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Contact: [EU-MIDAS@ec.europa.eu](mailto:EU-MIDAS@ec.europa.eu)

## Factsheet

### SWD/2019/330 final/2

Impact Assessment accompanying the document "Proposal for a Decision of the European Parliament and of the Council on the Strategic Innovation Agenda of the European Institute of Innovation and Technology (EIT) 2021-2027: Boosting the Innovation Talent and Capacity of Europe

### Supporting model(s)

EU-EMS

# Impact assessment SWD/2019/330 final/2

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## *Fact sheet on model contributions*

Source: Commission modelling inventory and knowledge management system (MIDAS)

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## Overview

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**Title**

Impact Assessment accompanying the document "Proposal for a Decision of the European Parliament and of the Council on the Strategic Innovation Agenda of the European Institute of Innovation and Technology (EIT) 2021-2027: Boosting the Innovation Talent and Capacity of Europe

**Document ID**

SWD/2019/330 final/2

**Year of publication**

2019

**Led by**

EAC

**Model(s) used**

EU-EMS

# EU-EMS

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**Full title**

EU Economic Modelling System

**Run for this impact assessment by**

European Commission

**Contributed to**

Baseline and assessment of policy options

**Helped to assess the following impacts**

<i>Impact area</i>	<i>Impact category</i>	<i>Impact subcategory</i>
Economic impacts	Operating costs and conduct of business	Adjustment, compliance or transaction costs
Economic impacts	Operating costs and conduct of business	Cost/availability of essential inputs (raw materials, machinery, labour, energy, ..)
Economic impacts	Operating costs and conduct of business	Business access to finance
Economic impacts	Operating costs and conduct of business	Investment cycle
Economic impacts	Operating costs and conduct of business	Market & marketing
Economic impacts	Operating costs and conduct of business	Regulation of business
Economic impacts	Operating costs and conduct of business	Opening/closing down of business
Economic impacts	Operating costs and conduct of business	Equal treatment of products and businesses
Economic impacts	Operating costs and conduct of business	Affects on individual Member States
Economic impacts	Administrative burdens on businesses	Information obligations placed on businesses

Economic impacts	Trade and investment flows	EU Exports & imports
Economic impacts	Trade and investment flows	Investment flows & trade in services
Economic impacts	Trade and investment flows	Non-trade barriers
Economic impacts	Trade and investment flows	Third countries
Economic impacts	Competitiveness (sectoral) of business	Cost of doing business
Economic impacts	Competitiveness (sectoral) of business	Market share & advantages in international context
Economic impacts	Competitiveness (sectoral) of business	Business' capacity to innovate
Economic impacts	Functioning of the internal market and competition	Free movement of goods, services, capital and workers
Economic impacts	Functioning of the internal market and competition	Competition
Economic impacts	Innovation and research	Stimulation of research and development
Economic impacts	Innovation and research	Markets for Innovation
Economic impacts	Innovation and research	Intellectual property rights
Economic impacts	Innovation and research	Promotion of academic or industrial research
Economic impacts	Innovation and research	Innovation for productivity/resource efficiency
Economic impacts	Consumers and households	Impact on vulnerable consumers
Economic impacts	Specific regions or sectors	Significant effects on sectors
Economic impacts	Specific regions or sectors	Impact on regions
Economic impacts	Specific regions or sectors	Disproportionately affected region or sector
Economic impacts	Third countries and international relations	International legal commitments
Economic impacts	Third countries and international relations	EU foreign policy and EU development policy
Economic impacts	Third countries and international relations	Impacts on third countries

Economic impacts	Third countries and international relations	Impacts on developing countries
Economic impacts	Third countries and international relations	Adjustment costs in developing countries
Economic impacts	Third countries and international relations	Goods traded with developing countries
Economic impacts	Macroeconomic environment	Economic growth and employment
Economic impacts	Macroeconomic environment	Investments and functioning of markets
Economic impacts	Macroeconomic environment	Macro-economic stabilisation
Social	Employment	Impact on jobs
Social	Employment	Impact on jobs in specific sectors, professions, regions or countries
Social	Employment	Indirect effects on employment levels
Social	Employment	Factors preventing or enhancing the potential to create jobs or prevent job losses
Social	Employment	Opportunities and incentives of workers/specific groups to work
Social	Working Conditions	Wages, labour costs or wage setting mechanisms
Social	Effects on income, distribution and social inclusion	Households income and at risk of poverty rates
Social	Effects on income, distribution and social inclusion	Inequalities and the distribution of incomes and wealth
Social	Effects on income, distribution and social inclusion	Access to and quality of social protection benefits
Social	Effects on income, distribution and social inclusion	Financing and organisation of social protection systems
Social	Effects on income, distribution and social inclusion	Cross-border provision of services, referrals across borders and cooperation in border regions
Social	Effects on income, distribution and social inclusion	Access to and quality of basic

	social inclusion	goods and services
Social	Education and educational systems	Level of education and training outcomes
Social	Education and educational systems	Skills used by individuals
Social	Education and educational systems	Education and mobility of workers
Social	Education and educational systems	Access to education and training
Social	Education and educational systems	Cross-border collaboration (education & training)
Social	Education and educational systems	Financing and organisation of educational systems
Social	Education and educational systems	Universities and academic freedom
Social	Social impacts in third countries	ILO Conventions and the implementation of the ILO Decent Work Agenda in third countries
Social	Social impacts in third countries	Employment, social protection and poverty impacts in non-Member States (including developing countries)
Environmental	International environmental impacts	Environment in third countries

*Further details can be found in:*

[Olga Ivanova, d'Artis Kancs and Mark Thissen; EU Economic Modelling System: Assessment of the European Institute of Innovation and Technology \(EIT\) Investments in Innovation and Human Capital; EUR 27796 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-57276-0, doi:10.2791/184008, JRC100796.](#)

# EU Economic Modelling System

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## *Fact sheet*

Source: Commission modelling inventory and knowledge management system (MIDAS)

Date of Report Generation: 06/10/2020

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## Overview

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**Acronym** EU-EMS

**Full title** EU Economic Modelling System

**Main purpose:**

Global Integrated financial-economic model for assessing the short-term employment effects and long-term structural productivity effects of innovation, human capital, green infrastructure and SDG policies in EU regions and European Neighbourhood countries.

**Summary**

EU-EMS is a dynamic spatial general equilibrium model. It has been developed by the PBL Netherlands Environmental Assessment Agency within the EU Horizon 2020 Research and Innovation Programme. It is being used for the policy impact support by the European Commission, European Investment Bank, European Institute of Innovation and Technology as well as EU Member States and European Neighbourhood Policy countries.

EU-EMS is a micro-founded macroeconomic model with a neoclassical equilibrium closure where supply and demand are balanced through a system of relative prices and behavioural functions. Policy-driven scenario perturbations are modelled as deviations from a benchmark equilibrium state of the economy affecting the optimal supply and demand behaviours of all the agents in all the economies. Policy shocks result in a reallocation of production and consumption, market transactions, goods and factors consistent with the new price system in the simulated counterfactual equilibrium. Policy appraisals are based on a comparison between the counterfactual and the benchmark equilibrium; an explicit modelling of financial transactions including a green finance, distributed ledgers, blockchain and SDGs. A particular attention is devoted to an explicit modelling of spatial spillovers, interactions and linkages between regional and sectoral economies and global value chains in EU regions, Member States and 35 non-EU countries including the European Neighbourhood Policy (ENP) countries.

EU-EMS can be used for ex-post policy evaluations and as well as for ex-ante policy impact assessment and provides sector-, region- and time-specific simulations to support EU policy evaluation of investments in innovation, education and human capital, green infrastructures and structural reforms across a wide array of policies. All direct, indirect and spatial spillover effects of public investments or EU policies are explicitly captured in EU-EMS. EU-EMS is suited for assessing distributional impact by income deciles (integrated with the EU-SILC micro-data), firm heterogeneity in terms of technology and productivity (efficiency, capital deepening, human resources, green technology).

**Keywords**

human capital , green infrastructure , research and innovation , education , Spatial Computable General Equilibrium (CGE) Model , SDGs

**Model category (thematic)**

Economy

**Model home page**

No information provided

## Ownership & license

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### **Ownership**

Joint copyright

### **Ownership details**

Copyright shared between the Netherlands Environmental Assessment Agency PBL and the European Commission.

### **Licence type**

Free software licence. The license grants freedom to run the programme for any purpose; freedom to run the program for any purpose; freedom to study (by accessing the source code) how the program works, and change it so it does enable computing; freedom to redistribute copies; and freedom to distribute copies of modified versions to others.

## Details

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### **EU-EMS structure and approach**

The conceptual framework of the EU-EMS is founded in the microeconomic theory and modelling techniques; it draws on the long tradition of the dynamic spatial general equilibrium modelling. EU-EMS has gone through several adjustments to fit policy advice purposes, and is firmly grounded in an academic peer-review process. Being a Computable General Equilibrium model, it is featured by a complex system of a large number of nonlinear equations that are solved simultaneously.

All transactions in the global value chains included in regional and sectoral economies result of agents optimising their production, consumption, employment, savings, investment, trade, education and other decision-making. Goods and services are consumed by households, government and firms, and are produced by firms operating in imperfectly competitive markets. Spatial interactions between regions and reallocation between sectors are captured through the trade flows of goods and services as well as production factors capital and labour. The capital mobility is represented through inter-regional investment flows, labour mobility through the inter-regional migration of workers. Spatial dimensions are a key element of the EU-EMS in terms of trade, labour and capital mobility (in terms of investment flows), and the location decisions of firms. Trade activities between regions are determined by transport costs, which are of iceberg type and imply that a given share of the goods ‘melts’ during shipping. Thus, transport infrastructure projects imply reduced transport costs between and within regions, thereby increasing the competitiveness of regions and competition between regional producers and consumers.

The theoretical underpinning of the innovation process and the factor productivity growth follows Griffith et al. (2001) and Acemoglu et al. (2006), where firms invest into both innovation (knowledge production) and adoption of technologies from the global technology frontier. In this framework, the selection of high-skill workers and firms is more important for innovation production than for knowledge adoption. Regional economies at early stages of development pursue an investment-based strategy, which relies on existing firms and managers to maximise investment but sacrifices selection. Closer to the world technology frontier, economies switch to an innovation-based strategy with short-term relationships, younger firms, less investment, and better selection of firms and managers.

In EU-EMS, economies (regions within EU, countries outside EU) differ by the type of production sectors, which capture overall production activities in the region. There are regions that specialise in traditional sectors like agriculture, whereas others specialise in skill- and knowledge-intensive sectors such as finance and industry. Heterogeneous economic sectors are characterised by a different degree of agglomeration and its importance for innovation, as innovation activities tend to be highly concentrated. Traditional sectors do not experience any agglomeration effects whereas skill- and knowledge-intensive sectors do, that result in some sectors growing faster than others. In order to capture inter-sectoral differences in the innovation activity and performance, all economic sectors are modelled within six broad innovation-intensity groups following the Eurostat

classification of the economic sectors according to their R&D intensity: (1) Traditional, (2) Low-tech industry, (3) Medium-tech industry, (4) High-tech industry, (5) Knowledge intensive services and (6) Other services (see Table 4). This classification follows the Eurostat's definition, where groups "High-technology" and "Medium-high technology" into "High-technology" are merged. These aggregated innovation-intensity sectors are also used in the econometric analysis for the estimation of structural innovation parameters in the model.

EU-EMS is a global model with a great geographic detail – it includes 62 countries and the Rest of the world. The EU27 Member States are further disaggregated into 236 NUTS2 regions and each regional economy is disaggregated into 63 NACE Rev.2 economic sectors. Goods and services are consumed by households, government and firms and are produced in markets that differ in the competition intensity. The macro-financial module of the EU-EMS includes Real Business Cycle features such as monopolistic competition, increasing returns to scale as well as overlapping generations. Spatial interactions between regions are captured through trade of goods and services (which is subject to trade and transport costs), factor mobility and knowledge spillovers. This makes EU-EMS a particularly well suited modelling tool for analysing policies related to the human capital, R&I and innovation.

#### **Input and parametrization**

The EU-EMS database has been constructed by combining national, European and international data sources; it contains a detailed regional level (NUTS2 for EU27 plus 35 non-EU countries) multi-regional input-output (MRIO) table for the world. The main datasets used for the construction of MRIO include the OECD database, the BACI trade data, the Eurostat regional statistics and national Supply and Use tables as well as detailed regional level transport database ETIS-Plus from the DG MOVE. The EU-EMS database has a detailed sectoral and regional dimensionality, EU27 Member States are disaggregated as 236 NUTS2 regions. Both sectoral and geographical dimensions of the model are flexible and can be adjusted to the needs of specific policy or research question. Transportation costs in EU-EMS are both good-specific and differentiated between the origin and destination regions. The inter-regional trade flows data at the level of NUTS2 are unique, as these data are not available from official statistical sources (e.g. Thissen et al. 2018; Ivanova, Kancs and Thissen 2020).

- Savings rate of households in each region
- Household consumption share for each region & sector
- Substitution elasticities between goods from different sectors in each region
- Share of factor use (capital, labour) and intermediate inputs in production in each region & sector
- Substitution elasticities between different factors of production in each region & sector
- Total factor productivity

- Substitution elasticities between goods from different regions for each sector
- Share of exports from each region & sector
- Transport cost rate for each region pair & sector
- Savings flows between regions

### **Main output**

Being a Spatial Dynamic General Equilibrium model, EU-EMS simulates shifts in the supply of goods and services and the corresponding demand changes that result from policy changes or from a price shock. EU-EMS models the links between connected markets (via trade and investment linkages); and determines a new set of prices and demands for various production factors (labour, capital). EU-EMS provides indicators and estimates of macroeconomic changes, such as GDP, overall demand, savings, employment, migration, participation, unemployment, education, human capital, investment, trade, productivity, leverage, multiplier and spillover effects across regions and sectors, etc. All output indicators are provided for each sector, 236 NUTS 2 regions of the EU and 35 non-EU countries.

- Factor supply by households (capital, labour) in each region
- Education by skill level and region
- Income of households in each region
- Taxes paid on income by households in each region
- Savings of households in each region
- Aggregate consumption of households in each region
- Price index of consumption goods in each region
- Household consumption in each region & sector
- Price of exports from each NUTS2 region to each NUTS2 region
- Average selling price in each region & sector
- Average production cost in each region & sector
- Profits in each region & sector
- Fixed cost of production
- Marginal cost of production in each region & sector
- Aggregate intermediate input in each region & sector

- Aggregate input of primary factor in each region & sector
- Price of aggregate intermediate input in each region & sector
- Intermediate input demand in each region & sector
- Total factor productivity in each region & sector
- Aggregate capital-factor demand in each region & sector
- Aggregate labour-factor demand in each region & sector
- Price of aggregate capital-factor demand in each region & sector
- Price of aggregate labour-factor demand in each region & sector
- Price of firm output in each region & sector
- Demand for factors (capital, labour) in each region & sector
- Taxes payed on factors in each region & sector
- Taxes payed on intermediate inputs in each region & sector
- Income of investor in each region
- Aggregate investment in each region
- Price of investment good in each region
- Investment demand in each region & sector
- Supply of factors (capital, labour) by government in each region
- Taxes rate on household income in each region
- Income of government in each region
- Aggregate consumption of government in each region
- Composite price of government consumption good in each region
- Government consumption in each region & sector
- Transfers from government to households in each region
- Government savings
- Demand for composite import good in each region & sector

- Price of composite import good each region & sector
- Exports from each NUTS2 region to each NUTS2 region
- Price of factors (capital, labour) in each region
- Unemployment rate for each region
- Firm sales in each region & sector
- Number of firms in each region & sector

**Spatial - temporal extent**

*The output has the following spatial-temporal resolution and extent:*

Parameter	Description
Spatial Extent / Country Coverage	EU-27 + 35 non-EU and European Neighbourhood Policy (ENP) countries
(Spatial) resolution	NUTS2
Temporal extent	2050
Temporal resolution	1-year-steps



## Quality & transparency

### Quality

Question	Answer	Details
Models are by definition affected by uncertainties (in input data, input parameters, scenario definitions, etc.). Have the model uncertainties been quantified? Are uncertainties accounted for in your simulations?	yes	Uncertainties are being quantified for each model run, when used for the EU policy support.
Sensitivity analysis helps identifying the uncertain inputs mostly responsible for the uncertainty in the model responses. Has the model undergone sensitivity analysis?	yes	Sensitivity analyses are undertaken for each model run, when used for the EU policy support.
Has the model undergone external peer review by a panel of experts, or have results been published in peer-reviewed journals?	no	EU-EMS has not yet undergone an external peer review (new model, v.1 released in 2019). An external peer review is in the planning.
Has model validation been done? Have model predictions been confronted with observed data (ex-post)?	no	EU-EMS has is being validated - observed data (ex-post).

#### References related to external peer-review and publication in scientific journals:

- No references provided in MIDAS

### Transparency

Question	Answer	Details
Is the model underlying database (i.e. the database the model runs are based on) publicly available?	yes	Yes, the EU-EMS underlying database is publicly available via the European Union Open Data Portal (EU ODP).
Can model outputs be made publicly available?	yes	Yes, EU-EMS outputs are made publicly available via the European Union Open Data Portal (EU ODP).
Is the model transparently documented (including underlying data, assumptions and equations, architecture, results) and are these documents available to the general public?	yes	Yes, EU-EMS is transparently documented (including underlying data, assumptions and equations, architecture, results) and the relevant documentation is available to the general public via the European Union Open Data Portal (EU ODP).
Is the model source code publicly accessible or open for inspection?	yes	Partially yes, the model source code is publicly accessible for inspection and can be requested from the authors. Until a full public release of the source code it is available on request from model developers.

#### References related to documentation:

- Thissen, M., Ivanova, O., Mandras, G. and Husby, T., European NUTS 2 regions: construction of interregional trade-linked Supply and Use tables with consistent transport flows, European Commission, 2019, JRC115439.

- Ivanova, O., Kancs, D. and Thissen, M., Regional Trade Flows and Input-Output Data for Europe, European Commission, 2020, JRC118892.
- Ivanova, O., Kancs, D. and Thissen, M., EU Economic Modelling System: Assessment of the European Institute of Innovation and Technology (EIT) Investments in Innovation and Human Capital , EUR 27796, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-57276-0, doi:10.2791/184008, JRC100796.

# The model's policy relevance and intended role in the policy cycle

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## **The model is designed to contribute to the following policy areas**

- Climate action
- Education and training
- Economy, finance and the euro
- Employment and social affairs
- Energy
- Regional policy
- International cooperation and development
- Digital economy and society
- Research and innovation
- Single market
- Trade

## **The model is designed to contribute to the following phases of the policy cycle**

- Formulation
- Implementation
- Evaluation

## **The model's potential**

EU-EMS is designed for assessing both the short-term employment effects and long-term structural productivity effects of EU investment policies in innovation, human capital, green infrastructure, SDGs and global value chains. Being a Spatial Dynamic General Equilibrium model, EU-EMS is able to simulate shifts in supply curves and corresponding demand adjustments that result from a policy change. EU-EMS is able to model the global value chains in EU-27 and 35 non-EU and European Neighbourhood Policy (ENP) countries, distributional impact by income deciles (integrated with the EU-SILC micro-data), firm heterogeneity in terms of technology and productivity (efficiency, capital deepening, human resources, green technology), green finance, distributed ledgers, blockchain and SDGs. EU-EMS provides indicators and estimates about macroeconomic changes, such as GDP, demand by decile, savings, employment, migration, participation, unemployment, education, human capital, investment, trade, productivity, leverage, multiplier and spillover effects across regions and sectors and global value chains. All output indicators are provided for each of the six economic sectors (Traditional sectors, Low-tech industry, Medium-tech industry, High-tech industry, Knowledge intensive services and Other services) and 236 NUTS 2 regions of the EU as well as 35 non-EU and European Neighbourhood Policy (ENP) countries.

## Previous use of the model in ex-ante impact assessments of the European Commission

Use of the model in ex-ante impact assessments since July 2017.

In the Year	EU-EMS contributed to the Impact assessment called	Led by	By providing input to the	The model was run by	Details of the contribution
2019	Impact Assessment accompanying the document "Proposal for a Decision of the European Parliament and of the Council on the Strategic Innovation Agenda of the European Institute of Innovation and Technology (EIT) 2021-2027: Boosting the Innovation Talent and Capacity of Europe  SWD/2019/330 final/2	EAC	Baseline and assessment of policy options	European Commission	The model helped to assess the following impacts: - Adjustment, compliance or transaction costs - Cost/availability of essential inputs (raw materials, machinery, labour, energy, ..) - Business access to finance - Investment cycle - Market & marketing - Regulation of business - Opening/closing down of business - Equal treatment of products and businesses - Affects on individual Member States - Information obligations placed on businesses - EU Exports & imports - Investment flows & trade in services - Non-trade barriers - Third countries - Cost of doing business - Market share & advantages in international context - Business' capacity to innovate - Free movement of goods, services, capital and workers - Competition - Stimulation of research and development - Markets for Innovation - Intellectual property rights - Promotion of academic or industrial research - Innovation for productivity/resource efficiency - Impact on vulnerable consumers - Significant effects on sectors - Impact on regions - Disproportionately affected region or sector - International legal commitments - EU foreign policy and EU development policy - Impacts on third countries - Impacts on developing countries - Adjustment costs in developing countries - Goods traded with developing countries - Economic growth and employment - Investments and functioning of markets - Macro-economic stabilisation - Impact on jobs - Impact on jobs in specific sectors, professions, regions or countries - Indirect effects on employment levels - Factors preventing or enhancing the potential to create jobs or prevent job losses - Opportunities and incentives of workers/specific groups to work - Wages, labour costs or wage setting mechanisms - Households income and at risk of poverty rates - Inequalities and the distribution of incomes and wealth

- Access to and quality of social protection benefits
- Financing and organisation of social protection systems
- Cross-border provision of services, referrals across borders and cooperation in border regions
- Access to and quality of basic goods and services
- Level of education and training outcomes
- Skills used by individuals
- Education and mobility of workers
- Access to education and training
- Cross-border collaboration (education & training)
- Financing and organisation of educational systems
- Universities and academic freedom
- ILO Conventions and the implementation of the ILO Decent Work Agenda in third countries
- Employment, social protection and poverty impacts in non-Member States (including developing countries)
- Environment in third countries

Details can be found in: [doi:10.2791/184008](https://doi.org/10.2791/184008)

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- *Ciaian, P., Ivanov, A. and Kancs, D., Universal basic income: A viable policy alternative, WORLD ECONOMY, ISSN 0378-5920 (online), 42 (10), 2019, p. 2975-3000, JRC116239.*
- *Employment and social developments in Europe 2019 : sustainable growth for all : choices for the future of Social Europe. - 10.2767/305832*
- *Niamir, L., Ivanova, O., Filatova, T., & Voinov, A. (2018). Tracing Macroeconomic Impacts of Individual Behavioral Changes through Model Integration. IFAC-PapersOnLine, 51(5), 96–101. doi:10.1016/j.ifacol.2018.06.217*