European Commission

JRC TECHNICAL REPORT

A cohesion policy analysis for Romania towards the 2021-2027 programming period

JRC Working Papers on
Territorial Modelling and Analysis
No 06/2022

Authors:
Crucitti, F.
Lazarou, N.J.
Monfort, P.
Salotti, S.

2022

Joint Research Centre

Contact information
Name: Simone Salotti
Address: Edificio Expo, C/Inca Garcilaso 3, 41092 Sevilla (Spain)
Email: simone.salotti@ec.europa.eu
Tel.: +34 954488406

EU Science Hub
https://ec.europa.eu/jrc

JRC129049

Seville: European Commission, 2022

How to cite this report: Crucitti, F., Lazarou, N.J., Monfort, P., and Salotti, S. (2022). A cohesion policy analysis for Romania towards the 2021-2027 programming period. JRC Working Papers on Territorial Modelling and Analysis No. 06/2022, European Commission, Seville, JRC129049.

The **JRC Working Papers on Territorial Modelling and Analysis** are published under the supervision of Simone Salotti and Andrea Conte of JRC Seville, European Commission. This series mainly addresses the economic analysis related to the regional and territorial policies carried out in the European Union. The Working Papers of the series are mainly targeted to policy analysts and to the academic community and are to be considered as early-stage scientific papers containing relevant policy implications. They are meant to communicate to a broad audience preliminary research findings and to generate a debate and attract feedback for further improvements.

A cohesion policy analysis for Romania towards the 2021-2027 programming period

Francesca Crucitti[a], Nicholas-Joseph Lazarou[a], Philippe Monfort[b], and Simone Salotti[a]

[a]*European Commission, Joint Research Centre (JRC), Seville, Spain*

[b]*European Commission, DG for Regional and Urban Policy (DG REGIO), Brussels, Belgium*

Abstract

We present an analysis on cohesion policy investments in the regions of Romania using the spatial dynamic general equilibrium model RHOMOLO in order to provide useful insights on the 2021-2027 programmes and their implications for growth and development. The analysis is based on a hypothetical distribution of the funding across the following fields of intervention: aid to the private sector, research and development, transport infrastructure, other infrastructure, and human capital. These interventions are modelled using a mix of demand and supply side shocks. We find that a projected €31.3 billion of cohesion policy funding would increase Romanian GDP by 3.8% at the end of the 10-years implementation period with respect to the no policy scenario. Our results suggest that there seems to be an equity-efficiency trade-off in Romania: in most cases, the returns of the policy in terms of GDP are maximised by investing in the capital city region, at the expense of worsening regional disparities. For some fields of intervention, though, the spillovers generated in the less developed regions are so large that the national GDP impact is similar when investing there rather than in the capital city region.

JEL Codes: C68, R13.

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

Executive summary

We use the RHOMOLO model to estimate the potential economic impact of a hypothetical allocation of European cohesion policy funding for the period 2021-2027 in Romania, and study its implications for growth and development for the country and its NUTS 2 regions.

The EU cohesion policy 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. In the programming period 2014-2020, cohesion policy was allocated €355.1 billion – almost a third of the total EU budget. For the 2021-2027 period, the budget has been set at €392 billion. 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.

This paper analyses the potential impact of the 2021-2027 cohesion policy programmes in Romania, a Member State to which for the 2014-2020 programming period was allocated about €24 billion of EU resources under the three main cohesion policy Funds. We worked together with the Romanian authorities to construct a baseline scenario based on a hypothetical allocation of funds across objectives and fields of intervention, and then to provide an ex-ante assessment of the likely impact of the 2021-2027 cohesion policy in the country and its regions. Then we used the model to produce alternative scenarios in order to explore further questions related to other possible uses of the funding.

We find that a projected €31.3 billion of cohesion policy funding for 2021-2027 has the capacity to increase Romanian GDP by 3.8% in 2030 (at the end of the implementation period) with respect to the no policy scenario, and by 2.5% ten years later. The results also suggest that reducing regional disparities can only be achieved by investing in the least developed regions of the country, and that the impact of the policy can be enhanced by selecting a policy portfolio which is adapted to the needs of these regions. It is sometimes argued that in order to promote development in lagging regions, cohesion policy resources should be concentrated in the most developed territories, so that the benefits of the interventions would be maximised and trickle down to the other regions. This does not seem to be the case in Romania. Investments in the capital city region generate little spillovers to other regions and hence do not foster development in less developed regions, nor reduce internal regional disparities.

1. Introduction

We estimate the potential economic impact of a hypothetical allocation of European cohesion policy funding for the period 2021-2027 in Romania, and study its implications for growth and development for the country and its NUTS 2 regions. We use the dynamic spatial computable general equilibrium (CGE) model RHOMOLO (Lecca et al., 2020a; Di Pietro et al., 2021), which has been developed by the European Commission to carry out territorial impact assessment of policies for the regions of the European Union (EU).

The EU cohesion policy 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. Considerable funding is devoted to reach these goals. In the programming period 2014-2020, cohesion policy was allocated €355.1 billion – almost a third of the total EU budget. For the 2021-2027 period, the budget has been set at €392 billion. The funding is delivered to regions through three main funds, the European Regional Development Fund (ERDF, 43% of cohesion policy), the Cohesion Fund (CF, 13%) and the European Social Fund (ESF, 18%). Together with the European Agricultural Fund for Rural Development (EAFRD, 22%) and the European Maritime and Fisheries Fund (EMFF, 1%), they constitute 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.

This paper analyses the potential impact of the 2021-2027 ERDF, CF, ESF, and JTF in Romania, a Member State which for the 2014-2020 programming period was allocated about €24 billion of EU resources under those four Funds (and more than €35 billion including the other ESIF funds). We worked together with the Romanian authorities to construct a baseline scenario based on a hypothetical allocation of funds across objectives and fields of intervention, and then to provide an ex-ante assessment of the likely impact of the 2021-2027 cohesion policy in the country and its regions. Then we used the model to produce alternative scenarios in order to explore further questions related to other possible uses of the funding.

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.[1] This additional information matters for the results, because the 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 policy therefore ultimately depends on how the funding is distributed among the country's regions and among the fields of intervention.

We use the dynamic spatial general equilibrium model RHOMOLO to estimate the macroeconomic effects of the cohesion policy interventions in the Romanian regions. The model is frequently used to

[1] 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.

estimate the regional impacts of cohesion policy, as for example in Portugal (Barbero and Salotti, 2021), in Bulgaria (Crucitti et al., 2021), and in Poland (Lecca et al., 2020b). It is also employed to estimate the impacts of other funding programmes such as Smart Specialisation (Barbero et al., 2021) or the impact of the Covid-19 crisis (Conte et al., 2020, and Sakkas et al., 2021).

We find that a projected €31.3 billion of cohesion policy funding for 2021-2027 has the capacity to increase Romanian GDP by 3.8% in 2030 (at the end of the implementation period) with respect to the no policy scenario, and by 2.1% ten years later. The results also suggest that reducing regional disparities can only be achieved by investing in the least developed regions of the country, and that the impact of the policy can be enhanced by selecting a policy portfolio which is adapted to the needs of these regions. It is sometimes argued that in order to promote development in lagging regions, cohesion policy resources should be concentrated in the most developed territories, 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 Romania. Investments in the capital city region generate little spillovers to other regions and hence do not foster development in less developed regions, nor reduce internal regional disparities.

Our evidence complements the literature which explores aspects like sustainability (Pîrvu et al., 2018), migration (Bostan et al., 2016), efficiency and competitiveness (Traşcă et al., 2013), economic and social cohesion (Chindriş-Văsioiu and Ungureanu, 2011), governance (Brad, 2018), and research and development (Diukanova and Chioncel, 2021). These studies collectively highlight the importance of cohesion policy for the Romanian economy.

The remainder of this paper is structured as follows: Section 2 describes the Romanian economy and the hypothetical distribution of 2021-2027 cohesion policy funding across Romanian 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 shows the results obtained with the baseline scenario and addresses the policy questions. Section 5 concludes.

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

2.1 Country Background

Table 1 reports some of the main economic and demographic indicators at the country level and by region. These features are important at the time of interpreting the results of the simulations in the later sections of the report. Noticeably, the capital city region (RO32) stands out in many aspects, compared to the other regions in the country. Not only it is much smaller and much more densely populated than the rest of the country, but its level of development is higher than the EU average, which is not the case in any of the other seven regions of Romania.

The GDP per head (in purchasing power standards, PPS) of the capital city region corresponds to almost 150% of the EU average. The GDP per head of the other regions ranges between 41% and 67% of the EU average. Finally, the capital city region also reports a growth rate significantly larger than most of the other regions, which implies that internal regional disparities are growing over time.

Table 1. Key economic Indicators of Romania and its NUTS 2 regions

	GDP per head (current prices) 2018, EU27=100	GDP per head (PPS) 2018, EU27=100	Real GVA growth, 2015-2018, yearly average	Population on 1/01/2018	Area in square kilometer	Population density (persons per square km)
RO (Romania)	36	66	3.83	19,533,481	239,390.8	81.6
RO11 (Nord-Vest)	32	60	6.28	2,560,504	34,160.5	75.2
RO12 (Centru)	33	63	4.15	2,325,371	34,099.7	68.4
RO21 (Nord-Est)	22	41	-0.38	3,222,732	36,849.8	88.0
RO22 (Sud-Est)	29	54	2.93	2,423,059	35,761.7	71.6
RO31 (Sud-Muntenia)	27	51	-0.33	2,965,415	34,453.0	87.1
RO32* (Bucuresti - Ilfov)	79	149	8.98	2,302,291	1,821.2	1,316.3
RO41 (Sud-Vest Oltenia)	27	51	1.7	1,949,813	29,211.7	67.6
RO42 (Vest)	36	67	7.33	1,784,296	32,033.2	55.9

Source: Eurostat. *Capital city region.

As explained above, some features of the regional economies are key drivers of the results of the simulations. The model is calibrated on 2013 data and the figures reported in the remaining tables of this section are taken directly from the model database in order to accurately reflect the context of the simulations.

In Table 2, the propensity to import is proxied by the share of imports over output for each NUTS 2 region of Romania. Table 3 also reports the share of imports coming from each of the other regions in Romania with respect to the total imports of the region.

Table 2. Share of imports over output

Region	**RO11**	**RO12**	**RO21**	**RO22**	**RO31**	**RO32**	**RO41**	**RO42**
Tot. Imports / output	26%	23%	30%	29%	24%	20%	25%	26%
Imports / output from rest of RO	73%	73%	77%	80%	71%	59%	77%	69%
Imports / output from EU	12%	12%	11%	12%	12%	13%	13%	14%
Imports / output from ROW	15%	15%	12%	8%	18%	27%	11%	18%

Source: RHOMOLO.

Table 3. Regional share of total imports from the rest of the Romania regions

	RO11	**RO12**	**RO21**	**RO22**	**RO31**	**RO32**	**RO41**	**RO42**
RO11		8%	13%	15%	4%	5%	12%	6%
RO12	9%		9%	6%	7%	6%	6%	7%
RO21	4%	5%		4%	5%	4%	6%	4%
RO22	9%	12%	8%		13%	14%	13%	11%
RO31	16%	12%	16%	15%		19%	10%	13%
RO32	20%	20%	21%	27%	29%		21%	19%
RO41	7%	9%	5%	9%	7%	5%		9%
RO42	7%	7%	5%	5%	5%	5%	8%	
TOTAL	**73%**	**73%**	**77%**	**80%**	**71%**	**59%**	**77%**	**69%**

Source: RHOMOLO.

The capital city region is the least open to trade relative to its output (with imports over output being equal to 20%, while the average value for the other Romanian regions is 26%), and it trades less with Romanian partners than the rest of the country. Only 59% of its imports come from the rest of the country. This contrasts with the less developed regions of the country where the fraction of imports coming from the rest of the country is on average 74%.

To have a better understanding of the industrial organization of the regions and their different technologies, we report in Table 4 the regional labour shares of value added and the shares by skill type (the latter sum to 100%). The capital city region is the one with the second highest labour share in the country (59%, with RO11 being the highest at 62%), which suggests that the predominant sector of activity is constituted by services.

Table 4. Share of labour (vs capital) in GDP

Region	**RO11**	**RO12**	**RO21**	**RO22**	**RO31**	**RO32**	**RO41**	**RO42**
Total labour share	62%	55%	46%	42%	46%	59%	53%	59%
High skill	58%	58%	53%	55%	59%	48%	60%	60%
Medium skill	21%	21%	21%	22%	21%	25%	20%	21%
Low skill	21%	21%	26%	24%	20%	27%	20%	19%

Source: RHOMOLO.

Table 5 presents some GDP-based measures of regional economic disparity. The first column reports the distance of each region from the average GDP in the country. The second column reports the distance with respect to the GDP of the capital region, which is the richest. As it emerges clearly from the table, within country disparity is significant. The GDP of the capital city region (RO32) is more than double that of each of the other regions of the country, with the least developed region's GDP (RO41) equal to less than one third that of RO32.

Table5. Regional disparities in Romania

	Average GDP =100	**RO32 GDP=100**
RO11	88	42
RO12	88	42
RO21	81	38
RO22	93	44
RO31	103	49
RO32	211	100
RO41	61	29
RO42	76	36

Source: RHOMOLO.

2.2 A hypothetical funds allocation for the 2021-2027 cohesion policy in Romania

We begin the analysis by presenting a hypothetical scenario in which cohesion policy continues to apportion funds to the regions of Romania during the 2021-2027 programming period in a way which mimics the allocation of the previous programming period. This constitutes the basis for the study of the alternative scenarios used to explore the potential future allocation of cohesion funding for the 2021-2027 programmes, as well as the other specific questions addressed in this document.

The baseline scenario is based on the following: (i) the likely total amount allocated to Romania for the 2021-2027 period; (ii) a hypothetical breakdown of the funding between various investment priorities; (iii) the geographical distribution of the funding across the country's NUTS 2 regions based

on the 2014-2020 programming period; and (iv) the expected time profile of expenditure during the implementation period (2021-2030), again based on the previous programming period data.

i) The total amount is taken from the information provided by the Romanian authorities at the beginning of 2021, and corresponds to €31,267.85 million for the whole country over the whole programming period.

ii) The baseline scenario assumes that the same amount of money (€809.11 million) is allocated to each of the 35 specific objectives (SOs) defined in the regulation, plus €2,139.72 million allocated to the Just Transition Fund (JTF) for the whole programming period. This information is used in the RHOMOLO model to define the economic mechanisms triggered by the policy. Table 6 presents the relationship between the broad fields of intervention and the model shocks used to simulate their impact in the economy, together with the country-level breakdown of the funding by field of intervention.[2] 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). The model shocks are described in the next section of the report.

Table 6. Cohesion policy spending categories for Romania 2021-2027 and related modelling assumptions

Field of intervention	Code	% of total	Associated RHOMOLO shocks
Transport infrastructures	TRNSP	5.2%	Increase in government current expenditure (demand-side shock) and reduction in transport costs (supply-side shock)
Other infrastructures (this includes the JTF)	INFR	50.8%	Increase in public investment (demand-side shock) temporarily increasing the stock of public capital (54% of the total INFR expenditure) and increase in government current expenditure (demand-side shock - 46% of the total INFR expenditure)
Human capital	HC	31.1%	Increase in government current expenditure (demand-side shock) of which 75% is linked to labour productivity enhancing effects (supply-side shock)
Research and Development	RTD	5.2%	Reduction in risk premium stimulating private investment (demand-side shock) with productivity enhancing effects (supply-side shock)
Aid to private sector	AIS	5.2%	Reduction in risk premium stimulating private investment (demand-side shock), of which 50% is linked to productivity enhancing effects (supply-side shock)
Technical Assistance	TA	2.6%	Increase in government current expenditure (demand-side shock)

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.

iii) The funding allocation for each region follows the same geographical distribution as for the 2014-2020 programming period and is reported in Table 7. Cohesion policy funding is expressed first as a % of the total and then as % of GDP (average over the whole implementation period).

Table 7. Geographical breakdown of expenditure

Region	RO11	RO12	RO21	RO22	RO31	RO32	RO41	RO42
% Over the full cohesion	13%	12%	18%	14%	16%	7%	11%	9%

[2] The Appendix illustrates how each SO is tagged with a field of intervention which determines the types of shocks implemented in the model to simulate the impact of the interventions on the economy.

policy budget for Romania								
% over regional yearly GDP (average)	2.7%	2.5%	3.9%	2.6%	2.8%	0.6%	3.2%	2.2%

Source: DG REGIO and Romanian authorities data on cohesion policy (2014-2020 and 2021-2027 programming periods).

iv) Finally, the expenditure time profile follows that of the 2014-2020 programming period, as depicted in Table 8. The shocks are assumed to last 10 years to account for the N+3 rule allowing funding to be used up to three years after the programming period ends.

Table 8. Time profile of expenditure

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Share of total expenditure	2.0%	3.6%	4.1%	6.7%	12.0%	18.4%	22.4%	18.6%	10.3%	1.9%

Source: DG REGIO data on cohesion policy (2014-2020 programming period).

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.

3. An overview of RHOMOLO and its cohesion policy shocks

3.1 A brief overview of the model

The dynamic spatial computable general equilibrium model RHOMOLO produces 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 (for a full description of the data construction, see Thissen et al., 2019). 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. In addition to the Input-Output (IO) information on the production and use of goods and services, and the income generated in that production, a SAM includes data on the secondary distribution of income, detailing the roles of labour and households (Miller and Blair, 2009).

The model has a distinctive regional focus, as it is calibrated with data for all the NUTS 2 regions of the EU27, as well as the UK and a residual region accounting for the rest of the World. 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 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. Thus, the model economic agents are not forward-looking and their decisions are based on current and past information.

The next sub-section explains 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 translated into model shocks. This allows us to construct

scenarios in which the state of the economy changes according to economic mechanisms which are specific to the types of intervention simulated.

3.2 Translating cohesion policy expenditures into model shocks

Each SO 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 (see Table 6 above). The effects of demand-side shocks 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 the Appendix. What follows is a brief explanation of the shocks used to simulate the effects of the cohesion investments associated with the various fields of intervention identified above.[3]

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 costs stimulating trade flows. Transport costs affect all ten economic sectors considered in the model. The estimated 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.

The cost per pupil of different levels of schooling, obtained from Eurostat, is used to estimate how much one year of additional training would cost to train one worker. 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.

[3] For more details on the parametrisation of each shock, see Crucitti et al. (2022).

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 (taken 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 questions developed in collaboration with DG REGIO and the Romanian authorities (Table 9). The questions deal with the GDP effects of the various types of intervention, with Q2, Q3, and Q4 dealing with redistribution of funds across Funds, fields of intervention, and regions in order to understand the consequences on growth and convergence. The second column of the table indicates the sections of the paper dealing with each question.

Table 9. Policy questions on the impact of 2021-2027 cohesion policy in Romania

Question	Section	Detailed question
Q1	4.2	Which are the specific objectives triggering the highest growth of Romania in medium and long term? Are there differences between regions?
Q2	4.3	To what extent the transfer of 20% from ESF to ERDF would be beneficial for Romania in terms of jobs and growth on medium and long term? Which objectives should benefit by a higher allocation and which are those where the allocation should be cut-off?
Q3	4.4	Which is the scenario of funds' allocation between specific objectives for the highest growth of the country as a whole? To what extent this will trigger deepening the disparities between regions?
Q4	4.5	Which is the scenario of funds' allocation between specific objectives enabling convergence of Romanian regions in terms of growth?

The four questions of Table 9 are answered relative to the baseline scenario. Thus, we begin by assessing (in sub-section 4.1) the potential impact of the hypothetical investments portfolio

presented above relative to the no policy scenario. We then present the results for the rest of the questions and discuss their policy implications.

4.1. The baseline scenario

We concentrate firstly on the GDP impact and then on the GDP multipliers.[4] The GDP impact is expressed as the percentage difference relative to no policy scenario. These indicators are reported for three different points in time. The first point is 10 years after the beginning of the simulation (2030) and matches the end of the implementation period: we consider it as the short run. Then, results are reported for *t=20* and *t=30* years (corresponding to 2040 and 2050, respectively) which can be considered as the long run, since demand side effects are fading out and supply side effects continue materialising such as in the form of increased productivity and reduced transportation costs.

In the baseline scenario, the policy shock occurs simultaneously in all NUTS 2 regions of Romania and across all spending categories. Table 10 reports the outcome of the simulation of the baseline scenario. In the short run (*t=10*), the highest impact occurs in region RO12 whose GDP increases by 4.84% relative to the no policy scenario, while the GDP in the capital city region RO32 is 2.40% above the value in the absence of the policy shock, a finding which reflects the low level of cohesion policy expenditure, amounting on average to 0.6% of yearly GDP in that region. Thus, in the short run, the impact on GDP is highly correlated with the magnitude of the policy injection as it is driven mainly 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 effects, which affects the regional GDP results. The highest impact in 2050 (*t=30*) occurs in RO22 (2.44%) followed by RO31 (2.39%).

While the GDP impact is relatively small in the capital region RO32, the multipliers are the biggest in all the periods reported in the table. Ten years after the beginning of the cohesion investments, the multiplier is above 1 in RO32, and close to 1 in the rest of the country, while it is well above 1 everywhere both twenty and thirty years after the first year of investments. Regarding the RO32 multipliers, there are two main reasons why they are the highest in the country. First, RO32 is different in many respects from the rest of the regions of the country, as explained in section 2. In particular, the region features a much higher research and development intensity (which tends to increase the impact of R&D oriented interventions), a larger share of the private sector on GDP (which makes interventions in support to the private sector more effective), and a highly labour intensive technology (which increases the impact of interventions in the field of human capital). The region is also the origin of a large share of the internal trade flows of the country which implies that it significantly benefits from the spill-overs stemming from the programmes implemented in the other regions of the country. The second reason is that RO32 largely benefits from the positive spillovers originating in other regions of the country due to the fact that most of the imports of Romanian regions come from the capital city region itself. This is analysed extensively in the next section.

[4] The multipliers are calculated as the cumulative impact on GDP over a certain period of time, divided by the total policy injection. For instance, a multiplier of 1.5 after 10 years means that GDP has increased by €1.5 for each € spent over a decade.

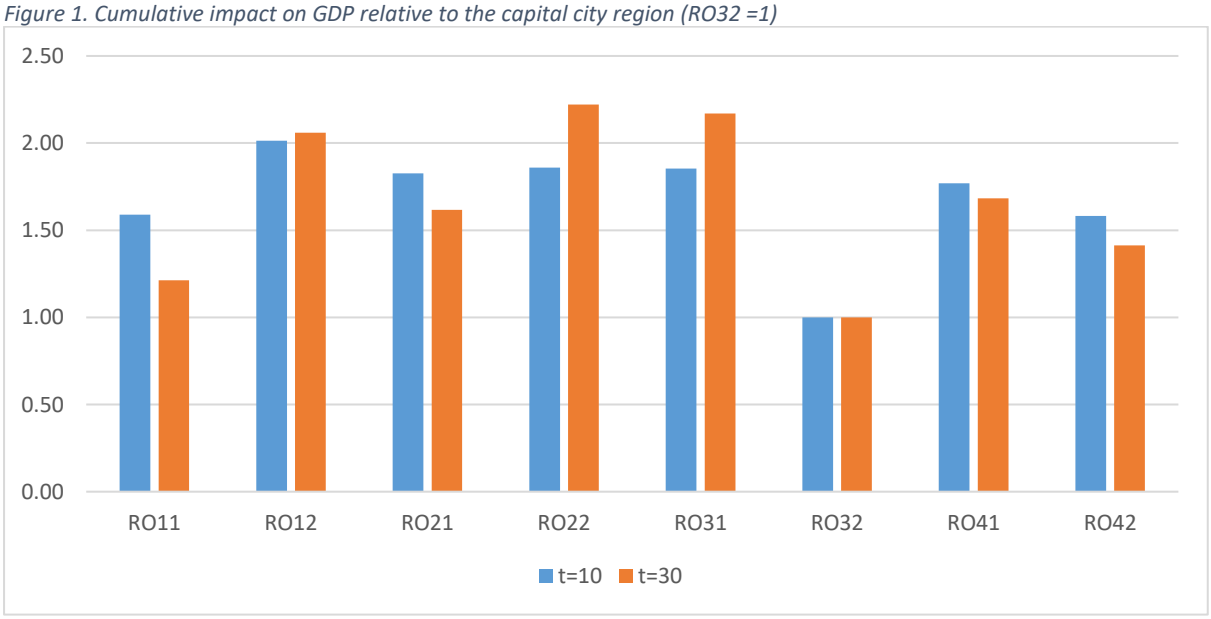
Table 10. GDP Impact in 10, 20 and 30 years, expressed as % differences from the no-policy-scenario GDP; multipliers in 10, 20 and 30 years; and cohesion policy expenditure as % of GDP (yearly average)

	% differences from no policy scenario GDP			GDP multipliers			Expenditure as % of yearly GDP (average)	Expenditure in million of €
	t=10	*t=20*	*t=30*	*t=10*	*t=20*	*t=30*		
RO11	3.82	2.13	1.34	0.74	1.74	2.36	2.71%	4127.4
RO12	4.84	3.32	2.27	0.96	2.48	3.55	2.49%	3783.4
RO21	4.39	2.67	1.78	0.66	1.51	2.08	3.94%	5534.4
RO22	4.47	3.35	2.44	0.98	2.41	3.51	2.62%	4252.4
RO31	4.46	3.35	2.39	0.87	2.26	3.30	2.77%	4940.3
RO32	2.40	1.54	1.10	2.28	4.98	6.99	0.62%	2251.3
RO41	4.25	2.79	1.85	0.71	1.76	2.48	3.25%	3439.5
RO42	3.80	2.38	1.56	0.80	2.11	2.98	2.22%	2939.2
RO	**3.81**	**2.53**	**1.74**	**0.93**	**2.25**	**3.19**	**2.25%**	**31267.9**

Source: RHOMOLO simulations.

Figure 1 shows, for each region, the cumulative impact on GDP over a time horizon of 10 years (blue bars) and 30 years (orange bars) in % deviations from the no policy scenario, expressed as a ratio to the impact in the capital city region (RO32). In the baseline scenario, all regions experience larger GDP cumulative increases relative to the richest one (RO32), and this difference is larger in the long run in three out of seven regions. The average cumulative impact relative to the richest one is almost 1.7 both for the 10 years horizon and for the 30 years one. This means that cohesion policy, as simulated here, would contribute to reduce the development gap between the less developed regions of Romania and its capital city region. It should be noticed that the amount of investments targeting the capital city region RO32 is about half the amounts targeting the rest of the regions of the country (€2251 million, versus an average in the rest of the country of €4145 million).

Figure 1. Cumulative impact on GDP relative to the capital city region (RO32 =1)



Source: RHOMOLO simulations.

4.2. Q1: Which are the specific objectives triggering the highest growth of Romania in medium and long term? Are there differences between regions?

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 Romania as a whole when targeted by cohesion policy investments. This allows to track the spatial spillovers stemming from a particular region and type of shock. Note that, due to the simplifying assumptions required by the modelling exercise, we refer to broad fields of intervention (such as aid to private sector, transport infrastructures, or technical assistance, for example) rather than to the 35 SOs of cohesion policy 2021-2027.

Table 11 illustrates the first set of results, across 10 years intervals. There is substantial regional heterogeneity in the results across regions within each spending category, and also across spending categories, which is maintained across time. As mentioned in the baseline scenario analysis, the capital region often yields the highest GDP multipliers across spending categories and time intervals. The HC multipliers are particularly larger than those of the rest of the country. This finding is attributed to i) to the specificities of the industrial organisation of the capital city region (with a large labour share, see table 4), and ii) to the large positive spillovers from the shocks implemented in the other regions.

Table 11. Regional GDP multipliers - country-wide shocks

	TRNSP			INFR			HC			RTD			AIS			TA		
Reg \ Time	10	20	30	10	20	30	10	20	30	10	20	30	10	20	30	10	20	30
RO	0.71	0.87	0.90	0.98	2.34	3.33	0.82	2.30	3.48	1.29	2.53	2.86	1.23	2.77	3.32	0.37	0.43	0.43
RO11	0.44	0.50	0.50	0.78	1.79	2.44	0.69	1.90	2.73	1.10	2.16	2.46	1.04	2.00	2.22	0.25	0.28	0.28
RO12	0.57	0.73	0.76	1.01	2.53	3.65	0.88	2.73	4.23	1.17	2.71	3.29	1.13	2.55	3.03	0.34	0.42	0.43
RO21	0.47	0.50	0.50	0.74	1.68	2.36	0.50	1.21	1.77	1.59	3.41	3.98	1.54	3.25	3.73	0.27	0.27	0.26
RO22	0.83	1.04	1.11	1.10	2.68	3.93	0.78	2.11	3.30	1.31	3.26	4.14	1.26	3.09	3.86	0.42	0.48	0.49
RO31	0.54	0.67	0.71	0.98	2.54	3.75	0.63	1.86	2.94	1.53	3.78	4.72	1.47	3.55	4.36	0.29	0.32	0.32
RO32	2.92	3.68	3.85	2.36	4.82	6.67	2.64	6.86	10.25	0.82	2.07	2.87	0.76	1.84	2.49	1.45	1.77	1.82
RO41	0.46	0.52	0.52	0.74	1.8	2.55	0.59	1.70	2.57	1.58	3.50	4.17	1.49	3.23	3.75	0.22	0.23	0.23
RO42	0.48	0.60	0.62	0.77	1.97	2.78	0.79	2.53	3.81	1.33	2.94	3.50	1.26	2.73	3.17	0.20	0.26	0.27

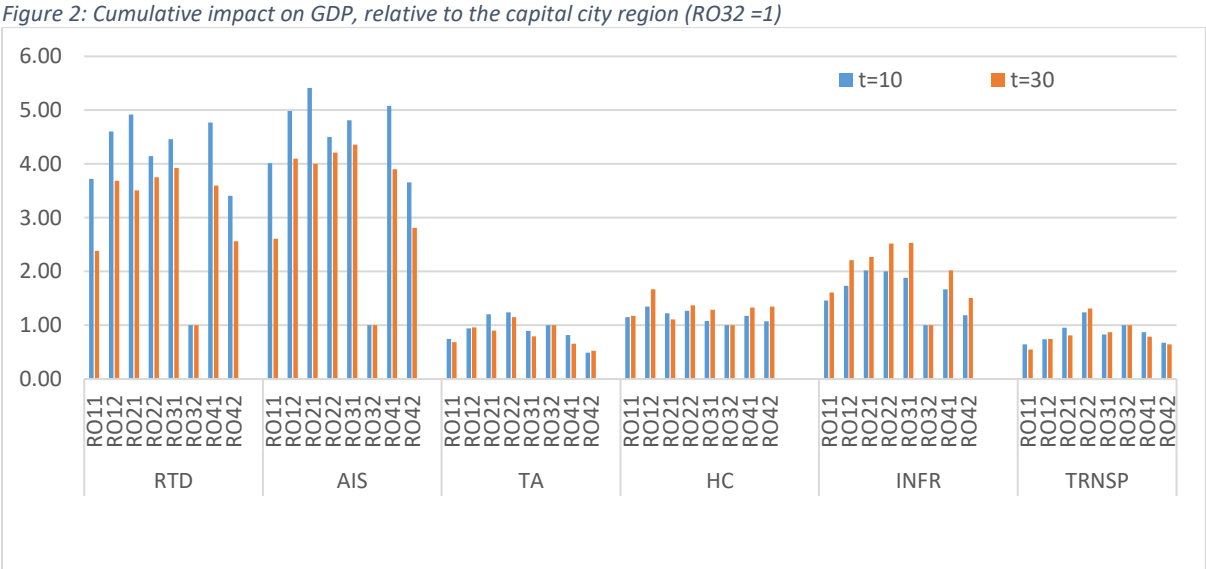
Source: RHOMOLO simulations.

Across the various spending categories, TA (which is modelled as current government expenditure) not surprisingly yields the lowest economic impact per euro spent (a country-level return of 0.37, 0.43 and 0.43 after 10, 20 and 30 years, respectively). On the other hand, the multipliers associated with the RTD, AIS, and HC shocks are the highest. Aside from the capital city region RO32, regions RO12, RO22, RO31 exhibit some of the highest multipliers in the country within each field of intervention.

In order to further compare the magnitude of the impact across regions, Figure 2 shows the cumulative impact of GDP (in terms of % deviations from the no policy scenario) over a time horizon of 10 years (blue bars) and 30 years (orange bars), by region and by shock, expressed as a ratio to the impact in the capital city region (similar to Figure 1 above). Both over the 10 and the 30 years horizon, the RTD, and AIS shocks (and to a lesser extent, the INFR and HC ones too) generate a larger impact in the less developed regions compared to the capital city region, therefore reducing the

existing development gap against the latter. On the other hand, the impact of TA and TRNSP is generally higher in the capital city region than in the rest of the country.

Figure 2: Cumulative impact on GDP, relative to the capital city region (RO32 =1)



Source: RHOMOLO simulations.

Table 12 presents the second set of results concerning the spatial distribution of spillovers for each spending category. We simulate the cohesion policy investments separately in each region and per field of intervention (for a total of 8 X 6 = 48 different scenarios). Note that in this case, the GDP of the regions other than the one where the shock is implemented can still increase due to the spillovers generated in the targeted region. Table 12 shows the 20 years region-specific multipliers stemming from each shock/field of intervention ("Reg." columns), while the "RO" columns record the country-wide multipliers for that shock. The "Sp." (standing for "Spillovers") columns show the difference between the country and the regional multipliers expressed as % of the country multiplier. This corresponds to the impact in all the regions in which the investments do not take place, in other words the country-wide spillovers generated by investing in a particular region and field of intervention.

Table 12. Region-specific and total (country-wide) multipliers from region specific shocks (t=20)

	TRNSP			INFR			HC			RTD			AIS			TA		
	Reg.	RO	Sp.	Reg.	RO	Sp.	Reg.	RO	Sp.	Reg.	RO	Sp.	Reg.	RO	Sp.	Reg.	RO	Sp.
RO11	0.35	0.63	45%	1.66	1.99	17%	1.76	2.19	20%	2.14	2.37	10%	1.97	2.19	10%	0.19	0.41	54%
RO12	0.52	0.89	41%	2.24	2.61	14%	2.42	2.84	15%	2.67	3.00	11%	2.51	2.83	11%	0.25	0.48	48%
RO21	0.36	0.69	48%	1.58	1.92	18%	1.08	1.38	22%	3.40	3.88	12%	3.23	3.71	13%	0.18	0.46	61%
RO22	0.57	0.83	31%	2.34	2.74	15%	1.72	2.02	15%	3.19	3.77	15%	3.01	3.58	16%	0.26	0.49	47%
RO31	0.32	0.66	52%	2.26	2.73	17%	1.56	1.91	18%	3.67	4.40	17%	3.43	4.14	17%	0.17	0.37	54%
RO32	2.25	2.88	22%	2.53	2.81	10%	4.73	5.24	10%	5.59	5.95	6%	4.77	5.08	6%	0.41	0.56	27%
RO41	0.35	0.58	39%	1.61	1.93	17%	1.49	1.82	18%	3.45	3.97	13%	3.16	3.65	13%	0.13	0.31	58%
RO42	0.46	0.69	33%	1.76	2.10	16%	2.30	2.74	16%	2.91	3.23	10%	2.69	2.99	10%	0.16	0.38	58%

Source: RHOMOLO simulations.

A comparison between the numbers of Tables 11 and 12 shows that simultaneous investments in all Romanian regions produce a higher multiplier for each region compared to a region-specific investment which does not include spillovers from the other regions (with the exception of RO32 for the AIS and RTD interventions). The second observation that emerges is that location matters.

Looking at the capital RO32, the table shows that the diffusion of benefits from the investment across the country is proportionally low. In all cases, the spillovers (with respect to the country multipliers) generated by the investments targeting RO32 are the lowest in the country. This is possibly due to the fact that the capital region imports relatively little from the rest of the country, although other regions are in a similar position in this respect (see Table 3). At the same time, RO32 benefits from relatively larger spillovers than the other regions, as the shocks implemented in the whole country result in relatively larger increases in the RO32 exports to the rest of the country.

On the other hand, investments in the RO11, RO21, RO31 and RO41 regions generate the highest spillovers, implying that investments in these regions significantly benefit the rest of the country as well.

Table 13 below ranks the 20 year multipliers associated to the various fields of interventions. It also shows the extent of spillovers generated by investments in each field of intervention. Although these numbers should not be taken at face value, as they depend on a series of assumptions within the general equilibrium modelling framework we used here, they provide some indications on the type of economic effects to be expected from the various types of investments under analysis.

*Table 13: Country level 20 year GDP multipliers (country-wide shocks) and spillovers**

	20 year multiplier	**Spillovers**
TRNSP	0.87	39%
INFR	2.34	16%
HC	2.30	17%
RTD	2.96	12%
AIS	2.77	12%
TA	0.43	51%

Source: RHOMOLO simulations. * Average of the region specific spill-overs reported in table 12.

Investments in research and development yield the highest returns with 2.96 euros of additional GDP for each euro spent 20 years after the start of the implementation period. It is closely followed by investments in aid to the private sector. Investments in public infrastructure and human capital also yield high returns while investments in transport and technical assistance produce a lower impact per euro spent.

These results are broadly in line with economic theory. In particular, investments in research and development and investments in human capital are almost systematically identified as a major engine of growth, independently from the level of development or the type of market organisation. Investments in infrastructure are also known for being an important driver of development in economies where the stock is low which is the case of Romania. Support to the private sector, notably to facilitate private investments, are also key factors of growth. Investment in technical assistance is modelled as a pure demand shock and the impact in the medium to long run is therefore limited.

There is substantial regional variability in the estimated impact of transport infrastructure investment. Tracking the impact of investments in transport has always been a challenge (see for instance the literature review by Banister, 2012), which is confirmed by the results obtained here. Three key aspects need to be taken into consideration when trying to gauge the impact of such investments on the economy of the recipient country. First, investments in transport are extremely costly. The baseline scenario considered here amounts to allocating around €1,620 million euros to transport in the eight regions of the country, which would correspond to the construction or

restoration of between 200 and 300km of roads (if all the funding was dedicated to roads). The Romanian road network is about 176 000km long, which implies that investments considered here would actually represent the equivalent of 0.2% of the national road network.

Second, access to market can only be significantly increased by improving the EU transport network, or at least the piece which is most used by the country to export its goods and services. This implies that if investing in transport is necessary for firms to connect to the national network, it will let them reach a significantly higher number of customers on the condition such interventions are coordinated with those implemented in the other countries. This means that investments in transport restricted to a limited number of regions (as in this simulation) can only have a limited impact and that the design of transport programmes should be closely coordinated, at least at the level of the main trade partners, and preferably at the level of the EU. Note also that 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.

The third aspect to be taken into account regarding transport infrastructure investments is that this type of investments is the one generating the most inter-regional spillovers. This means that the effects simulated here with country-wide policy shocks could very well underestimate the actual impact of transport investments of the whole EU cohesion policy, as spillovers originating in the regions of the EU outside Romania are not taken into account.

4.3. Q2: To what extent the transfer of 20% from ESF to ERDF would be beneficial for Romania in terms of jobs and growth on medium and long term? Which objectives should benefit by a higher allocation and which are those where the allocation should be cut-off?

We compare the outcome of the baseline scenario with one where 20% of the funds allocation is transferred from the ESF SOs to the SOs funded by the ERDF and the CF (see the Appendix for the correspondence between funds and SOs), in proportion to their weight in the original policy mix. This leads to the following change in the breakdown of funding per field of intervention.

Table 14. Baseline versus Q2 policy portfolio

FoI	Baseline	Q2
TRNSP	5.2%	5.7%
INFR	50.8%	55.4%
HC	31.1%	24.8%
RTD	5.2%	5.7%
AIS	5.2%	5.7%
TA	2.6%	2.6%
Total	**100.0%**	**100.0%**

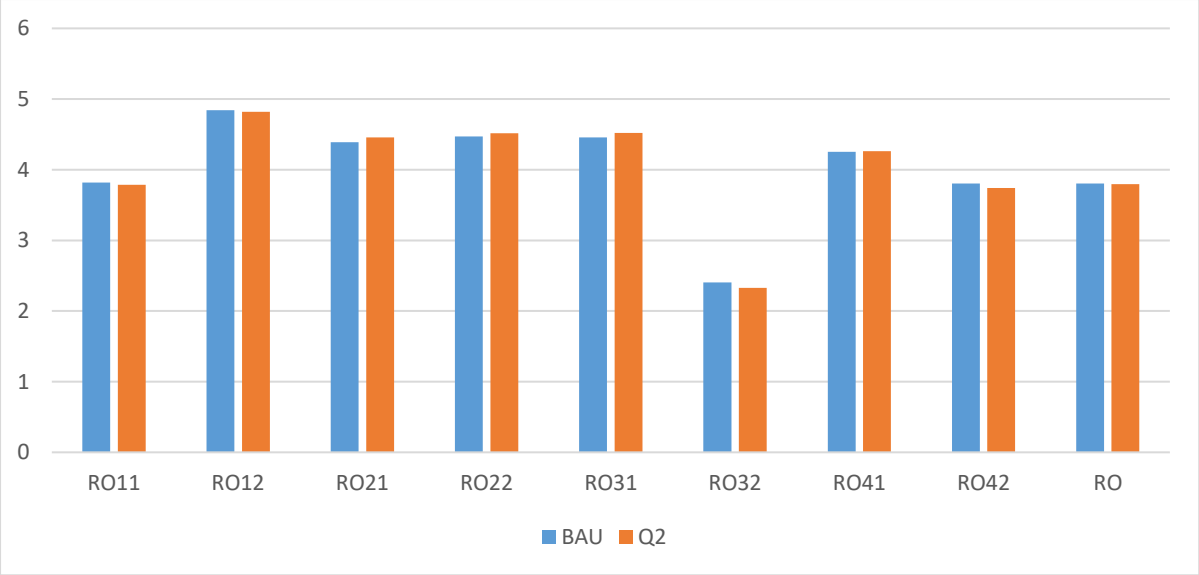
Source: own calculations.

Thus, the share of funding allocated to human capital decreases by around 6 percentage points (pp), from 31.1% to 24.8%. The share allocated to the fields associated to the ERDF and the CF increases by around 5 pp for INFR and 0.5 pp for RTD and AIS.

Figures 3a and 3b below show the impact on GDP under the baseline and the Q2 scenarios, 10 years and 20 after the start of the programmes, respectively. In the short run (Figure 3a), the impact on GDP under the Q2 scenario is higher for RO21, RO22 and RO31, while it is lower for the others. Ten years after the termination of the programmes (Figure 3b), the effects of investments in human

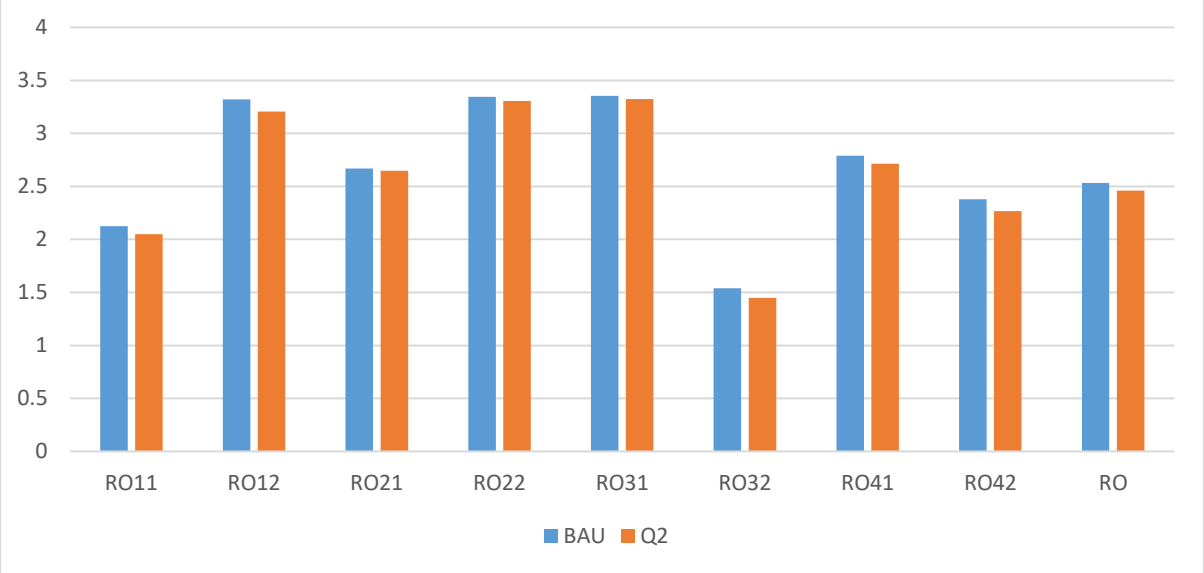
capital fully materialise and the impact on GDP of the Q2 portfolio is systematically below that of the baseline scenario, for all regions and for the country as a whole.

Figure 3a. Impact on GDP, baseline versus Q2, t=10



Source: RHOMOLO simulations.

Figure 3b. Impact on GDP, baseline versus Q2, t=20



Source: RHOMOLO simulations.

Overall, the differences between the two scenarios are rather small. At the country level, the twenty year multiplier associated to HC is the third largest one after RTD and AIS (see table 11). The Q2 scenario takes resources out of the human capital field of intervention and redistribute them across most of the other fields, some characterised by lower multipliers and others by higher ones, with relatively little effects on the twenty year GDP impact.

In general, lowering the share of funding dedicated to human capital does not contribute to increase the efficiency of the policy package, especially in regions where this type of investment is highly productive (like for instance the capital city region) or in regions where the multipliers associated to the other fields of intervention are relatively low. Support to the accumulation of knowledge and skills is a key ingredient of any development policy in all regions of Romania.

Note that whether the transfer of funding away from investment in human capital triggers a bigger impact or not also depends on how the freed resources are used. If reallocated to fields of interventions with a high multiplier, the outcome of this shift could be a general increase in the efficiency of the policy package.

4.4. Q3: Which is the scenario of funds' allocation between specific objectives for the highest growth of the country as a whole? To what extent this will trigger deepening the disparities between regions?

We compare the outcome of the baseline scenario with one where more funds are allocated to two fields of intervention which are associated with high multipliers at national level according to the analysis presented above and which represent a significant part of the policy portfolio, namely infrastructure (INFR) and human capital (HC). The scenario amounts to transfer 50% of the funding allocated to the other sectors of interventions (RTD, AIS, TRNSP, and TA) to these two sectors, so that the total amount is the same for the two scenarios.

This leads to the change in the breakdown of funding per field of intervention illustrated in Table 15. The share of funding allocated to human capital and infrastructure is increased by around 4% and by around 5%, respectively, while the allocation to the other fields are cut by half.

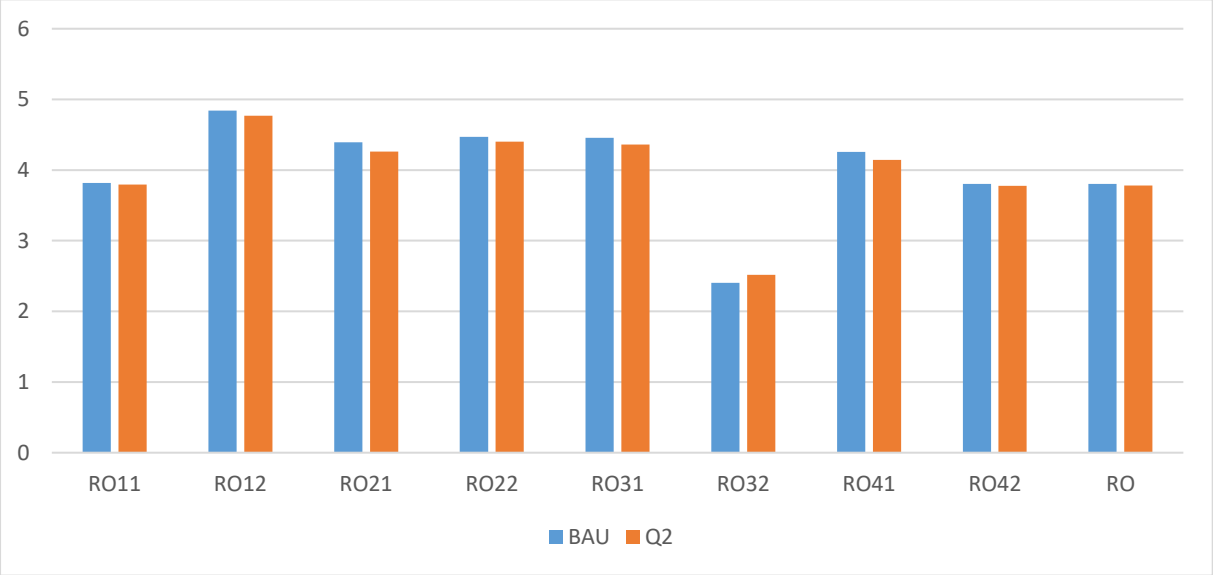
Table 15. Baseline versus Q3 policy portfolio

FoI	Baseline	Q3
RTD	5.2%	2.6%
AIS	5.2%	2.6%
INFR	50.8%	56.1%
TRNSP	5.2%	2.6%
HC	31.1%	34.8%
TA	2.6%	1.3%
Total	100.0%	100.0%

Source: own calculations.

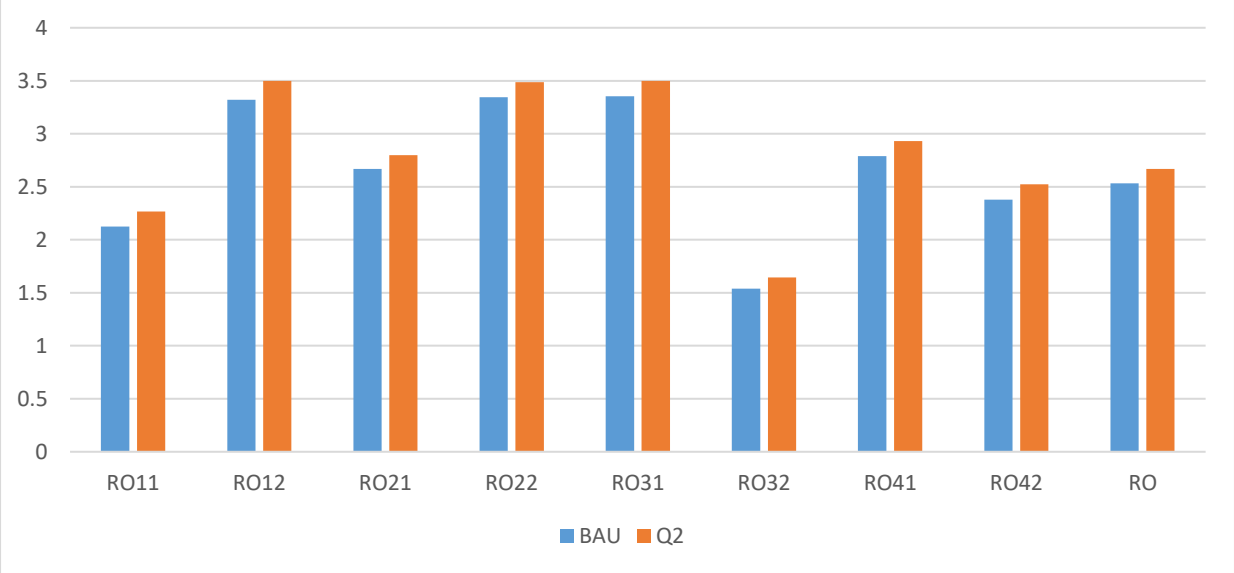
Figures 4a and 4b show the GDP impact of the two alternative policy packages 10 and 20 years after the start of the implementation period (respectively). In the short run (Figure 4a), the impact on GDP under the Q3 scenario is slightly lower for all regions except RO32, compared to the baseline case. The impact, however, is higher than the baseline one 20 years after the start of the policy implementation in all regions, as well as at the country level (Figure 4b). Given the amount of resources redistributed in the Q3 scenario, though, these differences remain small across all regions. At the country level, the effect on GDP after 20 years changes from +2.53 in the baseline to +2.66 in the Q3 scenario.

Figure 4a. Impact on GDP, baseline versus Q3, t=10



Source: RHOMOLO simulations.

Figure 4b. Impact on GDP, baseline versus Q3, t=20



Source: RHOMOLO simulations.

To analyse the effects of this new allocation on the territorial disparities within the country, Table 16 reports the distance of each region from the richest one (RO32) calculated using GDP cumulated changes. The first two columns refer to a 10 years horizon (*t=10*), the last two columns to a 20 years horizon (*t=20*).

The numbers in Table 16 show that the difference between the GDP of the capital city region and the rest of the country is reduced less in the Q3 scenario than in the baseline one. However, the reallocation of funds towards the fields of intervention characterised by high country-level multipliers (and constituting a substantial proportion of the total policy package according to the baseline scenario) does not entail any significant impact on regional inequality in Romania (the largest difference is registered in RO21 and RO41, and even for these regions it is relatively small).

Table 16. Cumulative GDP changes expressed as a ratio over RO32 cumulative GDP changes, baseline versus Q3

	t=10			t=20	
	Baseline	**Q3**		**Baseline**	**Q3**
RO11	1.36	1.30		1.46	1.41
RO12	1.65	1.57		1.96	1.88
RO21	1.70	1.61		1.77	1.69
RO22	1.74	1.67		1.95	1.88
RO31	1.60	1.53		1.91	1.83
RO32	1.00	1.00		1.00	1.00
RO41	1.53	1.44		1.73	1.65
RO42	1.19	1.14		1.44	1.40

Source: RHOMOLO simulations.

Thus, the reallocation towards the human capital and infrastructure fields of intervention is not a significant improvement relative to the baseline allocation in terms of economic growth. The difference between the impacts obtained in the two scenarios is rather small, and the alternative distribution of funds is not more beneficial than the baseline one in terms of reduction of the disparities across regions. In general, though the change it induces is positive (almost by construction, since the Q3 allocation of funds concentrates more resources on high-multipliers fields), the magnitude of the change is negligible.

4.5. Q4: Which is the scenario of funds' allocation between specific objectives enabling convergence of Romanian regions in terms of growth?

We investigate here three alternative scenarios related to Q4. According to the first one (Q4-1), the funds gets concentrated on the fields of intervention which, based on the Q1 results, trigger the highest impact for the four least developed regions of the country (those with the lowest level of GDP per capita), namely Northeast (RO21), Southeast (RO22), South-Muntenia (RO31) and Southwest Oltenia (RO41). According to the results reported in Table 11, the ranking of the 20 year multipliers by field of intervention in all these regions is as follows: RTD, AIS, INFR, HC, TRNSP, and TA.

Thus, under scenario Q4-1, the cohesion policy investments change with respect to the baseline allocation in that the RTD and AIS expenditure is increased by 50%, shifting the resources from all the other fields. Table 17 presents the resulting allocation of funds across fields of intervention in the four least developed regions of Romania, comparing it with the baseline allocation.

Table 17. Policy portfolio scenario, baseline versus Q4-1 in the least developed Romanian regions

	Baseline	**Q4-1**			
	All regions	**RO21**	**RO22**	**RO31**	**RO41**
RTD	5.2%	17.5%	7.8%	14.5%	14.5%
AIS	5.2%	17.5%	7.8%	14.5%	14.5%
INFR	50.8%	36.9%	47.9%	40.3%	40.3%
TRNSP	5.2%	3.8%	4.9%	4.1%	4.1%
HC	31.1%	22.5%	29.3%	24.6%	24.6%
TA	2.6%	1.9%	2.4%	2.1%	2.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: own calculations.

The second scenario (Q4-2) assumes that 15% of the cohesion funding is reallocated to the four least developed regions. Finally, the third one (Q4-3) analyses the effects of transferring 15% of the funding to RO32, the region with the highest GDP per capita in the country (see Table 18). For each of these scenarios, we will compare the simulation outcome with that of the baseline scenario.

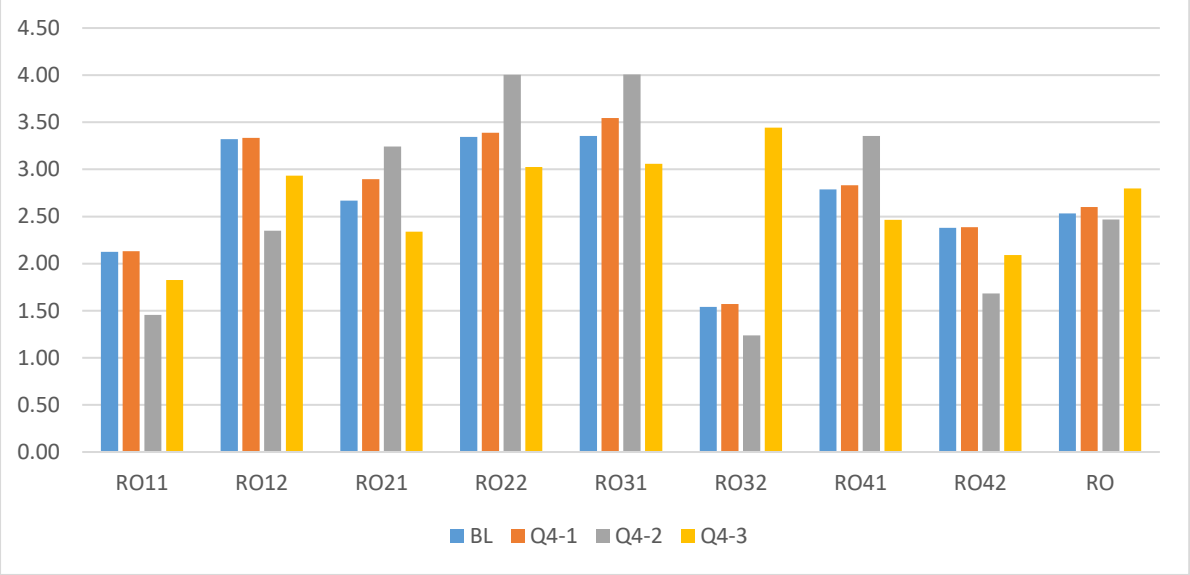
Table 18. Geographical distribution of funds: baseline, Q4-2, and Q4-3 scenarios

	RO11	RO12	RO21	RO22	RO31	RO32	RO41	RO42
Baseline	13.2%	12.1%	17.7%	13.6%	15.8%	7.2%	11.0%	9.4%
Q4-2	8.8%	8.1%	22.0%	16.9%	19.6%	4.8%	13.6%	6.3%
Q4-3	11.2%	10.3%	15.0%	11.6%	13.4%	21.2%	9.3%	8.0%

Source: own calculations.

Figure 5 shows the GDP impact under the baseline and the three Q4 scenarios, twenty years after the start of the implementation period (the results at *t=10* and *t=30* are not shown for the sake of brevity, but they are qualitatively similar).

Figure 5. 20 year GDP impact : baseline, Q4-1, Q4-2, and Q4-3 scenarios



Source: RHOMOLO simulations.

The impact on GDP of the four least developed regions (RO21, RO22, RO31, and RO41) is higher under the Q4-1 scenario than under the baseline scenario. This reflects the enhanced concentration of the policy portfolio on fields of intervention with the highest returns. The impact of the policy in the other regions is hardly affected, if at all positively, by the shift in policy portfolio in the four least developed regions, while the country-level impact is slightly higher. This suggests that the Q4-1 allocation would be more conducive to reducing regional disparities.

The impact on GDP in the four least developed regions is even higher under the Q4-2 scenario, as it implies that more funding is allocated to these regions. However, these resources are taken from the other regions where the impact is therefore smaller than under the baseline scenario. As a result, this policy package is also conducive to reducing regional disparities, but this comes at the cost of a smaller impact in the more developed regions of Romania. The impact at country level is also lower compared to the baseline scenario.

Finally, the Q4-3 implies a transfer of the funding to the capital city region (RO32) from the other regions of the country. As a result, compared to the baseline scenario the impact of the policy on GDP increases in RO32, but decreases in the other regions, in particular in the least developed ones.

The impact at country level is higher than in the baseline case, as investments in the capital city region have significantly higher returns than in other regions. However, this is obtained the cost of exacerbating regional disparities within the country.

5. Conclusions

We employ the RHOMOLO model to estimate the macroeconomic impact of 2021-2027 cohesion policy interventions in the Romanian 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. The impact of investments in the various fields of interventions varies from one region to another. Investments in infrastructure and transport are necessary in regions where these resources are lacking. Increasing the level of human capital is also important to maintain the pace of development of these regions. Investments in research and innovation, and aid to private sector yield higher returns than the other fields of intervention in the least developed regions of the country. This suggests that an investment portfolio in the less developed regions should be well balanced. For instance, investments in innovation are sometimes believed to be better targeted at the most developed regions only. This is probably relevant for frontier research activities, but research and development 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.

In the more developed regions, human capital investments yield the highest returns. As explained above, more developed regions generally have a more labour intensive technology, which implies that the impact of increasing labour productivity is particularly high. But there too, a well-balanced investment portfolio is necessary to produce the highest impact on economic performance, notably by keeping investing in infrastructure besides support to research and development and the private sector.

Romania is characterised by large differences between the levels of development of the capital city region and the other regions of the country. Bucharest-Iflov (RO32) stands as an outlier in the economic geography landscape with the features of a highly developed region, including higher research and development intensity, a larger share of the private sector in GDP, and a highly labour intensive technology. The region is also the origin of a large share of the internal trade flows of the country. This makes the returns to cohesion policy investments in this region particularly high compared to those of the other regions. As result, the country seems to be characterised by a so-called efficiency-equity trade off. In most cases, maximising the returns of the policy in terms of national GDP per euro invested would imply investing more resources in the capital city region, but this would lead to an increase in the level of regional disparities within the country and lowering the pace of convergence of the least developed regions with the rest of the EU.

Reducing regional disparities can only be achieved by investing in the least developed regions of the country, and the impact of the policy can be enhanced by selecting a policy portfolio which is adapted to the needs of these 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 Romania. 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.

In terms of fields of intervention, while the modelling results may suggest to go for corner solutions (like investing everything in the field with the highest GDP multipliers), this does not mean that some fields of intervention should be forgotten. Investments in all the areas targeted by cohesion policy are shown to significantly enhance regional economic performances.

We conclude that a balanced cohesion policy portfolio deployed simultaneously on all the Romanian regions would have the capacity to substantially improve the welfare in all regions while at the same time reducing the within-country 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.

Acknowledgments

The authors acknowledge the valuable comments made by Javier Barbero, Iva Gailly, Petra Urszuly, Claudia Magdalina and DG REGIO for sharing the data on the allocation of cohesion policy funding in Romania. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

References

Banister, D. (2012). Transport and economic development. *Transport Reviews*, Vol. 32, No. 1, 1-2

Barbero, J., Diukanova, O., Gianelle, C., Salotti, S., and Santoalha, A. (2021). Economic modelling to evaluate Smart Specialisation: an analysis on research and innovation targets in Southern Europe, *Regional Studies*, forthcoming. https://doi.org/10.1080/00343404.2021.1926959

Barbero, J., and Salotti, S. (2021). A general equilibrium analysis of the effects of the 2014-2020 European Cohesion Policy in the Portuguese regions. JRC Working Papers on Territorial Modelling and Analysis No. 02/2021, European Commission, Seville, JRC125285.

Bostan, I., Popescu, C., Dascalu, E. D., and Firtescu, B. N. (2016). The European Union Cohesion Policy and External Migration in Romania. Multistage Analysis. *Revista de Cercetare si Interventie Sociala* 54, 96-114.

Brad, A. (2018). When Romania met the Cohesion Policy. Regional governance in-between national conventions and European ideals. *Halduskultuur* 18(2), 127-148.

Card, D. (2001). Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems. *Econometrica* 69(5), 1127-1160. https://doi.org/10.1111/1468-0262.00237

Chindriş-Văsioiu, O., and Ungureanu, C. (2011). Importance of Economic and Social Cohesion Policy for Romania. *Journal of Knowledge Management, Economics and Information Technology*, 1(6), 1-11.

Conte, A., Lecca, P., Salotti S., and Sakkas S. (2020). The territorial economic impact of COVID-19 in the EU. A RHOMOLO Analysis. Territorial Development Insights Series no. JRC121261.

Crucitti, F., Lazarou, N., Monfort, P., and Salotti, S. (2021). A scenario analysis of the 2021-2027 European Cohesion Policy in Bulgaria and its regions. JRC Working Papers on Territorial Modelling and Analysis no. 06/2021, European Commission, JRC126268.

Crucitti, F., Lazarou, N., Monfort, P., and Salotti, S. (2022). The RHOMOLO impact assessment of the 2014-2020 cohesion policy in the EU regions. JRC Working Papers on Territorial Modelling and Analysis no. 01/2022, European Commission, JRC128208.

Di Pietro, F., Lecca, P., and Salotti, S. (2021). Regional economic resilience in the European Union: a numerical general equilibrium analysis. *Spatial Economic Analysis* 16(3), 287-312.

Diukanova, O., and Chioncel, M. (2021). A GDP impact evaluation of R&D investments in Romania using the CGE model RHOMOLO. JRC Working Papers series on Territorial Modelling and Analysis no. 10/2021, JRC126690.

Kancs, A., and Siliverstovs, B. (2016). R&D and non-linear productivity growth. *Research Policy* 45(3), 634-646.

Lecca, P., Barbero, J., Christensen, M., Conte, A., Di Comite, F., Diaz-Lanchas, J., Diukanova, O., Mandras, G., Persyn, D., and Sakkas, S. (2018). RHOMOLO V3: A Spatial Modelling Framework, EUR

29229 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-85886-4, https://doi.org/10.2760/671622, JRC111861.

Lecca, P., Christensen, M., Conte, A., Mandras, G., and Salotti, S. (2020a). Upward pressure on wages and the interregional trade spillover effects under demand-side shocks. *Papers in Regional Science* 99(1), 165-182.

Lecca, P., Salotti, S., and Conte A. (2020b). The importance of studying inter-regional spillover effects of European policies: application of the RHOMOLO model for Poland. JRC Working Papers on Territorial Modelling and Analysis No. 04/2020, European Commission, Seville, JRC120937.

Miller, R.E., and Blair. P.D., (2009). *Input-Output Analysis: Foundations and Extensions*. Cambridge University Press.

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

Pîrvu, R., Bădîrcea, R., Manta, A., and Lupăncescu, M. (2018). The effects of the cohesion policy on the sustainable development of the development regions in Romania. *Sustainability* 10(7), 2577.

Rauhut, D., and Humer, A. (2020). EU Cohesion Policy and spatial economic growth: trajectories in economic thought. *European Planning Studies* 28(11), 2116-2133. https://doi.org/10.1080/09654313.2019.1709416

Sakkas, S., Crucitti, F., Conte, A., and Salotti, S. (2021). The 2020 territorial impact of Covid-19 in the EU: A RHOMOLO update. Territorial Development Insights Series no. JRC125536.

Thissen, M., Ivanova, O., Mandras, G., and Husby, T. (2019). European NUTS 2 regions: construction of interregional trade-linked Supply and Use tables with consistent transport flows. JRC Working Papers on Territorial Modelling and Analysis No. 01/2019, European Commission, Seville, JRC115439.

Traşcă, D. L., Aceleanu, M. I., and Sahlian, D. (2013). Territorial efficiency of the cohesion policy in Romania. *Theoretical & Applied Economics*, XX(1), 103-112.

Appendix

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	HC	G

disabilities, effectiveness and resilience of healthcare systems and long-term care services;		
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 - Technical Assistance	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

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub

ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

Joint Research Centre

EU Science Hub