Consequences of the FP7 2012 call on European economy and employment

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Executive Summary

The impact of the FP7 2012 budget, 7 billions Euros has been assessed with the NEMESIS system of sector macroeconomic models, as part of the DEMETER funded project (Socio-economic sciences and humanities theme).

The FP7 call 2012 is expected to contribute to EU research and innovation with 7 billions Euros, with a higher attention than in the previous call to increase private R&D spending (enhanced support to innovation). This effort is expected to generate a total effort on research and innovation of 12.2 billions Euros. This implies that each Euro funded by the EU generates a total research and innovation investment of 1.74 Euro, of which 0.58 directly financed by the private sector. The leverage effect adopted here (0.5 for the public sector and 0.9 for the private one) is quite coherent with the most recent estimates of the econometric literature, which indicates values between 0.7 and 1.7.

Following the 7 billions Euros investments in research and innovation, 174.000 jobs are expected to be created in the short term. In the long term (15 years later) almost half million jobs would be generated as a consequence of new economic opportunities and increased EU competitiveness, domestic demand and exports induced by innovations.

The thrust produced by the initial research and innovation expenditure of 7 billions Euros will generate after 15 years 79.4 billions Euros of additional GDP, which represents, taking the total investment in research and innovation of 12.2 billions Euros, a multiplier of 6.5. This multiplicative effect is similar to the ones observed in previous exercises for the assessment of the Barcelona target and the FP7 2011 call for proposals.

The results are higher than in the previous assessment (FP7 2011 call for proposals) due to a slightly higher funding (7 billions instead of 6.5 billions) and a more important leverage effect for the private sector (0.9 instead of 0.54).

Impacts from a one-off shock induced by the 2012 call

	WP2012
EU investment in research and innovation (€ billions)	7
Total public and private investment in research and innovation (€ billions)	12.18
Jobs creation – short term	174000
Cumulative Job creations after 15 years	449189
Cumulative GDP growth (€ billions) after 15 years	79.4
Multiplier effect of 2012 investment in research	6.5

Introduction

The impact of the FP7 2012 call for proposals, 7 billion Euros, has been assessed with the NEMESIS system of sector macro-economic models, as part of the DEMETER Socio-economic sciences and innovation programme as done for the previous call for proposal. The results presented, should not be considered as intangible truth, but on the contrary, they are open for comments. Nevertheless they reflect an effort to analyse the impact of research and innovation funding by using a coherent framework based on national accounting and a set of theoretical assumptions and numerical evidence.

Moreover, in the last decade, several exercises have been conducted on the macroeconomic consequences of the increase of R&D, mostly with the NEMESIS model, but also with other models such as Worldscan QUEST and GEM-E3. These exercises, implemented to evaluate the macroeconomic consequences of an increase in R&D effort to 3% of GDP, are relatively coherent and teach robust lessons on the link between R&D effort and increase in GDP and employment.

In this note we present at first the mechanisms of the NEMESIS model that are mainly involved in this assessment, stressing the analysis of the leverage effect which conditions the efficiency of the research and innovation policy. Then we present how the simulation of the Call 2012 was implemented. At a latter stage, we present the impacts on productivity, GDP and employment throughout the period considered (15 years).

NEMESIS for R&D policy assessment

NEMESIS: A detailed hybrid econometric model

The NEMESIS model system is a modular system for each European country. European countries[2] are represented individually by one main economic module linked to three specific modules: energy and environment, agriculture, land use, which are interactively linked with the main economic module for these sub-modules. An additional sub-model, the regional one disaggregates the national level towards a regional one.

The model is mainly econometric, but some mechanisms are calibrated using the results of well proven econometric literature: it is the case for endogenous technical change. The econometric character of the model allows its adaptation to past conditions observed in the economy but it also allows the inclusion of alternative mechanisms of innovation, which for instance are not constrained by strict optimization conditions.

The model, adapted to “structural” policies, includes 30 sectors for the core economic model, which could be detailed through the inclusion of linked modules. These details are very important: *(i)* at first, because the implementation of structural policies (energy, environment, agriculture, R&D, innovation) is made at a detailed level; *(ii)* secondly, because the macroeconomic tracks of the model is the combination of purely macroeconomics (“top-down”) forces - for instance the wealth effects - and “bottom up” forces resulting from strong interactions between very heterogeneous sectors in terms of dynamics, but also in terms of composition (capital, labour, energy, etc). These interactions

[2] Except for Cyprus and Bulgaria.

are not only presented in the NEMESIS model by goods and services exchanges, but they are also extended to knowledge spillovers.

Leverage effect

The leverage effect or "crowding-in" effect describes the multiplier effect of €1 of research and innovation expenditures. Econometric works provide some results but mainly at a European level or a macro national one, more rarely at a sector level. This leverage effect is depending on several conditions which determine the expectations on the level and uncertainty of R&D returns. A main concern is about the comparison of the leverage effects of different sources of subsidies for instance regional, national or European.

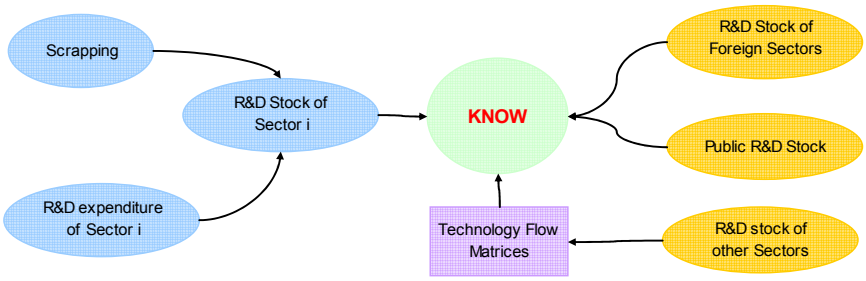
At a European level, investments in research and innovation appear to induce higher leverage effects that the national or the regional ones because of the network effects and of the transfer of best practices, justifying the higher returns which explain the difference. Many of the new initiatives on joint technology initiatives and research policies, as the European Research Area creation, aim at increasing this leverage effect.

The Risk-Sharing Finance Facility (RSFF) uses debt-based finance, to complement the FP7 funding. Research related risk is shared between the EU and the European Investment Bank (EIB). The first evaluations of RSFF (see L. Soete 2010) show since its creation in 2007 and until 2009 a very important leverage effect: 0.5 billion Euros of FP7 have induced, with the EIB support of 0.5 billion Euros, more than 16 billions Euros of expenditures in R&D. Exercises on FP assessment must take into account this RSFF outcome even if it concerns only a little part of FP7, and more generally make a sensibility analysis of results to the leverage adopted.

In the analysis of the previous call we used a conservative leverage effect of 0.54, but taking into account recent literature results, we adopted for the present simulation of the 2012 call the following leverage effect: 0.5 for public R&D investments (40% of the 7 billions funds) and 0.9 for the private sector. On average, these assumptions implies a leverage effect of 0.74, which means that one Euro of EU investment from the 2012 FP7 budget leads to 1.74 Euro of research and innovation expenditures, of which 0.58 financed by the private sector. This 0.74 leverage effect is compatible with the results of the econometric literature which indicates a leverage effect for the private sector between 0.7 and 1.7

A second important matter is the "knowledge spillovers". Impacts of innovation in the model depend not only on R&D expenditures of the sector, but also on the knowledge spillovers coming from others sectors, other countries and public research centres. This implies that innovation in a sector can also happen without R&D expenditures in the sector. In NEMESIS, it is then the knowledge variable of sector i that produces innovation.

Figure 1: Construction of the "knowledge variable" in the NEMESIS model



The works and the literature on the knowledge spillovers are now fairly important. Starting with an adaptation of the Johnson matrix (Johnson 2002) on technological flows based on patent data for the inter-sector spillovers and on trade flows for the external spillovers (which is a "proxy" variable). In the future, the model will update the hypothesis on the basis of contributions of the UNU-MERIT[3] and the EPFL[4] in the framework of the DEMETER project. The case of General Purpose Technologies (GPT), used by almost all the sectors, for instance the information and communication technologies, which are a main carrier for knowledge externalities, will be explicitly treated.

The last mechanism is the economic performance (productivity) of knowledge that was calibrated in the NEMESIS model using the econometric works based on R&D performance.

Macroeconomic results: implementation and impact

Implementation

In the simulation of the impact of the FP7 2012 Call, it is supposed a one-off shock of 7 billions Euros which gives rise to a total of 12.2 billions Euros. Whenever the shock is "one-off" and not maintained in time, cumulative GDP and employment generated by the shock are the accurate indicators that must be used for the assessment. On the contrary, when the analysis concerns a sustained shock, such as the whole Framework Programme, the differences between the baseline scenario and the simulation are the best indicators.

Concerning the allocation of FP7 funding between Member States, it is assumed to be the one observed at the beginning of the FP7 (see **Error! Reference source not found.**). The allocation of research and innovation funding between economic sectors of the model in each country is based on the grand-fathering principle, that is to say, proportionally to the level of R&D expenditures of each sector. Grand-fathering allocation is somehow virtual since it does not necessarily obey current funds allocation criteria in the FP.

[3] www.merit.unu.edu
[4] www.epfl.ch

Table 1 : FP7 funding allocation by country (source: DG Research)

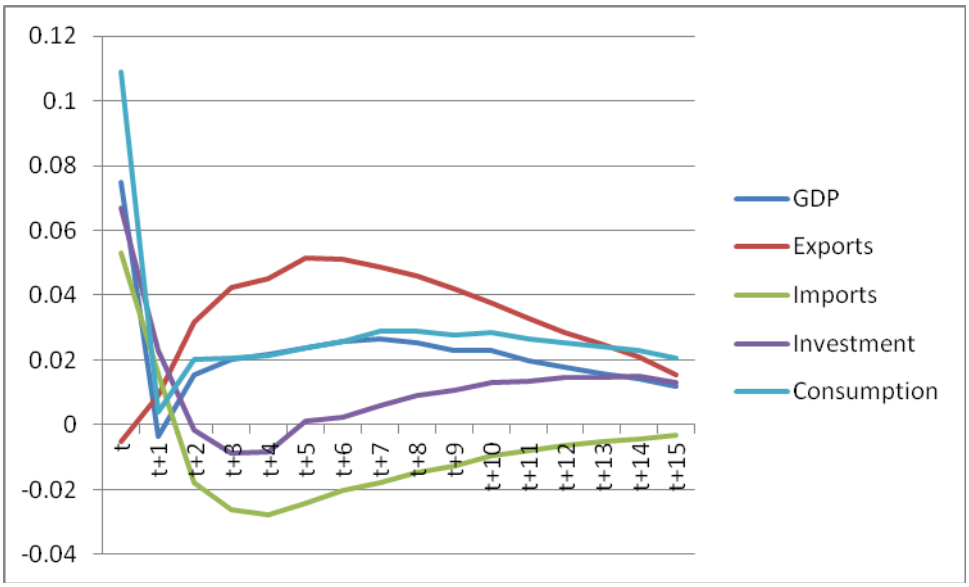
	FP7		FP7
Austria	3.00%	Italy	11.50%
Belgium	4.70%	Latvia	0.10%
Bulgaria	0.50%	Lituania	0.30%
Cyprus	0.30%	Luxembourg	0.10%
Czech-Republic	1.20%	Malta	0.10%
Denmark	2.30%	Netherlands	6.70%
Estonia	0.40%	Poland	1.90%
Finland	2.80%	Portugal	1.70%
France	11.60%	Romania	0.90%
Germany	18.00%	Slovakia	0.40%
Greece	3.50%	Slovenia	0.80%
Hungary	1.10%	Spain	7.70%
Ireland	1.30%	Sweden	4.30%
		United-Kingdom	12.70%

Impacts of the 7 billion Euros FP7 2012 call (one-off shock)

The 7 billions Euros result in a total R&D expenditure of 12.2 billion Euros divided proportionally across all sectors. We assumed that the shock was performed on a single year. The effects can be broken down into 4 phases:

1. **R&D expenditure phase**: Figure 2 shows that GDP grows from year one with an amplitude slightly inferior to the shock: 0.074. In fact, R&D investment consists mainly in physical investment (research hardware) and in jobs, which result in salary and consumption increase. During the first three years, there are only demand effects, because the additional R&D has not yet induced full impacts. This translates into higher prices and imports, which somewhat upsets external balance and causes a « leakage » of the multiplier. If the instant multiplier is smaller than one, the sum of the effects on the first three years is greater than unity, which is consistent with what is expected. A number of 174000 jobs are created the first year and then falls back almost completely, as does the GDP, reflecting a punctual shock.

Figure 2: Impacts of the one-off shock FP7 2012 call across all sectors (% gap from central account)



2. **Innovation and restructuring phase:** R&D then leads to a phase of innovation and restructuring in t+3, which increases labour productivity, reduces production costs and lowers prices. However, the increase in demand will take time and therefore, during this phase employment will fall below business as usual level, because of productivity gains.

3. **Diffusion and increase in demand phase:** During this phase, lower prices and improvements in quality will help increase domestic demand and improve competitiveness and external balance. Thus, between t+5 and t+10 the GDP continues to grow at 0.025% above the BAU level due to increased exports (+0.05%), the decline in imports (-0.02%) and increased consumption. Job creation per year is of around 34000 in t+10, which is small compared to GDP growth, but this weakness is explained by higher productivity growth due to innovation. In contrast, spending on research and innovation results in an increase of GDP and competitiveness, which may reduce the deficits of Member States.

4. **Obsolescence of innovation:** with scrapping of knowledge capital, the effects of innovation will decrease over time, and therefore the GDP and its components will decrease, as well as employment. In t+15 the residual effect will be much diminished, but will not be negligible: 30000 jobs, and +0.01% of GDP.

Cumulative impacts for the next 15 years

Cumulative GDP and employment are the true indicators to take into account for one-off shocks. In particular it is interesting to analyse on the total number of jobs and the overall increase in GDP generated by an expenditure of 7 billions Euros under the FP7 2012 call.

Over the 15 years period this initial expenditure leads to the creation of 449000 jobs. It also generates 79.4 billions Euros, which represents for a cost of 12.2 billion Euros a multiplier of 6.5. This is similar to the one observed for the assessment of the Barcelona target.

Table 2. Impacts from a one-off shock induced by the 2012 call

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