DEMETER PROJECT

R&D EFFORT DURING THE CRISIS AND BEYOND: SOME INSIGHTS PROVIDED BY THE NEMESIS MODEL SIMULATIONS

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INTRODUCTION

If many studies shed light on the importance of knowledge economics and R&D in order to face the structural challenges to come for Europe (competitiveness, ageing, energy, society problems, environment …), there has been, on the other hand, only a few work dealing with the relationship between R&D and the economic crisis. As the crisis might have lasting effects over potential GDP, competitiveness and employment, especially due to the slowdown in R&D effort caused by the latter crisis; an active research policy can, on the contrary, help keeping up economic activity and generate better conditions to end the crisis, or even fade any lasting effects of this negative shock.

The exercises proposed here are all related to one unifier topic: R&D. They were treated using simulations produced by the macro economic detailed model NEMESIS.

The first among them are related to the links between economic crises and R&D. Their results tend to show that active R&D policies can turn out to be really useful to restore an economic equilibrium, as GDP and employment can reach levels comparable with those forecasted prior to the crisis. Reciprocally, they show that a crisis might as well be a good opportunity to set up research oriented policies. The latter always lead to inflationary pressures in the beginning of the period, due to a raise in spending and labour demand in highly qualified activities, where "bottleneck" effects can exist; without any side effects over the supply side, as important "lagging" effect exist between the R&D effort and innovation. From this point of view, an expansionary policy as foreseen in the frame of the Barcelona agenda might be less expensive to initiate as previously planned.

Using these results that highlight the interest of raising R&D efforts in the new context associated with the crisis, the other simulations explore the different alternatives that might lead to an increase in R&D, and especially using subsidies based incentives. As a consequence, we will then successively analyse the effects of an increase of R&D framework programs, more precisely the doubling of the F.P. 8; as well as the redeployment of the European funding towards R&D support, in expectation of the projected financial reform.

Therefore, our study is hinged on four main sections:

1. R&D and crisis: The crisis reinforces the usefulness of research support policies.
2. What about reattempting the Barcelona objective?
3. The doubling of the F.P. 8: an incentive for R&D effort.
4. The redeployment of European funding towards R&D activity: the case of the Common Agricultural Policy

The scenarios and the commentaries are largely beholden to DG Research Officers and more precisely P. Valette, head of unit and D. Rosseti. The authors are indebted to them.

For each of these sections, we will present the results of a policy assessment simulated using the NEMESIS model and we will analyse its consequences in terms of growth, competitiveness and employment in Europe. Results were produced for each of the 27 member states, using a 30 levels sectoral break-up. However, the results presented here are only at the EU-27 level, as national results will be exploited later on. Indeed, once sorted, these results regarding the heterogeneity of policy effects on highly differentiated countries (sectors) in terms of the importance of R&D are likely to bring to light on useful insights regarding the implementation of the latter policy.

1-CRISIS AND R&D: THE CRISIS REINFORCES THE USEFULNESS OF RESEARCH SUPPORT POLICIES.

In this section, the main issue concerns the relationships between the crisis and R&D efforts: do R&D expenses raise (countercyclical) or decrease (procyclical) during the crisis? This question is complex, as it still divides theoreticians. To address it, we will begin with recalling the actual controversies, before realising a crisis simulation with the NEMESIS model. Then, we will show to what extent an R&D support policy can help wiping-off the marks made by the crisis on GDP and employment; the latter marks having otherwise lasting effects, due to the procyclical aspect of research.

1-1-R&D EFFORT SHRINKS DURING THE CRISIS

A first group of authors [1]argue that firms are more likely to carry out their R&D activity during recessions, in order to raise their efficiency and as a consequence their survival probability. In some models, where R&D fluctuations and investment are simultaneously endogenized, the opportunity cost of R&D as well as the possibility of agents' coordination, leads to countercyclical R&D activities. (Bental & Peled, 1996; François & Lloyd Ellis, 2003).

Therefore, these theories tend to highlight a positive effect of recessions over the long term growth rate. To support this finding, they argue that during a recession, inefficient firms go bankrupt, thus enabling resources to be used by other more efficient companies. More generally, as demand stagnates or decreases, more resources are available for non-directly productive activities, like R&D.

As a matter of fact, an economic optimum requires a countercyclical R&D investment, both for economic stabilisation reasons, as well as for structural long term growth issues.

However, always more authors are defending the concept of a procyclical R&D, which induces a substantial reduction of R&D expenses as well as a lack of future innovation, due to the crisis. Two types of arguments are presented here. The first concern stems from financial reasons, more precisely from liquidity risks on financial markets [cf.Aghion & alii (2005)]. The second issue is related to the fall of demand adressed to the firms, thus slowing down demand driven R&D. In the most recent studies [cf. Francois et Llyod-Ellis (2009)] the authors change their point of view as they emphasize the strongly procyclical aspect of R&D.

[1] *Bibliographic references*
Bental et Peled, "The accumulation of wealth and the cyclical generation of new technologies: A Search Theoretic Approach", /International Economic Review/,1996; François et Lloyd Ellis, "Animal spirits through creative destruction", */American Economic Review/*, 2003

This contraction of R&D efforts and hence of future innovations might have lasting effects on economic evolutions, more precisely on potential growth and employment.

1-2-A NEMESIS SCENARIO HIGHLIGHTS THE LASTING EFFECTS OF THE CRISIS.

Two scenarios are presented in this section: the first one is the baseline, that was carried out before the crisis and in which European countries are on a path that fluctuates slightly around their respective potential growth[2], depending on oil price and world demand variations (the former price arising from the PROMETHEUS model previsions, as the latter are issued from OECD prospects).
The other scenario is the crisis one, which is based on the DG ECFIN 2009 fall prospects. It uses real data for 2008 and forecasts for 2009 and 2010.

TABLE 1 : SHORT TERM EFFECTS OF THE CRISIS

	2008		**2009**		**2010**	
	GDP	*Employment*	*GDP*	*Employment*	*GDP*	*Employment*
Trend (growth rate)	2.7%	1.4%	1.6%	-0.4%	1.8%	-0.3%
Crisis (growth rate)	0.8%	1.2%	-4.1%	-2.3%	0.7%	-1.2%
Cumulartive GAP (%)	*1.9%*	*0.2%*	*7.6%*	*2.1%*	*8.7%*	*3.0%*

Table 1 shows the baseline and the crisis scenarios, as well as the cumulated GDP gap, which reaches 8.7% in 2010, due to the crisis.
We constrained the NEMESIS model to fit with the 2008, 2009 and 2010 data, before relaxing its trajectory up to 2025. Describing these economic sequences produced by the model's simulations is not a simple thing, since the mechanisms of the model are structural ones, especially at medium and long term. More accurately, the only financial variable being determinant for consumption and investment here is the interest rate: there are no proxy variables, neither for the financial environment, nor for the liquidity risks.
For these reasons, we toped up econometrical patterns of consumption and investment with slack variables supposed to take into account the financial environment framework, calibrated in such a way that the model's trajectory passes by each GDP point estimated by DG ECFIN. Also, one should take into account that the slack variables do not affect the econometrical relationships, which then still allow for sectoral differentiations.
Once these constraints applied, the model has no other ones on the rest of the time period, taking into account new available information over medium and long term as exogenous variables.

The crisis scenario is plotted in chart 1, next to the baseline scenario: the GDP deviation (€950 billions, base 2000) maintain itself after 2010 and even tends to deepen due to the R&D expenditures slowdown. Moreover, a more accurate analysis at the sectoral level (table 2) shows that the crisis does affect differently the various activities of the economy. As the crisis emerged from the financial sector, investments are particularly affected, while consumption

[2] Dependent on active population forecasts

shows a better resistance to the shock, at least in the beginning, thanks to "economic stabilisers" (layoff delays, unemployment compensations …)

CHART 1 : ÉVOLUTION OF THE GDP IN THE BASELINE AND CRISIS SCENARIOS

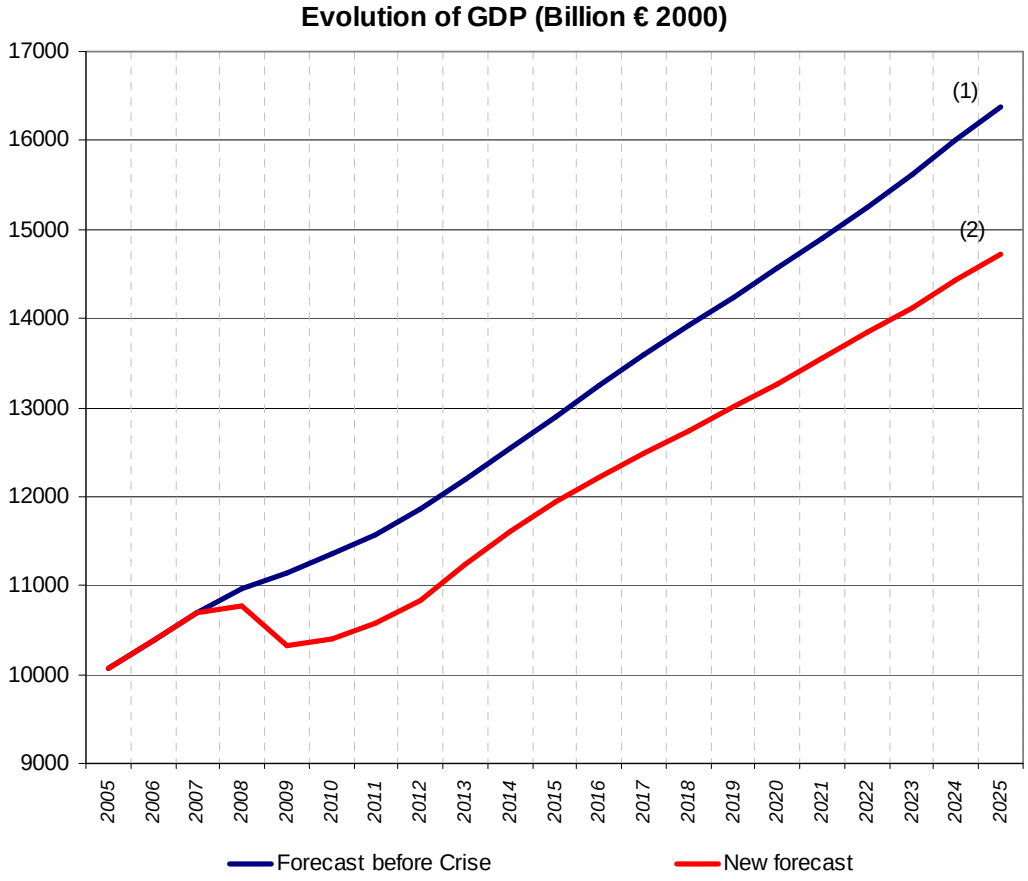


TABLE 2: SECTORAL EVOLUTION OVER THE PERIOD 2009-2025 IN GROWTH RATES, FOR THE BASELINE AND CRISIS SCENARIOS

	2008		2009		2010		2015		2020		2025	
	Trend	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*
Agriculture	0.0%	-0.4%	-0.4%	-1.6%	-0.2%	0.1%	0.7%	1.0%	0.5%	0.6%	0.6%	0.6%
Energy	1.5%	0.3%	-1.3%	-6.9%	0.6%	-2.3%	2.4%	2.6%	1.1%	0.9%	1.3%	1.1%
Intermediate goods	4.3%	2.7%	2.1%	-7.9%	1.7%	-2.2%	2.4%	3.9%	2.2%	2.1%	2.1%	2.0%
Equipment goods	4.7%	2.5%	2.2%	-11.0%	1.9%	-0.8%	2.6%	4.0%	2.3%	2.1%	2.4%	2.4%
Final consumption goods	2.3%	1.4%	1.3%	-3.8%	1.1%	-1.2%	1.7%	2.2%	1.4%	1.2%	1.4%	1.2%
Construction	4.8%	0.5%	0.8%	-17.6%	1.9%	1.1%	2.7%	3.0%	2.2%	0.8%	2.1%	1.7%
Distribution	2.3%	1.2%	1.5%	-3.9%	1.5%	-0.1%	2.4%	2.4%	1.9%	1.7%	1.9%	1.7%
Transports	3.2%	2.1%	1.9%	-5.2%	1.8%	-0.3%	2.7%	3.4%	2.3%	2.4%	2.3%	2.3%
Communications	2.8%	2.0%	2.0%	-2.2%	1.8%	-0.5%	2.8%	2.9%	2.2%	2.0%	2.3%	2.0%
Bank, finance, insurance	2.8%	2.0%	2.0%	-2.2%	1.8%	-0.5%	2.8%	2.9%	2.2%	2.0%	2.3%	2.0%
Other market services	2.4%	1.3%	1.5%	-3.5%	1.4%	-0.7%	2.5%	2.6%	1.9%	1.6%	2.0%	1.7%
Non market services	1.8%	2.1%	1.2%	1.2%	1.7%	1.5%	2.4%	2.1%	2.1%	2.3%	2.1%	1.7%
Total	2.9%	1.7%	1.5%	-5.4%	1.5%	-0.4%	2.4%	2.8%	2.0%	1.8%	2.0%	1.8%

Yet, it is the sector of investment goods that pursues most of the R&D activities (in terms of expenses). Consequently, not only the amount of R&D decreases due to the GDP fall, but also the R&D intensity (R&D/GDP) slightly diminishes as a consequence of the sectoral structure change (it switches from 1.9% to 1.8% in 2010)

Employment evolves in a slightly different way, since the decrease in wages originated by the rise of unemployment creates a cumulative deviation on labour costs. Hence, one year after the crisis, GDP becomes more labour intensive. Thus, the employment deviation, compared to

the baseline growth path, tends to appreciably diminish at medium term, before raising again at long term due to a growing GDP gap.

CHART 2: RESULTS FOR EMPLOYMENT, BASELINE AND CRISIS SCENARIOS

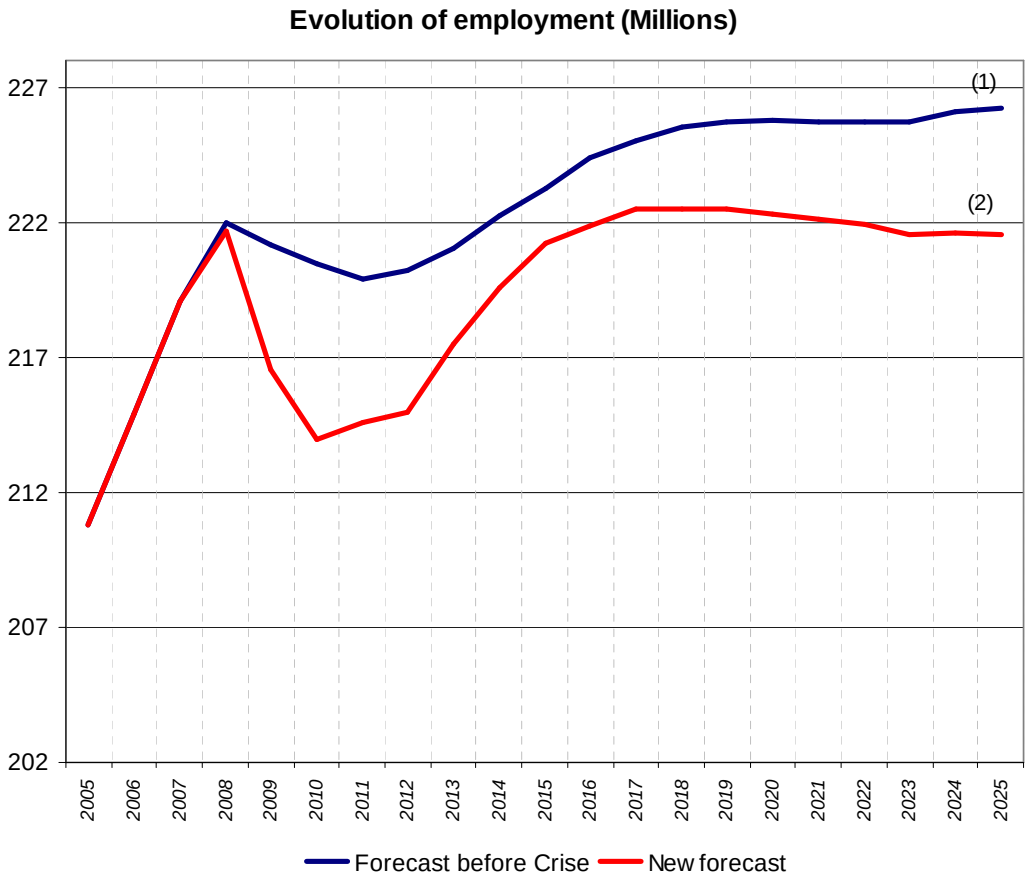


TABLE 3: EVOLUTION OF SECTORAL EMPLOYMENT, BASELINE AND CRISIS SCENARIOS, YEARLY GROWTH, IN MILLIONS

	2008		2009		2010		2015		2020		2025	
	Trend	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*	*Trend*	*Crise*
Agriculture	-0.4	-0.3	-0.4	-0.1	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2
Energy	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Intermediate goods	0.4	0.3	0.1	-0.7	-0.1	-0.5	0.0	0.2	-0.1	-0.1	-0.1	-0.1
Equipment goods	0.6	0.4	0.1	-1.1	0.0	-0.3	0.1	0.4	0.1	0.1	0.1	0.1
Final consumption goods	0.1	0.1	-0.2	-0.4	-0.2	-0.3	-0.1	0.0	-0.2	-0.2	-0.1	-0.1
Construction	0.6	0.1	-0.1	-2.0	0.0	-0.6	0.1	0.2	0.0	-0.1	0.0	0.0
Distribution	0.7	0.7	0.1	-0.3	0.2	0.3	0.6	0.8	0.5	0.5	0.5	0.5
Transports	0.1	0.1	-0.1	-0.3	-0.1	-0.1	0.0	0.1	0.0	0.0	0.0	0.0
Communications	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bank, finance, insurance	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other market services	0.5	0.4	-0.2	-0.8	-0.1	-0.8	0.2	0.2	-0.1	-0.2	-0.1	-0.1
Non market services	0.4	0.8	-0.2	0.7	0.1	0.2	0.4	0.2	0.2	0.2	0.1	0.0
Total	3.0	2.6	-0.9	-5.1	-0.7	-2.6	1.0	1.7	0.0	-0.2	0.2	-0.1

1-3-RESEARCH AS A WAY OUT OF THE CRISIS

We introduce now a new simulation, which is based on the crisis like the previous one, but that integrates a successful R&D incentive policy. This scenario is about the achievement of the former Barcelona objective, dealing with a R&D intensity rise from 1.8% in 2009 up to 3% in 2020. The results for GDP and employment of this active R&D policy scenario (3) are compared firstly to the baseline (1) and the crisis (2) ones, before we observe more precisely its other results in another section

As one can establish, the additional research policy allows almost to catch-up with the baseline employment level at the 2025 horizon. Why does such a difference exist?

Regarding GDP, the continuous R&D effort allows to fill in for 43% of the gap in 2025. Though this result is substantial, all the effects of the crisis are not wiped-off at this horizon and this situation probably requires some additional policies. However, one can note that the growth rate at the end of the period is greater than that of the baseline, suggesting that a subsequent recovery could happen in the next periods.

For the same reason that has been highlighted previously: because the decrease in labour cost is important in the scenario (3), which experiences the crisis. Indeed, one should recall here that the Phillips curve connects wage variations to unemployment level. Consequently, the wages fall during the crisis is cumulative and the wage difference between (1) and (3) is then considerable for the years 2012, 2013 and beyond (more than 5%). The resulting labour cost decrease allows then for a more employment intensive GDP for a given level of the latter, due to a substitution effect.

CHART 3: EVOLUTION OF GDP IN THE THREE SCENARIOS

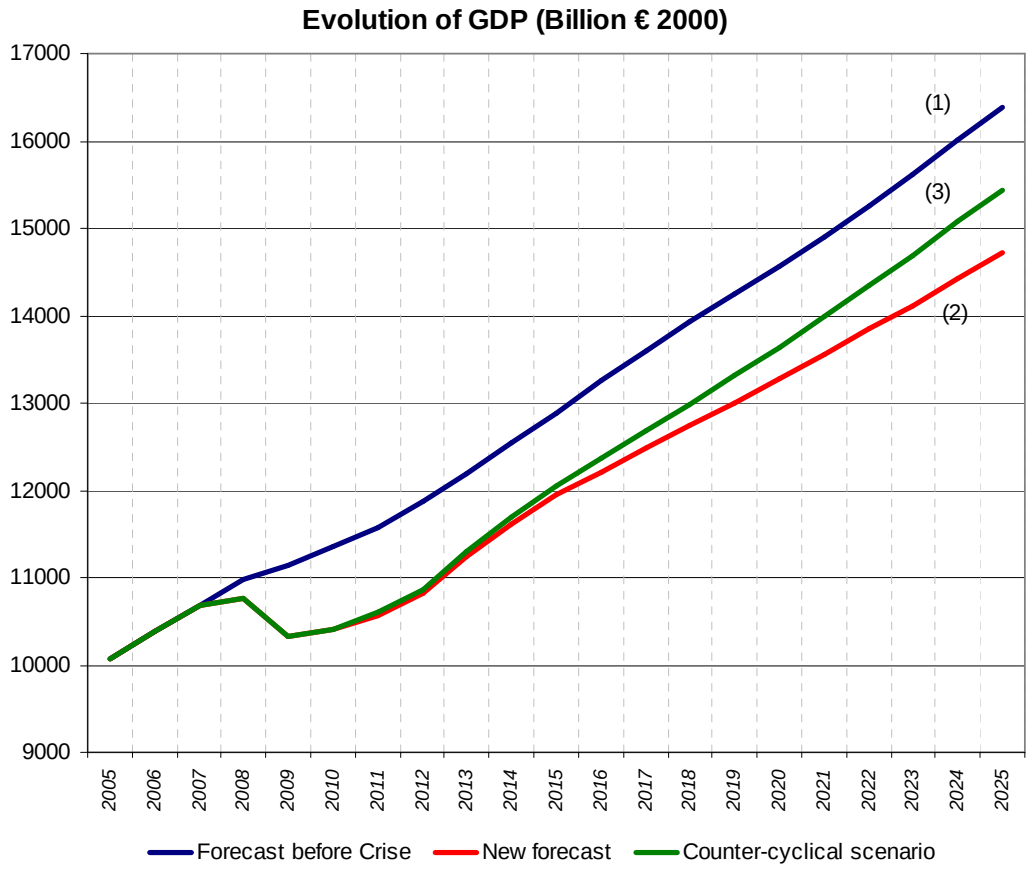
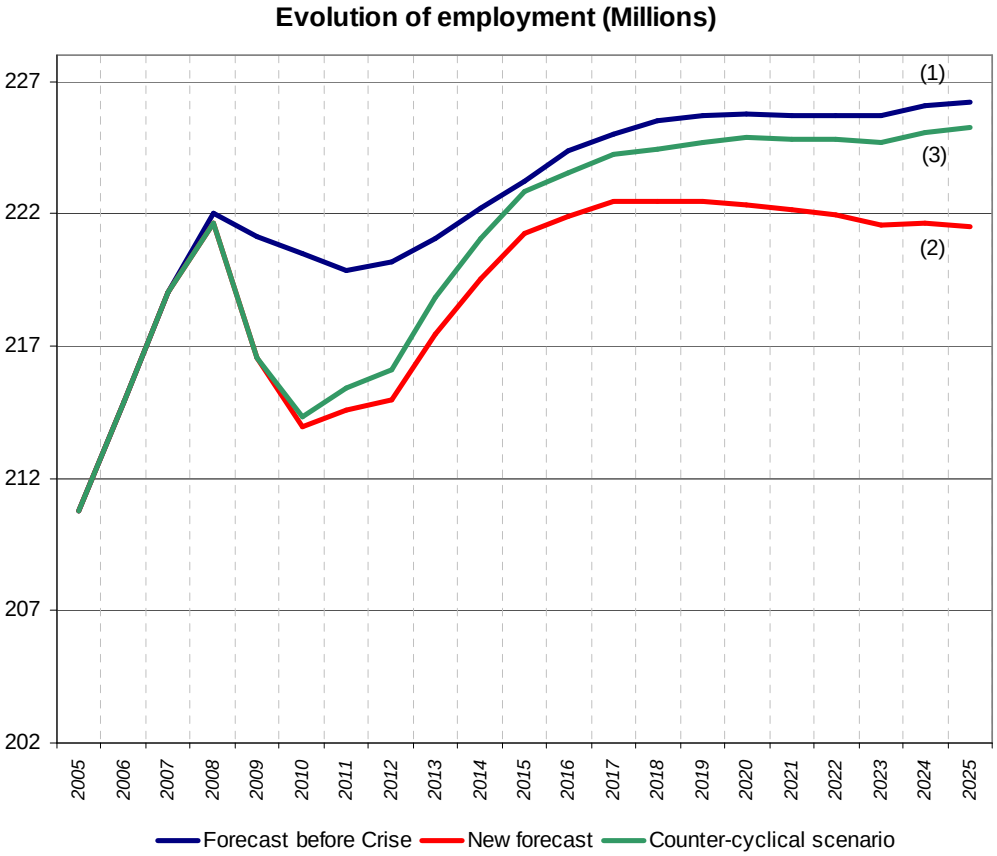


CHART 4: EVOLUTION OF EMPLOYMENT IN THE THREE SCENARIOS



As a conclusion of this first part, we chose to retain several important ideas:

- The crisis generates a lasting GDP gap (average 9%). Even if it seems that the economy catches up with the former GDP for some time, it turns out that the GDP gap deepens again at the end of the considered time period.
- Sectors are differently affected by the crisis: equipment good sectors, which carry out an important part of the R&D expenditures, are particularly harmed due to the investment fall. This tends to diminish the R&D intensity of the GDP in the beginning of the period.
- A successful R&D policy, leading to an R&D effort comparable to that of the Barcelona objective allows fitting in for 43% of the deviation originated by the crisis, by 2025. On the other hand, employment as forecasted before the crisis is almost reached by 2015, as a consequence of a strong wage decrease during the crisis, which then allows for a more job intensive GDP.

2-WHAT ABOUT REATTEMPTING THE BARCELONA OBJECTIVE?

The previous section has highlighted the fact that a sustained R&D effort is worthwhile to wipe-off lasting consequences of the crisis. Therefore, if an active R&D policy would be implemented today, in 2010, such that the Barcelona objective of 3% of R&D intensity would be reached by 2020, what would be the consequences on competitiveness, growth and employment? The Barcelona agenda has already been assessed by the NEMESIS[3] model. However, the difference is that the evaluation proposed here concerns all the EU-27 countries, with a modified implementation agenda. The objective is not set for 2010, but for 2020 and the economic crisis modifies in depth the situation in terms of funding, employment and the use of production capacities.

2-1- NEW ASSUMPTIONS AND R&D EXPENSES SCHEDULE.

Firstly, switching from 15 to 27 countries modifies slightly the contents of the Barcelona objective. Indeed, in the 12 new member states, the R&D intensities are generally much lower than in the average EU-15 countries. Thus, this supposes a more important effort for the new members, without disrupting the global effort, due to the economically relatively small size of the 12 new member states.

The new agenda adopted for the evolution of R&D intensities is also integrated in the member states' National Action Plans (NAP), which objectives are still defined at the 2010 horizon. In this simulation, we shifted forward this objective at the 2015 horizon, which thus leads to a 2.6% R&D intensity at this date, for EU as a whole. Between 2016 and 2020, the R&D intensity has then been linearly heightened by 0.4% in every member state to reach the objective of 3% average for the Union in 2020. Lastly, after 2020, R&D intensities are held constant.

In the mean, the evolution is presented in chart 5, which allows one to remark the slight drop of R&D intensity caused by the crisis, especially the fall of R&D intensive sectors.

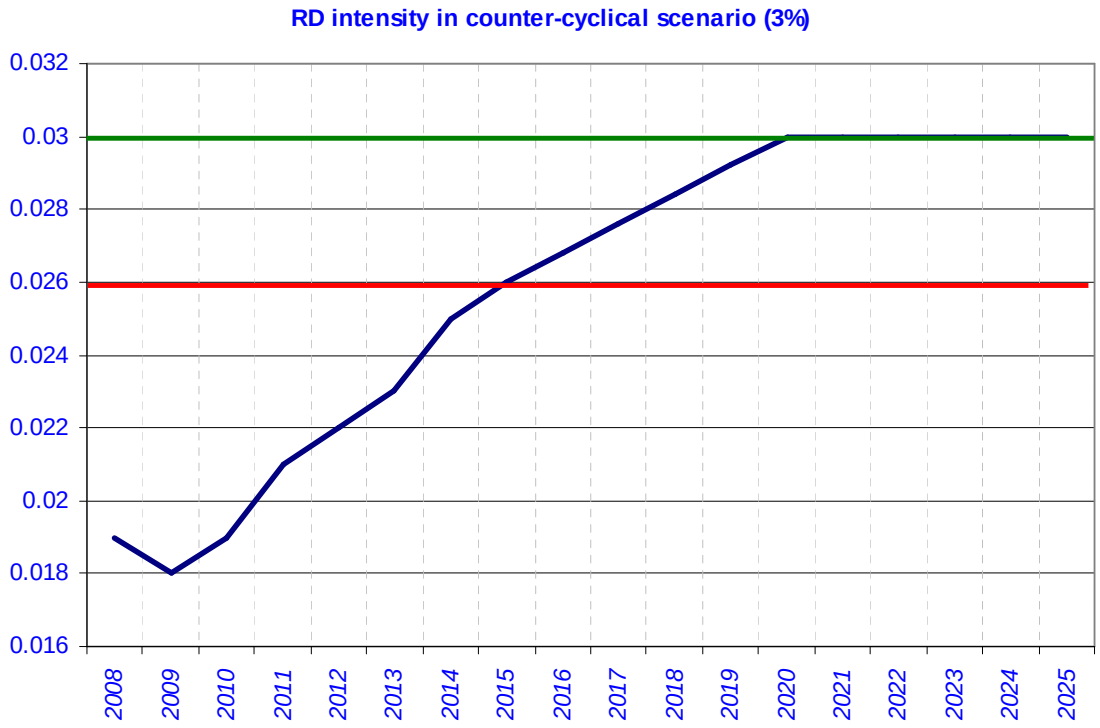
Finally, if such a policy were to be implemented today, it would then occur in an economically deteriorated environment (a GDP gap of 8.7% and an employment gap of 3% in 2009), which contrasts with the original conditions of the initial assessment.

[3] *Bibliographic references :*

Brécard D., Fougeyrollas A., Lemiale L., Le Mouël P, Zagamé P.: "Macroeconomic consequences of European research policy : Prospects of the Nemesis model in the year 2030", Research Policy 35 (2006) 910–924

Chevallier C., Fougeyrollas A., Lemiale L., Le Mouël P, Zagamé P : "A time to sow, a time to reap for the European countries : a macro-econometric glance at the RTD national action plans", Revue de l'OFCE, June 2006

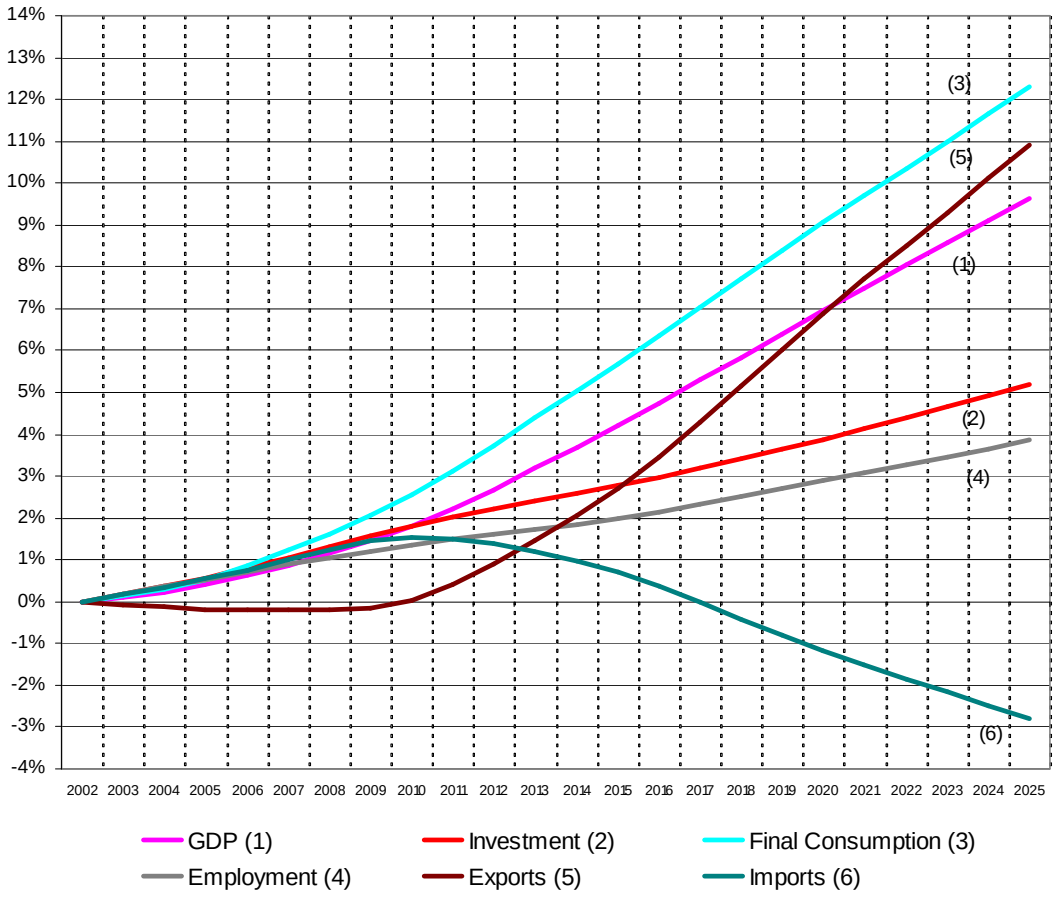
CHART 5: EVOLUTION OF R&D INTENSITY FOR THE WHOLE EU



2-2-THE NEW ASSESSMENT REINFORCES THE IDEA THAT R&D AND THE BARCELONA OBJECTIVE CAN TACKLE THE CRISIS.

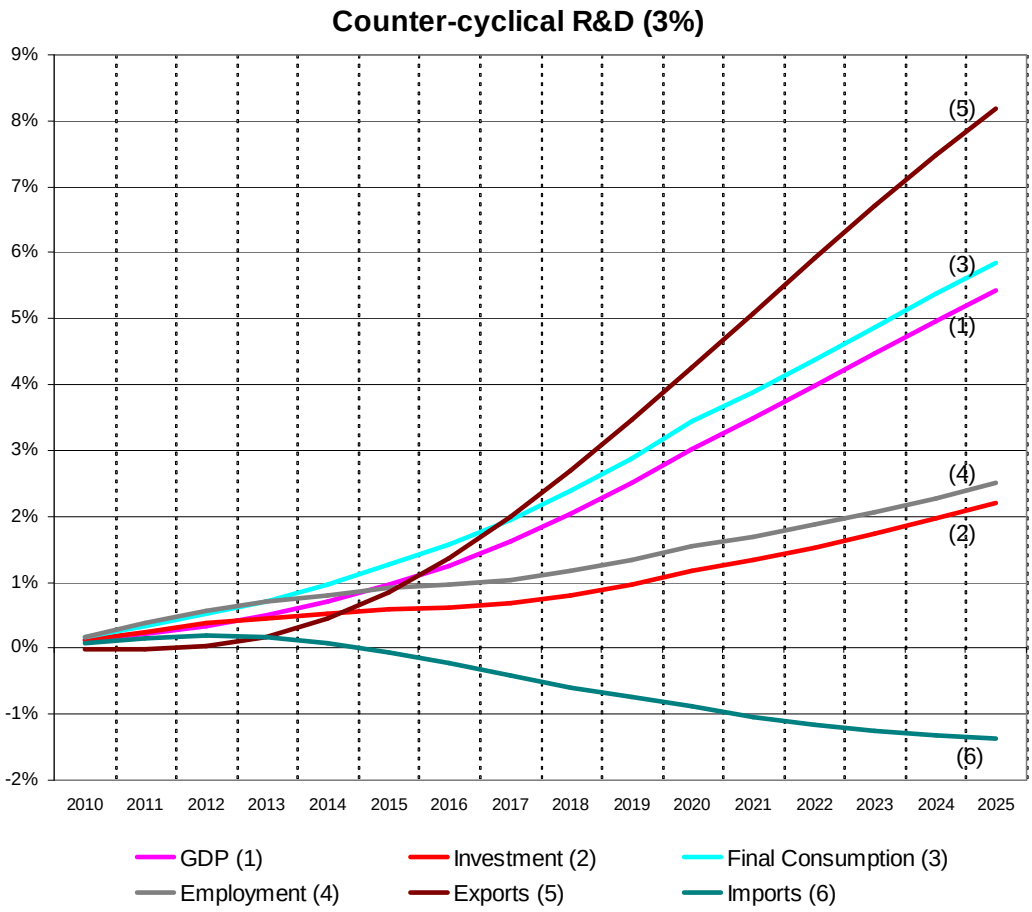
The previous assessment has shown that the macro-economic dynamic of the implementation of the Barcelona objective could be divided in two phases: a « maturation » one, where R&D expenses do not yet yield many innovations; and an « innovation » one, where all the effects of innovation are occurring. The economic mechanisms taking place in the first stage can be referred as Keynesian: R&D expenses and researchers hiring raise the demand and the inflationary pressures. These are caused by the cost of R&D, the tensions on the producing capacities and the growth of employment, which drives wages up. During this demand and inflation phase, the imports increase while the exports are reduced, thus raising the deficits, as one can see looking at chart 6.

CHART 6: EVOLUTION OF GDP AND ITS CONTENTS FOR THE PREVIOUS ASSESSMENT OF THE BARCELONA OBJECTIVE



When looking at chart 7, which represents the main macro-economic results of the new assessment, one can notice that the first phase of disequilibrium described above flattened here. Consequently, the economic situation (GDP and employment gaps) will circumscribe deficits in the beginning of the period. On the contrary, the « innovation » phase is pulled by exports, due to an enhanced competitiveness caused by the arrival of new innovations (price competitiveness with process innovation and structural competitiveness with quality innovation) and by consumption, due to an increase in real wage and quality innovation. Thereby, this phase is characterised by a substantial growth rate and the curbing of deficits

CHART 7: EVOLUTION OF GDP AND ITS CONTENT FOR THE NEW ASSESSMENT OF THE BARCELONA OBJECTIVE



The structural evolution of the innovation stage is comparable in the two assessments and leads to the same GDP and employment growth (when looking at comparable schedules); with the exception that, wages being lower, the contents of growth are different from the previous assessment. Indeed, the wage moderation here yields to a more export driven growth in the new assessment (competitiveness effect), rather than a consumption driven one.

To put it in a nutshell, one can say that the deteriorated economic situation makes even more appropriate the immediate implementation of the Barcelona objective. It would help reflating the economic activity at a reduced cost in terms of deficits and would lead to a better way out of the crisis, thus allowing the restoration of the macro-economic characteristics of the baseline scenario.

3-A WAY OF RAISING THE R&D EFFORT: THE DOUBLING OF THE 8TH FRAMEWORK PROGRAM.

The European Union's framework programs only represent a small share of the total research effort carried by the member states. However, their role is more crucial that one could assume, if looking only at those figures. Indeed, these programs generate crowding-in effects on the R&D expenses.

Hence, we are going to assess here the consequences, in terms of R&D efforts, of the doubling of the 8th framework program, financed by a proportional increase of the member states' contribution to the community's budget; this increase being in fact financed by taxes. After that, we will review the consequences of such a doubling on both GDP and employment.

3-1-THE DOUBLING OF THE 8TH FRAMEWORK PROGRAM AND THE ASSOCIATED CROWDING-IN EFFECTS IN TERMS OF R&D EFFORTS.

The research effort represented by the Framework program amounts only 0.054% of the GDP in 2009 and should rise up to 0.076% in 2013, according to the F.P.7 financial scheme adopted by the EU Commission. This level of effort is weak, compared to the total present effort of 1.9%. However, these public funding generate important crowding-in effects, as they allow the creation of networks as well as the transfer of best practices toward the least advanced research teams. Finally, these funding are distributed among the best European research teams, in a competition spirit.

All the aspects described above generate important leveraging effects. Indeed, the reallocation of the funding to the European teams, when taking into account their respective performance, leads to an extra crowding-in effect of 1,4, according to certain studies[4]. Thus, at the end of the 8th framework program, during which the amounts of the latter program would have doubled, the share of the R&D effort supported by the Framework program will reach 0.15% of GDP. When compared to the scenario where the efforts are not doubled, this case yields to a total increase of R&D effort of 0.18% of GDP (0.0075*2.4=0.18% of GDP)

This means that the sole doubling of the F.P.8 generates a rise in the research effort in terms of GDP by 0.18%. Yet, the Barcelona objective aims at increasing this effort from 1.9% up to 3% (i.e. a rise of 1.1%. Therefore, one can remark that the sole doubling of the F.P.8 would represent almost 20% (17% more precisely) of the desired objective, which is far from being negligible.

But this result is surely not the only one being interesting, and we are going to analyse the economic consequences of such a Policy.

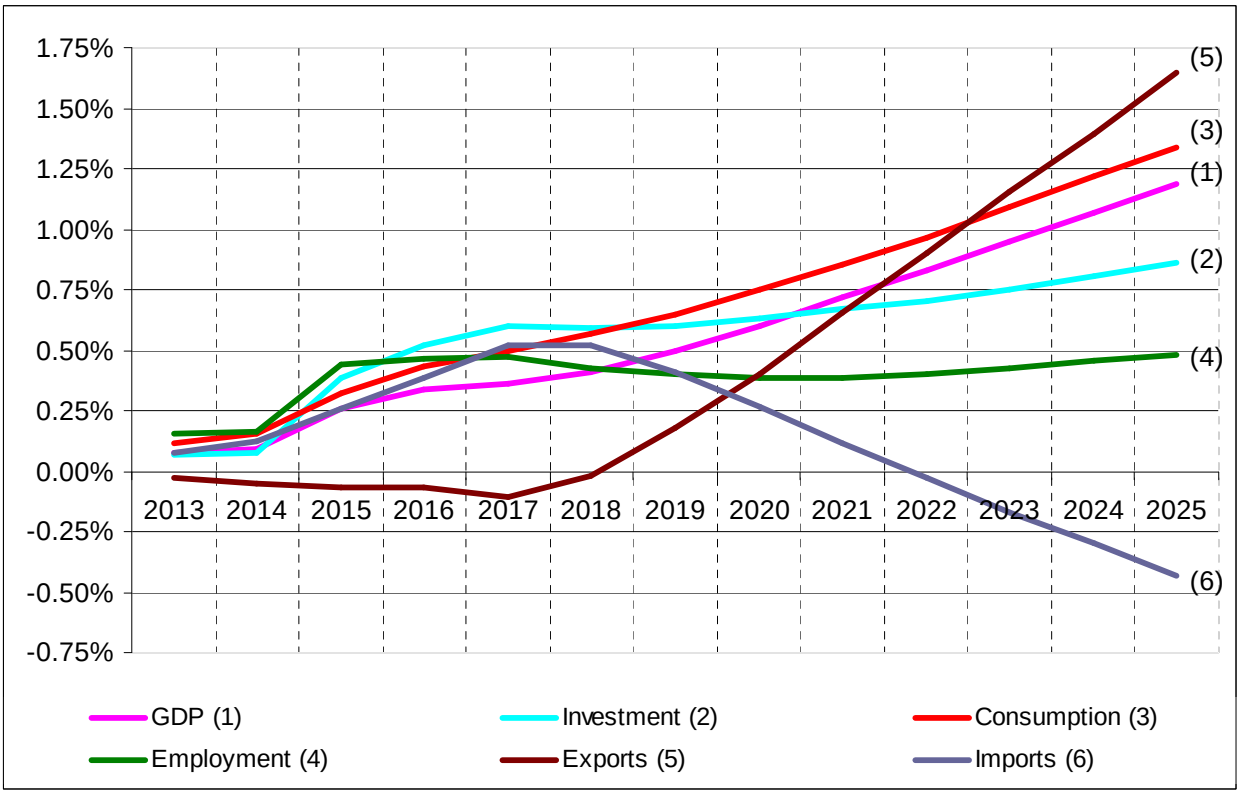
[4] *Bibliographic references*
Fougeyrollas A., Le mouel P., Zagamé P., contribution to the appendix « proposal for the council and the European Parliament decisions on the 7th framewrok program » (2005)

3-2-THE ECONOMIC CONSEQUENCES OF DOUBLING THE 8TH FRAMEWORK PROGRAM

The important amounts of the deficits faced by the European countries calls for a reflexion on the financing of this increase of the research framework programs. The simulation results presented here are based on a proportional increase of the member states' contribution, which would be financed at each member state level by a more or less proportional rise of the income tax and the corporation tax. Hence, the results are slightly less optimistic to that of the previous assessment, as the latter was based on deficits increase, without any financial or economic counterparts

In this new context, the GDP growth of 1.2% at the 2025 horizon must be connected to the 0.18% of increase of the R&D intensities, which creates a multiplier of more than 6 for all the similar types of R&D expenses. Hence, we fall back on ranges and values comparable to that of prior studies, when correcting for the tax reform required to finance this policy. However, employment presents a lower increase than GDP (+0.48%), due to productivity gains induced by these policies increasing the R&D effort. Yet, this still represents the creation of one million jobs at the 2025 horizon. We present here the simulation of the policy. Note that the baseline used here does not take into account the crisis, and that if the latter was integrated in the simulation it would affect the results of this policy (curbing of the deficits)

CHART 8: EVOLUTION OF GDP AND ITS CONTENT FOR THE DOUCLING OF THE 8TH FRAMEWORK PROGRAM



4-EU'S FINANCE REFORM.

In the prospect of a reform of the European funds and in agreement with the option of not raising the member states' deficits, we put forward here another simulation still regarding the doubling of the 8th framework program, which is however financed by a redeployment of a share of the CAP's funding.

This consist in suppressing a share of the subsidies (direct support, market support) to an extent comparable to that of the financing of a doubling of the framework program, which amounts to 9.9 billion Euros in 2020 and represents 16% of the CAP's funding[5]. We assumed in this exercise that trade tariffs were maintained.

We will review the global economic consequences of this redeployment, followed by a more accurate description of the consequences for the agricultural sector, agricultural revenues, employment and other data.

4-1-THE REDEPLOYMENT OF A SHARE OF THE CAP'S FUNDING TOWARDS THE RESEARCH FRAMEWORK PROGAMS: ECONOMIC CONSEQUENCES.

The implementation conditions in this simulation are closely related to those of the previous assessment: the 8th research framework program is raised progressively to reach a doubling in 2020. The only difference lies in the financing conditions, which switch here from the previously assessed taxes to a reduction of the subsidies. Therefore, tariffs are not removed. Hence, the dynamic of the simulation is almost identical to that of the previous assessment: increasing of the programs, leveraging effects, global R&D increase; the sole difference – the financing mode – only affects marginally the results.

TABLE 4

	2025
GDP	**1,19%**
EMPLOYMENT	**0,48%**

4-2-THE CONSEQUENCES ON AGRICULTURE: SIGNIFICANT ADJUSTMENT COSTS.

The NEMESIS model is constituted of several modules interacting with an economic core. Among these appears an agricultural module detailing agricultural production as well as agricultural inputs including seeds and fertilizers. Also, there is a land use module, which by interacting with the economic core and hence, the agricultural module, allows to calculate total production, agricultural prices, agricultural revenues, agricultural employment, the number of agricultural exploitations, grown surfaces as well as land price.

[5] Assuming that EU's budget grows at the same rate as GDP between 2010 and 2020

We present here a summation table of these agricultural data resulting from the NEMESIS simulation, for the 2025 horizon.

TABLE 5

	2025
Agricultural production	**-0,14%**
Grown land	**-0,46%**
Agricultural revenues	**-2,45%**
Agricultural employment	**-2,3%**

Agricultural dynamic seems to be the following: agricultural production does not vary much, but the removal of the direct and market supports induces a reorganization of farming led by the decreasing of agricultural revenues (-2.5%). Farmers compensate this decline by seeking productivity gains and hence, agricultural employment drops by 2.3%, which represents a loss of 350 000 jobs at the European level, that are added to the natural tendency of reduction of agricultural employment over this time period. Presumably, these results notify the need of restructuring policies, and the cost of the latter has to be integrated in order to get a global assessment of these policies.

CONCLUDING REMARKS

When looking at all the results presented here, they boil down to one strong conclusion : R&D policies aiming at increasing the R&D effort conceived with the Lisbon agenda and the Barcelona objective seem to be even more adapted to today's economic situation, deeply affected by the crisis

- They would help pulling up the economy, harmed by the crisis, while inducing only limited deficits and inflationary pressures, due to unemployment and under used production capacities.

- They could lead to a better way out of the crisis with a quite fast catching up of employment and a slightly slower one of GDP, compared to their potential levels prior to the crisis.

- Being partly publically financed, these policies would yield (at long term) enhanced economic growth, which hence increases the tax revenues that would allow to pay for the past deficits.

- The implementation of other structural policies, like green house gases reduction for example, could also give more breathing space for increasing the R&D effort incentive policies. This applies for the auctioning revenues of the EUTS permits, which when being

recycled this way, allow to raise the R&D intensity. NEMESIS simulations regarding the latter recycling Policy are carried out at the moment and will be presented soon.

Further work to come will now aim at exploiting all the national and sectoral results available, which are quite numerous, due to the level of detail reached by the model. These results are contrasted, as we already mentioned, since countries and sectors are quite heterogeneous with respect to their R&D efforts. These contrasts will give us some valuable insights in order to conceive policies specifically adapted to one nation or activity.

Methodological research will also continue with the DEMETER project. Two research paths are enhanced at the moment: the general-purpose technologies in the productive sectors and the refining of the implementation of human capital.

Lastly, other simulations will be achieved, more precisely on the new objective of 3% that would be easier to reach for European countries as a whole, but also easier to manage: 3% of effort for European universities on average (in terms of total budget compared to GDP)

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