Consequences of the 2013 FP7 call for proposals for the economy and employment in the European Union

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Executive Summary

We present here the impact of the FP7 2013 budget of € 8 billion. Our assessment uses the NEMESIS system of detailed macroeconomic models developed under the European Socio Economic Sciences and Humanities programme (SSH)[1].

The FP7 call is expected to contribute to EU research and innovation by way of € 8 billion grants.

- *The private sector, with a leverage effect of 0.9, will invest € 1.9 for every € 1 of EU grant. The public laboratories will invest € 1.5 for every € 1 grant. The mean leverage effect, 0.74, is in line with the estimates in the econometric literature. This means that, for € 1 grant, € 0.74 more are invested. All told, € 13.9 billion will be spent on R&D and innovation.*

- *Assuming a € 13.9 billion investment, and if we suppose for convenience that R&D expenditure is concentrated in a single year — i.e. a one-off shock — then employment could be expected to increase in that one year by more than 210 000. But these newly created jobs would be transitory because the direct shock of R&D and innovation expenditure is itself transitory. Also, the effects of this shock pass through different phases that can diminish employment transitorily. This is the case for the restructuring phase, when innovation and productivity gains appear without any immediate increase in demand for goods, something that takes time to work through after a price reduction. But the diffusion of innovation and the increase in domestic demand and competitiveness will again stimulate employment.*

- *Ultimately, what is important is the cumulative effect of this one-off shock. For employment, it is the number of persons working during a period of time, which must be expressed in persons-year or the so called job-equivalents: The cumulative effect is 569 000 persons-year for the 15 years period, after the policy is implemented. The cumulative GDP represents the full value of the wealth created by the initial R&D expenditure. Here it is € 75 billion after 15 years.*

Table 1: Impacts from a one-off shock induced by the FP7 2013 call for proposals

EU investment in research (€ billion)	8
Total investment in research (€ billion)	13.9
Jobs created — short term (persons-year)	210 000
Cumulative job creation for the 15 years period (persons-year)	569 000
Cumulative extra GDP for the 15 years period (€ billion)	75

[1] See the DEMETER, SIMPATIC, WIOD and NEUJOB research projects - http://ec.europa.eu/research/social-sciences/index_en.html

The impact of the FP7 2013 call for proposals, worth € 8 billion, has been assessed using the NEMESIS system of macro econometric models. The results must not be considered an incontrovertible truth, but merely as certain elements which are open to comment. Nevertheless, they represent a serious attempt to analyse the impact of research and innovation funding, by using a coherent framework based on national accounting, a set of theoretical assumptions and numerical evidence linked to the state of art of research on the Economics of R&D, and up-to-date simulation techniques.

Compared with last year's evaluation (FP 7 Call in 2012), the novelty lies in two major points. The volume is up from € 7 billion to 8 billion, i.e. an increase of about 14 % in nominal value and of 12 % in real value. The new crisis, the scale of which was not foreseen in June 2011, increases the GDP gap (between GDP forecasts before the crisis and current forecasts) and then, if we follow some of the results of the DEMETER project, lowers the opportunity costs of R&D policies.[2]

This document is organised as follows: We start with the main mechanisms we need to consider for R&D assessment with modelling, before presenting in four successive phases the effects on employment and economic activity of the 2013 call. The cumulative effects on job creation and GDP are then presented.

[2] Fougeyrollas A, Haddad P., Le Hir B., Le Mouël P, Zagamé P., 2010, 'R&D effort during the crisis and beyond: some insights provided by the NEMESIS model simulations', Demeter project, European Commission publication.

1- Modelling for R&D assessment

To assess R&D policy, we must use detailed macro sectoral models that describe the effect of FP funding for every activity. Three main mechanisms are involved: the leverage effect that enables us to determine the R&D expenditure arising from 1 € public funding; the knowledge spillovers that describe knowledge transfers to other sectors and other countries, and that will determine the knowledge variables; and the economic performance of knowledge.

1.1- Leverage effect

The leverage effect or 'crowding-in' effect describes the multiplier effect that € 1 of grant has on R&D expenditure. Econometrics gives some results, albeit mainly at a European or macro national level, more rarely at a sectoral level. This leverage effect depends on several conditions that determine expectations in terms of R&D returns. One main concern is about comparing the leverage effects of different sources of grants, e.g. regional, national or European.

At a European level, research grants might induce more leverage effects that national or regional ones. Network effects, transfer of best practices and higher returns could explain the difference. Many of the new initiatives on joint technology projects, research programming and ERA creation are aimed at increasing this leverage effect.

The Risk-Sharing Finance Facility (RSFF) uses — and this is an innovation — debt-based finance to complement FP7 funding. The risk is shared between the European Commission and the European Investment Bank. The first evaluations show that the leverage effect of the RSFF is very substantial. According to Soete (2010), since the creation of RSFF in June 2007, and up to December 2009, € 0.5 billion of FP7 assigned to the RSFF has, with the EIB support of € 0.5 billion, generated more than € 16 billion of R&D expenditure. Any FP assessment exercises must take into account this RSFF procedure even if it concerns only a small part of FP7, and more generally make a sensibility analysis of results to the leverage adopted

Taking into account recent literature results, we adopted for the present simulation of the 2013 call the following leverage effect: 0.5 for public R&D investments (40 % of the € 8 billion funding) and 0.9 for the private sector. In mean terms, these assumptions give a leverage effect of about 0.74, which means that € 1 EU investment from the 2012 FP7 budget generates € 1.74 of research and innovation expenditure. This 0.74 figure is quite compatible with the results of the econometric literature, which indicates a leverage effect for the private sector of between 0.7 and 1.7. To sum up then, the € 8 billion FP 2013 funding will generate € 13.9 billion R&D and innovation expenditure.

1.2- Knowledge spillovers

A second important matter is 'knowledge spillovers'. Impacts of innovation in the model depend not only on R&D expenditure of the sector, but also on the knowledge spillovers coming from other sectors, other countries and public research centres.

Quite a lot has been written about knowledge spillovers. For NEMESIS, we adapted the Johnson matrix (Johnson 2002) on technological flows based on patent data for inter-sectoral spillovers, while international spillovers were based on bilateral trade. During the DEMETER project, new knowledge matrices were built, using PATSTAT database and the Yale concordance matrix, and making it possible to describe inter-sectoral spillovers directly at international level. This work was based on the contribution of UNU-MERIT,[3] under the DEMETER Project, and was extended to General Purpose Technologies (GPT), used by almost all the sectors, e.g. the ICT, and a main carrier for knowledge externalities.

1.3- Economic performance

The economic performance of knowledge was calibrated on econometric work initiated by Griliches and Mairesse (1983). Their work was adapted to NEMESIS, with past data being 'calibrated' to take into account the impacts of spillovers and of product quality (Brécart *et alii*, 2006). Of course, these mechanisms play a major role in terms of the results. We assume in this document that the economic performance of the FP7 2013 funded projects is the same as for all other projects. This is a cautious assumption given that some studies argue that European funded R&D is more efficient.

1.4- Inter-sectoral and macroeconomic feedback in NEMESIS

The last point concerns macroeconomics. Having assumed that innovation increases productivity, quality and then demand at a sectoral level, we must take into account the inter-sectoral and macroeconomic feedback. The NEMESIS model track is hybrid in the sense that it is the resultant of pure top-down forces, mainly savings and consumption, linked to wages, employment prices and profit, and bottom-up forces that come from the interactions between 30 heterogeneous sectors in terms of dynamics and R&D effort. All these forces determine the competitiveness, growth and employment that are the outcome of implementing R&D policies. These results are available at national and sectoral level for every European country.

[3] www.merit.unu.edu.

2- The four phases of effects induced by 2013 FP funding

Let us now look at the four different phases of effects of the €8 billion grants for the 2013 FP7.

2.1- Implementation

The two main questions in terms of the implementation of FP concern the time profile and the allocation of grants. All the grant of €8 billion is handed over in the first year in a one-off shock. This is a simplification, because all the expenditure is in fact spent over at least three years, but making this simplification enables us to follow, year by year, the impact of this transitory grant, global effect of which will be assessed cumulatively.

The allocation of FP7 funding between Member States is assumed to be as observed at the beginning of the FP7 (see Table 2). The allocation of research and innovation funding between economic sectors of the model in each country is based on the 'grandfathering' principle, i.e. proportionate to the level of R&D expenditure in each sector. Grandfathering allocation tends to be virtual in that it does not necessarily accord with the current criteria for funds allocation in the FP.

Table 2: FP7 allocation (source: DG Research)

	FP7		FP7
Austria	3.00 %	**Italy**	11.50 %
Belgium	4.70 %	**Latvia**	0.10 %
Bulgaria	0.50 %	**Lithuania**	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 %

2.2- R&D allocation phase

The €8 billion grants, with a leverage effect of 0.74, generate €13.9 billion R&D expenditure. Figure 1 shows that GDP grows from year one on a scale slightly below the shock effect. In fact, R&D investment consists mainly in physical investment (research hardware) and in jobs, which result in

higher pay and consumption. During the first three years, there are only demand effects, because the additional R&D has not yet achieved its full impact. This translates into higher prices and imports, which upsets the external balance somewhat and causes the multiplier to 'leak'. 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. 210 000 jobs are created in the first year; the number then falls back almost completely, as does the GDP, since the shock is one-off.

Figure 1: One-off shock across all sectors (% gap from central account)

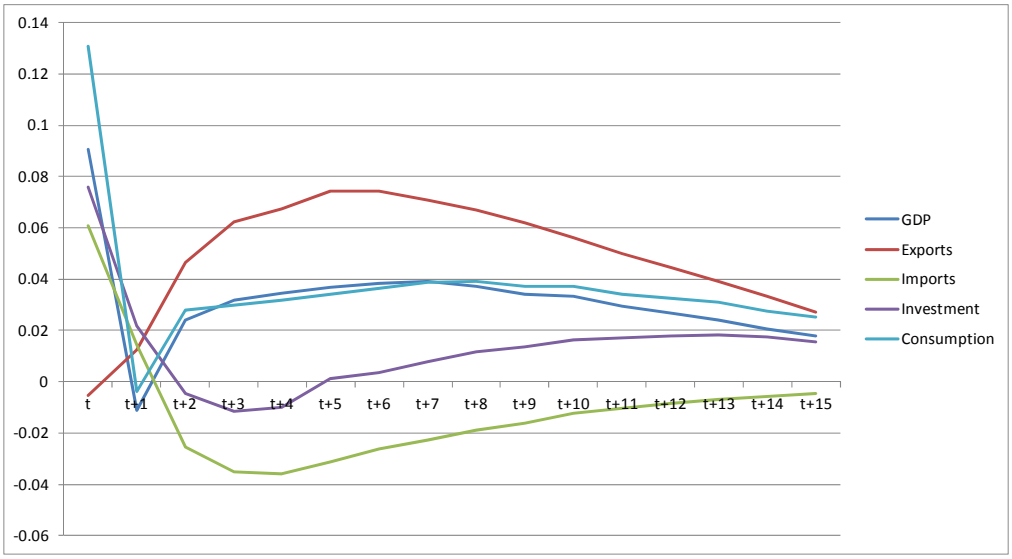
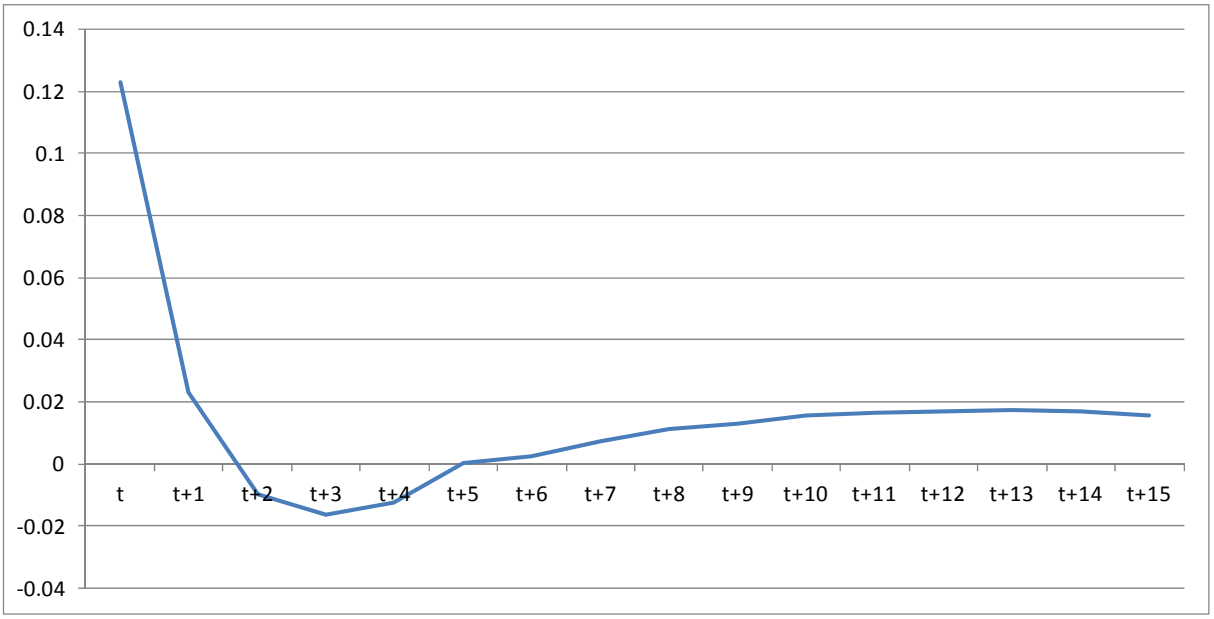


Figure 2: Employment trend (% gap from central account)



2.3- 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 pushes down prices. However, the increase in demand will take time to work through, so during this phase employment will fall below business-as usual-level, because of productivity gains.

2.4- Diffusion and increase in demand phase

During this phase, lower prices and improvements in quality will help boost domestic demand and improve competitiveness and the external balance. Thus, between t+5 and t+10 the GDP continues to grow above the BAU level due to higher exports, lower imports and increased consumption. Job creation is around + 0.02 % in t+10, which is small compared to GDP growth, but this is explained by higher innovation-induced productivity growth. In contrast, spending on research and innovation results in higher GDP and competitiveness, which may reduce the deficits of Member States.

2.5- The obsolescence of innovation phase

With the scrapping of knowledge capital, the effects of innovation will decrease over time, and so GDP and its components will decrease, as will employment. In t+15 the residual effect will be much diminished, but will not be negligible: +0.02 % jobs, and + 0.02 % GDP.

3- The cumulative socio-economic effects for the next 15 years

After the dynamic description of impacts year by year, it is important to calculate the cumulative effects associated with this one-off shock.

If we look at the time t+15 on Figure 1, we can observe in two distinct ways the effect on employment, and on GDP and its components. The first is the slack between, for instance, employment resulting from research and innovation grants and the baseline without grants. What we can see on the graph is that this effect depends on the phase in which it is observed. It is of course very important at the beginning when the R&D expenditure takes place. We have already commented on the chain of these different phases.

But the important thing, when we comment on the results, is to compare the cost for the European Commission (€ 8 billion) to the cumulative jobs or the cumulative GDP created. The cumulative jobs created are the area between the employment curves and the time axis. It must be expressed in terms of persons-years: it is a number of persons working during a period of time. In addition, all the financing demand on the FP must be associated with a work plan presented in person-months.

The cumulative GDP represents all the wealth created by the initial FP funding. It is interesting to calculate the multiplier effect of this expenditure, to see what value € 1 of FP can create.

If we look at Figure 1, we can see that almost all the components of GDP decrease after t+15, the obsolescence effect grows and then the benefits of research and innovation fade away. Of course, that situation is purely virtual in the sense that other FP expenditures after 2013 will take over. For these reasons, we decided to give the cumulative effects after 15 years. Of course the figures would have been higher after 30 years or more, and then the results are an underestimation of all the effects displayed by the one-off shock policy. Cumulative job creation in 2027 (t+15) is 569 000 persons-year. Over the 15 years period, this represents in average 38 000 jobs more than in a situation without the FP7 2013 call.

After 15 years, the wealth created came to € 75 billion; after 20 years it came to € 86 billion. At this time, the multiplier effect of R&D expenditures is 86/12.9, about 6.3. If we were to extend the simulation horizon to 25 years, the multiplier would have converged to a figure between 6.5 and 7, 6.5 being the figure generally calculated for the multiplier effect of a sustained shock after 25 years,[4] equivalent to the multiplier of a cumulative GDP reported for the one-off shock.

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[4] See Brécart *et alii*, 2006.