Simulating innovation, RnD, human capital and smart specialization policies using RHOMOLO general equilibrium model.

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Résumé / Summary

The purpose of this proposal is to present the analytical capabilities of RHOMOLO model in simulating innovation, R&D, human capital and smart specialization policies. To this end we intend to use as point of departure some of the directives of the European Commission (e.g. Europe 2020) along with inputs provided by the Smart Specialization Platform maintained by the Joint Research Centre of the European Commission.

RHOMOLO is a recursively dynamic spatial general equilibrium model of the European Commission. It is developed and used by Directorate-General Joint Research Centre (DG JRC) in cooperation with Directorate-General for Regional and Urban Policy (DG REGIO) for policy impact assessment and provides sector-, region- and time-specific model-based support to EU policy makers on structural reforms, growth and cohesion policies. In the tradition of Computable General Equilibrium (CGE) models, RHOMOLO relies on an equilibrium framework à la Arrow-Debreu where supply and demand are influenced by a system of prices subject to macroeconomic constraints. Policies are introduced as shocks to the existing equilibrium driving the system towards a new equilibrium by clearing all the markets after the shocks.
A a particular attention in RHOMOLO is devoted to the explicit modelling of spatial linkages, interactions and spillovers between regional units of analysis.

The current version of RHOMOLO covers 268 NUTS2 regions of the EU28 Member States and each regional

economy is disaggregated into six NACE Rev. 1.1 industries (agriculture, manufacturing and construction, business services, financial services, public services, and R&D) making it thus unique in terms of modelling and data usage among similar computable general equilibrium models developed by other policy institutes.

The RHOMOLO model has a sophisticated structure regarding product markets (segmentation and differentiation), labor markets (migration and unemployment), new economic geography features and last but not least regarding modelling innovation R&D and knowledge spillovers. Regarding the latter, "R&D and innovation" is treated as one specific differentiated-product sector operating with increasing returns to scale technologies. It is special in that innovation is produced by a national R&D sector populated by firms using only high-skill workers with specific skills, hired from a nationally integrated market, hence remunerating these workers at the same nation-wide wage. In addition, the national R&D sector sells its innovation services exclusively as an intermediate input to firms in all sectors within the same country only.

One of the key modelling issues with R&D is that of spillovers. As noted by Leahy and Neary (2007), any innovative activity has an information component that is almost completely non-appropriable and costless to acquire. Though this idea goes back at least to Marshall, its introduction in general equilibrium models is quite recent, either splitting research activities into an appropriable and non- appropriable knowledge (e.g. Goulder and Schneider, 1999 or Diao et al., 1999), or using a product variety extension mechanism à la Romer (1990), Grossman and Helpman (1991) or Aghion and Howitt (1992). In RHOMOLO, there are spatial technology spill-overs in the sense that the national R&D sector affects the total factor productivity of regional economies within each country, which results in inter-regional knowledge spillovers and diffusion from the stock of nationally accumulated knowledge. Therefore, the production of R&D services is associated with a positive externality. This positive externality, derived from the accumulation of a knowledge stock in the country, benefits all regions through sector and region specific knowledge spill-over elasticities.

Due to its high dimensionality implied by its extensive regional disaggregation - RHOMOLO can include more than one million equations, depending on the chosen options - the dynamics have to be kept relatively simple: expectations are assumed myopic, and it is solved sequentially period after period with stocks being upgraded at the beginning of each year. This implies among other things, exogenous savings rates, inefficient asset markets, and exogenous enforcement of inter- temporal budget constraints.

While analytical results are not available at the moment, based on past simulation experiments we expect significantly positive results due to labor and capital productivity increases through innovation and smart specialization (for example investing funds in Higher Education Institutes and Research Organizations).

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