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The RHOMOLO ex-post impact assessment of the 2014-2020 European research and innovation programme (Horizon 2020)

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The RHOMOLO ex-post impact assessment of the 2014-2020 European research and innovation funding programme (Horizon 2020)

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Abstract. This paper presents a macroeconomic evaluation of the impact of the Horizon 2020 funds, carried out using the spatial dynamic general equilibrium model RHOMOLO. The policy disbursement data used to feed the model relate to the actual use of the funds over the period 2014-2021, so this is considered an ex-post evaluation. The model simulations suggest that the GDP gains in 2021 for the European Union as a whole would be up to 0.19% compared to the hypothetical baseline with no innovation policy. The GDP gains are also expected to be significant after the end of the 2014-2020 programming period, due to the positive effects of process and product innovations resulting from Horizon 2020 funding. The effects gradually diminish due to the gradual obsolescence of the new knowledge and innovations generated by the policy intervention. The model results also reveal significant interregional spillovers in some, but not all, countries of the Union.

Keywords: innovation policy, regional growth, general equilibrium.

JEL Codes: C68, O30, R13.

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1. Introduction

Horizon 2020 (H2020) is the eighth framework programme for research and innovation of the European Union (EU), launched in 2013 for the programming period 2014-2020 (Regulation 1291/2013). With a budget of almost €74 billion, it represents a significant amount of investment in research and innovation with the aim of boosting economic growth and creating jobs. More specifically, the overall objective of the policy was to contribute to the achievement of research and innovation (R&I) objectives, including the target of 3% of gross domestic product (GDP) for research and development by 2020.[1]

The programme has attracted the attention of academics and researchers who have studied aspects such as its impact on innovation (Veugelers et al., 2015) and GDP growth (Pollex and Lenschow, 2018), as well as what motivates institutions to participate in the programme itself (Enger, 2018). This paper presents a macroeconomic assessment of the impact of the H2020 funds, carried out using the spatially dynamic computable general equilibrium (CGE) model RHOMOLO (Lecca et al., 2020). The model allows for scenario analysis, but the evaluation can be considered an ex-post evaluation in the sense that the data on policy injections used to feed the model refer to the actual deployment of H2020 funds over the period 2014-2021 (data on deployment beyond 2021 are not yet available at the time of writing, February 2023).

The main results of this analysis are presented in the official ex-post impact assessment of H2020 (European Commission, 2024). This analysis complements similar exercises carried out using the macroeconometric NEMESIS model and the dynamic stochastic general equilibrium (DSGE) QUEST model.[2] The three models used in this context differ along a number of dimensions: in addition to belonging to three different model families - CGE, macroeconometric and DSGE - they are calibrated using data for different levels of geographical and sectoral disaggregation.

The RHOMOLO model is calibrated using 2017 data at the NUTS-2 level, structured in an interregional set of social accounting matrices (SAMs) and organised into ten NACE Rev. 2 economic sectors. The data are constructed following the procedure outlined by García Rodríguez et al. (2023), updating the procedure described by Thissen et al. (2019). RHOMOLO is a general equilibrium model, so that in addition to the direct effects of the policy in terms of monetary injections and contributions collected to finance the policy, it is able to track the indirect and induced effects across all agents, regions and sectors of the economy.

The RHOMOLO model is the only one of the three models used for this particular impact assessment to provide results at the regional level and disaggregated by ten economic sectors. For this reason, it is seen as complementary to the analysis carried out with QUEST, a New Keynesian DSGE model with fully forward-looking intertemporal optimisation, which is lacking in CGE models, and also to the analysis carried out with NEMESIS, a macroeconometric model with the advantage of a highly detailed sectoral disaggregation, which is lacking in both RHOMOLO and QUEST.

According to the model simulations reported here, the impact on GDP started to increase steadily during the policy implementation phase. At the peak of the impact, in 2021, the GDP gains were up to

[1] Six specific objectives were also set, the main ones being strengthening Europe's scientific base, boosting Europe's industrial leadership and competitiveness, and increasing research and innovation's contribution to tackling societal challenges.

[2] In 2018, the ex-ante impact assessment of Horizon Europe (which is the ninth framework programme for research and innovation, successor of H2020) was carried out in a similar way (European Commission, 2018). Christensen (2018) and Christensen et al. (2019) explain the details of the RHOMOLO analysis related to that assessment.

0.19% compared to the hypothetical baseline in which no innovation policy was implemented by the EU. The GDP gains are also expected to be significant after the end of the 2014-2020 programming period, due to the positive effects of process and product innovation in the economy resulting from the disbursement of H2020 funds. The effects will gradually diminish due to the gradual obsolescence of the new knowledge and innovations generated by the policy intervention.

The paper is structured as follows: Section 2 briefly discusses the data (provided by the Directorate-General for Research and Innovation - DG RTD). Section 3 illustrates the strategy used to carry out the impact assessment. Section 4 presents the results of the modelling simulations and section 5 concludes.

2. The data

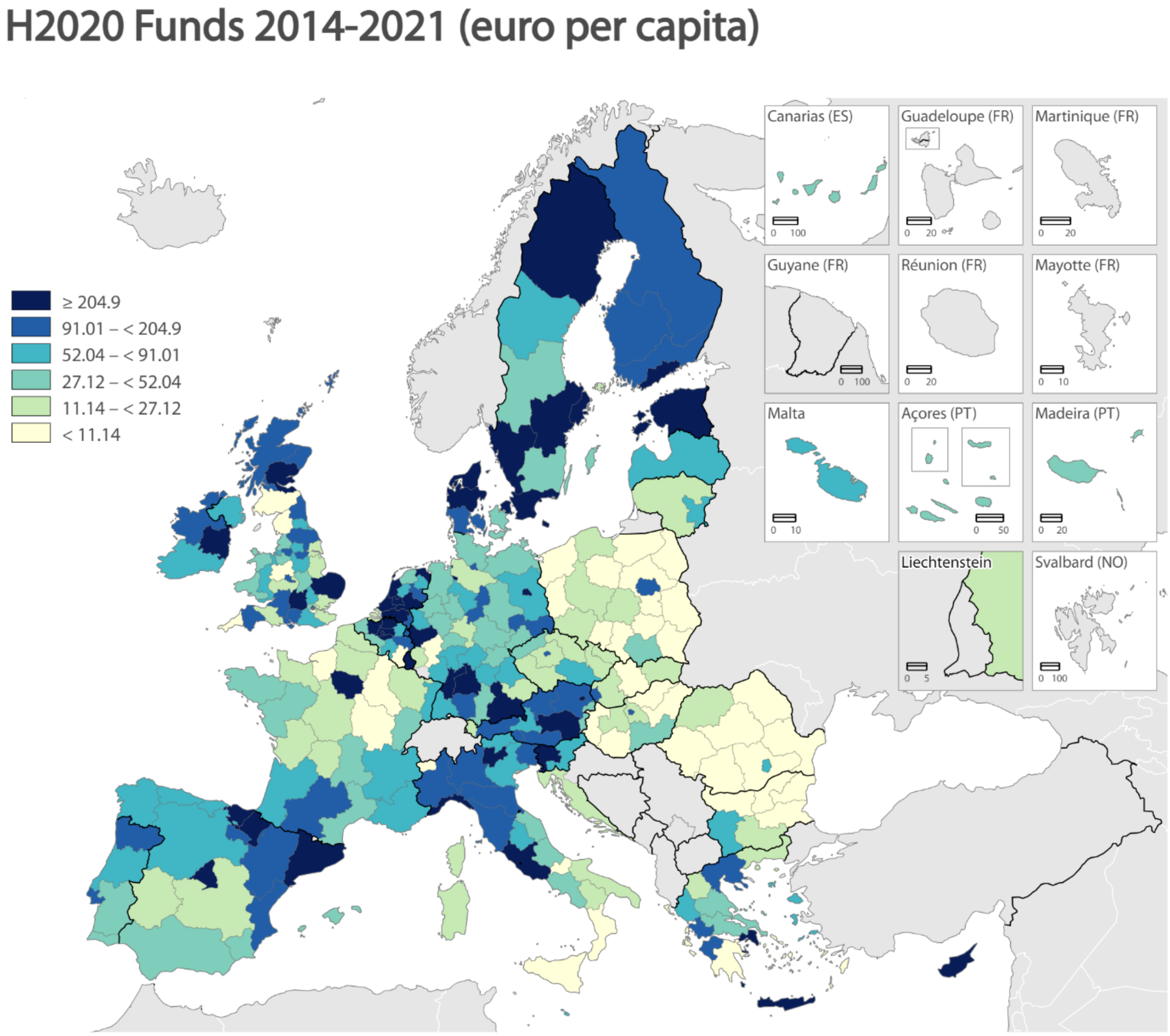
This impact assessment deals with the investments made under H2020 during the programming period 2014-2020. The data related to these investments have been provided by DG RTD in monetary terms by NUTS 2 region and by year between 2014 and 2021 (due to the so-called T+2 rule, regions and countries can spend the money allocated to them even after the official end of the programming period).

A detailed presentation of the H2020 data is beyond the scope of this document. Suffice it to say that the total amount of funds examined here is €63,570,469,166, which is less than the total budget of the policy, since the analysis is limited to funds intended for EU Member States (including the UK, which was a member for most of the programming period under analysis). Figure 2.1 shows the distribution of total per capita funding by region (over the whole programming period) used in the RHOMOLO analysis (data in euros).

Darker colours on the map indicate larger amounts of funding, and the map shows that these are mostly concentrated in Central Europe, with amounts exceeding €100 per capita. Several regions receiving a total of more than €150 million are located in Spain, Portugal, Ireland and the United Kingdom. The Eastern European regions stand out for the relatively low amounts of H2020 funds invested there, with some exceptions both in per capita and total terms, such as RO32 (București - Ilfov) in Romania, which received just over €200 million, PL91 (Warszawski Stołeczny) in Poland, which received almost €400 million, and EL30 (Attiki) in Greece, which received more than €1,000 million.

The regional distribution of funds presented here is interesting in itself and should be read in conjunction with the results of the modelling analysis presented in the remainder of this document. It is clear that the economic impact in a region will be correlated with the amount of money spent there, although interregional spillovers and indirect/induced effects of the shocks require the use of a general equilibrium framework to better understand the impact of the policy.

Figure 2.1: Territorial distribution of the H2020 funds



Source: European Commission's DG RTD (H2020 funds) and Eurostat (population).

3. The modelling strategy

The strategy adopted here is based on the Horizon Europe 2018 impact assessment mentioned above, as well as on the NEMESIS analysis, also included in the H2020 ex-post impact assessment (European Commission, 2024), which summarises the main features of previous impact assessments and sets out a strategy based on three scenarios. The RHOMOLO analysis is structured in a similar way.

3.1 The RHOMOLO model in a nutshell

RHOMOLO is a spatial dynamic CGE model with new economic geography features, the full mathematical description of which can be found in Lecca et al. (2018). The version of the model used for this impact assessment covers 276 NUTS 2 regions of the EU and the UK. Each region contains ten economic sectors operating under monopolistic competition (with the exception of agriculture and public services, which operate under perfect competition - see Table 3.1). Regional goods are produced by combining labour and capital with domestic and imported intermediate inputs. Public capital enters the production function as an unpaid factor.

Table 3.1 RHOMOLO economic sectors

Code	Nace Rev.2
A	Agriculture, forestry and fishing
B-E	Industry (except construction)
C	Manufacturing
F	Construction
G-I	Wholesale and retail trade, transport, accommodation and food service activities
J	Information and communication
K_L	Financial and insurance activities, real estate activities
M_N	Professional, scientific and technical activities; administrative and support service activities
O-Q	Public administration, defence, education, human health and social work activities
R-U	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies

Final goods are consumed by households, government and investors. Each region is inhabited by a representative household, which supplies labour of three skill types, consumes and saves part of its income. The government collects taxes, purchases public consumption goods, invests in the economy and transfers resources to the various agents in the economy. Goods and services can either be sold within the domestic economy or exported to other regions. Trade between regions is associated with a set of bilateral regional transport costs based on the Persyn et al. (2022) model. The RHOMOLO model incorporates imperfect competition in the labour market and allows for unemployment. Wage formation is assumed to follow a wage curve specification as in Blanchflower and Oswald (1995), which implies that lower unemployment increases workers' bargaining power and thus real wages.

The RHOMOLO model includes two types of capital: sector-specific private capital and public capital. The latter is accumulated by the government through public investment, and it is considered an unpaid factor of production freely available to firms in all sectors within each region (Barro, 1990, and Baxter and King, 1993). Public capital is subject to congestion (Fisher and Turnovsky, 1998), so its efficiency declines as production increases, and the elasticity of output to public capital is set to 0.08, in line with the findings by Bom and Lightart, 2014 (and also in line with the modelling choices made by Pfeiffer et al., 2021, using the QUEST model). Sector-specific private capital is accumulated by private investors. The investment-capital ratio is a function of the rate of return on capital and the user cost of capital, allowing the capital stock to reach its desired level smoothly over time.

R&D expenditure is modelled as private investment. Therefore, R&I expenditure generates demand for capital goods. In addition, R&I expenditure leads to the accumulation of an intangible knowledge capital stock, which has a positive effect on total factor productivity (TFP). Public spending to support R&I is introduced into the model as a reduction in the user cost of capital, which in turn generates an increase in private investment. The impact of R&I spending on TFP through the accumulated stock of knowledge capital is captured by a set of regional elasticities, ranging between 0.01 and 0.04, that are positively related to regional research and development (R&D) intensity. The intuition is that firms in regions that already spend a lot on R&D signal their pre-existing capacity to generate value from innovation activities. The range of R&D elasticities is between 0.01 and 0.04, which is in line with the existing literature on this topic (see, for example, Männasoo et al., 2018).

Expectations are assumed to be myopic and the model is solved sequentially, with stocks being updated at the start of each period. For this particular exercise, capital mobility within the EU was assumed, but no labour mobility.

3.2 The simulation strategy

In addition to the modelling setup, we construct our scenario analysis for the ex-post impact assessment of H2020 following the NEMESIS analysis, which is based on historical H2020 administrative data (source: Common Research Data Warehouse - CORDA). Firstly, it is assumed that 40% of the H2020 funding are allocated to basic research and 60% to applied research. The funds allocated to public bodies and higher education institutions are considered as basic research and the rest as applied research. The 40/60 split has also been used in the mid-term evaluation of H2020 and is in line with the distribution envisaged by the European Commission when designing the H2020 programme.

In RHOMOLO, basic research funding is simulated via an increase in public investment, which leads to a temporary increase in the public capital stock of the regions (which depreciates at a rate of 5% per year). Due to the role of public capital in the production function, in addition to the demand-side effect of increased (public) investment, this increases the productivity of firms.

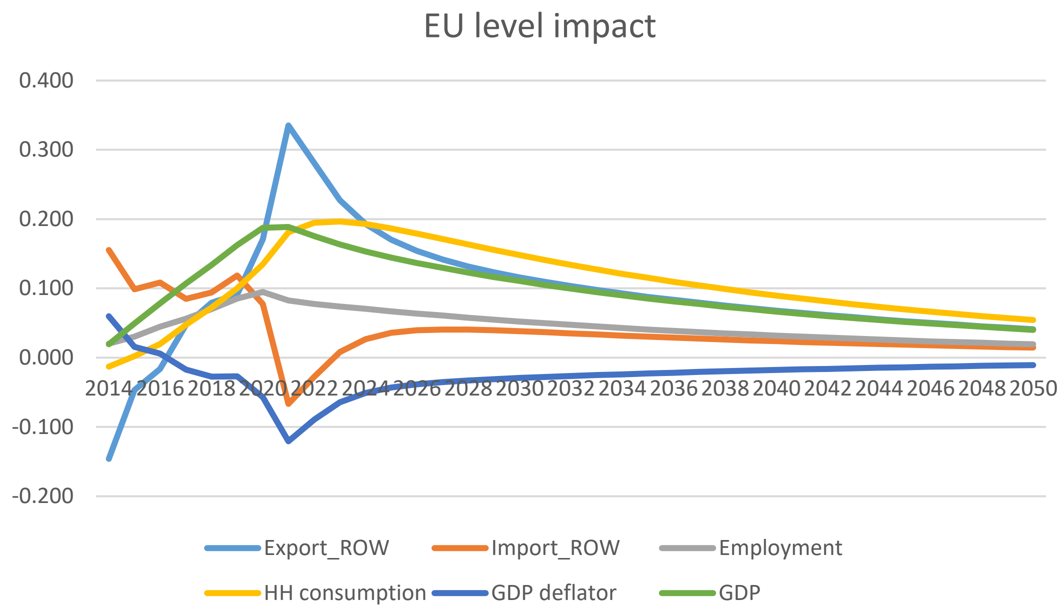
It is assumed that the applied research funds reduce the user cost of capital, leading to an increase in private investment. This is a demand-side effect that also leads to a temporary increase in the private capital stock (which depreciates at an annual rate of 15%). It is also assumed that this R&I investment leads to an increase in TFP, subject to an annual depreciation rate of 5% and with an elasticity that depends on the R&D intensity, as explained above.

Finally, it is assumed that the policy is financed by lump-sum transfers. In order to mimic the financing of the EU budget, regional contributions are proportional to the GDP weight of each region in the EU GDP. In other words, a region does not necessarily have to finance the policy with a contribution equal to the amount of H2020 earmarked for the region itself, but instead the contribution depends on the share of EU GDP generated in the region (and the distribution of funds presented in section 2 above).

4. The modelling results

Figure 4.1 shows the simulated impact of H2020 investments at EU level on a number of macroeconomic variables from 2014 to 2050. The figures shown are percentage deviations from the initial steady state, which is a hypothetical scenario in which no H2020 investments are introduced into the economy.

Figure 4.1: H2020 impact over time on selected macroeconomic variables



Source: RHOMOLO simulations.

The impact on GDP increases steadily over the implementation period, peaking at +0.189% in 2021. It then gradually declines as the monetary injection associated with the policy ends, the increased private and public capital stocks depreciate and the temporary increase in TFP fades. In 2050, the residual effects of the policy are relatively small, as GDP is 0.040% above its initial level. The policy injection also leads to improvements in employment, whose impact peaks at +0.095% in 2020, amounting to almost 220,000 persons (the total number of persons employed in the EU-28 in the base year of the model is almost 232 million).

The other variables presented in Figure 4.1 show that the H2020 injections lead to an initial deterioration in the EU's trade balance with the rest of the world (ROW), as imports increase and exports decrease in the early years of the simulation. This is due to the initial increase in demand caused by the policy injection and the subsequent increase in prices (measured here by the GDP deflator). Competitiveness then improves, leading to a fall in the price level, with a positive impact on exports and hence on the trade balance.

Table 4.1 below shows the percentage deviations from baseline for some key macroeconomic variables in selected years, including the GDP multiplier. The latter is obtained as the cumulative change in GDP divided by the size of the policy shock and can be read as the number of euros of GDP created for each euro invested in the policy. It increases over time as the impact on GDP is positive throughout the simulation period, while the policy shocks only last for the first 8 years.

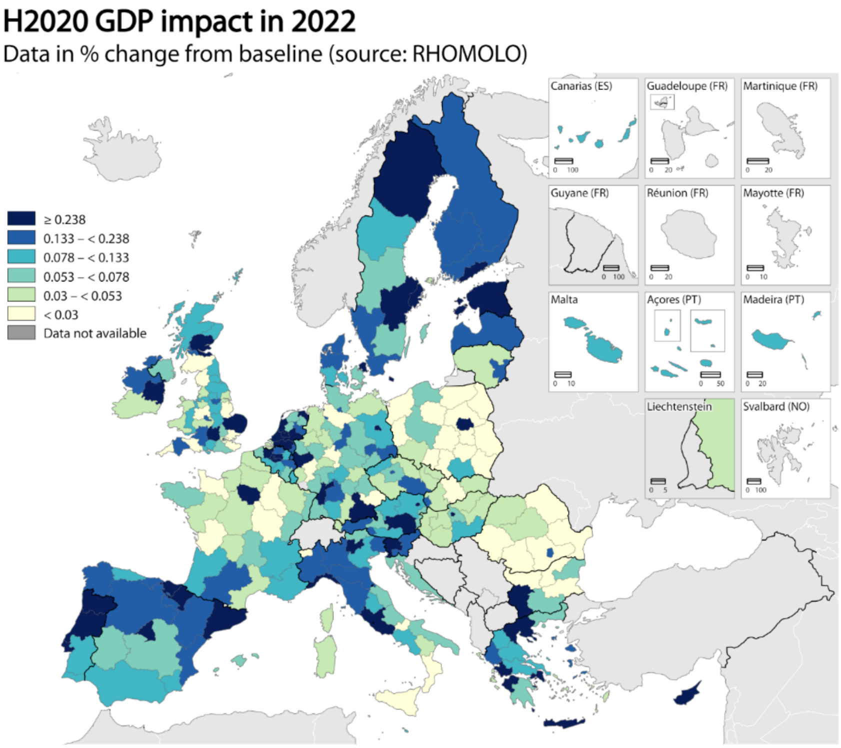
Table 4.1: H2020 impact in selected years on a selection of macroeconomic variables

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2030	2040	2050
GDP change (% w.r.t. baseline)	0.019	0.049	0.078	0.107	0.134	0.163	0.187	0.189	0.176	0.111	0.067	0.040
GDP change (bn €)	2.752	6.988	11.124	15.182	19.015	23.064	26.583	26.772	24.902	15.686	9.436	5.719
GDP multiplier	0.35	0.64	0.86	1.09	1.29	1.46	1.67	2.07	2.46	4.87	6.75	7.89
Exports change (% w.r.t. baseline)	-0.146	-0.047	-0.016	0.048	0.079	0.091	0.171	0.335	0.281	0.116	0.068	0.041
Imports change (% w.r.t. baseline)	0.155	0.099	0.108	0.085	0.094	0.119	0.078	-0.067	-0.028	0.038	0.024	0.015
Employment change (thousand persons)	47.064	70.464	103.822	130.970	162.974	197.913	219.816	191.027	179.673	121.180	73.801	44.981
H2020 contribution (bn €)	7.765	7.518	9.004	8.752	9.594	10.749	9.186	1.003	0.000	0.000	0.000	0.000

Source: RHOMOLO simulations (and DG REGIO for the H2020 contribution).

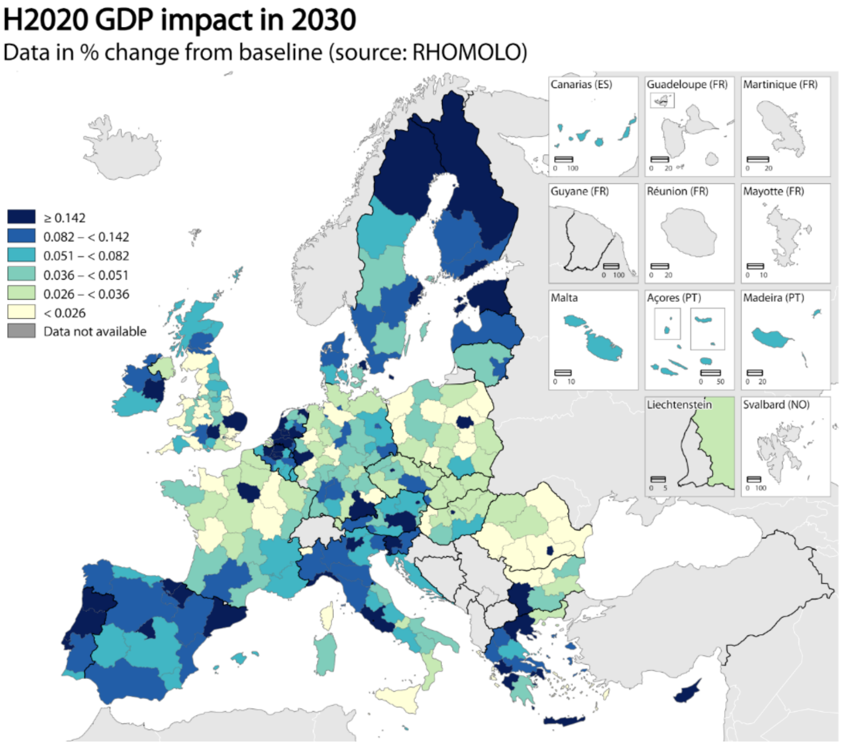
The advantage of using a spatial dynamic model is that results can be obtained for the different territories targeted by the policy. Figure 3.1 above shows the territorial distribution of the H2020 funds and it is to be expected that the GDP impact will reflect this distribution, especially in the short term. In the longer term, there will be spill-over effects, which could be either positive (due to synergies between regional economic systems) or negative (due to increased competitiveness in regions that benefit more from the policy at the expense of other regions). Figures 4.2 - 4.5 show the territorial distribution of the GDP impact of the H2020 policy injections, expressed as percentage deviations from the baseline (hypothetical scenario without H2020).

Figure 4.2 Territorial distribution of the H2020 GDP impact in 2022



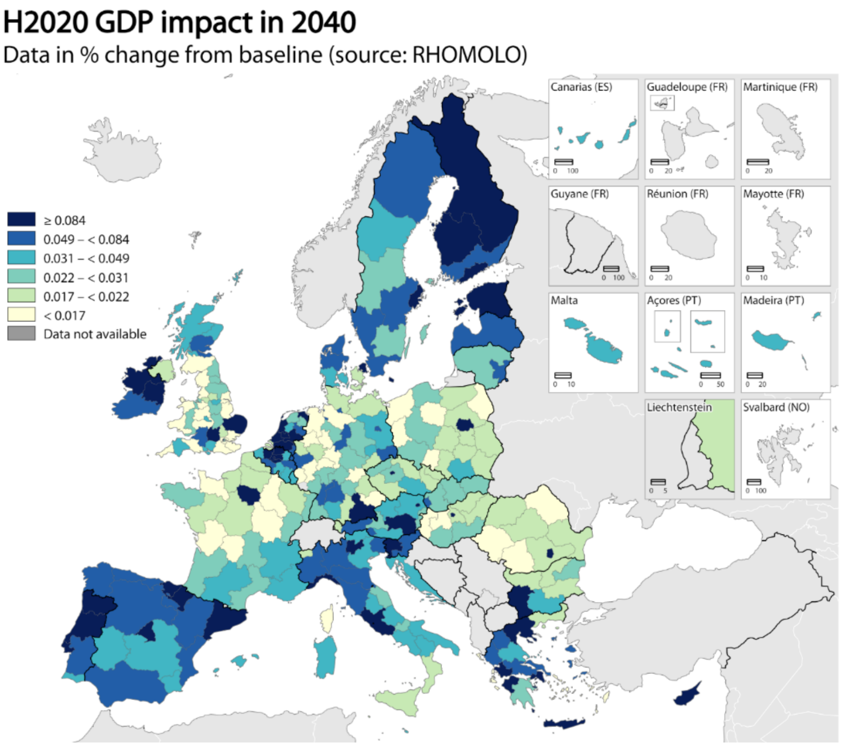
Source: RHOMOLO simulations.

Figure 4.3 Territorial distribution of the H2020 GDP impact in 2030



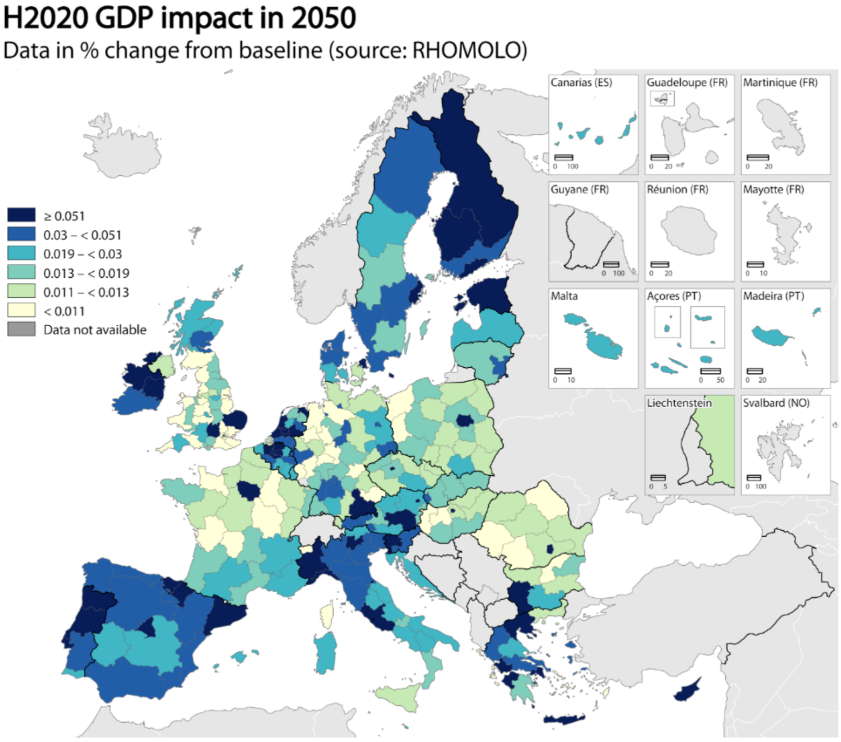
Source: RHOMOLO simulations.

Figure 4.4 Territorial distribution of the H2020 GDP impact in 2040



Source: RHOMOLO simulations.

Figure 4.5 Territorial distribution of the H2020 GDP impact in 2050



Source: RHOMOLO simulations.

The impact on GDP in 2022 (Figure 4.2) is stronger in the regions targeted by the H2020 policy. For example, the macroeconomic impact of the policy is relatively higher in the Scandinavian regions, Central Europe and the Iberian Peninsula. Moreover, in most countries the capital regions benefit more than the other regions, which is particularly evident in countries such as Poland, the Czech Republic, Slovakia, Bulgaria and Romania.

Over time, in countries such as Spain, Italy, Greece and Poland, the effects gradually spill over to regions receiving relatively less H2020 funding (see Figures 4.3, 4.4 and 4.5). However, this does not seem to be the case in all EU countries, as the effects remain mostly concentrated in the richest regions, which are also the capital regions in France, Bulgaria and Romania. This last finding is not entirely surprising: Crucitti et al. (2021) and Crucitti et al. (2022) found that investments in the capital regions of Bulgaria and Romania, respectively, show little spillover to the peripheral regions, because the trade flows of the richest regions are mostly with regions abroad and therefore investments there do not stimulate production in the neighbouring regions of the same country.

Overall, the magnitude of the impact decreases across the board, due to the temporary nature of the H2020 investments (from 2014 to 2021) and the depreciation rates of the temporarily increased private and public capital stocks, as well as the decay rate of the TFP improvements.

In Tables 4.2 and 4.3 we present the sectoral results for value added and employment for selected simulation years (the same as in Table 4.1, up to 2050). Note that we report value added because GDP is not available at the sectoral level, so the figures in Table 4.2 do not exactly match the GDP figures in Table 4.1. On the other hand, the employment results are fully comparable between Tables 4.3 and 4.1.

Overall, the sectoral effects on value-added and employment tend to be similar. Sectors with positive changes in value added tend to have positive changes in employment and vice versa. However, while the general trends are similar, there are differences in the magnitude of the impacts between the two tables. For example, sectors K_L (financial and real estate activities) are characterised by significant positive changes in value added, but the corresponding impact on employment is comparatively smaller or even negative in some years.

There are other sectors that stand out for their significant impact. For example, sector F (construction) shows significant positive changes in both value-added and employment, indicating its strong performance and potential for job creation. The private services sectors (G-I, J, K-L and M-N) are also characterised by positive changes in both value-added and employment.

In summary, these tables provide valuable insights into the sectoral value added and employment impacts of the Horizon 2020 policy. The results highlight the diversity of impacts across sectors and the potential of the policy to boost GDP growth and job creation in specific sectors. It is important to note that the sectoral shocks used to simulate the Horizon 2020 interventions are not sector-specific, as explained in section 2.2. Therefore, the results primarily reflect steady-state data on sectoral output and input-output relations between sectors.

Table 4.2: H2020 sectoral value added impact in selected years

% change w.r.t. baseline	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2030**	**2040**	**2050**
A	-0.003	0.017	0.039	0.066	0.093	0.123	0.157	0.190	0.197	0.149	0.092	0.056
B-E	-0.002	0.030	0.061	0.098	0.132	0.166	0.205	0.240	0.237	0.159	0.095	0.058
C	-0.006	0.027	0.054	0.087	0.116	0.144	0.180	0.210	0.200	0.119	0.071	0.043
F	0.110	0.152	0.205	0.233	0.260	0.299	0.298	0.200	0.155	0.081	0.050	0.030
G-I	-0.006	0.026	0.052	0.085	0.113	0.143	0.178	0.209	0.202	0.132	0.079	0.048
J	0.023	0.067	0.107	0.147	0.180	0.216	0.245	0.247	0.223	0.123	0.073	0.044
K_L	0.007	0.042	0.073	0.108	0.140	0.173	0.208	0.230	0.221	0.155	0.093	0.057
M_N	0.012	0.052	0.087	0.124	0.156	0.189	0.220	0.233	0.214	0.122	0.073	0.044
O-Q	0.064	0.073	0.094	0.101	0.115	0.132	0.127	0.065	0.049	0.028	0.017	0.010
R-U	0.003	0.028	0.050	0.076	0.099	0.124	0.151	0.170	0.166	0.121	0.073	0.045
Change w.r.t. baseline in mn €	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2030**	**2040**	**2050**
A	-7	50	113	193	274	360	461	559	577	439	270	165
B-E	-10	137	277	444	598	751	930	1086	1076	721	432	261
C	-128	601	1213	1952	2614	3236	4034	4708	4482	2675	1594	969
F	825	1135	1530	1742	1944	2231	2224	1496	1156	608	370	225
G-I	-155	684	1384	2237	2995	3770	4694	5539	5337	3479	2100	1274
J	159	462	736	1015	1243	1492	1693	1705	1538	848	502	304
K_L	144	921	1595	2362	3064	3785	4540	5031	4839	3383	2046	1236
M_N	188	821	1385	1972	2470	3000	3500	3693	3389	1944	1161	704
O-Q	1687	1942	2484	2665	3041	3484	3366	1714	1310	748	451	273
R-U	16	136	246	373	485	608	738	832	814	591	359	218

Source: RHOMOLO simulations (and DG RTD for the H2020 contribution).

Table 4.3: H2020 sectoral employment impact in selected years

% change w.r.t. baseline	2014	2015	2016	2017	2018	2019	2020	2021	2022	2030	2040	2050
A	-0.024	-0.002	0.011	0.033	0.049	0.065	0.095	0.140	0.135	0.090	0.056	0.034
B-E	-0.026	0.001	0.015	0.040	0.058	0.075	0.106	0.152	0.143	0.090	0.055	0.033
C	-0.019	0.008	0.023	0.047	0.064	0.077	0.106	0.138	0.125	0.070	0.042	0.026
F	0.181	0.157	0.190	0.183	0.204	0.240	0.200	0.021	0.024	0.042	0.026	0.016
G-I	-0.021	0.002	0.016	0.037	0.053	0.069	0.096	0.134	0.127	0.081	0.049	0.030
J	0.014	0.030	0.047	0.063	0.073	0.089	0.099	0.095	0.084	0.047	0.029	0.017
K_L	-0.022	-0.006	0.006	0.026	0.041	0.058	0.082	0.122	0.124	0.089	0.054	0.033
M_N	0.001	0.024	0.042	0.062	0.076	0.093	0.111	0.119	0.106	0.059	0.035	0.022
O-Q	0.073	0.060	0.070	0.062	0.071	0.080	0.063	-0.018	-0.016	0.002	0.002	0.001
R-U	-0.011	-0.005	0.003	0.016	0.028	0.043	0.060	0.085	0.093	0.073	0.045	0.027

Change w.r.t. baseline in thousands of persons	2014	2015	2016	2017	2018	2019	2020	2021	2022	2030	2040	2050
A	-0.694	-0.066	0.305	0.940	1.390	1.852	2.723	3.994	3.874	2.580	1.598	0.980
B-E	-1.458	0.055	0.861	2.260	3.257	4.189	5.933	8.517	8.053	5.038	3.080	1.881
C	-8.019	3.561	10.009	19.989	27.236	32.880	45.057	58.975	53.173	29.781	18.025	10.987
F	24.132	20.949	25.285	24.398	27.116	31.912	26.668	2.800	3.131	5.643	3.508	2.140
G-I	-10.263	0.869	7.713	18.542	26.190	34.246	47.426	66.126	63.003	40.200	24.472	14.901
J	1.428	2.993	4.596	6.173	7.176	8.824	9.797	9.338	8.263	4.675	2.828	1.723
K_L	-2.600	-0.655	0.696	2.967	4.754	6.759	9.548	14.191	14.466	10.325	6.269	3.810
M_N	0.262	6.140	10.900	15.965	19.617	24.065	28.506	30.790	27.337	15.186	9.125	5.543
O-Q	45.263	37.058	43.201	38.375	43.814	49.518	38.954	-11.001	-9.652	1.444	1.039	0.662
R-U	-0.988	-0.440	0.256	1.360	2.423	3.669	5.206	7.298	8.024	6.308	3.859	2.353

Source: RHOMOLO simulations (and DG RTD for the H2020 contribution).

5. Conclusions

This document presents the results of simulations carried out with the spatial dynamic CGE RHOMOLO model, using data on the use of H2020 funds over the period 2014-2021. It is an ex-post assessment in the sense that the input data on H2020 investments are up-to-date and reflect the actual disbursements made during the programming period. However, the results should not be interpreted as a way of tracking and monitoring the actual macroeconomic impact of the H2020 interventions, as they are based on assumptions regarding both the modelling setup and the simulation strategy used to simulate the impact of the investments, i.e. the economic channels activated by them. In other words, this is an ex-post impact assessment only in terms of the data used as input for the modelling, which refers to actual disbursements between 2014 and 2021.

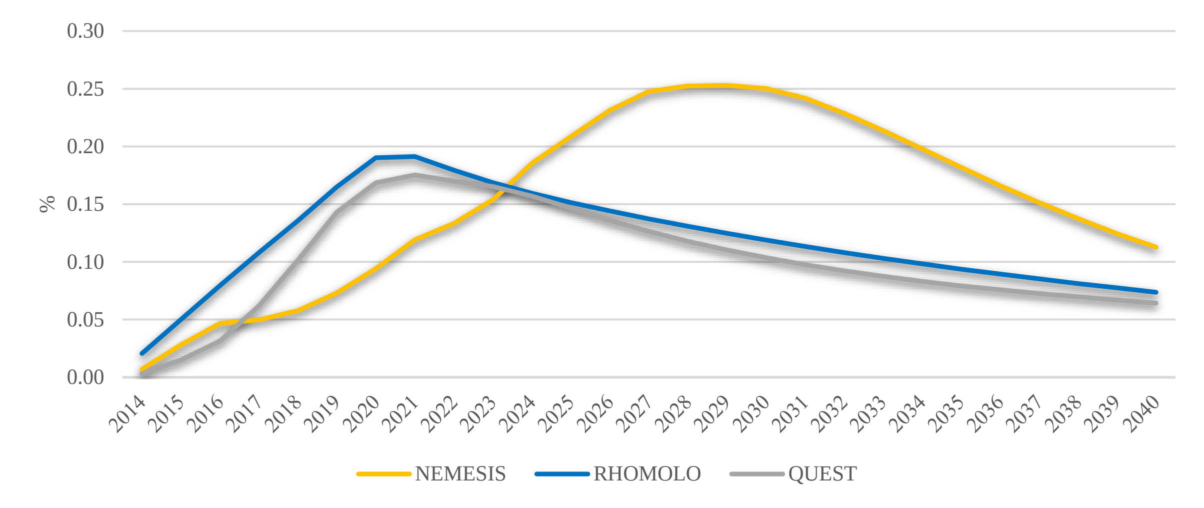
RHOMOLO is a general equilibrium model, so in addition to the direct effects of the policy in terms of cash injections and contributions levied to finance the policy, it is able to track the indirect and induced effects across all agents, regions and sectors of the economy. In addition to presenting the macroeconomic impact of the H2020 interventions at EU level on GDP, multipliers, employment, trade balance, consumption and prices, we have shown the territorial distribution of the GDP impact over time up to 2050.

The RHOMOLO simulations suggest that the policy has a significant macroeconomic impact, with significant inter-regional spillovers in some, but not all, EU countries. In some cases, such as Slovakia, Romania and Bulgaria, GDP effects are correlated with the policy injection even in the long run. In others, such as Spain, Portugal and Italy, the effects spill over from the regions primarily targeted by the policy to the rest of the country.

It is worth mentioning some limitations of the analysis. The results presented here assume that all funds allocated through H2020 are used efficiently and activate the economic channels used in the model to simulate their impact. The distinction between basic and applied research can be considered as a strong assumption, in particular due to its homogeneity across EU regions. Finally, the results are inevitably affected by the parameterisation of the shocks used to simulate the impact of the policy (including the elasticity used to govern the changes in TFP brought about by the H2020 investments or the output elasticity of public capital). We limit the uncertainty of our results by using values that are consistent with the existing literature on the subject, as explained in section 3.

A final piece of evidence in support of the validity of the RHOMOLO results presented here is the comparison with the results obtained with the QUEST and NEMESIS models at the aggregate EU level. Figure 5.1 shows the behaviour over time of the impact on GDP obtained with the three models.

Figure 5.1: GDP gains from the Horizon 2020 funds (% change with respect to the no-policy scenario)



Source: European Commission, 2024.

The RHOMOLO results at the EU level are close to the QUEST results. Although the nature of the two models is different (one is a regional CGE model, the other is a DSGE model calibrated with data for groups of countries), the aggregate results are comparable due to similar choices regarding the parameterisation of the shocks and the use of the same input data regarding the H2020 funds. On the other hand, the NEMESIS results differ from those of the other two models, both because of the different philosophy behind the model (NEMESIS is a macroeconometric model) and because of different assumptions regarding the timing of the materialisation of the supply-side effects of the policy injections.

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