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Assessment of the 2008 Reform of the Research Tax Credit

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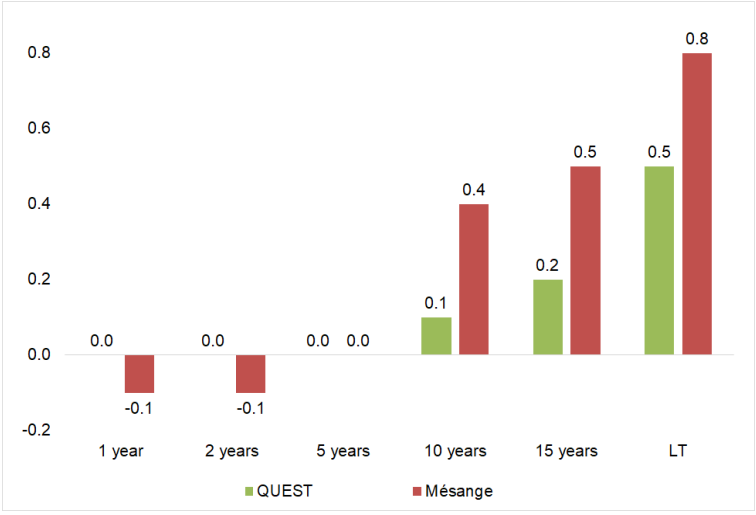
- The research tax credit (CIR), which was introduced in France in 1983, is a tax scheme to support businesses' R&D. The amount of the tax credit is calculated on the basis of R&D expenditure and offset against corporation tax. The measure underwent a reform in 2008, at which point the tax credit stopped factoring in the increase in expenditure in order to be calculated solely on the volume of expenditure, at a rate of 30% up to €100m and 5% thereafter.

- The 2008 reform generated a sharp rise in government expenditure in support of private-sector R&D. Subsequently, accrued research tax credits jumped from €1.8bn in 2007 to €6.5bn in 2018, thus making the tax credit the main R&D support scheme available to businesses in France. By stimulating companies' R&D expenditure, the reform fosters both innovation and productivity, which are crucial for long-term growth and competitiveness.

- Existing studies highlight the positive impact of the research tax credit reform at the microeconomic level, especially in terms of R&D expenditure and productivity of beneficiary companies. In 2019, the French Innovation Policy Assessment Commission (CNEPI) published initial microeconomic assessments which set forth an additionality effect following the 2008 reform, namely that one euro of research tax credit leads to one additional euro of private-sector R&D expenditure. As such, the reform has helped increase the level of private-sector R&D expenditure in France. Nevertheless, the CNEPI's most recent report in 2021 found that the effects of the reform have been heterogeneous depending on company size, substantial for firms with less than 250 employees but non-significant for larger businesses.

- When assessed using the DG Trésor's Mésange model, it is estimated that the reform will have increased economic activity by 0.5 percentage points of GDP and enabled the creation of 30,000 jobs after 15 years, as its impact on the economy is felt with a lag. In the longer term, the reform should boost activity by 0.8 percentage points of GDP and create 60,000 jobs. These effects take account of the funding of the reform through a cut in government expenditure, excluding the research tax credit. That said, they are still shrouded in great uncertainty.

Long-term impact of the 2008 research tax credit reform on activity, factoring in financing (as percentage points of GDP, relative to a baseline scenario)



Source: DG Trésor calculations.

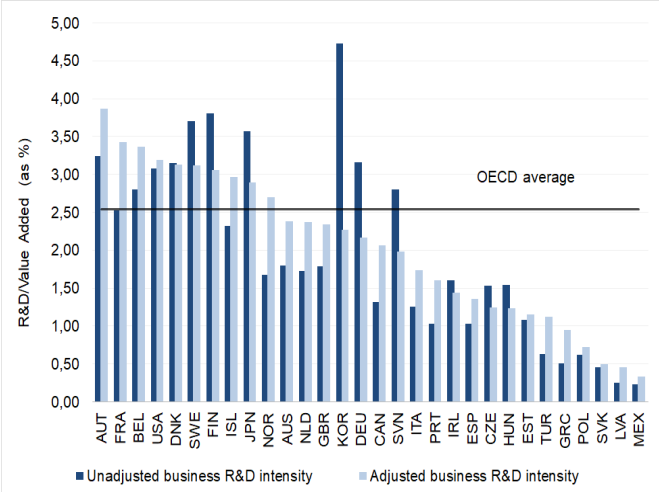
1. Innovation is central to long-term growth

Innovation is key to long-term growth and competitiveness. As R&D fosters innovation, it creates positive externalities in the form of benefits for society as a whole which are not considered by businesses when they make their R&D investment decisions. This means that without government intervention, these investments would be less than their socially optimal level. The research tax credit enables R&D investments by private-sector companies to come closer to their optimal level.

Since the adoption of the Lisbon Strategy in 2000, EU Member States have agreed to increase their public- and private-sector domestic expenditures on R&D to at least 3% of their GDP. In 2018, these expenditures reached 2.19% of GDP in France, meaning that they are just below the OECD average (2.42%), against 3.12% for Germany and 3.28% for Japan. France is lagging behind due to domestic business enterprise expenditure on R&D (BERD), which was worth 1.44% of GDP in 2018 compared to an average of 1.72% in OECD countries. From an accounting perspective, this gap results from the fact that the French industrial structure is made up of low- and medium-tech industries (agri-food, wood, etc.) where opportunities for R&D investments are more scarce. Once adjusted for this industrial structure, French industry is R&D intensive, with figures well above the average for OECD countries (see Chart 1). As an example, if France had Germany's economic structure, French companies' R&D investments would represent almost 2.6% of GDP,[1] which is well above the original Lisbon target of 2%. However, the structure of the French economy may also be partly attributable to the historic R&D strategies of industrial companies.

The research tax credit is now the core component of the government's private-sector innovation support policy. Following the 2008 reform, the cost of the tax credit rose sharply from €1.8bn in 2007 to €6.5bn in 2018. The increase has made it the main tax incentive measure available to businesses[2] and thus it is all the more important to assess its effectiveness.

Chart 1: Business R&D intensity adjusted for industrial structure



Source: OECD Science Technology and Industry Scoreboard 2017. A country's industrial structure-adjusted indicator of R&D intensity is a weighted average of its sectoral R&D intensities (ratio of R&D to value added), with the OECD industrial structure (sectoral share in OECD value added for 2015) being used as weighting across all countries. The unadjusted measure of R&D intensity is an average based on each country's sector ratio of R&D to value added and, thus, does not always correspond to domestic BERD ratios (the calculation fields are also different).

However, it is especially complicated to highlight the specific impact of the research tax credit and its reform. As it is a very broad and non-discriminatory measure (according to the business sector or type of research), it is hard to determine a counterfactual scenario without making strong assumptions, and it is also difficult to compare beneficiary businesses with a sample group of companies that do not benefit from the research tax credit but which have similar features. Furthermore, the effects of innovation on economic variables, such as productivity, are notoriously difficult to gauge, and the variables used to measure innovation are often flawed (number of patents, marketing new products, etc.).

In March 2019, the CNEPI published an assessment report on the research tax credit[3] after the 2008 reform. A number of research articles published as part of this report support previous findings pointing to the tax credit having an effect of additionality on businesses' R&D expenditure: one euro of research tax credit leads to one additional euro of R&D expenditure that would

(1) Balcone T. and C. Schweitzer (2019), "La recherche et développement des entreprises françaises au sein de l'Union Européenne : spécificités sectorielles et financement public", *Insee Référence*.
(2) This has been the case since the Competitiveness and Employment Tax Credit (CICE) was converted into a reduction of social security contributions in 2019.
(3) "L'impact du crédit d'impôt recherche", CNEPI report, March 2019.

not have been incurred had the scheme not existed.[4] Taking stock of the results found by microeconomic studies, we will make a macroeconomic assessment of the impact of the 2008 reform, looking at the economy as a whole and factoring in feedback effects.

Box 1: The 2021 assessment report on the research tax credit by the CNEPI

In 2021, the CNEPI published a new report that compiles various assessments of the impact of the 2008 research tax credit reform,[a] which replaced a complex system based on both the increase in and the volume of R&D expenditure with one based solely on volume (see 2.2 for details of the reform).

The study from the Public Policy Institute (IPP)[b] suggests a heterogeneous impact of the reform on the economic performance of businesses depending on their size. It is thought that the tax credit has had a positive effect for small and medium enterprises (SMEs, *i.e.* around 34% of accrued research tax credits), with a 15% uptick in turnover due to the reform and a 0.4% rise in the investment rate in intangibles.[c] On the other hand, the report notes that the scheme has had no effect on companies with more than 250 employees.

A second study from NEOMA Business School[d] concludes that, although the French research tax credit is more generous than the equivalent arrangements of France's trading partners, the performance of French groups is not visibly better than that of their international competitors. Factoring in the sector and size of the company, French groups seem to be experiencing the same relative decline as groups in neighbouring European countries, compared with the strong growth of Chinese and American firms. Drawing on a set of audits, the report shows that, whilst French multinationals do consider the role of the research tax credit when deciding where to locate R&D investments, they also take into account access to human capital, the role of intellectual property, public-sector research and the transfer of high-quality technology.

Lastly, a study from SEURECO[e] uses the NEMESIS model to provide an assessment of the macroeconomic impact of the research tax credit. Among the set of scenarios put forward, the estimate of the impact of the 2008 reform (assuming that this reform is final) is comparable, in theory, to the estimates advanced below. With this modelling, the short-term impact of the reform on activity is weak as the economic gains of R&D take time to occur. On the other hand, estimates of the reform's longer-term impact are much higher in NEMESIS than those in the Mésange and QUEST macroeconomic models that are set out below (see chart on cover page). After 15 years, it is estimated that the reform will have increased GDP by 1.1 percentage points (compared to 0.2 in QUEST and 0.5 in Mésange with financing) and, in the long term, the reform could generate an increase of 1.6 points of GDP (compared to 0.5 in QUEST and 0.8 in Mésange with financing).

a. "Évaluation du crédit d'impôt recherche", CNEPI report, June 2021.
b. Bach L., Bozio A., Guillouzouic A., Malgouyres C., N. Serrano-Velarde (2021), "Les impacts du CIR sur la performance économique des entreprises", IPP report no. 33.
c. It should be noted that the 2008 research tax credit reform was conducted during an economic crisis and that the observation period for the estimate of the causal impact of the reform ended four years later in 2012. This could skew the results: as R&D is a long-term investment, it could be that the effects of the reform had not yet fully occurred during these four years.
d. Lhuillery S., Menu S., Tellechea M., S. Thiéry (2021), "La R&D des groupes français et le CIR", *working document*.
e. Pierre Le Mouël and Paul Zagamé (2021), "Évaluation économique du renforcement du CIR : Exercice de simulation avec le modèle NEMESIS".

(4) CNEPI report, *op. cit*.
Mulkay B. and J. Mairesse (2018), "Nouveaux résultats sur l'impact du Crédit d'Impôt Recherche", study for the Ministry for Higher Education, Research and Innovation (MESRI).
Lopez J. and J. Mairesse (2018), "Impacts du CIR sur les principaux indicateurs d'innovation des enquêtes CIS et la productivité des entreprises", study for the MESRI.
Bozio A., Cottet S. and L. Py (2019), "Évaluation d'impact de la réforme 2008 du crédit d'impôt recherche", IPP report no. 22.

2. Government support for R&D and innovation

2.1 Economic justification and the diverse nature of government support for private-sector R&D

The rationale for public intervention to support private-sector R&D is that innovation gives a higher social yield than a private one. R&D is non-rival (the same technology may be used by several people) and non-exclusive (ideas can be disseminated at zero cost), and this creates major externalities: a researcher can improve their productivity by capitalising on discoveries made by other researchers. Arrow (1962)[5] and Nelson (1959)[6] show that innovation's positive effects on the economy are not internalised by businesses as they cannot claim ownership of them. There are two types of innovation externalities. Firstly, the dissemination of innovation by technology and knowledge spillovers[7] and, secondly, the product market rivalry effect prompting firms to innovate in order to avoid losing market share to competitors. Despite problems with measurement accuracy, many studies have confirmed the existence of innovation externalities using both microeconomic[8] and macroeconomic[9] data. Without government intervention, companies' investments in innovation would remain too low, *i.e.* under the socially optimal level.[10]

To bring private R&D investments closer to their socially optimal level, government support for innovation can take various forms.[11] A significant criterion for support for R&D and innovation is the distinction between "vertical" and "generic" support. Vertical support consists in funding targeted R&D projects (choice of a specific stakeholder, technology or sector). For instance, the Fourth Invest for the Future Programme, with appropriations of €20bn over five years, has a "targeted component" for financing technologies of the future on specific strategic markets. Conversely, generic support funds all R&D expenditure without prior selection. The research tax credit belongs to this second category.

Generic support avoids altogether avoids issues of information asymmetry when selecting innovative projects. Indeed, the government is generally not better informed than the market and could make poor choices in terms of sectors, technologies or businesses.[12] However, this support has a drawback in that it provides little guidance for the economy's industrial structure in developed countries when dealing with "major societal goals".[13] This is particularly true for environmental issues, which are combined with substantial ratchet effects: businesses have now invested so much in "brown" R&D and the cost of converting to "green" R&D – the cost of changing path – would be high.[14] This means that only funding cross-cutting R&D will not help to change production paths and could even heighten the ratchet effect, unlike targeted support for "green" R&D.[15] This is why there needs to be balance between vertical and horizontal policies.

2.2 The research tax credit is the main R&D support scheme in France

France has one of the most generous government support systems among OECD countries. In 2017, public funding of private-sector R&D, in the form of

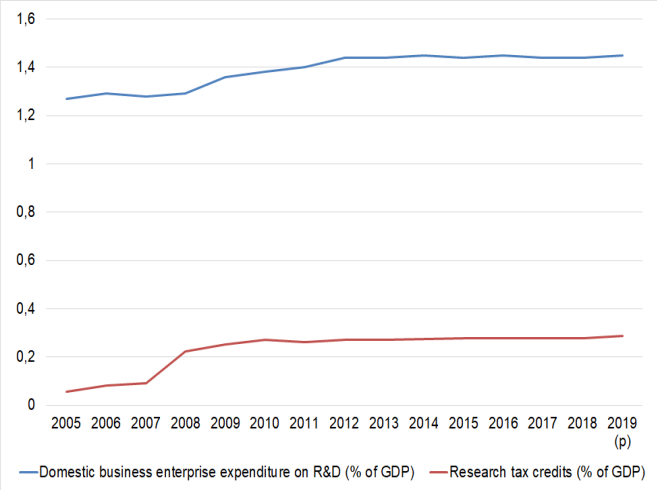
(5) Arrow K. (1962), "Economic Welfare and the Allocation of Resources for Invention", in *The Rate and Direction of Inventive Activity*, Princeton University Press, 609-625.
(6) Nelson R. R. (1959), "The Simple Economics of Basic Scientific Research", *Journal of Political Economy*, 77:297-306.
(7) These spillovers often take place informally, within the boundaries laid down by the legal framework governing intellectual property, by product dissemination, integrated value chains or worker mobility.
(8) Hall B. H., Mairesse J. and P. Mohnen (2010), "Measuring the Returns to R&D", in *Handbook of the Economics of Innovation*, 2:1033-1082, North-Holland.
(9) Coe D. T. and Helpman E. (1995), "International R&D Spillovers", *European Economic Review*, 39(5), 859-887.
(10) Bloom N., Schankerman M. and J. Van Reenen (2013), "Identifying Technology Spillovers and Product Market Rivalry", *Econometrica*, 81(4):1347-1393. Jones C. I. and J. C. Williams (1998), "Measuring the Social Return to R&D", *The Quarterly Journal of Economics*, 113(4).
(11) To compare the benefits and drawbacks of the different types of R&D support schemes, Bloom N., J. Van Reenen and H. Williams (2019), "A Toolkit of Policies to Promote Innovation", *Journal of Economic Perspectives*, 33 (3)
(12) Against the backdrop of post-war planning, the government had a structuring role in providing huge and highly selective funding to certain industrial sectors (nuclear, aeronautics, IT and communication, etc.), with mixed outcomes.
(13) Mazzucato M. (2013), "The Entrepreneurial State".
(14) Aghion P., Dechezleprêtre, A., Hémous D., Martin R. and J. Van Reenen (2016), "Carbon Taxes, Path Dependency, and Directed Technical Change: Evidence from the Auto Industry", *Journal of Political Economy*, vol. 124(1).
(15) A carbon tax and, more broadly, environmental regulations, could also help increase the volume of "green" R&D (by raising the cost of investing in "brown" R&D). See, for instance Calel R. and Dechezleprêtre (2016), "Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market", *Review of Economics and Statistics* 98(1).

direct support and tax incentives, amounted to 0.4% of GDP in France versus 0.21% in the United States and 0.07% in Germany.[16]

The research tax credit, which was introduced in 1983, is a tax scheme that is offset against corporation tax and calculated on the basis of businesses' R&D expenditure.[17] Prior to the 2008 reform, the tax credit was based on both the volume of and the increase (when applicable) in R&D expenditure. The rate applied to the volume of expenses was 10% whilst the rate applied to the increase in expenses was 40%. There was also a €16m cap on the research tax credit per company. The reform eliminated the proportion calculated on the increase in expenses; the research tax credit is now calculated on volume alone, at a rate of 30% up to €100m and 5% thereafter. After 2008, the scope of the scheme and a number of its rules changed slightly. In 2013, the research tax credit was extended to include innovation expenditure, such as the cost of prototype design for new products, for SMEs. This is known as the innovation tax credit (CII),[18] the macroeconomic impact of which is not addressed in this paper.

Between 2005 and 2019, French domestic BERD rose from €22.5bn to €32.2bn, or from 1.27% to 1.45% of GDP (see Chart 2). There was also a rise in accrued research tax credits from 0.1% of GDP in 2007 to 0.3% in 2019, with the sharpest increase having taken place between 2007 and 2008 when the reform was introduced, followed by a levelling out after 2013.

Chart 2: Domestic BERD and research tax credits 2005 to 2019 (as % of GDP)



Source: MESRI - Information Systems and Statistical Studies (SIES) and Insee. (p) provisional data.

3. Macroeconomic effects and assessment of the 2008 research tax credit reform

3.1 Expected theoretical effects and modelling of the reform

The macroeconomic effect of the reform has been modelled using the Mésange macroeconometric model,[19] which factors in both the direct impact of the reform and the resulting feedback effects. The reform was modelled in the form of exogenous shocks on productivity and on the cost of skilled labour and capital, with a final shock being added to take into account financing.

In the short term, an increase in the generosity of the research tax credit is equivalent to a fall in the cost of R&D, which can be broken down into a lowering of the labour cost, the cost of capital and the cost of operating expenses.[20] This reduction in the cost of R&D results in an increase in the R&D expenditure of businesses which is particularly intensive in skilled workers. Consequently, the rise in private-sector R&D expenditure breaks down into an increase in investment in capital and a higher demand for skilled workers.

Once the 2008 reform reached its full effect, it led to an increase in accrued research tax credits of 0.19 points

(16) As the data is from 2017, it does not factor in Germany's 2020 introduction of a research tax credit, whose arrangements are less generous than the French scheme.
(17) The research tax credits accrued by a business for a given year can be partly set off against the corporation tax during the subsequent four years. As a result, the government's annual research tax credit expenditure differs from the credis declared by businesses for the corresponding year.
(18) Up to a ceiling of €400,000, the innovation tax credit applies to eligible expenditure at a rate of 20%. The fiscal cost of the scheme is around €200m per annum.
(19) Dufernez A. S. *et al.* (2017), "Le modèle macroéconométrique Mésange : réestimation et nouveautés", *DG Trésor working document* no. 2017-04.
(20) Broken down between capital and labour in proportion to their respective share of R&D expenditure excluding operating expenses.

of GDP[21] and contributed to lowering the cost of R&D by an equivalent amount. Payroll accounts for around 80% of R&D expenses with the remaining 20% being capital expenditure.[22] Taking this labour/capital breakdown for businesses, the 2008 reform can be modelled as a reduction of the labour cost for skilled workers of approximately 0.16 points of GDP[23] and a cut in the cost of capital of roughly 0.03 points of GDP,[24] once the stationary state has been reached.

In the long term, the increase in R&D expenditure leads to product innovation (better standard of products, development of new ones) or process innovation (improvement in the quality and efficiency of production processes), which boosts businesses' productivity.[25] Lopez and Mairesse (2018)[26] estimate that the reform led to an average 1.7% increase in apparent labour productivity for beneficiary companies and that the impact was felt after five years.

Innovation is not only beneficial to firms involved in R&D but also, more broadly and via indirect effects, to the economy as a whole (see 2.1). To factor in the externalities of innovation, we are assuming that the labour productivity of businesses that do not benefit from the research tax credit increases at a proportion that is half that of beneficiary companies.[27] This shock is applied to sectors in which R&D intensity, measured by the ratio of R&D expenditure to the sector's value added, is higher than that of the French economy[28] (manufacturing, information and communication sectors, and specialised, scientific and technical business activities).

Overall, it is estimated that the 2008 research tax credit reform has generated a 0.35% increase in labour productivity for the wider economy, that is to say the total direct effects of innovation[29] (0.25%) and its knock-on effects[30] (0.10%). This can be modelled as a rise in the efficiency of labour starting from the fifth year so that apparent labour productivity increases by 0.35% in the long term.

In order to hold government expenditure constant, financing of the reform was conventionally modelled in Mésange as a reduction of generic public spending[31] in the commensurate amount of the excess research tax credits accrued as a result of the reform, *i.e.* 0.19 percentage points of GDP once it reached its full effect.[32]

3.2 Macroeconomic effects of the reform

Factoring in financing (see chart on cover page), the 2008 research tax credit reform is thought to have had:

- a slightly adverse short-term effect on activity of –0.1 percentage points of GDP, which becomes positive after the fifth year. This is due to the combination of the slow materialisation of the impact of R&D on productivity and the short-term negative impact of the reduction of government expenditure used to fund the research tax credit.

(21) These are the excess research tax credits accrued in 2017 versus their 2008 level (the implicit assumption is that, in a scenario without the reform, the amount of these tax credits would be deemed to have been constant since 2008). The calculation was made using data from the Public Finances Directorate General.
(22) According to a DG Trésor estimate based on data from the Ministry for Higher Education, Research and Innovation, the proportion of R&D expenditure relating to capital accounted for 17% of the total amount in 2016 whereas the proportion of expenditure on salaries was 83%.
(23) This represents a 0.5% reduction in the labour costs of skilled workers compared to their initial value.
(24) This represents a 0.4% reduction in the cost of capital compared to its initial value.
(25) Griffith R., Huergo E., Mairesse J. and B. Peters (2006), "Innovation and Productivity Across Four European Countries", *Oxford Review of Economic Policy*, 22(4):483-498.
Crépon B., Duguet E. and J. Mairesse (1998), "Research, Innovation and Productivity: An Econometric Analysis at the Firm Level", *Economics of Innovation and New Technology*, 7(2):115-158.
(26) Op. cit.
(27) Ugur M., Churchill S. and H. Luong (2020), "What Do We Know About R&D Spillovers and Productivity? Meta-Analysis Evidence on Heterogeneity and Statistical Power", Research Policy, 49. By comparing the impact of externalities in almost 60 empirical studies, the authors consider that the average effect is half of that noted in companies that carry out their own R&D.
(28) Balcone T. and C. Schweitzer (2019), "La recherche et développement des entreprises françaises au sein de l'Union européenne : spécificités sectorielles et financement public", *Insee Références*.
(29) Namely the aggregate impact of a 1.7% productivity shock for businesses benefiting from the research tax credit by weighting their share in each sector by headcount and by weighting the sectors in GDP by value added.
(30) Namely the aggregate impact of a 0.85% productivity shock for businesses not benefiting from the research tax credit that belong to sectors in which R&D intensity is greater than that of the French economy.
(31) The reduction in generic public spending is broken down as follows: 8% on public investment, 25% on public-sector compensation, 9% on the social benefits in kind of the general government sector, 12% on the intermediate consumption expenditure of the general government sector, 46% for social benefits other than in kind. See p. 105 of the *DG Trésor Working Document* no. 2017-04 on the Mésange model.
(32) Here, the reduction of government expenditure is simulated with a 15-year period for the effect to fully materialise following rollout of the reform.

- a positive medium-term effect on activity: by 2023, 15 years after the reform was introduced, it is estimated that GDP will have increased by 0.5 points mainly thanks, to the impact of innovation on labour productivity. The reform should also benefit employment as, within the same timeline, almost 30,000 jobs could have been created.
- a positive long-term effect on activity, as the 2008 reform should enable 60,000 jobs to be created and for activity to be boosted by 0.8 points of GDP.

Box 2: Assessment of the 2008 research tax credit reform using the QUEST model

QUEST is a dynamic stochastic general equilibrium model that was developed and is used by the European Commission to analyse the Member States' macroeconomic policies.[a] For our assessment, we used the QUEST III R&D version, with settings for France. Unlike Mésange, this model includes an R&D sector, and technical progress in the model is semi-endogenous. The R&D sector employs highly skilled workers[b] and uses available stocks of knowledge to create new patents which are held by households that are not liquidity constrained. In the model, an increase in the amount of tax credits for R&D enables a reduction in the royalties required by these households from businesses for making their intangible capital (their patents) available. This leads to a reduction in these businesses' fixed costs, as is the case with the research tax credit. This means that demand for new patents rises, which stimulates R&D and causes highly skilled workers to be reassigned from production to research.[c] In the long term, as with the results from the Mésange model, this reform bolsters productivity and therefore GDP as well as the wages of these highly skilled workers.

Against this backdrop, the 2008 research tax credit reform was modelled by a permanent increase in the amount of tax credits for R&D, namely a shock of 0.19 points of GDP in 2018, after taking a few years to fully materialise. The increase is financed by a gradual rise in the flat-rate tax paid by households in order to comply with the fiscal rule.[d] This tax hike does not immediately cover the amount required to fund the entire measure, but the fiscal rule is such that the general government balance returns to its initial level in under 10 years.

In the short term, the 2008 reform could have enabled the cration of 30,000 jobs but does not appear to have had an impact on growth (see chart on cover page). Fifteen years later, it is estimated that the reform will allow for 20,000 job creations and will increase activity by 0.2 percentage points of GDP relative to a baseline scenario. In the long term, it is thought that the reform will lead to a 0.5 point increase in GDP and 20,000 jobs relative to a scenario without the reform.

a. Roeger W., Varga J. and J. in 't Veld (2008), "Structural Reforms in the EU: A Simulation-Based Analysis Using the QUEST Model with Endogenous Growth", *European Economy Economic Paper*, 351.
D'Auria F., Pagano A., Ratto M. and J. Varga (2009), "A Comparison of Structural Reform Scenarios Across the EU Member States: Simulation-Based Analysis Using the QUEST Model with Endogenous Growth", *European Economy - Economic Paper* no. 392.
b. A representative research institute sets the level of employment so as to maximise profit given the level of wages, the stocks of knowledge available and the adjustment costs relating to hiring new workers.
c. This mechanism slows down the materialisation of the impact on GDP: because the supply of highly skilled labour is limited, the sector manufacturing final goods is penalised by this reassignment of workers to research.
d. The fiscal rule ensures the long-term budgetary neutrality of public policies as the flat-rate tax adjusts so that the debt reaches its long-term target.

The results, when modelling the reform without factoring in financing, point to the fact that, with a 15-year timeline, an increase of around 0.6 percentage points of GDP would have been generated. By way of comparison, the impact estimated by the NEMESIS macroeconomic model, in the context of the CNEPI's most recent report in 2021 (see Box 1), would be almost twice as large. In addition, the outcomes using the Mésange model and honed on the basis of recent economic literature are in line with the ex-ante estimate put forward by DG Trésor in 2009. That estimate pointed to an impact of the non-financed reform of between 0.3 and 0.6 points of GDP after 15 years.[33]

The foregoing suggests that the impact of the research tax credit reform could be taking a fairly long time to be felt and estimates of this impact are still shrouded in

(33) See Cahu P., Demmou L. and E. Massé (2009), "The Economic Impact of the 2008 Research Tax Credit Reform", *Trésor-Economics* no. 50.

major uncertainty. Besides the specific modelling of the R&D sector, which exists in QUEST but not in Mésange, assessment of the reform using the latter model is broadly based on the calibration of the efficiency shock, which was carried out using a single microeconomic assessment with little temporal perspective.[34]

Furthermore, the assessment is limited to the impact of the research tax credit reform taken as an increase in the generosity of the scheme. This macroeconomic assessment does not factor in the possible benefits gleaned from the change in how the scheme functions, namely the changeover from calculations essentially based on the increase in R&D expenditure to ones based on volume. The former calculation method could have led to several adverse effects:[35] i) an incentive to stagger rather than smooth out R&D investment, ii) an inefficient incentive to segment R&D across subsidiaries and subcontractors, iii) complexity which could compromise full use of the scheme by some firms.

(34) Lopez and Mairesse (2008), *op. cit.*
(35) For an analysis of the adverse effects of the previous research tax credit calculation method, see *Trésor-Economics* no. 50, *op. cit.*

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