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A scenario analysis of the 2021-2027 European Cohesion Policy in Bulgaria and its regions

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A scenario analysis of the 2021-2027 European Cohesion Policy in Bulgaria and its regions

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Abstract

We employ the spatial dynamic general equilibrium model RHOMOLO to estimate the economic impact of the 2021-2027 Cohesion Policy in Bulgarian NUTS-2 regions and analyse the implications for growth and development in Bulgaria. The main investment areas covered by the policy fall into the following five fields of intervention: aid to the private sector, research and development, transport infrastructure, other infrastructure, and human capital. They are characterised by a varying degree of positive demand and supply side effects on regional and aggregate development, which, together with the level of the shocks, determine the impact on GDP. We find that a projected €10.9 billion of Cohesion Policy funding would increase Bulgarian GDP by 3.4% above its baseline value at the end of the implementation period in 2030 and by 2.4% ten years later. Our results suggest that there is no systematic equity-efficiency trade-off in Bulgaria which mainly arises as the consequence of low spillovers in the capital city region versus the strictly higher spillovers observed in the rest of the country's regions. We conclude that a balanced Cohesion Policy portfolio would foster a high impact on national GDP, maintain a high intensity of spillovers and reduce regional disparities in Bulgaria.

JEL Codes: C68, R13.

Keywords: RHOMOLO, Cohesion Policy, regional growth, regional development, Bulgaria.

1. Introduction

We estimate the potential economic impact of a hypothetical European Union (EU) Cohesion Policy funding for the period 2021-2027 in Bulgaria and study its implications for growth and development for the country and its NUTS 2 regions. For this purpose we employ RHOMOLO, a dynamic spatial computable general equilibrium (CGE) model for EU regions and sectors, developed by the European Commission for territorial impact assessment.

The EU Cohesion Policy is the EU's main investment policy. It aims to strengthen economic and social cohesion by reducing disparities in the level of development between regions by supporting job creation, business competitiveness, economic growth, sustainable development, and improving citizens' quality of life.¹ The funding is delivered to regions through two main funds, the European Regional Development Fund (ERDF, 43% of Cohesion Policy) and the Cohesion Fund (CF, 13%). Together with the European Social Fund (ESF, 18%), the European Agricultural Fund for Rural Development (EAFRD, 22%) and the European Maritime and Fisheries Fund (EMFF, 1%), they comprise the European Structural and Investment Funds (ESIF). In order to facilitate the implementation of the Green Deal, the Just Transition Fund (JTF) was recently launched as the new financial instrument within the 2021-2027 Cohesion Policy with a budget of €17.5 billion, aiming to provide support to territories facing serious socio-economic challenges arising from the transition towards climate neutrality. Around 70% of the resources go to the economic, social and territorial cohesion objective, with more than half of that targeting less developed regions where GDP is less than 75% of the EU average.

The aim of this paper is to analyse the potential impact of the 2021-2027 ERDF, CF, ESF (including the Youth Employment Initiative), and JTF in Bulgaria, a Member State which for the 2014-2020 programming period was allocated 7.72 billion of EU resources under those three Funds (and more than 10 billion including the other two funds of ESIF). This Cohesion Policy funding was used for the implementation of investments that increased environmental protection, upgraded infrastructure, promoted educational and vocational training, research and development and social inclusion inter alia.

Based on consultations with the Bulgarian authorities on the draft Partnership Agreement, we obtain the most up to date information regarding the amount allocated to Bulgaria for the 2021-2027 programming period and the breakdown of the funding into various investment priorities. In order to get a full picture for the impact assessment analysis, this information was integrated with data for the previous programming period on the geographical distribution of funding across the country's NUTS 2 regions, and on the expected time profile of expenditure which is spread over ten years, from 2021 to 2030).² This permits us to construct a baseline scenario generating a potential macroeconomic impact in the country with a certain variation across its regions. Investments supported by the EU funding are likely to generate spatial spillovers, as programmes implemented in a given region could affect the other regions of the country as well. The economic impact of the

¹ In order to reach these goals and address the diverse development needs in all EU regions, € 355.1 billion – almost a third of the total EU budget – has been set aside for Cohesion Policy for the programming period 2014-2020. (https://ec.europa.eu/regional_policy/index.cfm/en/policy/what/investment-policy/). The exact budget for the 2021-2027 period is being negotiated at the time of writing (July 2021).

² The implementation period exceeds the seven year programming period by three years as cohesion policy allocations, which are divided into annual tranches, must be spent within two or three years. This is referred as the N+2 or N+3 rule, with N being the start year when the money is allocated.

policy therefore ultimately depends on how the funding is distributed among the country's regions and among the fields of intervention. This is analysed by addressing four additional policy questions which showcase the variation in the regional and aggregate policy impact and could assist the policy maker in designing the investment portfolio when targeting mitigation of regional disparities or boosting economic activity across regions.

We use the dynamic spatial general equilibrium model RHOMOLO to estimate the macroeconomic effects of the Cohesion Policy interventions in Bulgarian regions. The structure of the model – calibrated based on data for 267 NUTS 2 regions of the EU27 + the UK – makes it a suitable tool for evaluating policies implemented at the regional level, as well as for evaluating the territorial impact of policies implemented at the national and European levels. Economic models like RHOMOLO are routinely used for policy impact assessments and evaluations (see for example Barbero et al., 2021; Barbero and Salotti, 2021; Conte et al., 2020; and Lecca et al., 2020). Ex-ante evaluations are carried out prior to policy implementation, and inform the decision-taking process with regards to the selection of alternative policy designs.

We find that a projected €10.9 billion of Cohesion Policy funding for 2021-2027 has the capacity to increase Bulgarian GDP by 3.4% above its baseline value in 2030 (at the end of the implementation period) and by 2.4% ten years later. We identify that a balanced distribution of investments in aid to the private sector, infrastructure and research and development may lead to the mitigation of regional disparities in Bulgaria. The capital city region is the most developed region of Bulgaria and, according to our simulations, it provides high investment returns in almost all fields of intervention. However, given the relatively low level of generated spillovers of investments there, concentrating resources in that region may lead to amplification of regional disparities and would not necessarily lead to the best economic performance for the whole country. In fact, the results suggest that there is no systematic equity-efficiency trade-off in Bulgaria, which mainly arises as the consequence of low spillovers in the capital city region versus the strictly higher spillovers in the rest of the country's regions. It is therefore possible to design a policy portfolio which produces a high impact on national GDP while at the same time contributing to reduce regional disparities within the country.

The remainder of this paper is structured as follows: Section 2 describes the Bulgarian economy and the distribution of 2021-2027 Cohesion Policy funding across Bulgarian NUTS 2 regions and investment priorities. Section 3 provides an overview of RHOMOLO and the modelling of investments depending on the policy questions so as to run the model. Section 4 analyses the baseline scenario and addresses the policy questions. Section 5 concludes.

2. The Bulgarian Economy and the 2021-2027 Cohesion funding distribution

2.1 Country Background

Table 1 lists the country and regional statistics at the NUTS 2 level of regional disaggregation for year 2018.³ The capital city region, BG41, is by far the most developed of the country, with GDP per head corresponding to around 82.3% of the EU average. The GDP per head of the other regions ranges between 33.1% and 41.6% of the EU average. Recently, GDP growth has been slower in the less developed regions (with the exception of BG34 and BG42), which implies that internal regional disparities are growing over time.

³ The latest year that does not include projections.

Table 1. Economic Indicators of Bulgarian NUTS 2 regions

Region	GDP per capita 2018, EU-28=100	Real GDP growth, 2008-2018, annual average (%)	Population (2018, thousands)	Employment (2018, thousands)	Income of Households (2018, mln €)	% Change in real income of Households (2008-2018, %)	2014-2020 Cohesion Funding (mln €)	2021-2027 Cohesion Funding (provisional, mln €)
Bulgaria (BG)	51.0	1.9%	7,050	3,068.9	33,609.08	+78%	7,630.82	10,894.96
Severozapaden (BG31)	33.1	0.8%	755.9	266.3	2,217.34	+34%	879.35	1,279.29
Severentsentralen (BG32)	34.5	1.0%	794.9	323.7	2,829.84	+47%	899.49	1,295.68
Severozitochen (BG33)	40.7	1.3%	933.7	397	3,449.37	+67%	999.36	1,422.53
Yugoiztochen (BG34)	41.6	2.5%	1,039.5	438.5	3,944.7	+54%	1,104.13	1,572.93
Yugozapaden (BG41)*	82.3	2.1%	2,108.3	1,034.3	15,977.43	+119%	2,217.56	3,136.76
Yuzhentsentralen (BG42)	35.8	2.1%	1,417.4	609.2	5,190.39	+56%	1,530.94	2,187.77

Source: Eurostat and DG REGIO (Cohesion Funding data). *Capital city region.

A number of features of the regional economies will likely drive the nature of the impact of Cohesion Policy interventions. In particular, the following three stand out: the level of development, trade openness (and in particular the propensity to import), and the intensity in the usage of production factors.

In Table 2, trade openness is proxied by the share of imports over output for each NUTS 2 region of Bulgaria. The table also reports the percentage of imports coming from each of the other regions in Bulgaria with respect to the total imports of the region.

Table 2. Share of imports in output and regional share of imports from the rest of the Bulgarian regions.

	BG31	BG32	BG33	BG34	BG41	BG42
Imports/output	24%	27%	44%	54%	86%	63%
BG31		4%	4%	2%	2%	2%
BG32	13%		18%	2%	1%	2%
BG33	5%	8%		3%	2%	2%
BG34	13%	7%	5%		2%	5%
BG41	22%	23%	13%	9%		11%
BG42	12%	7%	4%	5%	3%	
TOTAL	65%	50%	44%	22%	9%	23%

Source: RHOMOLO.

The capital city region BG41 is by far the most open to international trade, as it mostly trades with partners outside Bulgaria and only 9% of its imports come from the rest of the country. This contrasts with the less developed regions whose trade is to a much larger extent intra-country in nature, the capital city region being the relatively most important source of imports. For instance, 65% of BG31 imports come from other regions of the country, and 22% from the capital city region.

The technology in the Bulgarian regions differs widely from one another and reflects their industrial fabric. In particular, the capital city region is much more labour intensive than the other regions in which the predominant sector of activity is not constituted by services as much as in BG41.

Table 3. Share of labour (vs capital) in GDP

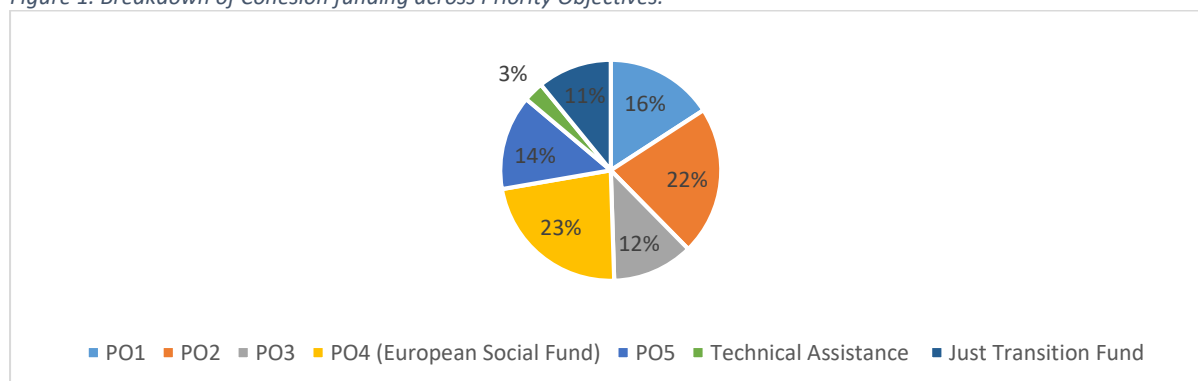
Region	BG31	BG32	BG33	BG34	BG41	BG42
Labour share	55.2%	48.2%	49.8%	52.5%	71.1%	58.2%

Source: RHOMOLO.

2.2 The 2021-2027 Cohesion Policy in Bulgaria

Based on the October 2020 draft of the Partnership Agreement, the Cohesion Policy investments allocated to Bulgaria for the 2021-2027 programming period stand at €10.9 billion. The draft Agreement contains the breakdown of the funding between five Priority Objectives (PO1: Smarter Europe; PO2: Greener, low carbon Europe; PO3: More connected Europe; PO4: More social Europe; and PO5: Europe closer to citizens), technical assistance, and the JTF as per Figure 1. For the 2021-2027 programming period, each Priority Objective is broken down into a series of Specific Objectives (SOs) which reflects the nature of the interventions envisaged. Currently, and in the absence of information regarding the distribution of the funding among the SOs, we assume that the amount under each Priority Objective is equally shared among the SOs covered by each Priority Objective. Therefore there are 23 SOs corresponding to 5 Priority Objectives, 12 ESF areas of intervention (all listed under SO 4.1), technical assistance and the Just Transition Fund (the full list of SOs can be found in the Appendix).

Figure 1. Breakdown of Cohesion funding across Priority Objectives.



Source: DG REGIO. Please note that this breakdown is based on an early draft of the Partnership Agreement and will most certainly change before the Agreement is finalised.

At this stage two assumptions need to be introduced as ingredients to the model. First, the geographical breakdown of the funding among the NUTS 2 regions of Bulgaria is assumed to be the same as for the 2014-2020 period (see Table 4). Second, it is assumed that regional funding under each SO is distributed accordingly. Likewise, the time profile of expenditure of the funds is taken from the one established for the 2014-2020 programming period at the country level as per Table 5. We refer to this allocation as the baseline scenario in the rest of the Report. The simulation strategy adopted to quantify the effects of the investments is described in the following Section, together with a brief presentation of the RHOMOLO model.

Table 4. Geographical breakdown of expenditure

Region	BG31	BG32	BG33	BG34	BG41	BG42	Total
Share	11.7%	11.9%	13.1%	14.4%	28.8%	20.1%	100.0%

Source: DG REGIO.

Table 5. Time profile of expenditure

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Share of total expenditure	2.3%	4.7%	7.9%	11.2%	14.2%	16.7%	17.7%	14.7%	8.8%	1.7%

Source: DG REGIO.

3. The RHOMOLO model and modelling Cohesion Policy in Bulgaria

3.1 A brief overview of the model

RHOMOLO is a dynamic spatial computable general equilibrium model whose purpose is to provide analyses with sector-, region-, and time-specific results related to investment policies and structural reforms in the EU. The model is calibrated on a set of fully integrated EU regional Social Accounting Matrices (SAMs) for the year 2013 which is taken as the baseline state of the economy. The SAMs account for all the transactions in the economy: purchasing of intermediate goods, hiring of factors, and current account transactions of institutions including taxes and transfers, consumption and savings, as well as trade flows. A SAM includes more information than a simple Input-Output (IO) table (which contains information on the production and use of goods and services and the income generated in that production), as it includes data on the secondary distribution of income, detailing the roles of labour and households (Miller and Blair, 2009).

The main distinctive feature of the model lies in its regional dimension, as it is calibrated with data for 267 NUTS 2 regions of the EU27 + the UK, as well as for a residual region accounting for the rest of the World (Thissen et al., 2019). Thus, the model is well-equipped to analyse the territorial impact of funding programmes and policies, especially those with a marked geographical focus such as the EU Cohesion Policy.

The full mathematical description of the RHOMOLO model is beyond the scope of the present Report and can be found in Lecca et al. (2018). Succinctly, the model economies are disaggregated into ten economic sectors (based on the NACE Rev. 2 industry classification), and firms are assumed to maximise profits and produce goods and services according to a constant elasticity of substitution production function. The remaining agents in the model include utility-maximising households and a government which collects taxes and spends money on public goods and transfers. Capital and labour are used as factors of production, and transport costs are based on the transport cost model by Persyn et al. (2020). The model is solved in a recursively dynamic mode, where a sequence of static equilibria is linked to each other through the law of motion of state variables. This implies that economic agents are not forward-looking and their decisions are solely based on current and past information.

The next sub-section is devoted to the illustration of how the Cohesion Policy investments are introduced into the model in order to simulate their effects on the economy. Essentially, the detailed information on the SOs of the 2021-2027 Cohesion funding must be simplified and translated into modelling shocks. This allows us to construct scenarios in which the state of the economy changes according to specific economic mechanisms which are specific to the type of intervention simulated, such as aid to private sector or investments in transport infrastructures.

3.2 Translating Cohesion Policy expenditures into model shocks

For the purposes of the analysis, we grouped the 37 spending categories (corresponding to the 35 SOs, technical assistance and the Just Transition Fund) 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).⁴

Each spending category was assigned to a model shock to simulate an appropriate, identified economic impact, resulting in the fields of interventions being modelled either with single shocks, or with combinations of shocks according to the nature of the interventions. The breakdown by field of intervention and model shock is presented in Table 6 along with a brief description of the nature of the shock that is assumed in the RHOMOLO model. The demand-side effects are temporary in nature and reflect the transfer of resources resulting from the implementation of the Cohesion Policy package. The supply-side effects are structural and capture the long-lasting changes stemming from each policy intervention. The associated labels of the SOs can be found in Appendix A. We now describe the specificities of each of the fields of intervention represented by model shocks.

Table 6. Definition of Fields of Intervention and model shocks

Field of intervention	Field of intervention Label	Model shock	Demand-side effects	Supply-side effects	Share of 2021-2027 expenditure
Transport infrastructures	TRNSP	TRNSP	Increase in public consumption	Decrease in transportation costs	11.6%
Other infrastructures	INFR	IG (50%)	Increase in public investment	Temporary increase in the stock of public capital (5% depreciation rate)	49.5%
		G (50%)	Increase in public consumption		
Human Capital	HC	HC	Increase in public consumption	Increase in labour productivity (75% of the HC expenditure)	23.1%
Research and Development	RTD	RTD	Stimulates private investment	Increase in total factor productivity (TFP)	6.2%
Aid to private sector	AIS	RPREMK	Reduction in risk premium stimulating private investment	Temporary increase in the stock of private capital (15% depreciation rate) (100% of the AIS expenditure)	6.2%
				Increase in TFP (only 50% of the AIS expenditure)	
Technical assistance	TA	G	Increase in public consumption		3.3%

Source: RHOMOLO modelling assumptions and DG REGIO.

Transport infrastructures (TRNSP) - The resources allocated to transport infrastructure are assumed to generate temporary effects through increases in government consumption in order to account for the purchase of goods and services required to build the actual infrastructures. The associated supply-side and long-lasting effect is simulated through a reduction in transport cost stimulating trade flows. Transport costs affect all ten economic sectors considered in the model. The estimated

⁴ Technical Assistance to Bulgaria is not considered in the analysis as the demand for it, as well as the nature and content of any intervention is unknown. Additionally the amount reserved for it (3.3% of the Cohesion Policy budget) is very small.

reduction in costs due to Cohesion Policy investments is calculated with a linear approximation of the impact of comparable transport investments estimated with the transport cost model by Persyn et al. (2020).

Other infrastructures (INFR) - Regional investments in non-transport infrastructures are typically related to electricity networks improvements, water treatment, and waste management. These are modelled and implemented in RHOMOLO either as a public investments (IG - when associated with industrial processes) or as a government consumption (G). The IG shock is implemented as an exogenous increase in public investment augmenting the amount of the public capital stock, which enters the production function of the model as an unpaid factor.

Investment in human capital (HC) - The implementation of human capital policies is modelled in RHOMOLO as follows. First of all, in the short run all the HC expenditures are modelled as government current expenditure. Then, in order 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 the policy. Then, following the empirical literature on Mincer-type regressions (Card, 2001), labour efficiency is assumed to increase by 7% for each additional school year gained, with country-specific adjustments related to the PISA score accounting for different returns to education.

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.

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 supply-side permanent effects associated to this policy are simulated through a TFP improvement. The money injection is translated into TFP shocks 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 data retrieved from Eurostat.

Aid to private sector (AIS) - Cohesion Policy supports investors who want to engage in risky activities with a high potential for fostering economic growth and employment. These investments are assumed to stimulate private investments via a reduction in the risk premium and, therefore, in the user cost of capital (RPREMK). 50% of the AIS spending is assumed to have productivity-enhancing effects as in the case of RTD.

Technical assistance (TA) - This investment on the economy is modelled as an increase in public current expenditure (G) to account for purchases of goods and services associated with the transfer of resources, with no associated supply-side effects. This field of intervention is not discussed in this paper.

It should be noted that all the supply-side long-run effects decay over time. The stocks of public and private capital depreciate at a 5% and 15% yearly rate, respectively, and both the productivity improvements and the transport cost reductions also decay at a 5% yearly rate. The reason behind this assumption is that even research and development breakthroughs leading to productivity

improvements eventually cease to represent an advantage for the regional economy which benefit from them. Also, the model takes into account the fact that the Cohesion Policy is financed by the EU budget to which each Member State contributes proportionally to its GDP, the national contribution being financed through lump-sum taxes in RHOMOLO. The latter decrease household disposable income, thus adversely affecting the economic performance and partly offsetting the positive impact of the programmes.

4. Simulation Strategy and Results

Our simulations are based on a set of policy relevant questions developed in collaboration with DG REGIO (Table 7). Besides the first question on the effects of the specific interventions, the rest of the questions aim to identify the impact of redistributing funding across the regions, or SOs, or combinations of both, starting from the baseline scenario in which funds are distributed across SOs and regions as described in sub-section 2.2. The second column of the table reports the sections of the paper dealing with each question.

Table 7. Policy questions on the impact of 2021-2027 Cohesion Policy in Bulgaria

Q1	S. 4.2	Which field of intervention would trigger the highest GDP impact in which region(s)?
Q2	S. 4.3	What would be the impact of distributing half of the transport budget to the different regions equally compared to the baseline situation?
Q3	S. 4.4	What would be the impact of distributing half of the energy efficiency budget to the different regions equally compared to the baseline situation?
Q4	S. 4.5	What would be the impact of significantly increasing the transport or energy efficiency allocation for the two least developed regions?

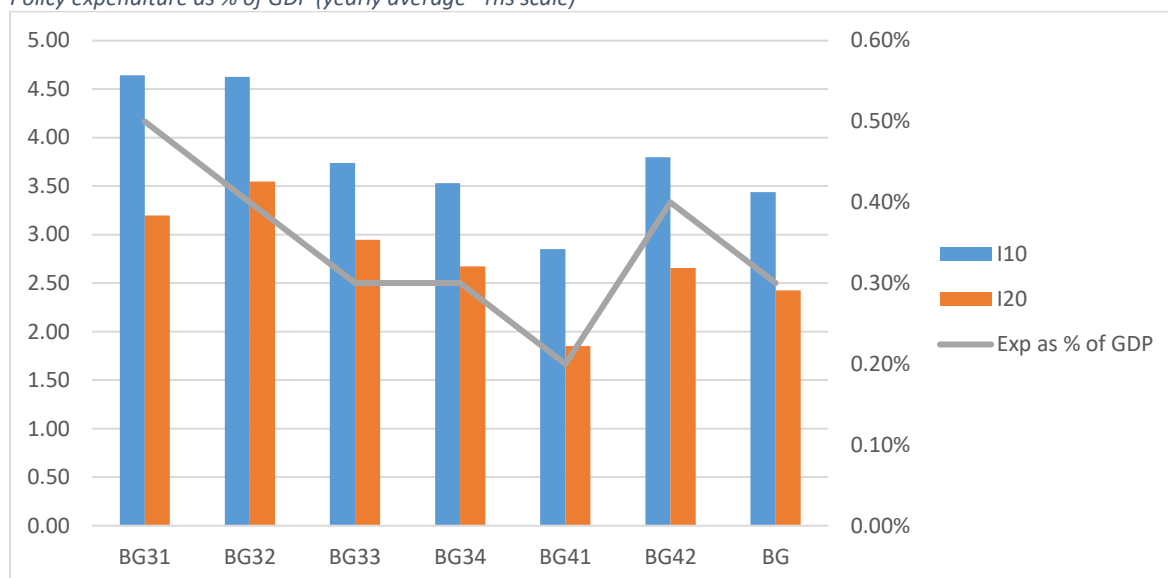
By employing the RHOMOLO model we can establish how the reallocations envisaged in questions 2 to 4 affect the impact of the policy on the country's and the regional economies. This can yield valuable information for the European and Bulgarian policy makers in the context of designing the 2021-2027 Cohesion Policy programmes. The questions are answered relative to the baseline scenario which reflects the simultaneous expenditure of funds across fields of intervention and Bulgarian regions. Before tackling the four policy questions of Table 7, we assess (in sub-section 4.1) the potential impact of the hypothetical investments portfolio illustrated above relative to the no policy scenario. We then present the results corresponding to each question and discuss their policy implications.

4.1. The baseline scenario

RHOMOLO is a general equilibrium model and therefore each simulation produces a large amount of results. Thus, choices must be made in order to present the most relevant information specific to the research question addressed by each analysis. In this case, we concentrate firstly on the GDP impact and then on the GDP multipliers. The GDP impact is expressed as the percentage difference relative to no policy scenario. 2030 is the last year in which Cohesion Policy investments are made and can be considered as the short run in which the GDP impact mainly reflects the demand side effects described in Table 6. The supply-side effects are also at work, but their effects die out much later. The results for 2040 can be interpreted as the long run impacts of the policy since starting from 2030 only the supply side or structural aspects remain. These effects pertain to changes in productivity and transportation costs. Some residual demand side effects remain: for example, the public capital stock depreciates slowly so that the effects of public investments can still be felt in the regional economies ten years after the end of the implementation period. Figure 2 shows the impact on GDP

in 2030 and in 2040⁵, as well as the magnitude of the Cohesion Policy investments with respect to GDP, in the Bulgarian regions and in the country as a whole.

Figure 2. Impact on GDP in 2030 (I10) and 2040 (I20) as % differences from no-policy-scenario GDP (lhs scale), and Cohesion Policy expenditure as % of GDP (yearly average - rhs scale)



Source: RHOMOLO simulations.

The magnitude of the impact closely follows that of the policy injection in the regional economy. In the short-run, the highest impact is in BG31 where GDP in 2030 is around 4.6% higher than in the absence of the programmes. During the implementation period, Cohesion Policy expenditure in BG31 corresponds on average to 0.5% of regional GDP per year. In BG41, the impact is only 2.8% above the no-policy-scenario at the end of the implementation period, but expenditure corresponds to 0.2% of yearly GDP on average. This is not surprising, as in the short run the impact on GDP is mostly driven by the demand side shocks of increased investment and current expenditure. In the longer run, the importance of supply-side effects increases with respect to that of the demand-side ones, thus the picture changes slightly (for instance, the impacts in BG31 and BG32 differ more in 2040 than in 2030).

Table 8 reports the impact on GDP in 2030 and 2040 in columns I10 and I20 respectively, and the GDP multipliers in 2030 and 2040 in columns M10 and M20. The latter are defined as the cumulated changes in GDP in absolute values divided by the full amount of the policy investments. For instance, a multiplier of 1.5 means that for each euro spent through the policy, GDP increases by 1.5 euro. The last column reports the average amount of Cohesion Policy allocation with respect to yearly GDP during the implementation period.

Table 8. Impact on GDP in 2030 (I10) and 2040 (I20) expressed as % differences from no-policy-scenario GDP, multipliers in 2030 (M10) and 2040 (M20), and Cohesion Policy expenditure as % of GDP (yearly average)

BAU	I10	I20	M10	M20	Expenditure as % GDP
BG31	4.64	3.20	0.80	1.58	0.5%
BG32	4.63	3.55	0.83	1.83	0.4%
BG33	3.74	2.95	0.88	1.97	0.3%
BG34	3.53	2.67	0.84	1.82	0.3%
BG41	2.85	1.85	1.27	2.59	0.2%

⁵ I10 and I20, respectively: 10 and 20 stand for the years after the beginning of the policy implementation.

BG42	3.80	2.66	0.78	1.59	0.4%
BG	3.44	2.43	0.95	1.99	0.3%

Source: RHOMOLO simulations.

The multiplier is the highest in BG41 where 1 euro invested through Cohesion Policy returns 2.6 euros in GDP after 20 years. This is to a large extent due to some of the characteristics of the capital city region which are analysed in detail in the next Section but it is also due to the fact that the region is the one benefitting most from positive spillovers originating in other regions of the country. While in 2030 the multiplier is lower than one in most of Bulgaria, it is largely above one by 2040. This reflects the fact that, due to its substantial supply-side effects, the benefits of Cohesion Policy continue after the end of the programmes, highlighting the structural effects of the policy in the medium to long run.

4.2. Q1: Which spending category would produce the highest GDP impact in which region(s)?

We perform two sets of experiments to answer to this question. First, we run individual simulations per field of intervention simultaneously across all regions to identify the region in which the highest GDP impact is produced. Second, we simulate region-specific investments to identify which region of the country generates the highest GDP impact for Bulgaria as a whole when targeted by Cohesion Policy investments.

For the first case, the shocks occur simultaneously in all Bulgarian regions and the regional GDP multipliers are reported in Table 9. For each field of intervention, the multipliers are calculated both at the end of the implementation period of the policy (10 years), and ten years afterwards (20 years). For the shocks with substantial supply-side effects, like infrastructure investments, it is more meaningful to look at the long run impact on GDP rather than at the effects in the short run only.

Table 9. Regional GDP multipliers - country-wide shocks

	AIS		RTD		INFR		TRNSP		HC	
	10 yrs	20 yrs	10 yrs	20 yrs	10 yrs	20 yrs	10 yrs	20 yrs	10 yrs	20 yrs
BG31	0.80	1.85	0.86	2.01	0.94	1.90	0.57	0.63	0.70	1.37
BG32	0.84	2.03	0.91	2.25	0.98	2.30	0.66	0.81	0.61	1.37
BG33	0.86	2.16	0.95	2.44	1.05	2.44	0.66	0.84	0.67	1.53
BG34	0.88	2.12	0.97	2.38	0.99	2.20	0.56	0.66	0.70	1.57
BG41	1.04	2.38	1.18	2.76	1.37	2.85	1.34	1.71	1.20	2.72
BG42	0.85	1.97	0.94	2.22	0.88	1.87	0.65	0.78	0.63	1.33

Source: RHOMOLO

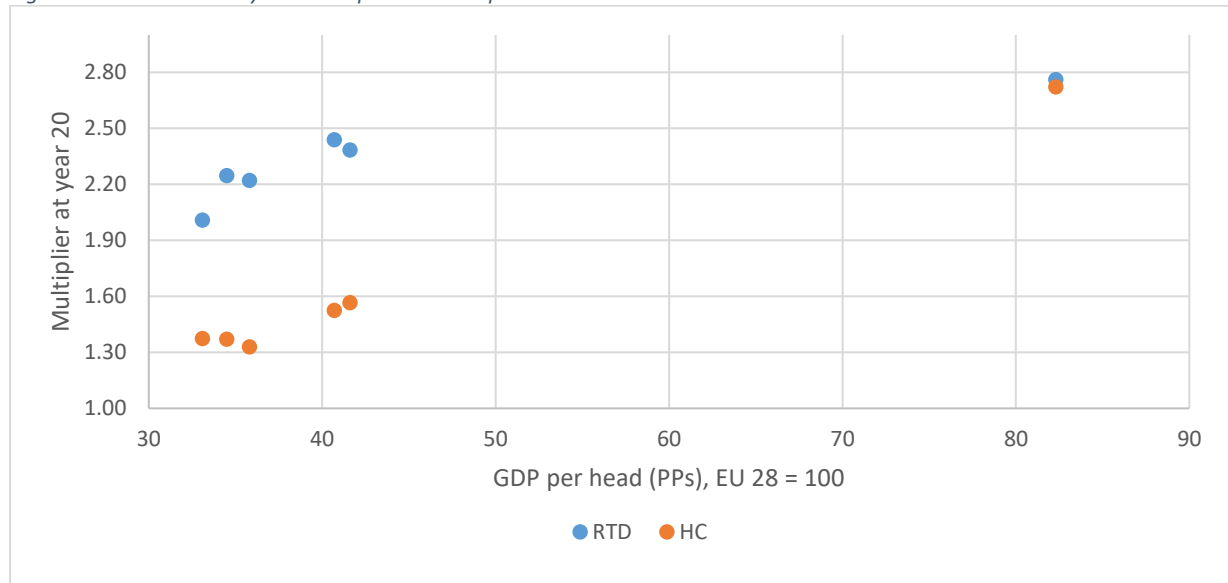
Important regional differences in the multipliers for all fields of intervention arise, with AIS being the field characterised by the narrowest range of multipliers.⁶ The capital region BG41 tends to have the biggest economic impact from the funding shocks, however in the cases of AIS and RTD the differences with the rest of the regions are not large. The TRNSP and HC fields exhibit the largest variation between BG41 and the other regions. One explanation for the large impact of transport infrastructure investments in BG41 lies in its trade openness (see Table 2 above): reducing transport

⁶ Differences in the values of the multipliers may seem small but they actually correspond to significant differences in terms of returns. For instance, the 20 year RTD multiplier of BG31, 2.01, yields an compound annual rate of return of 3.5%, whilst the RTD multiplier for BG41, 2.76, corresponds to a rate of 5.2% per annum respectively, according to: $Return_{r,t} = Multiplier^{1/(t-t_0)} - 1$, where t is the year after the policy implementation in region r and t_0 refers to the year before the policy implementation.

costs in that region significantly benefits GDP because it affects a large volume of trade flows. Given the intense economic activity of the region, it is also possible that the benefits are generated via reduced costs of within-region flows of goods and services.

Returns on investments in human capital are particularly high in BG41. This is due to the fact that technology in the capital city region is more intensive in labour, and in particular skilled labour, than in the other regions and increasing the stock of this production factor has therefore a bigger impact on GDP.⁷ The data also suggest a positive correlation between the HC (and RTD) multipliers and the level of development (measured by GDP per capita) as highlighted by Figure 3.

Figure 3. RTD and HC 20 years multipliers vs GDP per head



Source: EUROSTAT and RHOMOLO.

The reasons for this positive correlation are mostly linked to the specificities of the industrial fabric of the various regions. The capital city region hosts more R&D intensity activities than the other regions of Bulgaria, at least twice as much as in the other regions.⁸ In 2018, 7.9% of the employment was in the high-technology sectors and 39.6% in knowledge intensive services, also higher than in the rest of the country. As highlighted in the literature (see for instance Kancs and Siliverstovs, 2016), the impact of R&D investments on firm productivity is likely to be higher in places with high levels of R&D intensity and the impact of R&D investments is therefore higher in this region. Regarding investments in human capital, labour intensive technology in the capital city region (especially medium to high skill labour) explains why the return on investments in human capital is between two or three times the magnitude observed in other regions. Yet this should not prevent investment in R&D and human capital from being ingredients of a good development policy in all Bulgarian regions, including the less developed ones. R&D investments in more developed regions may promote frontier research activities, but R&D also covers activities such as production processes and market and/or organisational innovation relevant for economic agents in less developed regions as well. This explains why the impact of R&D investment is the largest in BG41, but it is significant in other regions as well.

⁷ This effect is the equivalent to the Rybczynski (1955) theorem within RHOMOLO.

⁸ In 2018, R&D intensity activities over GDP in BG41 was 1.1% versus the other regions ranging between 0.3% and 0.5% (source: Eurostat).

Table 10 contains both the regional and country GDP 20 years multipliers corresponding to the second set of experiments, where a particular funding shock is simulated in one region at a time (the country multipliers are calculated by dividing the sum of the changes in GDP in all the regions of the country, including the ones that are not shocked, by the region-specific investment). This allows to quantify the effects in the region, and also to identify any spillover effects to the rest of the Bulgarian regions stemming from the region-specific investments.⁹

Table 10. Regional and country GDP multipliers (20 years) - region-specific shocks

	AIS		RTD		INFR		TRNSP		HC	
	Reg	Cnt	Reg	Cnt	Reg	Cnt	Reg	Cnt	Reg	Cnt
BG31	1.70	2.06	1.86	2.22	1.70	2.18	0.45	0.91	1.24	1.62
BG32	1.81	2.19	2.02	2.42	2.05	2.59	0.60	1.03	1.20	1.58
BG33	1.88	2.22	2.15	2.50	2.11	2.56	0.56	0.89	1.28	1.58
BG34	1.86	2.20	2.11	2.47	1.89	2.32	0.44	0.77	1.33	1.65
BG41	1.96	2.06	2.32	2.43	2.25	2.39	1.22	1.34	2.26	2.37
BG42	1.80	2.11	2.04	2.36	1.65	2.03	0.59	0.91	1.16	1.46

Source: RHOMOLO

The regional multipliers of Table 10 suggest that RTD investments would trigger the highest impact in all Bulgarian regions compared to the other fields of intervention, with slightly larger effects in the capital city region BG41. These results confirm that HC investments would lead to a much higher GDP response in BG41 compared to the rest of the country. Turning to the country multipliers, investing in the capital region BG41 does not necessarily result in the highest country-level GDP multiplier, except for the case of HC and TRNSP. In all the other cases, the impact of the policy on the country's GDP is maximised when a region other than BG41 is shocked, namely BG33 in the case of AIS and RTD, and BG32 for INFR. This result stems from the substantial spillover effects which are usually larger when less developed regions are shocked. This is highlighted in Table 11 which contains the spillovers expressed as percentage of the country multipliers of Table 10.

Table 11. Spillovers expressed as % of country GDP multipliers (20 years) - region-specific shocks

	AIS	RTD	INFR	TRNSP	HC
BG31	17%	16%	22%	51%	23%
BG32	17%	17%	21%	42%	24%
BG33	15%	14%	18%	37%	19%
BG34	15%	15%	19%	43%	19%
BG41	5%	5%	6%	10%	5%
BG42	15%	14%	19%	35%	21%

Source: RHOMOLO

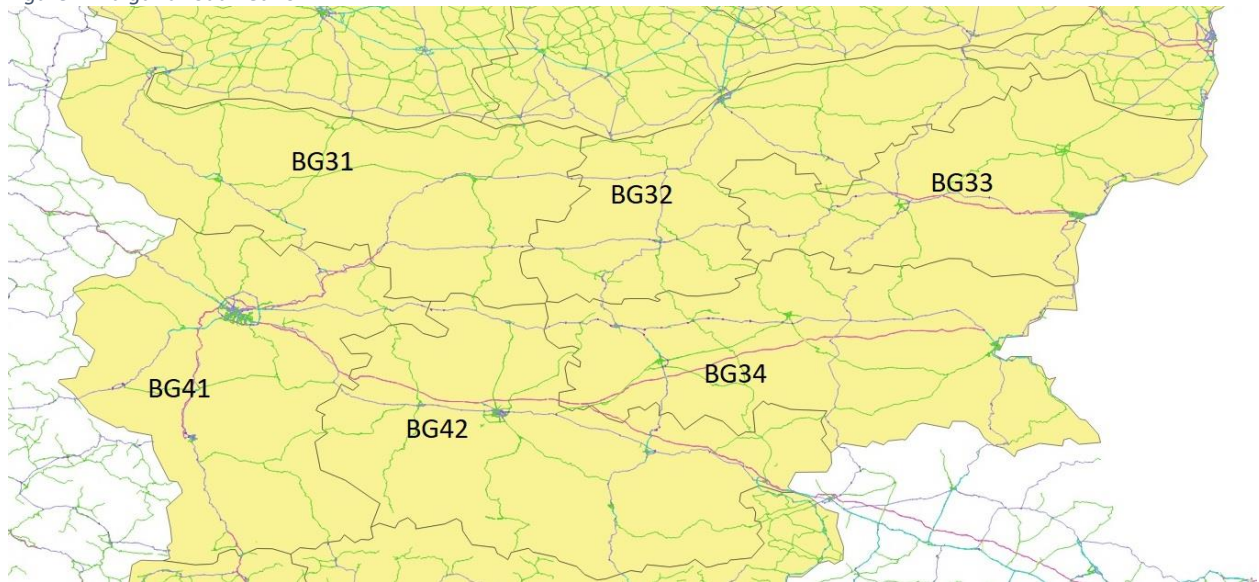
Table 11 shows that investments in the less developed regions generally generate larger spillover effects. For example, between 14% and 17% of the AIS and RTD country multipliers are due to spillovers when regions other than BG41 are shocked. That number is only 5% when the RTD investments target BG41. The equivalent share for INFR is 18-22% relative to only 6% for BG41. In fact, investments in the capital region generate the smallest spillovers to the rest of the country, irrespective of the type of shock considered. The reason is that less developed regions have a higher propensity to import goods and services from other Bulgarian regions because they have less capacity to satisfy the Cohesion Policy-related demand with their own production. Typically, the capital city region would be the one benefiting the most from this type of demand generated by

⁹ Thus these results come from 30 different simulations (five fields of intervention times six regions).

investments in less developed regions. The figures in Table 2 confirm this intuition: only 9% of the BG41 imports come from the other Bulgarian regions, while the picture is different for the latter, especially for BG31, BG32, and BG33 whose imports mostly come from the rest of Bulgaria, standing at 65%, 50% and 44% of total imports, respectively.

One clear result arising from Table 10 is that TRNSP investments generate the largest spillovers of all, suggesting that investing even in one sole region may affect the connectivity and quality of the whole country's transport network. Hence the spillover and the impact at the country-level should be the largest when investing in regions hosting the main transport nodes and corridors of the country regarding trade in goods and services. Figure 4 shows the road network of Bulgaria, from which the central role played by the transport corridors of BG31, BG32 and BG42 in connecting the country with its main trading partners emerges clearly. Given the fact that the trade partners of the country such as Romania and Germany are located North-West, and Turkey and Greece in the South-South-East, investments in BG31, BG32, and BG42 yield substantial returns for the country as a whole, second only to those of BG41 investments (the latter generate high returns both for the large trade flows characterising the region, and for its within-region activity).

Figure 4. Bulgaria road network



Source: PostGIS.

The above results lead to important policy considerations. If the objective of the policy is to foster development in the less developed regions of Bulgaria and reduce regional disparities, investments should take place there and not concentrate exclusively in the capital city region. Region-specific returns may be the highest there, but they are mostly contained within the boundaries of the region itself and the benefits would not trickle down to the other regions of the country.

On the contrary, given their high propensity to import from other regions within the country, the impact of investments in less developed regions tends to spread to the whole country. For example, investments in fields other than transport in BG31 and BG32 produce between 14 % and 24% of their benefits outside the regions themselves, while in BG41 this share is at most 6% (and only 10% for transport infrastructure). This argument is particularly prominent in fields of intervention such as research and development, infrastructure and human capital. This implies that in order to maximise the impact at country level, Cohesion Policy investments should not exclusively target the capital city region. It also implies that there is no systematic efficiency-equity trade-off in Bulgaria as it is

possible to design policy portfolio which contribute to reduce regional disparities and at the same time are conducive to a high impact at country level.

Another implication of the analysis is that the Cohesion Policy portfolio in less developed regions should be balanced. Investments in infrastructure and transport are of course necessary in regions where these resources may be lacking, but support to small and medium enterprises, to R&D and investment in human capital remain key ingredients of a good development policy in these regions. For instance, investments in R&D are sometimes believed to be better targeted at the most developed regions only. This is probably relevant for frontier research activities, but R&D also covers activities such as production processes and market and/or organisational innovation which are relevant for economic agents in less developed regions as well.

4.3. Q2: What would be the impact of distributing half of the transport budget to the different regions equally compared to the baseline situation?

It is not a priori clear whether reallocating transport investment from the more developed regions (BG41 and BG42) receiving relatively larger amounts of TRNSP funds to the other regions would yield a higher, lower or negligible GDP impact in Bulgaria. This would ultimately depend on the differences in multipliers and intensity of the spillovers caused by the redistribution of funding.

Table 12 tabulates the redistribution of funding allocated to transport. We collect half of the budget allocated to each region according to the baseline scenario and equally redistribute it to the six regions. This alternative distribution of funds lead to additional TRNSP investments in BG31, BG32, BG33, and BG34, while less money is allocated to BG41 and BG42.

Table 12. Baseline and Q2 alternative budgets allocated to transport infrastructure investments (€ mln)

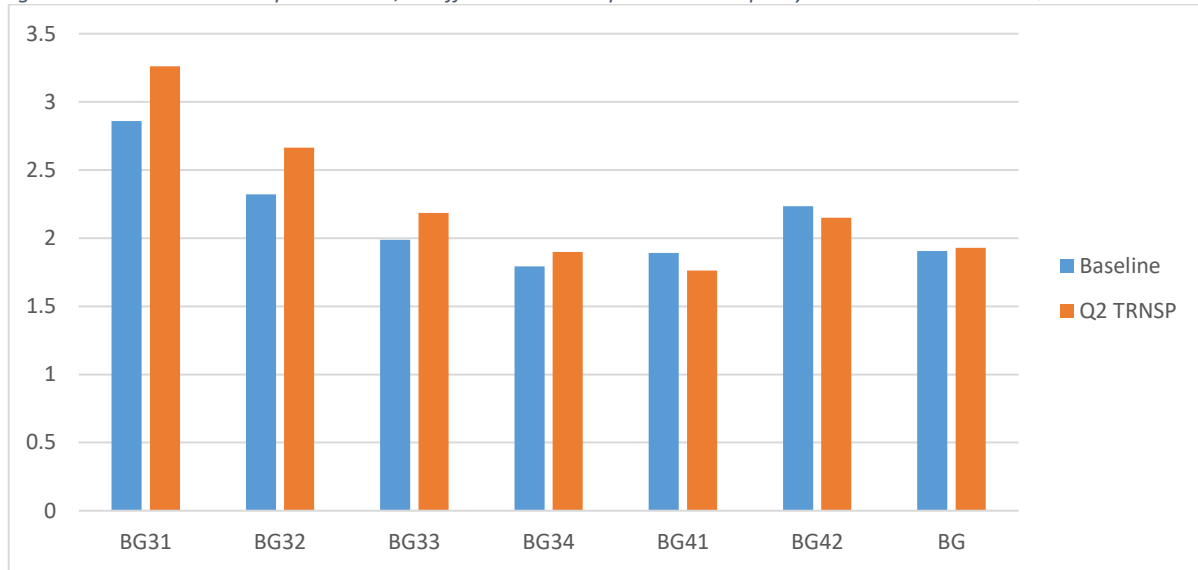
	BG31	BG32	BG33	BG34	BG41	BG42	Total
TRNSP baseline	147.76	149.65	164.31	181.68	362.31	252.69	1,258.40*
Q2 alternative TRNSP scenario	178.75	179.69	187.02	195.71	286.02	231.21	1,258.40*

Source: JRC-DG REGIO calculations. * Corresponds to about 12% of the 2021-2027 Cohesion funding.

To identify which funding distribution generates the highest aggregate impact, we perform two simulations. The first is a scenario in which we shock all regions only with the TRNSP investments of the baseline scenario. The second is the alternative scenario reported in Table 12. In both cases the investment is simultaneously deployed to all regions.

Figure 5 presents the cumulated GDP impact 20 years after the initial deployment of investment (2040). The cumulated GDP impact per region is measured as the percentage difference from the GDP of the no policy scenario.

Figure 5. Cumulated GDP impact in 2040, % difference with respect to the no policy scenario - Baseline vs Q2 TRNSP



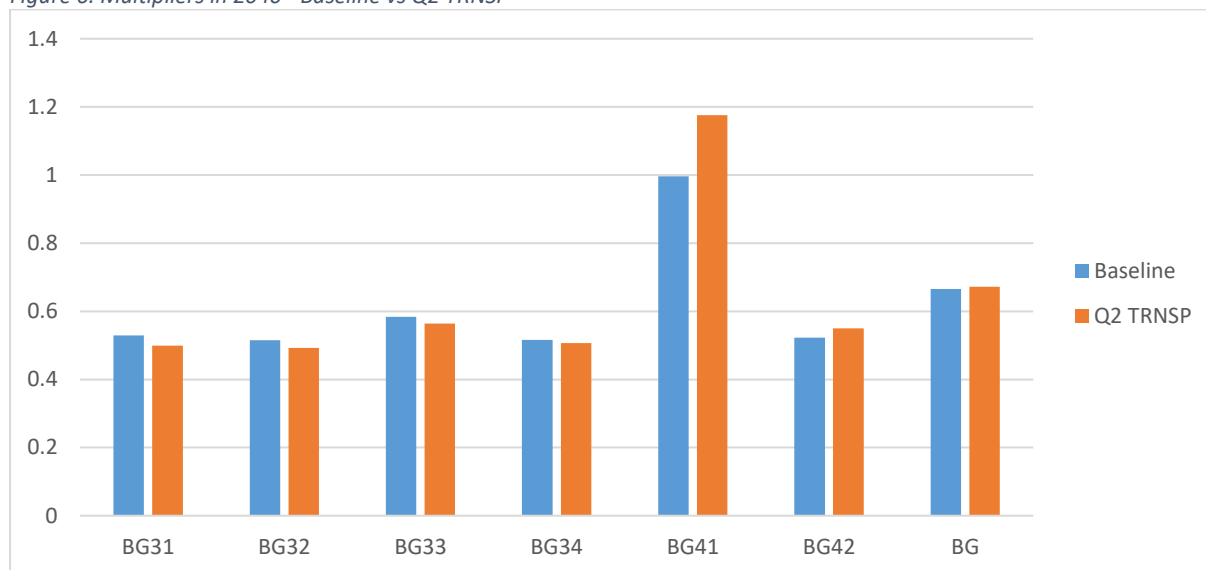
Source: RHOMOLO simulations.

The GDP impact is larger in regions receiving additional funding, while it is smaller in BG41 and BG42 in which the investments were decreased under the alternative case than in the baseline scenario. This is true both at the end of the implementation period (year 10 - not reported for brevity), when the impact is mainly driven by the demand-side effects of the investments, and 20 years after the beginning of the policy, a period in which supply-side effects are the main components of the policy impact. For Bulgaria as a whole, the 20-year cumulated GDP impact is slightly higher in the alternative scenario, although the difference can be considered negligible (+1.91% vs +1.93%).

Figure 6 shows the associated GDP multipliers under the two scenarios in 2040. The increase in the multiplier for BG41 is particularly significant and it can be attributed to two different effects. First, concentrating more of transport investment in other Bulgarian regions increases the spillovers from which the capital city region benefits. In particular, the scenario implies that investments are larger in BG31 and BG32, two regions crossed by important international trade corridors which partly compensates for less investment in the more developed regions. Building transport infrastructures there is therefore likely to generate substantial spillovers in BG41.

Second, investment in transport infrastructure feature decreasing returns to scale. Consequently, in a region such as BG41 with a relatively large endowment, smaller investments tend to be more productive than larger ones, making the multiplier higher under this scenario. As a result, even if resources are shifted away from the capital city region where the returns are high, the impact per euro at country level is hardly affected. At the same time, it contributes to reduce regional disparities in the country.

Figure 6. Multipliers in 2040 - Baseline vs Q2 TRNSP



Source: RHOMOLO simulations.

Thus, even if investments in transport generate important spillovers since they affect the whole transport network, in the case of Bulgaria, the regions benefitting from the transfer are also those where the GDP impact tends to increase. Similarly, the impact decreases in the regions where investments are reduced, and for the country as a whole there is hardly any significant difference in terms of GDP impact between the two scenarios.

4.4. Q3: What would be the impact of distributing half of the energy efficiency budget to the different regions equally compared to the current situation?

We follow the same strategy as in the previous section by generating an alternative distribution of funding across regions, although in this case the focus is on infrastructure investments, which is how energy efficiency spending is treated in RHOMOLO. Thus, we simulate solely the INFR investments simultaneously deployed in all the regions of Bulgaria and we compare the resulting GDP impact and multipliers with those of the baseline INFR investments.

Energy efficiency investments (*SO 2.1: Promoting energy efficiency and reducing green-house gas emissions*) form part of the INFR field of intervention and are modelled in RHOMOLO as a public investment shock IG increasing the stock of public capital. Table 13 shows the baseline distribution and the alternative one related to the question above. In the latter case, similarly to the previous section, half of the baseline initially allocated to each region is equally redistributed to the six regions. This results in more investment being available in BG31, BG32, BG33, and BG34, and less in BG41 and BG42, the latter two regions being the ones receiving the biggest shares of the total SO 2.1 budget in the baseline scenario.

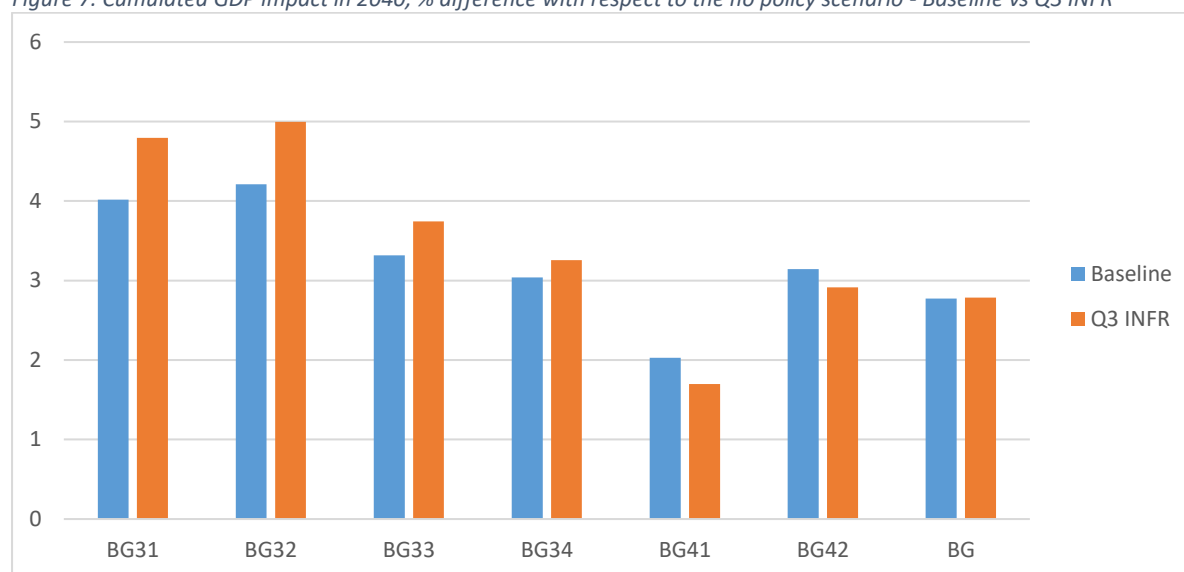
Table 13. Baseline and Q3 alternative budget allocated to SO 2.1 (€ mln)

	BG31	BG32	BG33	BG34	BG41	BG42	Total
INFR baseline	34.71	35.15	38.59	42.67	85.10	59.35	295.56*
Q3 alternative INFR scenario	42,00	42.21	43.93	45.97	67.18	54.31	295.56*

Source: JRC-DG REGIO calculations. * Corresponds to about 3% of the 2021-2027 Cohesion funding.

Figure 7 shows the associated cumulated GDP impact (with respect to the no policy scenario) under the two scenarios in 2040, ten years after the end of the implementation period. As in the previous section, the results reveal that the GDP impact is larger in the regions receiving more investment compared to the baseline, and smaller in the two regions in which investments decrease.¹⁰ The effect of the shift of resources on the impact of the policy at country level is negligible, both at the 10 and 20-year intervals (the first is not reported for the sake of brevity).

Figure 7. Cumulated GDP impact in 2040, % difference with respect to the no policy scenario - Baseline vs Q3 INFR



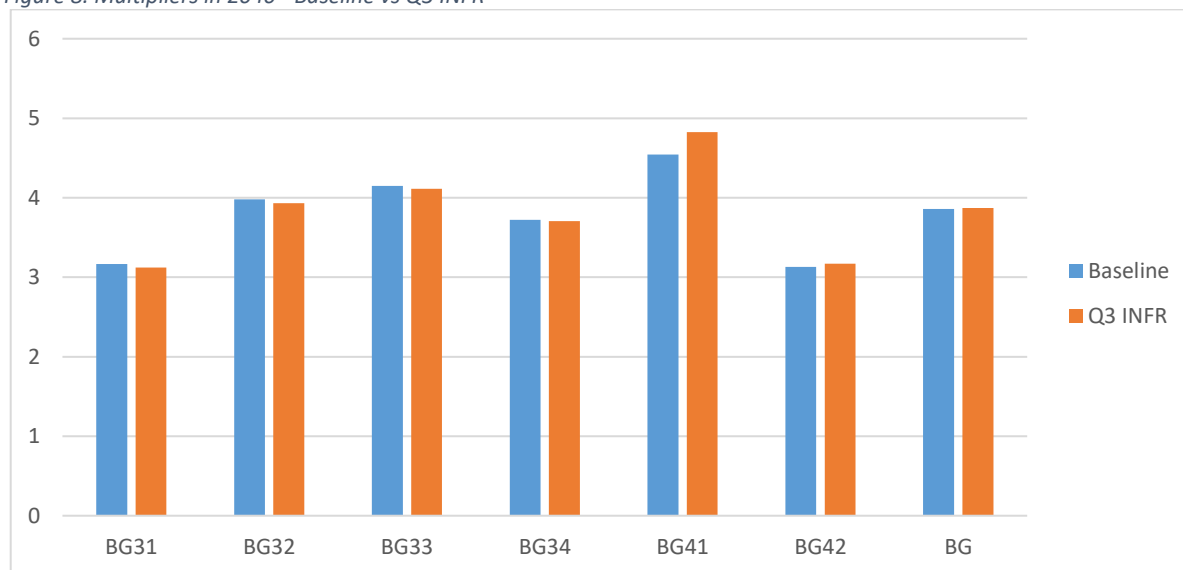
Source: RHOMOLO simulations.

The analysis of the multipliers (Figure 8) helps explaining why this redistribution of funds among Bulgarian regions hardly affects the country-level impact of the policy on GDP.

The GDP multipliers in the two regions from which resources are shifted away are higher under the Q3 INFR scenario. Similarly to the Q2 TRSNP scenario, this is due to a combination of higher positive spillover from the regions where resources are transferred and to the decreasing returns to scale attached to the accumulation of public capital. This implies that larger investments may be less effective than smaller ones. This seems to be the case for BG41, since the amount invested in public capital in the alternative scenario is significantly smaller than the one invested in the baseline scenario, leading to a lower multiplier. As a result, even if resources are shifted away from the regions where they are most productive, the increase in the multiplier generated in these regions is such that the multiplier at the country level is only marginally affected.

¹⁰ The effect of the shift continues to materialise for several years after the termination of the programmes since the public capital stock is assumed to depreciate slowly, at a rate of 5% per year.

Figure 8. Multipliers in 2040 - Baseline vs Q3 INFR



Source: RHOMOLO simulations.

In conclusion, shifting energy efficiency investments from more to less developed regions yields a lower policy impact in the former and a higher impact in the latter. Since the impact on national GDP is practically unchanged, the outcome promotes the mitigation of regional disparities without loss of impact at country level.

4.5. Q4: What would be the impact of significantly increasing the transport or energy efficiency allocation for the two least developed regions?

According to Table 1, the two least developed regions of Bulgaria are Severozapaden (Northwestern - BG31) and Severen tsentralen (Northern Central - BG32), with a GDP per head corresponding respectively to 33.1% and 35.5% of the EU average. In order to answer the question, we create two alternative scenarios by shifting 20% of the funding allocated to each of these two regions to either TRNSP or INFR. The total regional amount remains unchanged and resources are shifted towards TRNSP or INFR from the other fields of intervention in proportion to their weight in the baseline policy mix as shown in Table 14.

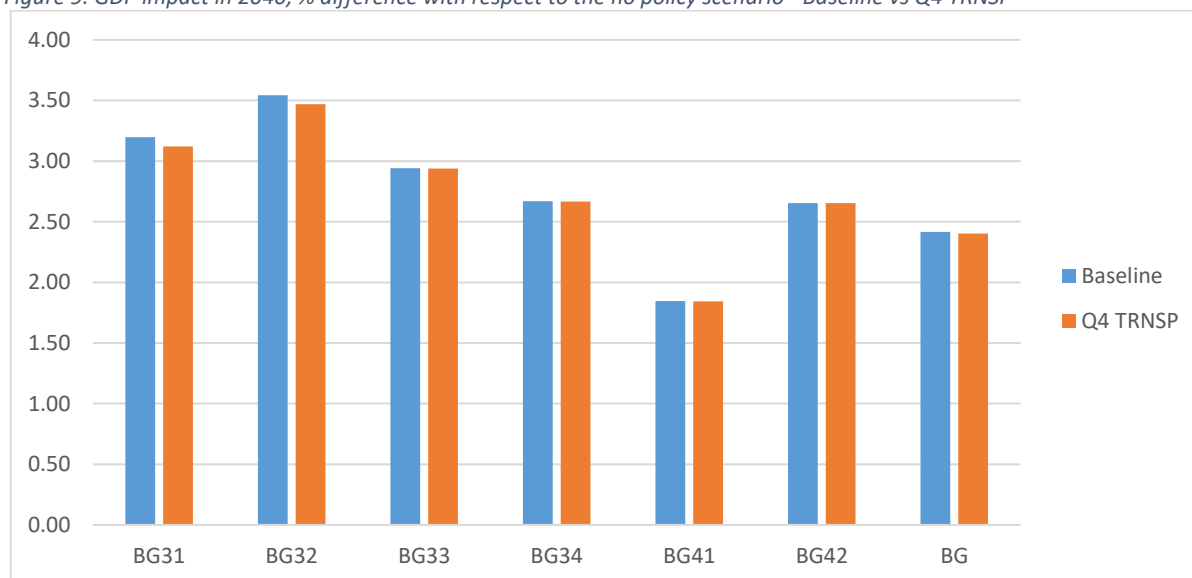
Table 14. Baseline and Q4 alternative policy portfolios (€ mln and % over total)

Fol	Baseline		Q4 TRNSP		Q4 INFR	
	BG31	BG32	BG31	BG32	BG31	BG32
RTD	79.6 (6.2%)	80.6 (6.2%)	77.5 (6.1%)	78.5 (6.1%)	64.0 (5%)	64.8 (5%)
AIS	79.6 (6.2%)	80.6 (6.2%)	77.5 (6.1%)	78.5 (6.1%)	64.0 (5%)	64.8 (5%)
INFR	633.6 (49.5%)	641.7 (49.5%)	617.0 (48.2%)	624.9 (48.2%)	760.3 (59.4%)	770.0 (59.4%)
TRNSP	147.8 (11.6%)	149.7 (11.6%)	177.3 (13.9%)	179.6 (13.9%)	118.8 (9.3%)	120.3 (9.3%)
HC	295.9 (23.1%)	299.7 (23.1%)	288.2 (22.5%)	291.9 (22.5%)	237.8 (18.6%)	240.9 (18.6%)
TA	42.8 (3.3%)	43.4 (3.3%)	41.7 (3.3%)	42.3 (3.3%)	34.4 (2.7%)	34.9 (2.7%)
Total*	1,279.3	1,295.7	1,279.3	1,295.7	1,279.3	1,295.7

Source: DG REGIO. * Totals correspond to about 12% of the 2021-2027 Cohesion funding.

Figures 9 and 10 present the RHOMOLO simulation results, by comparing the impact on GDP 20 years after the start of the implementation period of TRNSP and INFR investments. These are compared against the baseline case and are all expressed relative the GDP level of the no policy scenario. Focusing on transport, the impact on GDP in the two least developed regions of the country is slightly lower while there is no significant difference in impact in the other regions or at the country level. Because the long run multiplier is relatively low for investments in transport infrastructure in those regions (see Table 9), the shift of resources to this field away from the others tends to reduce the policy impact. The consequences on the other regions and on the country as a whole are negligible.

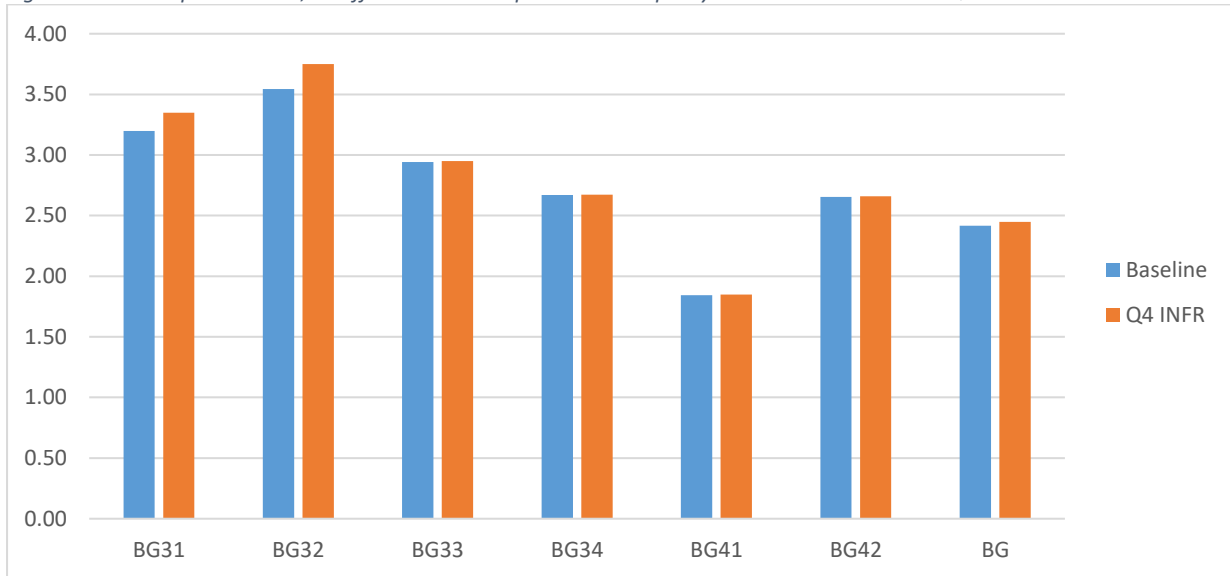
Figure 9. GDP impact in 2040, % difference with respect to the no policy scenario - Baseline vs Q4 TRNSP



Source: RHOMOLO simulations.

On the contrary, the shift of the policy portfolio towards investment in energy efficiency increases the GDP impact in the two regions concerned. Given the high INFR multipliers (see Table 9), an increase in energy efficiency investment yields a slightly more effective policy portfolio. The effect of this shift on the other regions is negligible while the impact at country level slightly increases.

Figure 10. GDP impact in 2040, % difference with respect to the no policy scenario - Baseline and Q4 INFR



Source: RHOMOLO simulations.

These results should be interpreted carefully. Investing in transport and ensuring a good connection of firms to local and extra-regional markets is a pre-condition for the development of less developed regions. However, three key aspects need to be considered when trying to gauge the impact of such investments on regional GDP and income.

First, investments in transport are extremely costly. The scenario considered here amounts to increasing the allocation to transport by around 30 million euros in BG31 and BG32, which corresponds to the construction, upgrade, or restoration of less than 10 km of roads per region according to our assumptions. Second, market access can only be substantially increased by improving the whole transport network. Investing in transport in the less developed regions allow existing firms to serve more distant markets only on condition that such interventions are coordinated with those implemented in other regions. Investments in transport restricted to a limited number of regions can therefore only have a limited impact and that the design of regional programmes in the area of transport should be closely coordinated, at least at the level of the country, preferably at the level of the EU to be productive. Third, if improving the transport network increases access of local firms to other markets, it also facilitates imports and hence increases the extent to which they are competing with firms located in other regions. The end result on regional GDP is therefore a priori ambiguous (see also Melitz, 2003).

As for the investments in energy efficiency, improving public infrastructure increases aggregate firm productivity in the long run. While these interventions are not among those yielding the highest returns, notably compared to investments in research and development or support to the private sector, such investments should be reflected in the policy portfolio in order to foster development in less developed regions where infrastructure is still significantly lacking.

5. Conclusions

We employ the RHOMOLO model to estimate the macroeconomic impact of 2021-2027 Cohesion Policy interventions in the Bulgarian NUTS 2 regions. We used the latest available information on the Cohesion Policy allocation as an input for the modelling exercise to answer four policy relevant questions that can inform the design of the programmes for this period.

Several considerations stem from the analysis. First, if the objective of the policy maker is to reduce regional disparities within the country, investments need to take place in the less developed regions. It is sometimes argued that in order to promote development in lagging regions, Cohesion Policy resources should be concentrated in the most developed/high growth places, so that the benefits of the interventions would be maximised and trickle down to the other regions (see for example Rauhut and Humer, 2020). This is not the case in Bulgaria. Investments in the capital city region only generate little spillovers to other regions and hence do not foster development in less developed regions, nor reduce internal regional disparities.

On the other hand, interventions in the less developed regions are shown to considerably spillover to other regions. As a result, if the objective of the policy is to maximise the impact of the programmes at the country level, it is better to invest in all the regions of the country, despite the fact that specific types of investments yield exceptionally high returns in certain regions. For investment portfolios such as those we study in relationship to Cohesion Policy though, the results imply that there is no equity-efficiency trade-off in Bulgaria in the sense that it is possible to design programmes which at the same time produce the highest impact at country level and contribute to reduce regional disparities.

Regarding the choice of fields of intervention, the modelling results suggest that the spending categories facilitating aid to the private sector, research and development, and infrastructure could be particularly effective in the less developed regions. In the capital city region, most types of investments would yield the highest impact.

We analysed also a number of alternative allocations of resources across regions and fields of intervention. Reallocating the funding targeting transport infrastructure or energy efficiency from more to less developed regions causes the GDP impact to decrease in the regions where investment is reduced and to increase in those where investment is increased. At the same time, the returns on investments in the regions from which resources are diverted tend to increase due to decreasing returns to scale and spillover effects. The net effect is that the impact on the country's GDP in all experiments would remain substantially unchanged relative to no reallocation, but regional disparities would decrease.

Significantly increasing transport or energy efficiency investments for the two least developed regions by reallocating funding from other spending categories within these regions would cause a lower GDP impact in the case of transport investment and a higher GDP impact from energy efficiency investment in those two regions. The former result is grounded on the relatively low GDP multiplier for transport, and on the fact that the small amount of resources mobilised in the scenario would not result in a significant change in the regional road networks (only 0.1%-0.2% of the country network would be affected). On the other hand, investments in public infrastructure such as energy efficiency in less developed areas would reduce the within-country regional disparities by increasing the GDP of that region, given the high multipliers observed for this field of intervention.

We conclude that a balanced Cohesion Policy portfolio deployed simultaneously on all the Bulgarian regions would have the capacity to substantially improve the welfare in all Bulgarian regions while at the same time reducing regional disparities. The policy portfolio of the regional programmes must be adapted to the local context and coordination across programmes would be ideal to maximise the benefits offered by the policy. A sound geographical distribution of the funding would allow to fully exploit synergies and the many spillovers possibly generated by the programmes to simultaneously foster development in the lagging regions and boost the country's GDP.

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Appendix A

Specific Objectives (SOs)	Field of intervention	Model shock
ERDF/CF - 1.1 - Developing and enhancing research and innovation capacities and the uptake of advanced technologies	RTD	RTD
ERDF/CF - 1.2 - Reaping the benefits of digitisation for citizens, companies, research organisations and governments public authorities	RTD	RTD
ERDF/CF - 1.3 - Enhancing sustainable growth and competitiveness of SMEs and job creation in SMEs, including by productive investments	AIS	RPREMK
ERDF/CF - 1.4 - Developing skills for smart specialisation, industrial transition and entrepreneurship	AIS	RTD
ERDF/CF - 1.5 - Enhancing digital connectivity	INFR	IG
ERDF/CF - 2.1 - Promoting energy efficiency and reducing green-house gas emissions	INFR	IG
ERDF/CF - 2.2 - Promoting renewable energy	INFR	IG
ERDF/CF - 2.3 - Developing smart energy systems, grids and storage outside TEN-E	INFR	IG
ERDF/CF - 2.4 - Promoting climate change adaptation, and disaster risk prevention, resilience, taking into account eco-system based approaches	INFR	IG
ERDF/CF - 2.5 - Promoting access to water and sustainable water management	INFR	G
ERDF/CF - 2.6 - Promoting the transition to a circular and resource efficient economy	INFR	G
ERDF/CF - 2.7 - Enhancing protection and preservation of nature, biodiversity, and green infrastructure, including in urban areas, and reducing all forms of pollution	INFR	G
ERDF/CF - 2.8 - Promoting sustainable multimodal urban mobility, as part of transition to a net zero carbon economy	INFR	IG
ERDF/CF - 3.2 - Developing a climate resilient, intelligent, secure, sustainable and intermodal TEN-T	TRNSP	TRNSP
ERDF/CF - 3.3 - Developing and enhancing a sustainable, climate resilient, intelligent and intermodal national, regional and local mobility, including improved access to TEN-T and cross-border mobility	TRNSP	TRNSP
ERDF/CF - 4.1 - Enhancing the effectiveness and inclusiveness of labour markets and access to quality employment through developing social infrastructure and promoting social economy	INFR	IG
ERDF/CF - 4.2 - Improving equal access to inclusive and quality services in education, training and lifelong learning through developing accessible infrastructure, including by fostering resilience for distance and on-line education and training	INFR	IG
ERDF/CF - 4.3 - Promoting the socioeconomic inclusion of marginalised communities, including low income households and disadvantaged groups including people with special needs, through integrated actions including housing and social services	INFR	G
ERDF/CF - 4.3bis - Promoting the socio-economic integration of third country nationals, including migrants through integrated actions, including housing and social services	INFR	G
ERDF/CF - 4.4 - Ensuring equal access to health care and fostering resilience of health systems, including primary care, and promoting the transition from institutional to family- and community-based care	INFR	G
ERDF/CF - 4.5 - Enhancing the role of culture and sustainable tourism in economic development, social inclusion and social innovation	INFR	G

ERDF/CF - 5.1 - Fostering the integrated and inclusive social, economic and environmental development, culture, natural heritage, sustainable tourism, and security in urban areas	INFR	G
ERDF/CF - 5.2 - Fostering the integrated and inclusive social, economic and environmental local development, culture, natural heritage, sustainable tourism and security, in areas other than urban areas	INFR	G
ESF+ - 4.1.i. - Improving access to employment and activation measures of all jobseekers, in particular youth, especially through the implementation of the Youth Guarantee, long-term unemployed and disadvantaged groups on the labour market, and of inactive people, promoting self-employment and the social economy;	HC	HC
ESF+ - 4.1.ii. - Modernising labour market institutions and services to assess and anticipate skills needs and ensure timely and tailor-made assistance and support to labour market matching, transitions and mobility;	HC	HC
ESF+ - 4.1.iii. - Promoting a gender-balanced labour market participation, equal working conditions, and a better work/life balance including through access to affordable childcare, and care for dependent persons;	HC	HC
ESF+ - 4.1.iii.bis - Promoting adaptation of workers, enterprises and entrepreneurs to change, and active and healthy ageing and a healthy and well-adapted working environment addressing health risks;	HC	HC
ESF+ - 4.1.iv. - Improving the quality, effectiveness and labour market relevance of education and training systems, to support acquisition of key competences including digital skills;	HC	HC
ESF+ - 4.1.ix - Enhancing the equal and timely access to quality, sustainable and affordable services; modernising social protection systems, including promoting access to social protection; improving accessibility including for persons with disabilities, effectiveness and resilience of healthcare systems and long-term care services;	HC	G
ESF+ - 4.1.v. - Promoting equal access to and completion of, quality and inclusive education and training, in particular for disadvantaged groups, from early childhood education and care through general and vocational education and training, and to tertiary level, as well as adult education and learning, including facilitating learning mobility for all;	HC	HC
ESF+ - 4.1.vi. - Promoting lifelong learning, notably flexible upskilling and reskilling opportunities for all taking into account digital skills, better anticipating change and new skills requirements based on labour market needs, facilitating career transitions and promoting professional mobility;	HC	HC
ESF+ - 4.1.vii - Fostering active inclusion with a view to promoting equal opportunities, non-discrimination and active participation, and improving employability;	HC	HC
ESF+ - 4.1.viii - Promoting socio-economic integration of third country nationals and of marginalised communities such as the Roma;	HC	HC
ESF+ - 4.1.x. - Promoting social integration of people at risk of poverty or social exclusion, including the most deprived and children;	HC	G
ESF+ - 4.xi - Addressing material deprivation through food and/or basic material assistance to the most deprived, including accompanying measures	HC	G
TA	TA	G
JTF - 8.1 - Enabling regions and people to address the social, economic and environmental impacts of the transition towards a climate-neutral economy	INFR	IG



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