

# The European Commission's science and knowledge service

Joint Research Centre



**Knowledge for Policy**

**Territorial Economic Analysis & Modelling**

**RHOMOLO**

**Andrea Conte, PhD**

**European Commission, Joint Research Centre**

**Trieste, January 23rd, 2020**

# Supporting policy with scientific evidence

## AI Watch

Monitor the development, uptake and impact of Artificial Intelligence for Europe

## Knowledge Centre for Bioeconomy

We enhance the knowledge base for policymaking on the bioeconomy through better knowledge management.

## Competence Centre on Composite Indicators and Scoreboards

Our expertise on statistical methodologies and in developing sound composite indicators provides policy-makers with the 'big picture' for informed policy decisions and progress monitoring.

## Disaster Risk Management Knowledge Centre

We provide a networked approach to the science-policy interface in Disaster Risk Management (DRM), across the EU Commission, Member States and the DRM community worldwide.

## Knowledge Centre for Food Fraud and Quality

We produce and make sense of scientific information to protect the authenticity and quality of food supplied in the EU.

## Competence Centre on Foresight – Megatrends Hub

Megatrends are long-term driving forces that are observable now and will most likely have significant influence on the future. This Hub is a dynamic collaborative repository of information and resources on the main megatrends shaping our world.

## Knowledge Centre for Global Food and Nutrition Security

We support the EU global commitment to end hunger, achieve food security and improve nutrition through a dedicated, reinforced science-policy interface and a fostered inter-policy dialogue.

## Competence Centre on Modelling

We promote a responsible, coherent and transparent use of modelling to support the evidence base for EU policies.

## Competence Centre on Text Mining and Analysis

We use text mining and analysis tools to extract information from online data, including traditional or social media, or from large public or proprietary document sets.

## Competence Centre on Microeconomic Evaluation

We advise EU policy making through ex-post causal evaluation and data-driven microeconomic analysis.

## Competence Centre on Technology Transfer

The CC TT provides technology transfer policy related expertise and services to the European Commission and other institutions of the Union and operational support services to a broader range of stakeholders.

## Knowledge Centre on Migration and Demography

We provide independent scientific evidence for EU policymaking in migration and demography related fields.

## Knowledge Centre for Territorial Policies

We support EU policymaking through better knowledge management on territorial (urban and regional) related issues.

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# Territorial Profile



Spain (ES) > Andalucía (ES61)

## Andalucía (ES61)

**Total Population** (Ref. 2015 )  
**8.4m inhabitants**

**Total Employment** (Ref. 2015 )  
**2.62m employees**

**GDP per head** (Ref. 2015 )  
**19.5k EUR/head**

**Population Density (weighted)** (Ref. 2015 )  
**119.07 Inhabitants/ha**

**Unemployment rate** (Ref. 2015 )  
**31.6 %**

**Tertiary Education** (Ref. 2015 )  
**28.3 % of total population**

European Commission > Knowledge for policy > Territorial > Territorial Dashboard >

Territorial Dashboard

Home Territorial Profile European Trends Thematic Analyses

Map Level: Region

Select Regions: Andalucía (ES61)



Spain (ES) > Andalucía (ES61)

## Andalucía (ES61)

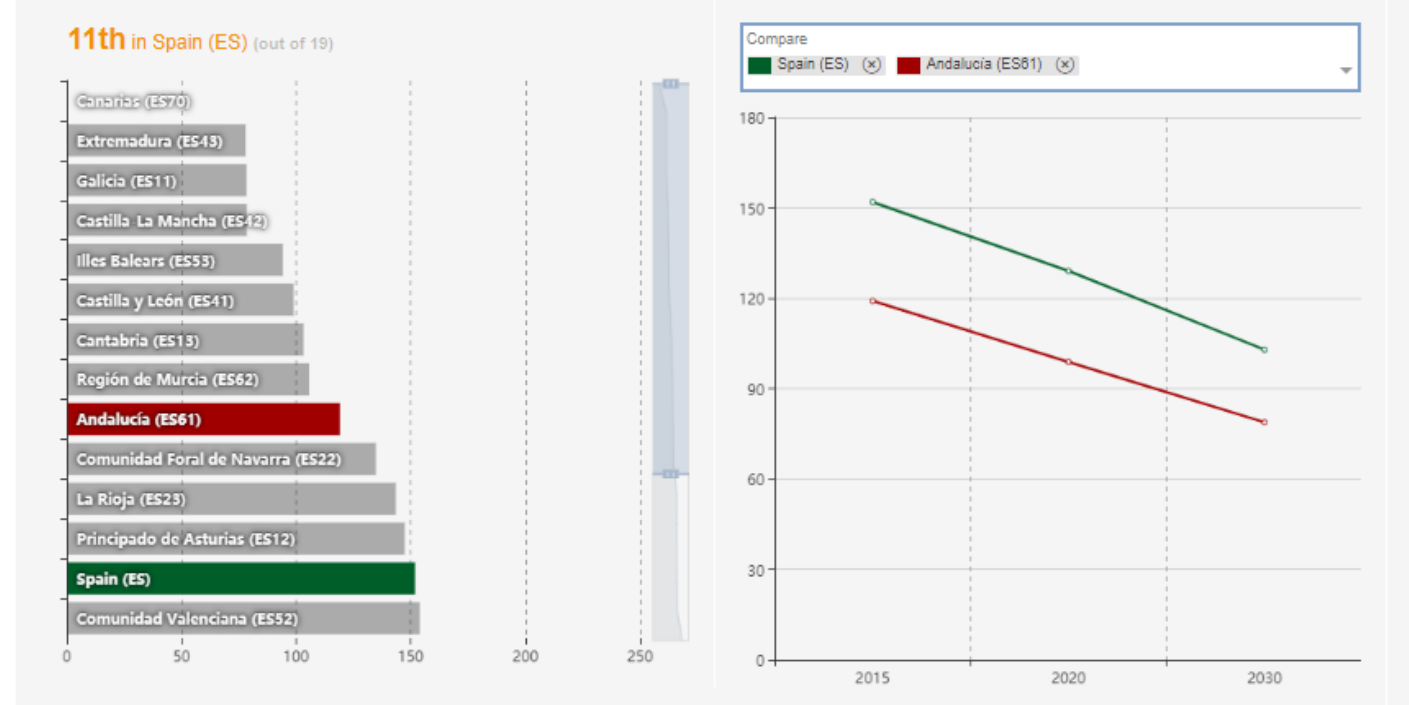
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**GDP per head** (Ref. 2015 )  
**19.5k EUR/head**

### Population Density (weighted)

Population weighted density refers to the average of the density of all parcels of land that make up a city, with each parcel weighted by its population.





# Better Regulation Toolbox

## Better regulation toolbox

### PAGE CONTENTS

**I. General principles of better regulation**

**II. How to carry out an impact assessment**

**III. Identify impacts in impact assessments, evaluations and fitness checks**

**IV. Implementation, transposition and preparing proposals**

**V. Monitoring the application of an intervention**

**VI. Evaluations and fitness checks**

**VII. Stakeholder consultation**

**VIII. Methods, models and costs and benefits**

**Documents**

## I. General principles of better regulation

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- TOOL #1. [Principles, procedures & exceptions](#)
- TOOL #2. [The Regulatory Fitness Programme and the REFIT Platform](#)
- TOOL #3. [Role of the Regulatory Scrutiny Board](#)
- TOOL #4. [Evidence-based better regulation](#)
- TOOL #5. [Legal basis, subsidiarity and proportionality](#)
- TOOL #6. [Planning and validation of initiatives](#)
- TOOL #7. [Drafting roadmaps, evaluation roadmaps and inception Impact assessments](#)

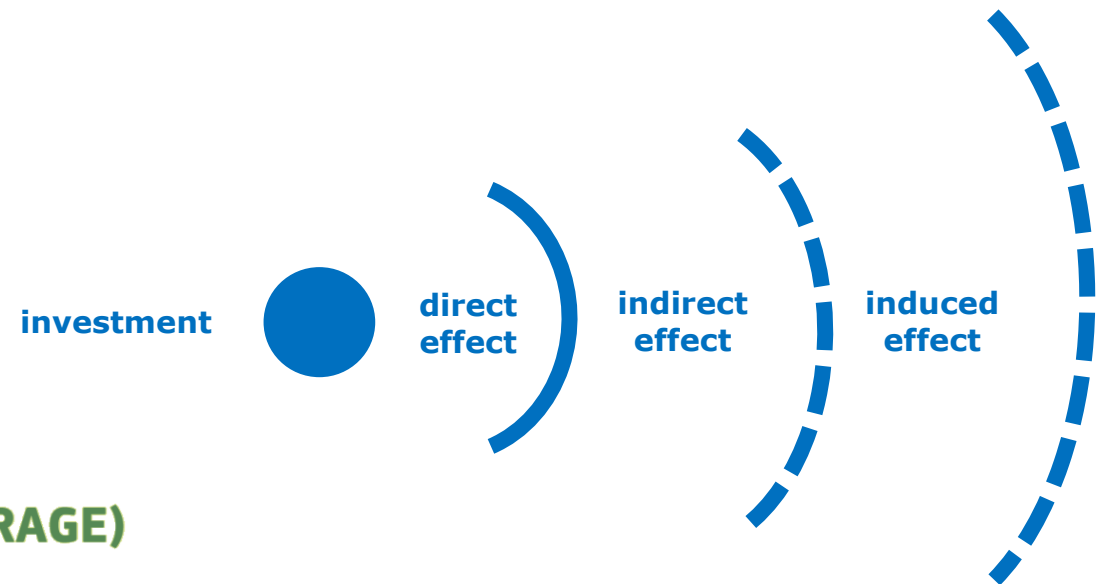
## II. How to carry out an impact assessment

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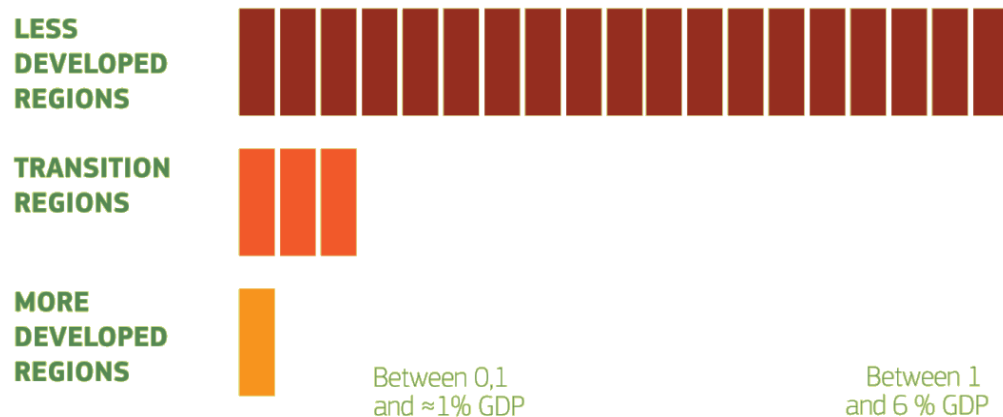
- [Introduction](#)
- TOOL #8. [What steps should I follow for an impact assessment?](#)
- TOOL #9. [When is an impact assessment necessary?](#)
- TOOL #10. [Financial programmes and instruments](#)
- TOOL #11. [Social partner initiatives](#)
- TOOL #12. [Format of the impact assessment report](#)
- TOOL #13. [How to undertake a proportionate impact assessment](#)
- TOOL #14. [How to analyse problems](#)
- TOOL #15. [Risk assessment and management](#)
- TOOL #16. [How to set objectives](#)
- TOOL #17. [How to identify policy options](#)
- TOOL #18. [The choice of policy instruments](#)

# RHOMOLO: Dynamic Spatial General Equilibrium Model for EU Regions and Sectors

**RHOMOLO** simulates the impact of policies on each specific region's economic performance



## **SIMULATED IMPACT ON GDP GROWTH (AVERAGE)**



**Growth calculated is higher for the less developed regions.**

In the long run this could bring all EU regions to a similar level of wealth.

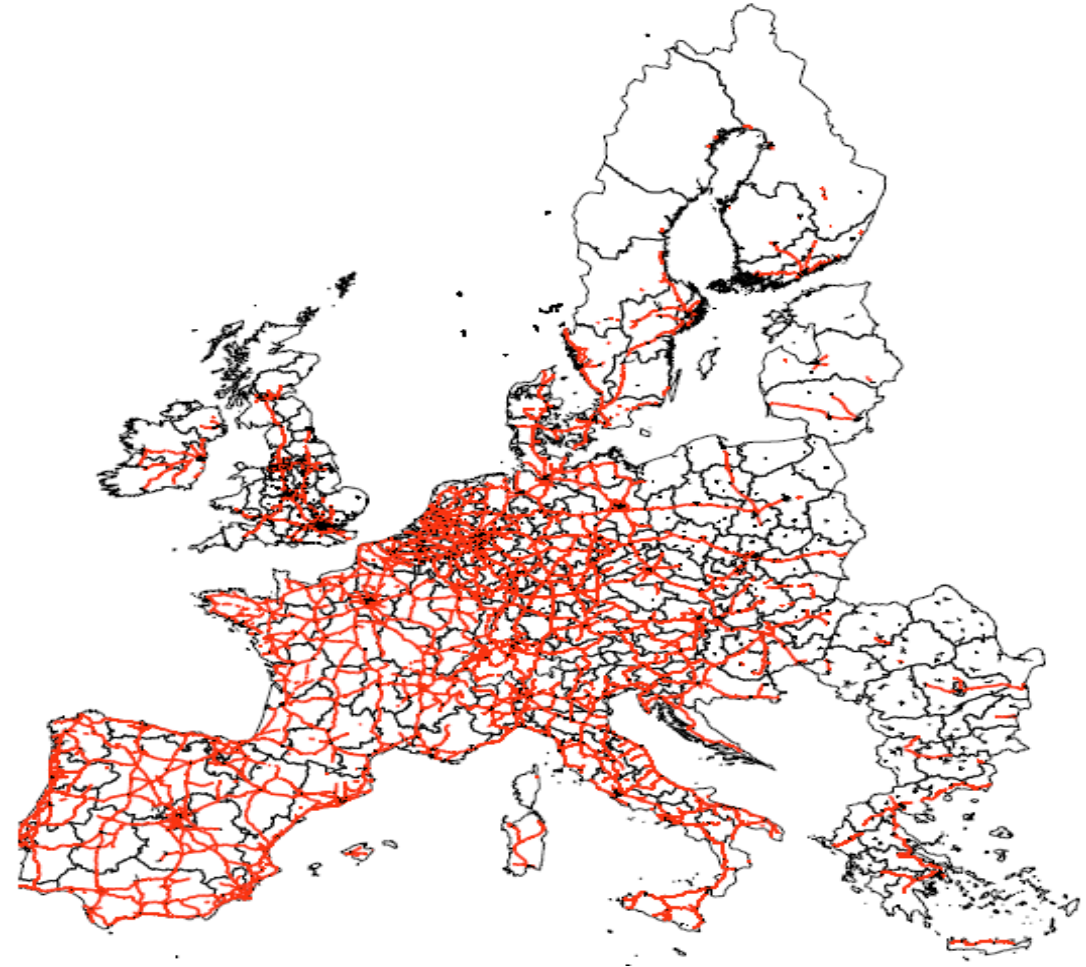
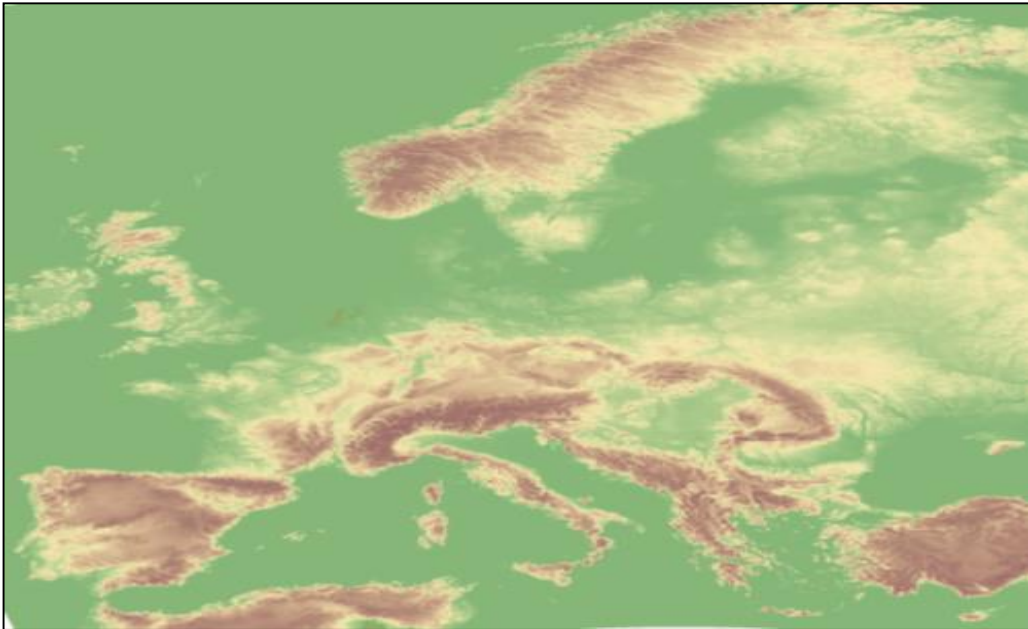
# RHOMOLO Modelling Framework

- RHOMOLO is the **multi-sectoral economic model** developed by DG JRC for the impact assessments of EU Policies;
- It shows how **policy shocks** may affect economic and social outcomes at the regional, country and sectoral level (deviation from baseline).
- It captures key determinants of the spatial distribution of economic activities:
  - ✓ Sector-composition: through **regional I/O tables** and Social Accounting Matrices;
  - ✓ Spatial configuration: through **asymmetric sector- and region-pair-specific** trade costs and spatial technological spillovers.



# Unique Sectoral and Geographical Granularity

1. **Regional IO Tables**
2. **Territorial Accessibility via existing Infrastructure** (sector- and region-pair-specific asymmetric trade costs + spillovers)



Source: OpenStreetMap

# And a detailed population distribution



# RHOMOLO IO

## A stylised interregional Social Accounting Matrix : 2 sectors, 1 and 2, producing 2 types of products

IRIOT		region 1: Use		region 2: Use		region 1: Supply		region 2: Supply		region 1: Use	region 2: Use	
		sector 1	sector 2	sector 1	sector 2	product 1	product 2	product 1	product 2	hhd - Inv	hhd - inv	total
region1	sector 1					3	7					10
	sector 2					2	6					8
region 2	sector 1							5	2			7
	sector 2							3	6			9
region 1	product 1	1	1	1						1	1	5
	product 2	2	3		2					5	1	13
region 2	product 1	1		2	1						4	8
	product 2		1							1	6	8
region 1	value added	6	3							transfer	transfer	9
region 2	value added			4	6					transfer	transfer	10
	total	10	8	7	9	5	13	8	8	7	12	

- The use of these products by different sectors in different regions is presented in the first 4 columns.
- The production of these products is presented on the top 4 rows.
- Total production in these sectors is provided in the last column on the right.
- In the bottom two rows total value added which is an aggregation of both labour and capital income.
- International trade (product level) and is divided over different types of use.
- The use of the final demand categories are presented in the last 2 columns.
- The use of the different producing sectors are presented in the first 2 columns.
- Region 1 exports 3 units of product 2 to Region 2 where 2 units are used by sector 2 and 1 unit by final demand



# RHOMOLO IO Framework



## JRC TECHNICAL REPORTS

The RHOMOLO-IO modelling framework: a flexible Input-Output tool for policy analysis

*JRC Working Papers on Territorial Modelling and Analysis No 06/2019*

Mandras, G., Conte, A., Salotti, S.

2019

## *Applications*

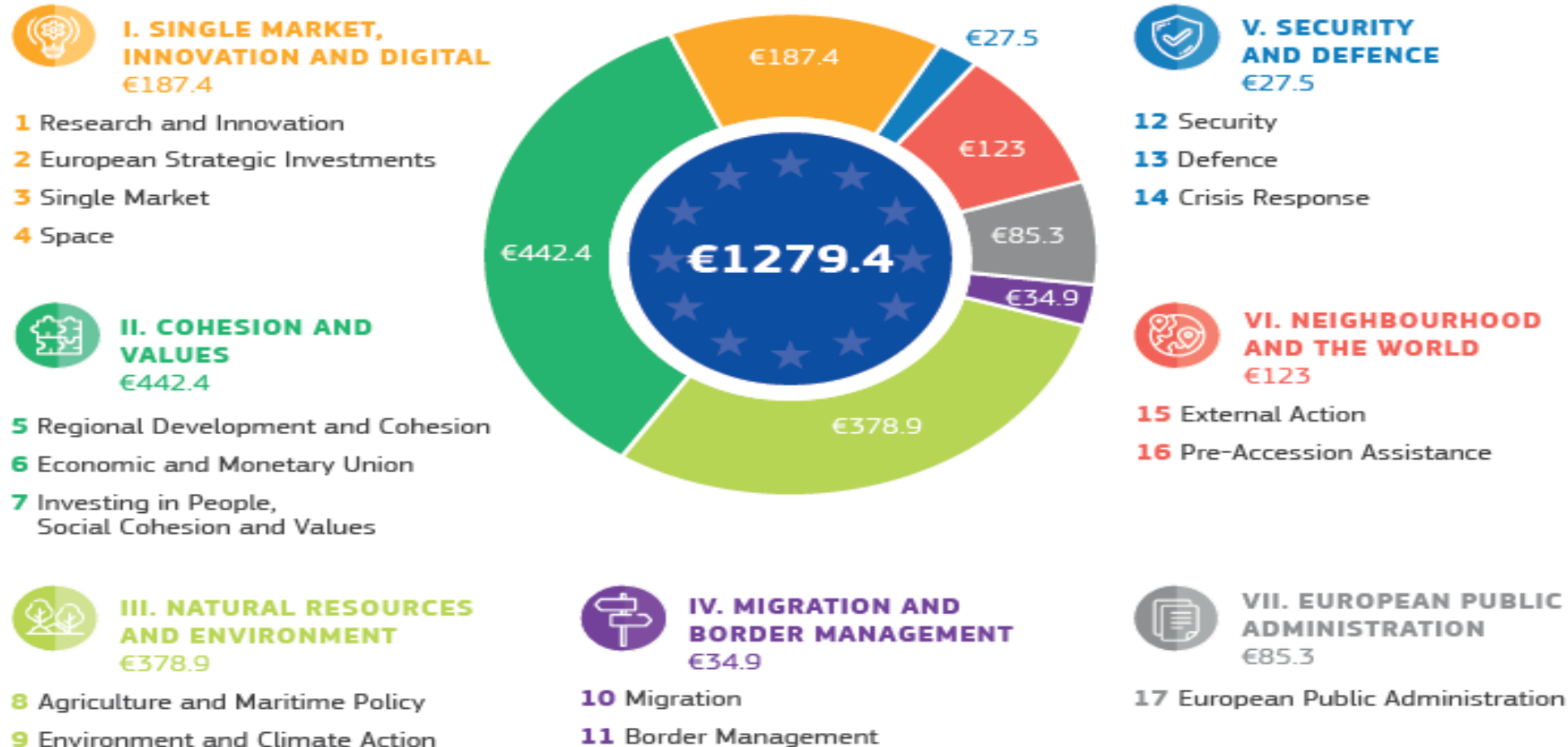
- The evaluation of TEN-T projects
- Employment Analyses
- European Globalisation Adjustment Fund (EGF)
- Coal Regions in Transition
- Consumption Redistribution Analysis
- Trade (& Value Added) Analysis



# MFF Proposal 2021-2027

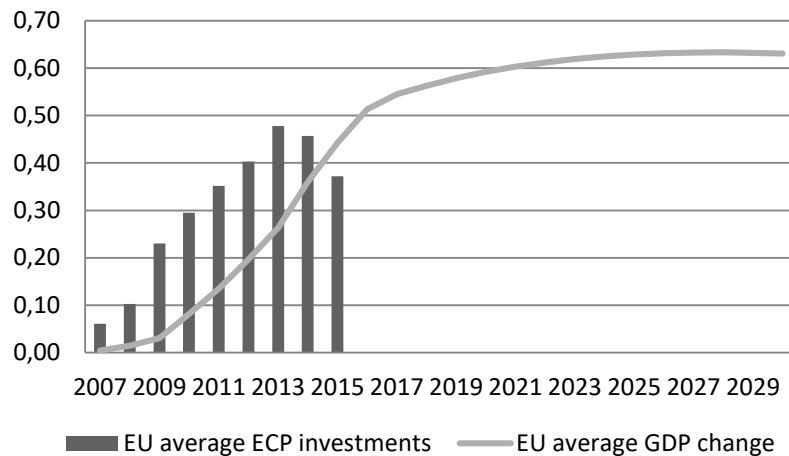
## THE NEW MULTIANNUAL FINANCIAL FRAMEWORK 2021 - 2027 A BUDGET FOR A UNION THAT PROTECTS, EMPOWERS AND DEFENDS

In billion euro, current prices

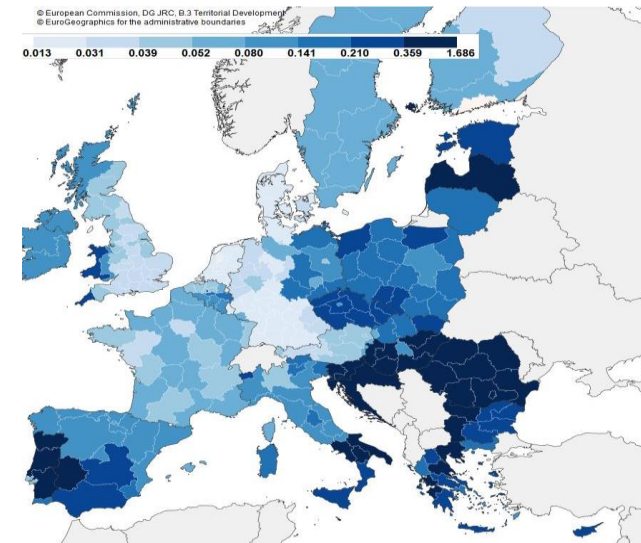


# Horizontal Support to COM Impact Assessments

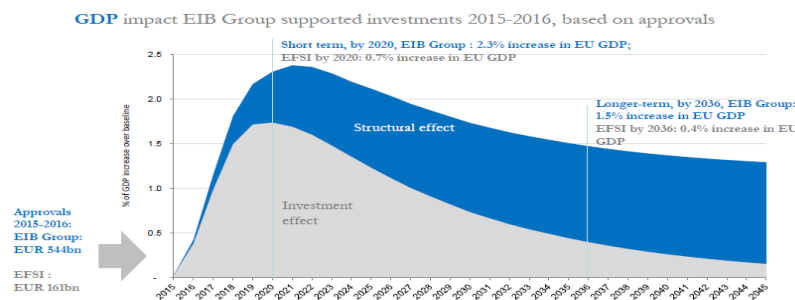
**European Structural and Investment Funds (SWD (2018) 282 final)**



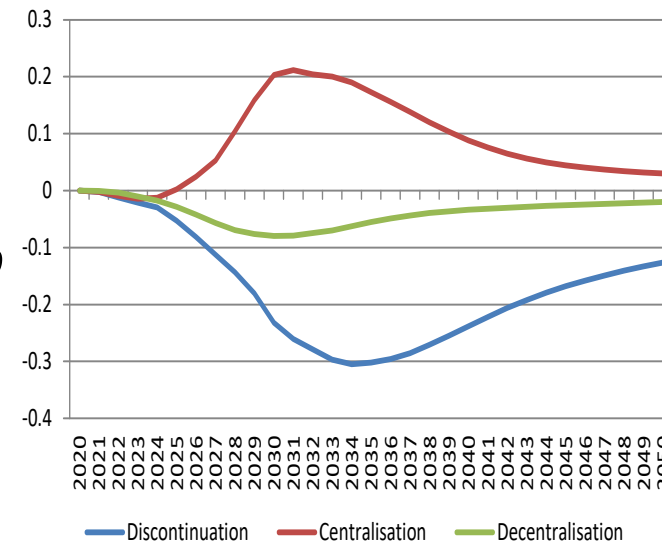
**European Social Fund (SWD (2018) 289 final)**



**European Fund for Strategic Investments (EIB / JRC Annual Report)**



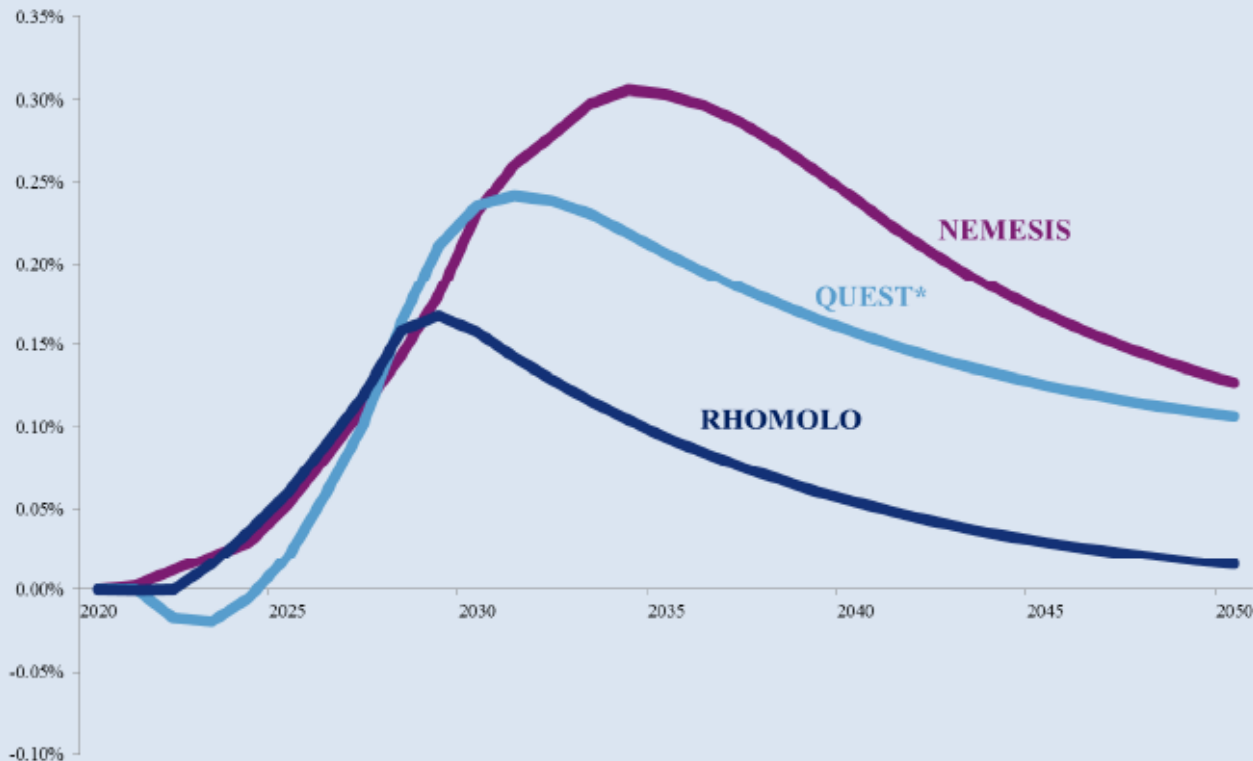
**Horizon 2020 (SWD (2018) 307 final)**





# Impact assessments with RHOMOLO RTD

Figure 1: GDP gains from the continuation of Horizon 2020 (percentage change compared to a situation without Framework Programme)



\*Note: Figures calculated for EU-27; different sets of results from QUEST are presented in Annex 5 based on different funding assumptions. This graph presents the scenario with higher benefits

SWD(2018)307 final, June 7<sup>th</sup>, 2018



JRC TECHNICAL REPORTS

Assessing the regional socio-economic impact of the European R&I programme

JRC Working Papers on Territorial Modelling and Analysis No 05/2018

Christensen, M.

2018

# Impact assessments with RHOMOLO CAB (Katainen)



**The European Fund for Strategic Investments (EFSI)**

Making smarter use of financial resources



**Support: how you can benefit from the Plan**

Visibility for projects, technical assistance and how to apply



**Improving the business environment in the EU**

Removing obstacles to investment

- **Four pillars:** Capital Market Union, Energy Union, Digital Single Market, Single Market Strategy (relevant DGs involved)

**COM(2018) 771 final**  
**November 22<sup>nd</sup>, 2018**



# Impact assessments with RHOMOLO EIB

- **EIB / JRC Annual Reporting**
- **Last Press Release October 22<sup>nd</sup>, 2019**



JRC - EIB Policy Insights

JRC - EIB TERRITORIAL DEVELOPMENT INSIGHT SERIES - OCTOBER 2019

European Commission | European Investment Bank

**THE EUROPEAN FUND FOR STRATEGIC INVESTMENTS: THE RHOMOLO-EIB 2019 UPDATE**

MARTIN CHRISTENSEN, GEORG WEIERS, ANDREA CONTE, MARCIN WOLSKI, AND SIMONE SALOTTI

- The European Fund for Strategic Investments (EFSI) is the central pillar of the Investment Plan for Europe. It tackles the post-crisis investment gap in the EU and aims to revive investment in strategic projects in all EU Member States.
- EFSI was launched jointly by the European Investment Bank (EIB) Group and the European Commission.
- Every year, policy simulations are carried out using the RHOMOLO-EIB Computable General Equilibrium (CGE) model in order to assess the macroeconomic effects of EFSI-supported operations.
- This Policy Insight contains the result of the latest set of simulations quantifying the estimated macroeconomic impact on EU GDP and employment of all EFSI-supported operations approved as of June 13, 2019.
- The EFSI is contributing significantly to job creation and growth. The EIB-JRC estimates suggest that, by 2019, it has already, created more than 1 million jobs (1.7 million by 2022), with a positive contribution to GDP of 0.9% (1.8% by 2022) over the baseline.
- The results of the analysis highlight the importance of investments for jobs and economic growth.

**Juncker Plan has made major impact on EU jobs and growth**

Financing under the Plan's European Fund for Strategic Investments has increased EU gross domestic product by 0.9% and added 1.1 million jobs

ECONOMICS - IMPACT STUDIES

**Assessing the macroeconomic impact of the EIB Group**

European Commission | European Investment Bank



# Background Material

## Territorial Development - JRC Policy Insights

TERRITORIAL DEVELOPMENT INSIGHTS SERIES - OCTOBER 2018



### THE IMPACT OF THE EUROPEAN SOCIAL FUND: THE RHOMOLO ASSESSMENT

STYLIANOS SAKKAS, ANDREA CONTE, AND SIMONE SALOTTI

- The ESF is Europe's main instrument for supporting jobs, helping people get better jobs and ensuring fairer job opportunities for all EU citizens.
- The ESF includes 4 different thematic objectives aimed at promoting sustainable employment, social inclusion, education and the efficiency of the public administration.
- Policy simulations using the RHOMOLO dynamic CGE model show positive aggregate macro-economic effects of the ESF policy intervention.
- The ESF stimulates GDP and employment via increases in labour productivity, education and training, and additional demand-side effects.
- RHOMOLO is able to quantify the impact of the ESF in the EU as a whole as well as in each one of the 267 NUTS 2 EU regions. Less developed regions reap most of the benefits of ESF policy intervention.
- By 2030, the cumulative GDP impact of the ESF is larger than its cost, that is the ESF generates more than one euro for each euro spent in it.

#### 1. Policy context

The objective of the EU's Cohesion Policy (ECP) is to reduce the differences in the level of development of the European regions in order to strengthen economic, social and territorial cohesion. Rather than being solely focused on inter-regional income distribution, the ECP aims at promoting smart, inclusive, and sustainable economic growth in all EU regions through a number of coordinated policies.

In this context, the European Social Fund (ESF) plays a crucial role. For the 2014-2020 programming period, the ESF resources amount to 89 billion euros, almost 25% of the 350 billion euros allocated for the ECP.

Among the 11 Thematic Objectives (TOs) of the latter, the ESF aims at enhancing human capital and social cohesion through the following ones:

- TO 8: Promoting sustainable, equitable employment and supporting labour mobility.
- TO 9: Promoting social inclusion, combating poverty and discrimination.
- TO 10: Investing in education, training and lifelong learning.
- TO 11: Improving the efficiency of the public administration.

Most of the funds (71%) are allocated to TOs 8 and 10, 24% goes to TO 9, and 5% to TO 11.

#### 2. The RHOMOLO simulations

We perform policy simulations related to the ESF intervention using the RHOMOLO dynamic spatial Computable General Equilibrium model developed by the JRC (Lecca et al., 2018). Modern macroeconomic models such as RHOMOLO provide coherent and internally consistent frameworks to analyse the channels through which macroeconomic policies affect national and regional economies. In particular, RHOMOLO provides sector-, region- and time-specific results to support EU policy making and investment programs. The current version of RHOMOLO covers all EU NUTS2 regions, each regional economy being disaggregated into ten economic sectors.

We use a combination of labour productivity shocks and government consumption shocks to simulate ESF policies. The aim is to capture both structural and long-lasting effects stemming from changes in labour productivity as well as short-run demand side effects stemming from government consumption shocks. The model simulations estimate the policy's potential effects in a controlled environment; simulations are carried out assuming that there are no ex-post implementation inefficiencies (such as low absorption rates, rent seeking, etc.). Also, we use provisional commitments data (not actual payments) for the period 2014-2023. The model is calibrated with 2014 as its baseline year. Starting from that benchmark, we simulate both the short-run to medium and long-run effects of the ESF.



## JRC TECHNICAL REPORTS

### RHOMOLO V3: A Spatial Modelling Framework

Lecca P., Barbero J., Christensen M.A., Conte A., Di Pietro F., Diaz-Lanchas J., Dukanova O., Mandras G., Peryni D., Sakkas S.

2018



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EUR 20229 EN



## JRC TECHNICAL REPORTS

### The third pillar of the Investment Plan for Europe: An impact assessment using the RHOMOLO model

JRC Working Papers on Territorial Modelling and Analysis No 02/2018

Christensen, M., Conte, A., Di Pietro, F., Lecca, P., Mandras, G., Salotti, S.

2018



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# With its own website, newsletters, online (reduced) model, events, etc.

The screenshot shows the EU Science Hub website page for the RHOMOLO model. At the top, there is a navigation bar with links for 'Subscribe', 'Europa Analytics', 'Cookies', 'Legal notice', 'Contact', 'Search', and a language dropdown set to 'English (en)'. Below this is a search bar with the text 'Search' and a magnifying glass icon. The main header features the European Commission logo and the text 'EU SCIENCE HUB' and 'The European Commission's science and knowledge service'. A breadcrumb trail reads 'European Commission > EU Science Hub > The RHOMOLO model'. A secondary navigation bar includes links for 'Home', 'About Us', 'Research', 'Knowledge', 'Working With Us', 'Procurement', 'News & Events', and 'Our Communities'. The left sidebar contains a menu for 'RHOMOLO' with sub-items: 'Policy applications & publications', 'Team', and 'RHOMOLO Webtool'. The main content area has a large blue banner with the title 'RHOMOLO' and subtitle 'Dynamic Spatial General Equilibrium Model for EU Regions and Sectors'. Below the banner is a section titled 'The RHOMOLO model' with a detailed description of the model's purpose and development. To the right, there is a 'Related Publications' section listing several articles.

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### RHOMOLO

Policy applications & publications

Team

RHOMOLO Webtool

## RHOMOLO

### Dynamic Spatial General Equilibrium Model for EU Regions and Sectors

### The RHOMOLO model

RHOMOLO is the spatial computable general equilibrium model of the European Commission focusing on EU regions. It has been developed and maintained by the [regional economic modelling team](#) at the Directorate-General Joint Research Centre (DG JRC) in cooperation with Directorate-General for Regional and Urban Policy (DG REGIO). It is used for policy impact assessment and provides sector-, region- and time-specific simulations to support to EU policy making on investments and reforms covering a wide array of policies.

RHOMOLO (v2) covers all EU regions, disaggregating their economies into NACE rev.2 sectors, entailing a constant effort on data updating and

#### Related Publications

- Energy efficiency as an instrument of regional development policy? The impact of regional fiscal autonomy
- EU coal regions: opportunities and challenges ahead
- Transport liberalization and regional imbalances with endogenous freight rates
- WIOD SAMs adjusted with Eurostat data for the EU-27



# Thanks

Questions and inputs/feedback?

You can find me at **[andrea.conte@ec.europa.eu](mailto:andrea.conte@ec.europa.eu)**

More information on RHOMOLO:

<https://ec.europa.eu/jrc/rhomolo>