reduction in transport costs both depends on the amount invested and on the proximity between the regions concerned. The further away the trading regions are, the less improvement in transport infrastructure leads to reduction in transport costs between the two regions. Finally, the impact of lowering transport costs on regional economic performance also depends on their implication in trade, the regions whose economy is largely based on trade with the other regions being likely to benefit most from the improvement of the EU transport network.

This underlines the significant role of spatial spill-overs, through which the impact of cohesion policy is not limited to the regions where the expenditure is recorded, and how important it is to take them into account to properly assess how the policy delivers its results.

5. Interregional spill over effects: an example

The analysis of investment in transport infrastructure has underlined the role played by spatial spill-overs. However, they are not limited to this particular field of intervention. Indeed, not only other fields can also generate such type of effects, notably investments in R&D as knowledge accumulated in a given region can benefit to others through processes of imitation or technological externalities whose impact on the geographical distribution of technology have been abundantly documented by the literature.

Regions of the EU are also part of a vast system of interactions where firms (and to some extent workers) relocate across the Union, thereby shaping the economic geography of the EU. Cohesion policy interventions in one region can affect this spatial equilibrium and hence produce an impact throughout the rest the EU.

RHOMOLO has been developed to capture the effects of cohesion policy on the economic geography of the EU and this section gives an example of how the impact of the programmes implemented in particular regions tend to disseminate in space through the various mechanisms mentioned above. The experiment conducted here consists in a scenario where only one Member State would receive support from cohesion policy and check whether the gains spill over to the rest of the EU as a result of indirect trade effects and other inter-regional inter-dependencies. The Member State selected for this exercise is Poland and Map 5 below shows the impact of the Polish programmes on GDP of the EU NUTS 2 regions, at the end of the programming period years and 20 years after.

Map 5: Impact of cohesion policy programmes implemented in Poland on GDP, 2015 and 2030, % deviation from baseline
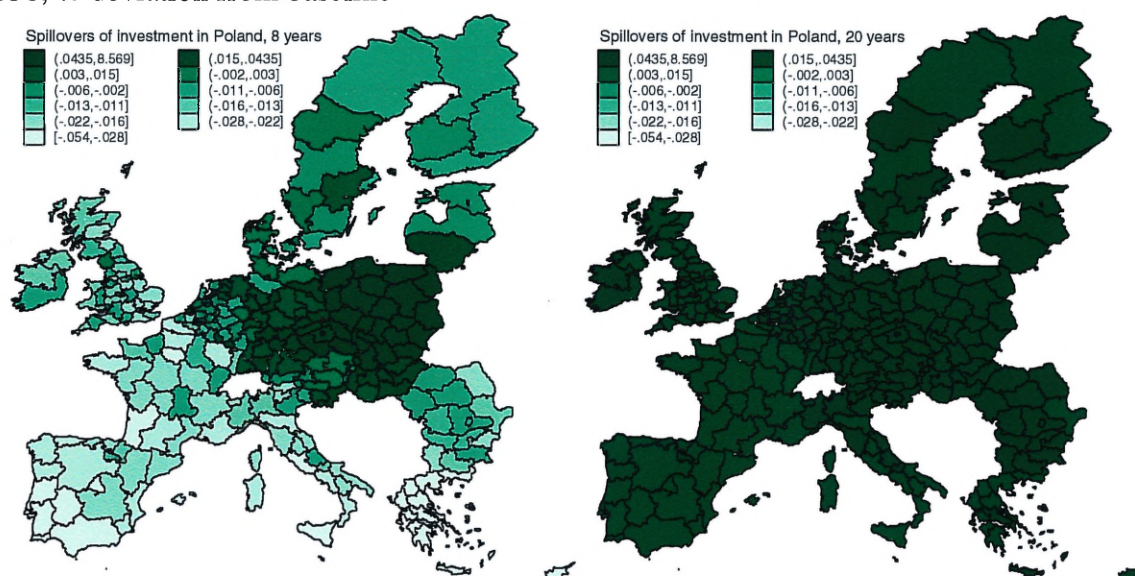
Source: RHOMOLO

According to the results, the impact on the Polish economy is positive both in the short run (2015) and in the long run (2030), which is in line with expectations. At the end of the implementation of the Polish programmes, the impact on the other regions is mixed (table 5). It is positive and significant for some regions and negative for others. In particular, the positive benefits spill over tend to materialise in regions close to Poland, the impact being the highest in Západné Slovensko (SK02), Severovýchod (CZ05) and Střední Morava (CZ07). In contrast, a number of regions, especially in Italy, Spain, France, Greece and the UK experience negative GDP changes from the baseline scenario.

However, in the long run, the impact of the policy fully develops in the recipient economy which generates positive spill-over in all regions, eventually offsetting the negative ones observed in the short run. As the right hand pane of the map suggests, in the long-run all regions in the EU enjoy the positive economic benefits of the programmes implemented in Poland. The analysis shows that it takes 11 years from the start of the Polish programmes to have all EU regions being positively affected.

Table 4: Impact of programmes implemented in Poland on GDP, 2015 and 2023, % deviation from baseline

Impact on GDP 2015				Impact on GDP 2023			
Top 10		Bottom 10		Top 10		Bottom 10	
SK02	0.15	PT20	-0.05	SK02	0.09	FR52	0.04
CZ05	0.13	GR42	-0.05	LT00	0.09	FR41	0.04
CZ07	0.13	GR21	-0.05	CZ05	0.08	ES63	0.04
CZ08	0.13	PT15	-0.05	SK03	0.08	ES64	0.04
SK04	0.12	GR23	-0.05	SK04	0.08	FR62	0.04
SK03	0.11	GR14	-0.05	CZ07	0.08	FR61	0.03
CZ06	0.11	GR25	-0.05	CZ02	0.08	FR83	0.03
LT00	0.10	GR24	-0.05	SK01	0.08	FR81	0.03
CZ02	0.10	GR13	-0.05	HU22	0.07	FR63	0.03
CZ03	0.10	PT18	-0.07	BG34	0.07	FR30	0.03

Source: RHOMOLO