Consequences of the 2010 FP7 Budget on European Economy and Employment

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[1] In addition to the signatories of this presentation, many people have participated in this work by defining the framework of the evaluation and even simulations to achieve. To begin with : P. Valette and D. Rossetti, DG Research Directorate SSH, P. Brenier and C. Robin Champigneul DG Research. Finally the researchers involved in the DEMETER network and Erasme team. We express our deep gratitude to all.

Summary

Introduction

The impact of the FP7 2010 budget, 6.5 billion Euros, has been assessed with the NEMESIS system of sectoral macro-economic models, as part of the DEMETER SHS programme. As usual under such circumstances, shown results should not be looked at as intangible truths: they call for comments, even sometimes for amendment of some of the model's mechanisms. Nevertheless, they have the merit to emanate from an exercise based on numbers that fit into a coherent framework, and first of all a coherent accounting framework, which grants those results a certain degree of credibility. Moreover, in the last seven or eight years, many 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; those exercises, implemented mostly 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.

Therefore, the macroeconomic results on GDP growth and employment that can be linked to the commission's 6.5 billion funding for a year can be regarded as fairly robust. But the exercise presented here goes further in that different implementations have been presented, both to guide policy action and to test some of the model's mechanisms.

Indeed, the question of the allocation of efforts across different sectors has been explicitly raised: should we allocate such efforts across all sectors, concentrate on R&D intensive sectors or, on the contrary, on the least advanced sectors? The model gives some ideas on the subject, but those ideas must be understood as being mostly aimed at provoking thought or at deepening the model's mechanisms.

Finally, remember that this assessment results from previous FP evaluations that were performed with NEMESIS in June 2005 by the commission staff. A summary of this work is available on www.erasme-team.eu. The value of this new work is to assess the impact of funds decided in this 2010 stage of the FP.

We will consider first the conditions for the implementation of this 6.5 billion Euros funding by the FP and then we will comment on the results in the case where funds are allocated to all sectors and in the cases where it is allocated only to some sectors based on their intensity in R & D.

The implementation of the 6.5 billion Euros effort

The first question is that of the crowding-in leverage effect that results from European funding. The second question is that of the temporal distribution of the effort. The last one is related to the application sectors of those FPs.

On the leverage effect

The point is to calculate the total R&D expenditure that will follow the 6.5 billion Euros injection. Econometric studies show that public subsidies have a leverage effect on private sector R&D between 0.7 and 1.7, that is to say that each funded Euro leads to a total research expenditure of 1.7 to 2.7 Euros (see e.g. David, Hall and Toole (2000), Guellec and van Pottelsberghe (2003) …).

At the cost of risking an underestimation of the impact of these FP expenditures, we have opted for a low leverage hypothesis, the 6.5 billion Euros funding leading to a 10 billion Euros investment, which is just above 0.5. The motivation behind this choice is to avoid criticism on an essential hypothesis in a context where econometric estimates are sometimes very different. Note that the 3.5 billion extra spending comes essentially from private companies.

On the expenditure schedule

The shock is a one-off shock: the 6.5 billion Euros expenditure (0.054 % of European GDP) giving rise to 10 billion Euros R&D expenditure (0.084 % of European GDP) is not renewed.

The expense can be spread over one or more years, it doesn't matter. In a one-off shock, what matters is the cumulative effect on employment, GDP and components of GDP. In particular, for employment, the important figure is not so much the employment gap with the reference scenario than the cumulative number of jobs-year that could be created. For this reason, it has been hypothesised that the shock would take place in a single year and results are provided as gap and cumulated for t+1, t+2, etc.

We also conducted a second series of simulations in which the 0.084 % European GDP R&D shock is maintained throughout the t to t+15 period.

The value of such simulations does not lie so much in the comparison between two sets of simulations than in the assessment of the cumulative effects of one-off shocks. For it is a well-known property that if the model can be considered as linear, which is the case here as the shocks are low (less than 0.1% of GDP), then the result gap for a sustained shock in a given year is equivalent to the cumulative gaps of a one-off shock up to that year. Therefore the curves associated to sustained shocks give us at a glance the cumulative effects of a one-off shock.

The distribution of shocks

Three assumptions were used for the distribution of shocks; under the first, funds are distributed on all productive sectors under the grandfathering rule, that is to say proportional to the respective research efforts of the last known year (2008).

Under the second assumption, funds are concentrated on R&D intensive sectors (see Table 1) under the grandfathering rule.

Table 1 NEMESIS' R&D intensive sectors

Chemistry and Pharmacy
Agricultural and Industrial Machines
Office Machines
Electrical Goods
Transport Equipment

Under the third assumption, efforts are concentrated on the least R&D intensive sectors.

Table 2 Main Non-Intensive Sectors

Energy
Metals
Rubber and Plastics
Agro-Food industries
Textile and clothing
Other Consumer Goods
Construction
Distribution (services)
Transport (services)
Communications (services)
Financial Intermediation and Insurance
Other Market Services

The value of these three assumptions is to enable a better understanding of sectoral mechanisms of innovation and possibly give some indication of the desirable allocation of funds.

Macroeconomic Results: grandfathering allocation across all sectors

Note here that the grandfathering allocation is somewhat virtual since it does not necessarily obey to fund allocation criteria. In particular, NEMESIS had in the past been used to assess the whole FP7 with funds allocated according to performance criteria, that is to say in terms of number of patents for private sectors, and number of publications for public laboratories.

The "grandfathering" is applied here to all sectors of each country and hence all European countries, we will discuss here first the case where the shock is punctual (One-off 6.5 billion funding), and then the case of a sustained shock.

Consequence of the 6.5 billion Euros subsidy decided in 2010 (one-off shock)

Results are presented as an annex to Table 3 and

Table 4.

The 6.5 billions result in a total R&D expenditure of 10 billion Euros divided proportionally across all sectors. The 10 billion Euros decided in 2010 will result in expenditures in 2011, 2012.

We assumed that the shock was performed on a single year, which is the same as what is interesting is the cumulative effect on GDP and employment (which we find in the case of a sustained shock). The effect can be broken down into 4 phases:

1. **R&D expenditure phase**: On Figure 1, we see that GDP grows from year one with an amplitude slightly inferior to the shock: 0.06 instead of 0.084. 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 borne fruit. 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. Employment increases by 165,000 units the first year and then falls back almost completely, as does the GDP, since the shock is punctual. Of course, employment consists mostly of skilled job (109,000), created positions being primarily of researchers and technicians.

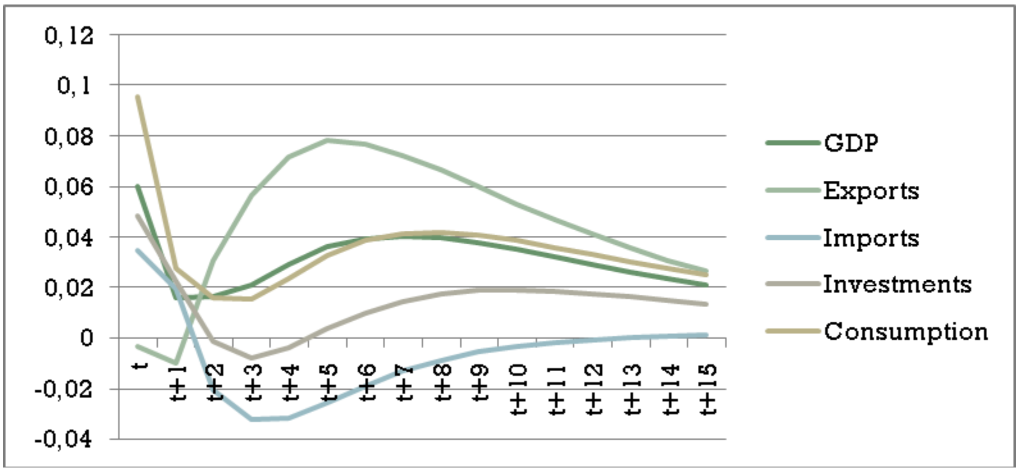


Figure 1 One-off shock across all sectors (% gap from central account)

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 2015 and 2020 the GDP continues to +0.04% above the BAU level due to increased exports (+0.08%), the decline in imports (-0.03%) and increased consumption. Employment goes to +21 000 in 2020, which is small compared to GDP growth, but this weakness is explained by higher productivity growth due to innovation. In contrast, spending on R & D has resulted in an increase of GDP and competitiveness, which may reduce the deficits of member states.

4. **The 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 2025 the residual effect will be much diminished, but will not be negligible : 14,000 jobs, including 12,000 skilled and +0.02% of GDP.

Cumulative Effects Across 2010-2025

Cumulative GDP and employment are the true indicators to take into account for one-off shocks. In particular it is interesting to speculate on the number of job years and overall increases in GDP generated by an expenditure of 6.5 billion Euros under the FP.

Over the 2010-2025 period we observe that this initial expenditure has led to the creation of 275,000 job years of which 115,000 are qualified. This represents an average cost to the commission of 23,600 Euros per job, and to all stakeholders of 36,400 Euros. Observe that of the 275,000 jobs, 160,000 are unskilled. That means that there is no crowding out of unskilled jobs in research policies.

This initial expenditure has even generated 63.377 billion Euros, which represents for a cost of 10 billion Euros a multiplier of 6.3. This is pretty close to what we observed for the assessment of the Barcelona target.

Consequence of a 6.5 Billion Euros Sustained Shock

Results are presented in annex to Table 15

We observe in Figure 2 the initial phase of maturation up to t+3, the multiplier effects of sustained spending: increased employment and consumption and increased imports. Once innovation begins to unfold without interruption from 2013, GDP increases steadily, since the obsolescence phase described for a one-off shock, is “erased” by the constant renewal of innovations resulting from a sustained shock. Employment no longer decreases, but only increases less because of the shift in demand.

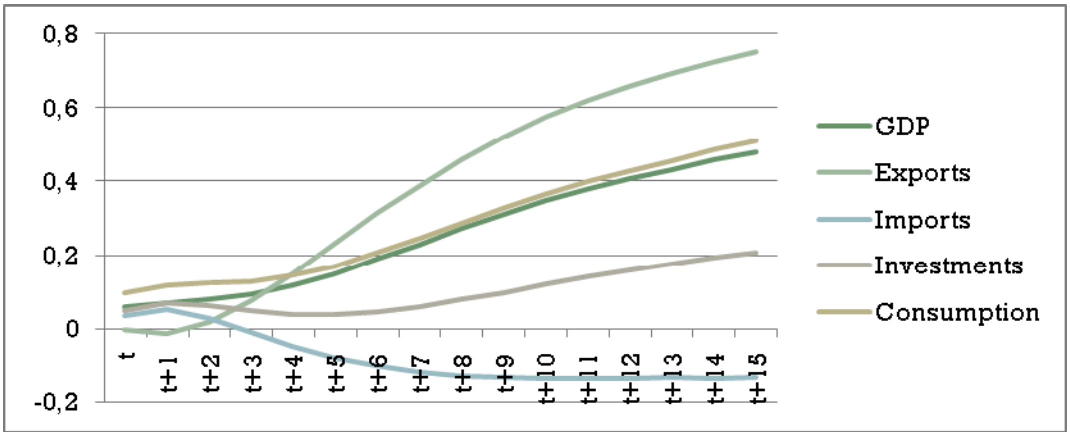


Figure 2 : Choc maintenu sur tous les secteurs (% d'écart au B.A.U.)

Observe that these are exports resulting from the continuous flow of innovations enhancing the competitiveness of European economies, which raise the GDP, and to a lesser extent the consumption due to advances in productivity (that lower prices for goods) and quality.

The results are similar to assessments for FP7 above, except that they take into account the effects of the crisis.

Instant results for 2020 and 2025 are consistent with what was expected for employment and GDP. They are relatively close to the cumulative results for a one-off shock: thus in 2025 the gap is 310,000 jobs, while cumulative jobs are 275,000 job years. The higher gap than for the work that we will discuss now measures the nonlinearity of the model for the performed variant.

Differentiated sectoral allocations

Allocation across all sectors is now dropped for an allocation still according to grandfathering rules but first on most R&D intensive sectors, then on other sectors.

R&D Concentration on R&D Intensive Sectors

Results are annexed to Table 3 and

Table 5

When concentrating R&D on intensive sectors, we get in 2025 slightly lower cumulative results for GDP and employment, i.e. 57 billion Euros and 222.000 jobs compared to 63 billion Euros and 275.000 jobs in the « all sectors » scenario.

To analyze the gap, let's have a look at the sustained shock simulations, which show instantaneous gaps close to the cumulative results of the one-off shock.

The difference between the two tables in 2025 lies essentially in the consumption level and in the external balance. Concentration of R&D efforts on industrial sectors allows for a better improvement both of exports (+0.77% compared to +0.75%) and imports (-0.16% compared to -0.13%). However consumption suffers from the lack of research and development and therefore progress in many sectors that underlie it. In addition, while almost all countries profited, yet unevenly, from the recovery effort, here mostly those countries with very R&D intensive sectors are set to profit.

A country like Germany will profit from this concentration by raising research in chemistry and capital goods and will therefore greatly improve its external balance. But as an important part of these exchanges take place with other European countries, this will worsen their situation. This will be confirmed by the next piece of work. Finally note that, compared to the previous piece of work, the difference in employment impacts mostly skilled labour, because concentration on R&D intensive sectors will improve production and employment in skilled labour intensive sectors.

R&D Concentration in Low Intensity Sectors

Results are presented in annex (Table 3 et Table 6)

It's the best variation in terms of cumulative GDP and employment: +81 billion Euros and 437 000 jobs.

To explain this, let's study the results tables relative to a sustained shock, which, in terms of gap, provide a good approximation of the cumulative effects of a one-off shock, as was already mentioned.

Cumulative GDP increases by +0.59 in 2025 as opposed to +0.48 and +0.43 for the two preceding variants. It is mostly consumption that drives growth, as exports and investment are weaker than in the previous variation. This recovery in consumption is mainly due to progress in sectors sustaining consumption, which receive most of the R&D funding. One can then imagine a virtuous cycle: improvement in productivity decreases production costs for these products, which increases their demand by consumers. Moreover, this increase in consumption is not detrimental to external balance as domestic products gain competitiveness. On top of this, there are quality effects. On the other hand, exports and external balance improve less than when investment is focused on industrial sectors. But there is an accounting reality that also explains the performance of this variation: European countries consumption accounts for 60% of European GDP whereas consolidated exports account only for 14%.

We have tried to go further in the appreciation of these phenomena by going further into the detail of the 30 sectors in NEMESIS. It appears that the main beneficiary of this policy is the "other market services" which includes both human and corporate services. This sector, whilst low in R&D intensity is very important in terms of value added (approximately 25%) and R&D volume (10% of total R&D). Therefore, this sector drives growth and one must stop and contemplate the meaning that can be attached to this result.

Recall that the β coefficients describing economics performance elasticities to knowledge (see annex 1) have been calibrated globally and modulated by sector so as to get converging marginal productivity of research across sectors. Is this hypothesis acceptable? Moreover, it appears that in this services sector, R&D spending is essentially a spending aimed at adapting innovations made in other sectors. The case of information and communications technologies (I.C.T.) is, in this respect, a case in point: R&D spending in services is mostly aimed at adopting these technologies. Therefore, one can interpret the model's results by saying that important efforts (in the form of R&D spending) must be realised to better equip services in ICT. This connects to a problematic dear to many European economists who see in the insufficient productivity in services (and therefore in the delay in ICT diffusion) a limitation to potential European growth.

Anyway, the importance of the message calls for deeper investigations.

Finally, note that this policy is the most favourable regarding unskilled labour because of the growth of sectors intensive in this kind of labour.

Conclusion

In conclusion we would like to repeat here the main messages that the work with NEMESIS allows us to deliver.

First are the results that we describe as “robust”:

- Funding by Europe of 6.5 billion Euros will entail an expenditure of at least 10 billion Euros, 3.5 billion being funded by private agents.
- The 10 billion Euros R&D spending will lead to macroeconomic changes in a succession of four phases
    - A first phase of R&D expenditure and "maturity", which will see increased employment and GDP as expenditures are incurred. This phase will be followed by a significant decline of employment and GDP, which will almost fall back to their original level when expenditures are cut.
    - A second phase of “innovation and restructuring” in which employment will decline because of productivity gains.
    - A third phase of dissemination and increased demand with GDP and employment rising again because of increased competitiveness and consumption (lower prices).
    - A phase of "obsolescence" at which innovations will be progressively affected by obsolescence and GDP and employment gradually returning to their original level.
- In total this expenditure will enable cumulatively over the period 2010-2025, to generate between 57 and 81 billion Euros of production and between 222,000 and 430,000 job years. The jobs created are 60% of unskilled jobs, thereby allowing the rejection of the hypothesis of the crowding out of unskilled jobs by research.

Other findings deserve further discussion. The key finding is that these policy assessments are best when research is concentrated in sectors less intensive in R&D. This would allow some catch-up from less advanced sectors, but also to expand demand domestic to the European market, while not adversely affecting the productivity of exposed sectors. What comes to mind is the case of services where productivity could be improved thanks to a greater effort in R & D, meaning in this case, a greater dissemination of new information and communications technologies. This issue is currently taken further in the DEMETER project with an analysis of the diffusion of "general purpose technologies” (GPT).

Annexe 1 : le progrès technique dans NEMESIS

La spécificité de Némésis est l'endogénéisation du progrès technique à travers trois phases : de la R&D au stock de savoir, du stock de savoir à l'innovation et de l'innovation à la performance économique.

Le stock de savoir

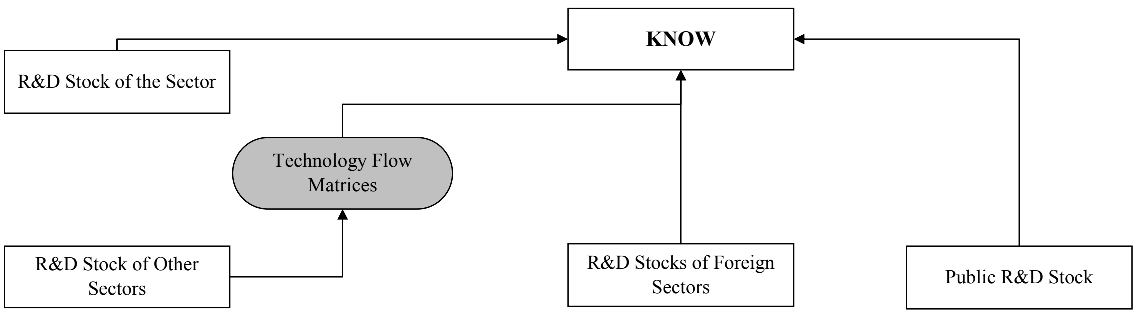
La variable qui joue un rôle essentiel dans l'endogénéisation du progrès technique dans Némésis est la variable « savoir » (KNOW) qui découle du stock de R&D. Le stock de R&D d'un secteur est déterminé par ses dépenses de R&D et par un taux de déclassement constant. il est constitué comme un stock de capital, le déclassement traduisant ici l'effacement progressif

des connaissances (figure 1).

Figure 1: De la dépense de R&D au Stock de R&D

Le « savoir » n'est pas seulement déterminé par le stock de R&D du secteur mais aussi par toutes les externalités de connaissance de tous les autres secteurs nationaux et étrangers (figure 2). Les externalités de connaissance émises par les autres secteurs dépendent de leurs stocks de R&D, par l'intermédiaire des matrices de flux technologiques. Ces matrices, différenciées par secteur et par pays, sont construites d'après la méthodologie développée par Johnson pour l'OCDE (Johnson, 2002)). Elle consiste à identifier, pour chaque brevet déposé à l'Office européen, les secteurs producteur et utilisateur de l'innovation décrite par le brevet. Cela permet ensuite de déterminer dans quelle proportion les connaissances accumulées dans un secteur vont bénéficier aux autres à travers le calcul de coefficients de transfert de connaissances, les connaissances étant, par hypothèse, ici portées par les brevets. Ce travail est réalisé à un niveau très détaillé (plus de 100 secteurs) et les résultats sont ré-agrégés dans la nomenclature sectorielle de Némésis, sous la forme de matrices de flux technologiques. Le « savoir » se nourrit également du stock de R&D des secteurs étrangers et du stock de R&D publique.

Figure 2. Le stock de connaissances



Du stock de savoir à l'innovation

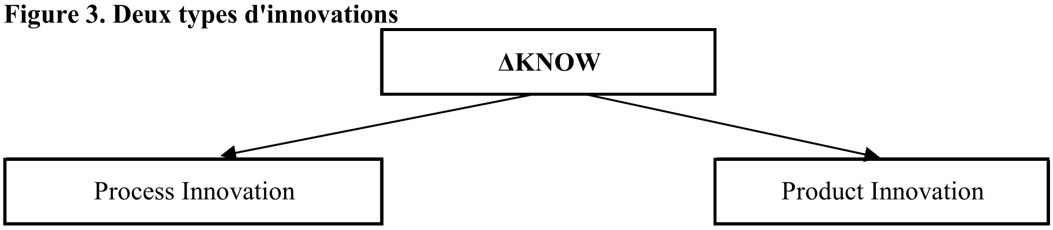
Les innovations sont déterminées par la variation du stock de savoir (figure 3). Les deux types d'innovation sont ici envisagés :

— les innovations de procédé qui augmentent la productivité globale des facteurs dans la spécification que nous avons retenue ;

— les innovations de produit qui se traduisent, dans la nomenclature fixe de la comptabilité nationale qui sous-tend Némésis, par des améliorations de qualité.

Ces deux types d'innovations agissent très différemment sur la performance économique.

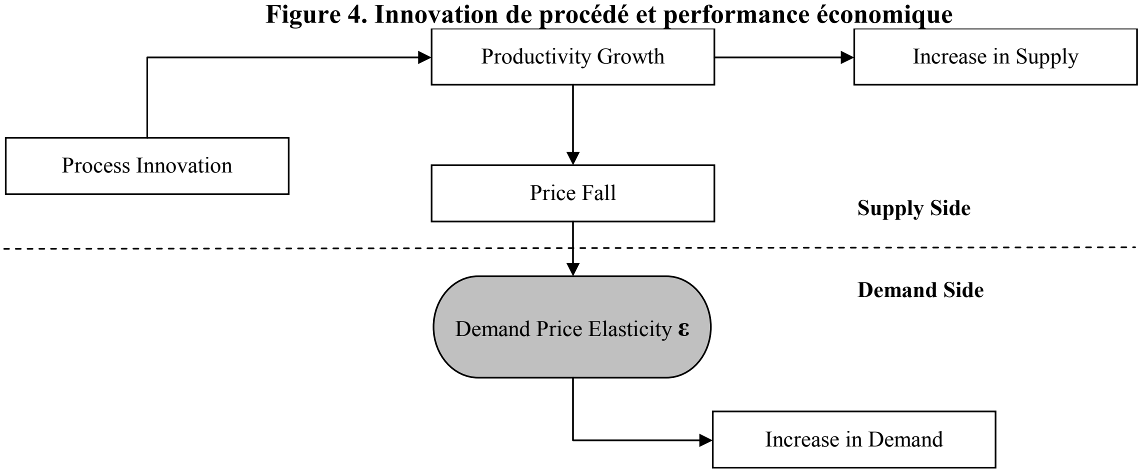
Figure 3. Deux types d'innovations



De l'innovation à la performance économique

L'innovation de procédé ne conduit pas aux mêmes effets que les innovations de produit. L'innovation de procédé augmente la productivité globale des facteurs, accroît ainsi l'offre de produits et baisse le coût unitaire de production, et donc le prix. Cette baisse de prix induit une augmentation de la demande, qui dépend de l'élasticité prix de la demande (figure 4).

Figure 4. Innovation de procédé et performance économique

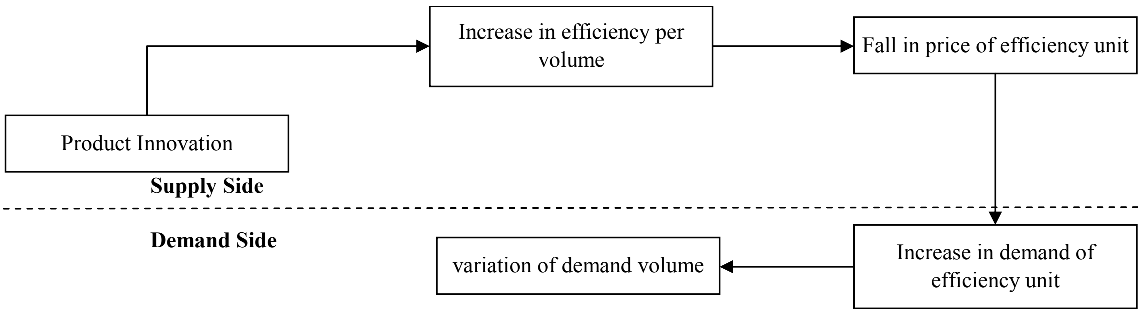


L'accroissement de la demande permet d'absorber le surcroît d'offre (à emploi constant) si l'élasticité prix de la demande est supérieure ou égale à un. Les estimations économétriques en séries chronologiques révèlent cependant une élasticité généralement inférieure à un pour chaque secteur, et donc pour l'ensemble de l'économie. Ce résultat vient de l'hypothèse d'une firme représentative par secteur : on ne considère pas la firme innovante en concurrence avec les autres entreprises de son secteur d'activité. Cela revient à supposer que l'ensemble des firmes du secteur innove et baisse ses prix. L'augmentation de la demande dépend alors de la capacité d'absorption figurée par l'élasticité inférieure à un. Dans ce cas, l'innovation de procédé diminue l'emploi des facteurs puisque les effets d'offre l'emportent sur les effets de demande.

L'innovation de produit agit comme un accroissement de l'efficience par unité de volume et augmente la demande d'unités d'efficience (figure 5). La production en volume n'est maintenue qu'à la condition que la hausse de demande pour la nouvelle efficience soit juste égale à l'augmentation de l'efficience due à l'innovation. En général, l'innovation de produit

fait plus que compenser la baisse de l'emploi de facteur due à l'innovation de procédé. Par conséquent, la R&D conduit à une augmentation du PIB et de l'emploi des facteurs simultanément.

Figure 5. Innovation de produit et performance économique



Les effets *ex ante* de l'innovation sur le PIB dépendent des effets de l'accroissement du savoir sur la productivité globale des facteurs et la qualité et, par ce biais, sur la demande : l'accroissement de la production est en effet lié aux accroissements de la demande issus de l'innovation de procédé et de l'innovation de qualité respectivement (encadré 1).

Encadré 1. Les effets des innovations sur la performance économique

→ Innovation de procédé : l'accumulation du savoir (KNOW) génère un accroissement de la productivité globale des facteurs (TFP).

$$\frac{\Delta TFP}{TFP} = a\frac{\Delta KNOW}{KNOW}$$

→ Innovation de produit : l'accumulation du savoir (KNOW) entraîne une amélioration de la qualité (QUAL).

$$\frac{\Delta QUAL}{QUAL} = a'\frac{\Delta KNOW}{KNOW}$$

→ La performance économique : l'accroissement de la production (Y) dépend de l'augmentation de la demande due aux innovations.

$$\underbrace{\frac{\Delta Y}{Y}}_{\text{Accroissement de production}} = \underbrace{\varepsilon\frac{\Delta TFP}{TFP}}_{\text{Accroissement de demande dû aux innovations de procédé}} + \underbrace{\varepsilon'\frac{\Delta QUAL}{QUAL}}_{\text{Accroissement de demande dû aux innovations de produit}}$$

soit, $\frac{\Delta Y}{Y} = (\varepsilon a + \varepsilon' a')\frac{\Delta KNOW}{KNOW} = \beta\frac{\Delta KNOW}{KNOW}$

En définitive, la performance économique, mesurée par l'accroissement de la production

due à l'accroissement de savoir, s'écrit :

$$\frac{\Delta Y}{Y} = \beta\frac{\Delta KNOW}{KNOW}$$

La plupart des études économétriques disponibles relient l'accroissement de la production

à l'accroissement du stock de R&D (SRD) selon la formule[2] :

$$\frac{\Delta Y}{Y} = \alpha\frac{\Delta SRD}{SRD}$$

La différence entre ces deux approches est une prise en compte explicite de toutes les externalités

dans la première et une prise en compte implicite ou nulle dans la seconde.

Les études économétriques (Mohnen (1990), Mairesse et Sassenou (1991), Grilliches (1992), Nadiri (1993), Cameron (1998), ...) révèlent une fourchette assez large pour le paramètre β de 0.05 à 0.2. Les résultats sont indépendants des méthodes retenues. Cependant lorsque β est estimé à partir de séries de coupe instantanée (inter-entreprises), il est plus élevé qu'à partir d'estimations chronologiques.

Dans le modèle NEMESIS, les paramètres α et β ont été calibrés de manière à reproduire la valeur désirée du β moyen. Ceci a été realisé en faisant des tests de sensibilité sur les données historiques afin de reproduire les tendances passées. Ensuite les β sectoriels ont été différenciés à en utilisant les intensités de R&D.

[2] La formule qui sert à ces estimations est $\frac{\Delta Y}{Y} = A(SRD)^{\alpha}F(K,L,...)$ En principe, α est inférieur à β

Appendix 2: The importance of externalities in NEMESIS

Knowledge externalities included in the current version of the model are international and intersectoral externalities. For the former, matrices of bilateral trade flows are used, and for the latter, matrices of exchange of patents across industries constructed using the method developed by Johnson (Johnson 2002) are used.

These methods can be improved and it is one of the DEMETER project's goals to refine international and intersectoral externalities (UNU-MERIT / ERASMUS) particularly by introducing generic technologies (General Purpose Technologies).

For now, we have repeated the same exercise as before with a modified model, first removing international externalities and then deleting externalities altogether. We compare new results to initial results.

Results without international externalities

For detailed results, see: Table 18, Table 19 and Table 20.

Without international externalities, results are clearly worse in terms of GDP since for all three cases (all sectors, intensive sectors and other sectors) GDP at t+15, drops respectively from +0.48, +0.43% and +0.59% to +0.38% +0.32% and +0.53%. The hierarchy is maintained between different sectors. Production loss is on average of about 15-20% and this gives an idea of the importance of externalities.

In contrast, employment drops respectively from +309 000, +246 000 and +450 000 to +255 000, +186 000 and +406 000, which is a lesser decline. Two reasons explain this result: first the Keynesian stimulus of the first phase, which created many jobs is exactly the same as before, then scientific progress disseminating less, gains in labour productivity are lower.

Results without any externality

For detailed results: Table 21, Table 22 and Table 23

Results without externality are obviously even worse, since for the three scenarios (all sectors, industries and other critical sectors), we get respectively +0.17% +0.14% and +0.21%. This means that, compared to the case where all externalities are taken into account, we lose about 60% of cumulative production. This shows that with this evaluation, intersectoral externalities are more important.

Employment at t+15 stands at respectively +172 000, +122 000 and +275 000. These figures call for two comments: the hierarchy between the three variants is maintained and the decrease compared to the results of simulations with externalities is less important for employment than for

GDP. This is due to labour productivity loss in the absence of externalities.

All these results must be taken with great caution. The increased importance of intersectoral externalities, in particular, should be reviewed when we will have a new and less simplistic assessment of international externalities in the DEMETER project. Similarly, the approach of General Purpose Technologies enables progress in the analysis of intersectoral trade.

Appendix 3 : Results

One-off Shocks

Table 3 : Cumulative gap for one-off shock with externalities (thousands for employment, millions for GDP)

Total employment	t+10	t+15
Tous	191.3	275.8
Intens	154.0	222.1
Non-intens	299.1	437.4

Skilled	t+10	t+15
Tous	103.0	115.5
Intens	93.1	102.4
Non-intens	134.5	159.4

Unskilled	t+10	t+15
Tous	88.1	160.2
Intens	60.8	119.7
Non-intens	164.6	277.9

GDP	t+10	t+15
Tous	44630.1	63318.0
Intens	40452.2	57365.8
Non-intens	56285.3	81273.7

Table 4 Components of GDP and employment: one-off shock with externalities, all sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.04	0.04	0.02
Exports	0.00	0.08	0.05	0.03
Imports	0.03	-0.03	0.00	0.00
Investments	0.05	0.00	0.02	0.01
Consumption	0.10	0.03	0.04	0.02
Employment	**t**	**t+5**	**t+10**	**t+15**
Total employment	164.63	-1.32	21.07	13.78
Unskilled	55.47	0.66	18.17	11.76
Skilled	109.15	-1.98	2.90	2.02

Table 5 Components of GDP and employment: one-off shock with externalities, intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.03	0.03	0.02
Exports	0.00	0.08	0.05	0.03
Imports	0.04	-0.03	-0.01	0.00
Investments	0.05	0.01	0.02	0.01
Consumption	0.10	0.02	0.03	0.02
Employment	**t**	**t+5**	**t+10**	**t+15**
Total employment	160.26	-5.71	16.95	11.49
Unskilled	54.15	-2.87	14.83	9.95
Skilled	106.10	-2.83	2.11	1.55

Table 6 Components of GDP and employment: one-off shock with externalities, non-intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.05	0.05	0.03
Exports	0.00	0.07	0.05	0.03
Imports	0.03	-0.02	0.00	0.00
Investments	0.05	0.00	0.02	0.02
Consumption	0.09	0.06	0.06	0.04
Employment	**t**	**t+5**	**t+10**	**t+15**
Total employment	178.63	10.54	34.77	23.51
Unskilled	59.80	9.82	28.62	19.28
Skilled	118.82	0.73	6.15	4.22

Tableau 7 Cumulative gap for one-off shock without international externalities (thousands for employment, millions for GDP)

Total employment	t+10	t+15
Tous	178.7	245.6
Intens	146.5	196.7
Non-intens	291.8	422.2

Skilled	t+10	t+15
Tous	103.1	113.3
Intens	94.8	101.9
Non-intens	132.5	155.8

Unskilled	t+10	t+15
Tous	75.6	132.3
Intens	51.6	94.8
Non-intens	159.2	266.3

GDP	t+10	t+15
Tous	20391.3	27590.7
Intens	18995.7	25613.6
Non-intens	24754.4	34010.7

Table 8 Components of GDP and employment: one-off shock without international externalities, all sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.03	0.03	0.02
Exports	0.00	0.06	0.04	0.02
Imports	0.03	-0.02	0.00	0.00
Investments	0.05	0.00	0.01	0.01
Consumption	0.10	0.03	0.03	0.02
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	164.6	-3.2	16.1	11.6
unskilled	55.5	-1.2	13.8	9.7
Skilled	109.1	-2.0	2.3	1.8

Table 9 Components of GDP and employment: one-off shock without international externalities, intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.02	0.02	0.01
Exports	0.00	0.06	0.04	0.02
Imports	0.04	-0.02	0.00	0.00
Investments	0.05	0.00	0.01	0.01
Consumption	0.10	0.02	0.02	0.02
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	160.3	-7.1	11.8	8.7
unskilled	54.2	-4.4	10.3	7.5
Skilled	106.1	-2.7	1.5	1.2

Table 10 Components of GDP and employment: one-off shock without international externalities, non-intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.04	0.04	0.03
Exports	0.00	0.06	0.05	0.02
Imports	0.03	-0.02	0.00	0.01
Investments	0.05	0.00	0.02	0.02
Consumption	0.09	0.05	0.05	0.04
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	178.6	8.9	32.2	22.4
unskilled	59.8	8.6	26.5	18.4
Skilled	118.8	0.4	5.7	4.0

Table 11 Cumulative gap for one-off shock without externalities (thousands for employment, millions for GDP)

Total employment	t+10	t+15
Tous	206.1	243.9
Intens	183.8	213.0
Non-intens	278.6	346.4

Skilled	t+10	t+15
Tous	118.8	126.6
Intens	111.7	117.5
Non-intens	141.1	155.9

Unskilled	t+10	t+15
Tous	87.2	117.2

Intens	72.1	95.3
Non-intens	137.4	190.4

GDP	**t+10**	**t+15**
Tous	35760.4	50656.8
Intens	31165.7	43851.5
Non-intens	50461.2	72783.1

Table 12 Components of GDP and employment: one-off shock without externalities, all sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	**t+5**	**t+10**	**t+15**
GDP	0.06	0.01	0.01	0.01
Exports	0.00	0.02	0.01	0.01
Imports	0.03	-0.01	0.00	0.00
Investments	0.05	0.00	0.01	0.01
Consumption	0.10	0.01	0.01	0.01
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	164.6	0.3	7.5	7.7
unskilled	55.5	0.3	5.9	6.1
Skilled	109.1	0.1	1.5	1.6

Table 13 Components of GDP and employment: one-off shock without externalities, intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	**t+5**	**t+10**	**t+15**
GDP	0.06	0.01	0.01	0.01
Exports	0.00	0.02	0.02	0.01
Imports	0.04	-0.01	0.00	0.00
Investments	0.05	0.01	0.01	0.01
Consumption	0.10	0.01	0.01	0.01
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	160.3	-1.5	5.5	6.2
unskilled	54.2	-1.2	4.4	4.9
Skilled	106.1	-0.3	1.1	1.2

Table 14 Components of GDP and employment: one-off shock without externalities, non-intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.02	0.02	0.01
Exports	0.00	0.01	0.01	0.00
Imports	0.03	0.00	0.00	0.01
Investments	0.05	0.00	0.01	0.01
Consumption	0.09	0.03	0.02	0.02
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	178.6	8.3	14.5	13.0
unskilled	59.8	6.6	11.3	10.2
Skilled	118.8	1.7	3.1	2.8

Sustained Shocks

Table 15 Components of GDP and employment: sustained shock with externalities, all sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.15	0.35	0.48
Exports	0.00	0.23	0.57	0.75
Imports	0.03	-0.08	-0.13	-0.13
Investments	0.05	0.04	0.12	0.21
Consumption	0.10	0.17	0.36	0.51
Employment	**t**	**t+5**	**t+10**	**t+15**
Total employment	164.6	69.7	190.6	309.9
Unskilled	55.5	-16.0	91.9	194.7
Skilled	109.1	85.7	98.6	115.2

Table 16 Components of GDP and employment: sustained shock with externalities, intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.14	0.32	0.43
Exports	0.00	0.25	0.59	0.77
Imports	0.04	-0.09	-0.16	-0.16
Investments	0.05	0.05	0.13	0.21
Consumption	0.10	0.14	0.29	0.41
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	160.26	60.58	150.35	246.40
Unskilled	54.15	-21.11	61.33	145.05
Skilled	106.10	81.69	88.98	101.34

Table 17 Components of GDP and employment: sustained shock with externalities, non-intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.17	0.40	0.59
Exports	0.00	0.19	0.53	0.74
Imports	0.03	-0.06	-0.09	-0.05
Investments	0.05	-0.02	0.04	0.16
Consumption	0.09	0.24	0.52	0.76
Employment	**t**	**t+5**	**t+10**	**t+15**
Total employment	178.63	80.65	249.16	450.16
Unskilled	59.80	-13.77	133.21	302.16
Skilled	118.82	94.42	115.90	147.99

Table 18 Components of GDP and employment: sustained shock without international externalities, all sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.12	0.27	0.38
Exports	0.00	0.16	0.43	0.57
Imports	0.03	-0.04	-0.09	-0.08
Investments	0.05	0.03	0.08	0.15
Consumption	0.10	0.15	0.30	0.42
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	164.6	78.1	162.8	255.4
unskilled	55.5	-10.1	65.7	144.9
Skilled	109.1	88.2	97.0	110.4

Table 19 Components of GDP and employment: sustained shock without international externalities, intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.11	0.23	0.32
Exports	0.00	0.17	0.43	0.56
Imports	0.04	-0.05	-0.10	-0.11
Investments	0.05	0.04	0.08	0.13
Consumption	0.10	0.12	0.23	0.31
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	160.3	70.0	120.4	186.7
unskilled	54.2	-14.8	32.8	90.5
Skilled	106.1	84.9	87.6	96.2

Table 20 Components of GDP and employment: sustained shock without international externalities, non-intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.15	0.36	0.53
Exports	0.00	0.15	0.45	0.64
Imports	0.03	-0.04	-0.07	-0.02
Investments	0.05	-0.01	0.04	0.16
Consumption	0.09	0.21	0.46	0.68
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	178.6	83.7	225.0	406.2
unskilled	59.8	-10.9	112.6	264.4
Skilled	118.8	94.7	112.4	141.8

Table 21 Components of GDP and employment: sustained shock without externalities, all sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.08	0.13	0.17
Exports	0.00	0.04	0.14	0.19
Imports	0.03	0.01	-0.02	-0.03
Investments	0.05	0.06	0.07	0.10
Consumption	0.10	0.11	0.16	0.20
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	164.6	128.0	142.8	172.9
unskilled	55.5	25.0	38.6	64.0
Skilled	109.1	103.0	104.2	109.0

Table 22 Components of GDP and employment: sustained shock without externalities, intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.07	0.11	0.14
Exports	0.00	0.05	0.15	0.21
Imports	0.04	0.00	-0.04	-0.06
Investments	0.05	0.07	0.09	0.11
Consumption	0.10	0.09	0.12	0.14
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	160.3	117.2	112.1	122.6
unskilled	54.2	18.4	16.4	26.1
Skilled	106.1	98.8	95.6	96.6

Table 23 Components of GDP and employment: sustained shock without externalities, non-intensive sectors (as % gap from BAU scenario for GDP, and thousands jobs gap for employment)

	t	t+5	t+10	t+15
GDP	0.06	0.08	0.13	0.21
Exports	0.00	0.00	0.09	0.16
Imports	0.03	0.02	0.01	0.05
Investments	0.04	0.03	0.05	0.12
Consumption	0.09	0.14	0.22	0.33
Employment	**t**	**t+5**	**t+10**	**t+15**
Total	178.6	139.8	173.2	275.7
unskilled	59.8	28.4	58.0	143.2
Skilled	118.8	111.4	115.1	132.5

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