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Is CICE, the French tax credit scheme, a support for R&D activities? An ex post evaluation of the CICE

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Is CICE, the French tax credit scheme, a support for R&D activities? An *ex post* evaluation of the CICE[1]

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Abstract

The most important economic policy measure of the Hollande presidency in France is the Competitiveness Employment Tax Credit (CICE). Introduced in 2013 with an initial tax credit of 4% on wage bill bellow 2.5 times the minimum wage (SMIC) the rate of CICE has been increased to 6% in 2014. The CICE is weakly targeted as far this tax credit can be used for almost all purposes among them R&D activities. The purpose of this paper is to assess the impact of CICE on R&D activities. This is the first paper investigating the *ex post* effects of CICE on R&D. We use comprehensive French administrative firms-level datasets and the R&D survey over 2009-2014. We apply difference-in-difference combined with instrumental variables methods to control for endogeneity of the CICE. We find no effects of CICE on R&D expenditures in 2013 and 2014.

***Key worlds*:** Treatment evaluation models, Business Taxes and Subsidies, Public policy, Research and Development

JEL Classification: C21, H25, J38, O30

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Introduction

The most important economic policy measure of the Hollande presidency in France is the Competitiveness Employment Tax Credit (CICE). Introduced in 2013 with an initial tax credit of 4% on wage bill bellow 2.5 times the minimum wage (SMIC) the rate of CICE has been increased to 6% in 2014. The CICE concerns most of the firms (more than 95% of the French firms benefit from the CICE) and has several targets "Firms that are taxed on their profits can benefit from a tax credit […] designed to increase their competitiveness through improvement in investment, **research, innovation**, training, hiring, prospect of new markets, ecologic transition and in recovering their cash flow." (CICE, tax code). In other words, the CICE is weakly targeted as far this tax credit can be used for almost all purposes, only executive manager's earnings and dividends increases are prohibited. To our knowledge, there is no equivalent tax credit scheme in other countries. Very few *ex post* evaluations of the CICE have been so far conducted (Carbonnier, Malgouyres, Mayer, Py and Urvoy (2016); Gilles, L'Horty, Mihoubi and Yang (2016); and Guillou S., R. Sampognaro, T. Treibich and L. Nesta (2016)). They are mostly devoted to the evaluation of the CICE effects on employment, wages and firms performances or exports but not on the research and development activities. This paper is the first to investigate the impact of CICE impact on the R&D expenditures and activities.

A second tax credit related to the R&D activities (CIR) was introduced in France in 1983. During the twenty five first years, the tax base of CIR was the changes in R&D expenditures with very low tax ceilings. Since 2008, the CIR is much more generous. The tax base of the CIR is the amount of R&D expenditures (and no more its changes) and tax ceilings have been significantly increased. As a consequence, several *ex post* evaluations of the CIR and especially its reform in 2008 have been carried on: Bosio, Irac and Py (2014); Lhuillery, Marino and Parrota (2013); and Mulkay and Mairesse (2013). All those studies conclude to a positive impact of the CIR since 2008 on R&D expenditures and R&D investment. Some of them point out a delay between the reform in 2008 and their most important impact on the R&D activities between 2012 and 2015. Several countries have experimented a similar tax credit related to R&D activities. The *ex post* evaluation of those tax credits a quite similar to French studies. Hall and Van Reenen (1999) and Bloom, Griffith, and Van Reenen (2002) find a positive effect of tax credit on OECD countries. Kringelholt Fowkes, Sousa and Duncan (2015) find strong positive impact of tax credit on R&D expenditures. Lokshin and Mohnen (2010) find that tax credit in Netherland has a positive impact on R&D investments.

The evaluation of the effects of CICE on the R&D expenditures should take into account the CIR. In this regards we will control for the exposition to CIR considering the ratio of R&D expenditure to the added value or the amount of R&D expenditure. We merged a set of comprehensive micro-databases and the R&D survey from 2009 to 2014. The first results point out that the CICE has no impact on R&D activities, whatever the R&D outcome considered.

The first section describes the firm level micro-datasets and the second displays the descriptive statistics. The third section presents the identification strategy. Results are presented in the fourth section. Section five concludes.

Dataset

Several comprehensive administrative databases have been merged to build our workhorse dataset. First we need precise information about the amount of tax credit at the firm level. The French Fiscal administration (Dgfip) provides the MVC dataset containing each year the amount of tax credit.

In order to get information on wage bill subject to the CICE (below 2.5 times the minimum wage) we use the BRC database provided by Acoss-Urssaf, the French central agency of social security organization. This dataset contains also information about employment and wages.

DADS a comprehensive administrative database (a matched employers-employees database), produced by Insee (French National Statistical Agency) provides information on employment, working hours, wages and their decomposition by socio-professional categories (SPC), gender, age, labor contract.

The fiscal database, FARE (Insee), provides firms account indicators: gross sales, added value, gross operating, net results, profit margin, return rate, investment productivity and dividends.

The R&D survey (Ministry of Higher Education, Training and Scientific Research) provides crucial information about R&D activities. This survey collects information from firms that make R&D expenditures or at least that made R&D expenditures in the three previous years. From the R&D we get information on: total R&D expenditures, its decomposition in internal and external spending, employment involved in R&D activities as well as wages and patents.

Our workhorse dataset is constructed considering the following filters:

- We consider only firms employing at least 5 workers.
- We drop public administrations and a part of non-profit organization which are not subject to business taxes and as consequence could not benefit from CICE
- We do not consider specific sectors: Farming [4], Financial and Insurance[5] and temporary work agency[6]
- We discard the firms former nationalized[7]
- We remove from the sample the firms with financial indicators with extreme values (1% highest and 1% lowest)

After merging all the sources, we consider firms present in all the datasets for the time period 2009-2014. Since we use the R&D Survey, we face an important attrition, the dataset contains 1,189 firms. In order to check the robustness of our results we consider two alternative datasets:

- The first for the period 2011-2014 with 1,773 firms
- The other on the sample 2011-2013 containing 2,001 firms.

[4] Firms of the farming sector rely on a specific social security regime. We do not have access to this dataset.
[5] The economic indicators provided by FARE such as added value, gross sales are not completely relevant for these sectors.
[6] During 2013 and 2014 the open question of tax credit retrocession to their customers was not solved. The Court of Cassation provided verdict only in March 2014.
[7] For those firms the data for workers with a civil servant status are not available.

Descriptive statistics

Table 1 reports the descriptive statistics for each quartile of the apparent CICE rate in 2013 based on the variables in 2012 from a balance sample on the period 2009-2014 containing 1189 firms. If the firms size measured by the number of employees are quite similar (from 400 to 500 employees per firm), the average wage, the wage bill and the structure of employment by SPC are quite different. As expected, the average wage and the wage bill decrease with the apparent CICE rate. The average wages ranges from 30K€ per year for the last CICE quartile to 60K€ for the first quartile. The average wage bill is nearly twice bigger in the firms with the lower CICE rate than in firms with highest CICE rate. The employment of the firms with highest exposition to the CICE (Q4) is composed of 70% of blue collars and employees and of 14% of executives compared to companies with lowest exposition to the CICE where blue collars and employees represent only 20% of the employment and executives 57%. The share of workers involved in R&D activities is equal to 4.33% in the firms with higher CICE rates (Q4) in contrast with the 23.7% for the firms with the lowest CICE rate (Q1). The variables related to the firm activities vary significantly with respect to the CICE exposition. Compared to the firms with the highest CICE rate (Q4), the firms with lowest CICE rate (Q1) have higher gross sales, labor productivity, return rate, export share in gross sales, R&D expenditure share in value added, patents (for Q1 and Q2) and lower debt ratio. The firms with the lowest CICE rate belong more often to the tertiary sector and less often to the manufacturing sector.

The evolutions of the previous variables display a strong contrast regarding to the exposition to the CICE (table 2). In comparison with firm with the highest CICE rate, the firms with the lowest CICE rate experience higher growth rate for fixed-term labor contract, average wage and wage bill, labor productivity, gross sales, investment and R&D expenditure and lower growth rate for blue collars, young worker, labor contract with undetermined duration.

To sum up, the firms with the lower CICE rate have a higher proportion of high skill workers with higher wages, are more productive, display a good financial health, are more involved in R&D activities and export a larger part of the their production. At the opposite, the firms with higher CICE rate, have a higher proportion of low skill worker, are less productive, display poor financial health, have the lowest R&D activities and export share, and belong more often to the industrial sector. Focusing on R&D activities, firms with higher R&D expenditures are characterized by a lower CICE rate.

Table 1. Descriptive statistics. Apparent CICE rate in 2013 and firms features in 2012.

Features / App. CICE rate in 2013	CICE<1.35%	1.35<=CICE<2.00	2.00<=CICE<2.57	CICE>=2.57
Number or firms	297	297	298	297
Average nb of workers (BRC)	487	482	411	520
Average nb of workers (DADS)	488	483	407	512
Average nb of workers (FARE)	453	457	385	471
Average wage bill (BRC, K€)	29 687	21 201	15 793	15 509
Average wage bill (DADS, K€)	29 569	21 351	15 763	15 862
Average wage bill (FARE, K€)	29 027	20 822	15 622	15 509
Average wage rate (BRC, K€)	60.93	44.01	38.47	30.30
Average wage rate (DADS, K€)	60.56	44.18	38.74	30.98
Average wage rate (FARE, K€)	64.05	45.54	40.61	32.95
Average sales (K€)	179 494	126 276	106 624	125 491
Labour productivity (K€)	137.41	91.06	81.21	66.01
Mark up rate	24.44%	21.10%	20.77%	22.28%
Return rate	14.97%	10.90%	8.41%	9.88%
Capital intensity (K€)	108.65	110.53	132.74	109.71
Abroad sales / Overall sales	44.68%	43.81%	43.70%	26.58%
Investment / Added value	7.17%	11.14%	10.99%	11.75%
Indeptness rate	15.43%	32.86%	37.42%	40.20%
Financial exp. rate	4.22%	7.36%	10.39%	5.88%
R&D expenditure / Added value	36.08%	20.78%	13.81%	7.42%
Share of internal R&D exp.	75.01%	86.32%	86.69%	87.22%
Share of external R&D exp.	24.99%	13.68%	13.31%	12.78%
Share of R&D workers	23.68%	13.69%	8.87%	4.33%
Number of patents	10.96	14.43	2.54	1.30
Business sector				
Manufacturing	29.74%	63.69%	74.77%	75.59%
Construction	0.98%	0.99%	1.23%	0.89%
Services	69.28%	35.32%	24.00%	23.52%
R&D business sector	9.81%	3.96%	5.85%	4.77%
Categories of workers				
Blue collar workers	12.44%	29.49%	42.38%	37.50%
Employees	7.31%	7.21%	7.99%	32.60%
Profession intermédiaires	22.77%	23.09%	25.25%	15.53%
White collar workers	57.23%	40.01%	24.09%	14.22%
R&D engineer	21.11%	20.68%	8.57%	3.45%
R&D technician	4.35%	4.22%	3.63%	2.00%
Women	33.54%	28.02%	28.23%	36.40%
Workers younger than 30	15.85%	19.49%	18.20%	25.88%
Workers aged 50 and more	27.70%	26.20%	25.68%	21.18%
Not fixed term contract	91.39%	92.15%	91.64%	85.14%
Fixed term contract	5.50%	5.54%	5.70%	12.85%
Full time workers	85.25%	87.64%	90.49%	81.06%

Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2009-2014 balanced panel of 1,189 firms employing 5 workers coming from the private non-farm business sector.
Notes: Considered CICE intensities are quartiles of the apparent CICE rate that are computed over 2013.
Reading: There are more manufacturing firms among firms that benefit more from the French CICE tax credit (75.59 quartile in the fourth quartile) than among those that benefit less from this tax credit (29.74 percent in the first quartile).

Table 2. Descriptive statistics. Apparent CICE rate in 2013 and evolutions in outcome variables between 2012 and 2013.

Outcome / App. CICE rate in 2013	CICE<1.35%	1.35<=CICE<2.00	2.00<=CICE<2.57	CICE>=2.57
Number of firms	297	297	298	297
Average nb of workers (BRC)	-0.22%	0.34%	-0.50%	-0.32%
Average nb of workers (DADS)	0.28%	0.40%	-0.02%	-0.06%
Average nb of workers (FARE)	0.39%	0.44%	0.55%	-0.46%
End of year nb of workers (BRC)	0.63%	-0.64%	-0.84%	-0.24%
End of year nb of workers (DADS)	0.92%	0.37%	-0.45%	-0.15%
End of year nb of workers (FARE)	0.58%	0.31%	-0.81%	0.57%
Wage bill (BRC)	2.83%	2.07%	1.80%	0.77%
Wage bill (DADS)	3.15%	2.48%	2.37%	0.73%
Wage bill (FARE)	4.29%	2.19%	1.39%	1.03%
Average wage rate (BRC)	3.05%	1.72%	2.31%	0.73%
Average wage rate (DADS)	2.86%	2.07%	2.39%	0.79%
Average wage rate (FARE)	3.88%	1.75%	0.84%	1.50%
Labour productivity (K€)	3.27	1.44	2.43	0.90
Sales	4.19%	-0.99%	0.86%	0.05%
Added value	2.78%	2.02%	3.56%	0.90%
Gross operating surplus	-2.56%	3.67%	14.09%	2.69%
Mark up rate	-1.26pp	0.34pp	2.11pp	0.39pp
Return rate	-1.36pp	-0.10pp	0.84pp	-0.04pp
Investment	3.78%	2.47%	2.60%	1.59%
Total R&D expenditures	5.37%	-0.26%	2.71%	1.38%
Internal R&D expenditures	2.48%	-0.75%	3.39%	1.26%
External R&D expenditures	14.05%	2.74%	-1.71%	2.23%
Current R&D expenditures	3.40%	-0.27%	5.03%	3.44%
Number of R&D workers	1.34%	-3.64%	3.96%	4.09%
Number of patents	-7.10%	-24.47%	23.99%	-22.57%
R&D wage bill	2.30%	-2.67%	4.55%	4.32%
Categories of workers				
Blue collar workers	-7.25%	-7.55%	-1.02%	-0.41%
Employees	0.89%	4.51%	-0.98%	1.34%
Interm. professions	1.72%	2.23%	1.13%	0.29%
Executives	0.43%	2.89%	0.14%	-3.31%
R&D engineers	2.35%	0.82%	3.58%	-11.55%
R&D technicians	-4.11%	3.12%	0.61%	0.89%
Women	-0.85%	0.27%	0.49%	-0.55%
Moins de 30 ans	-5.14%	-2.34%	-2.45%	-0.82%
50 ans et plus	5.45%	1.84%	4.87%	5.79%
Not fixed term labour contract	0.22%	0.14%	0.04%	0.03%
Fixed term labour contract	-15.06%	-21.00%	-9.98%	-3.72%
Full time workers	0.59%	1.80%	1.28%	-0.45%

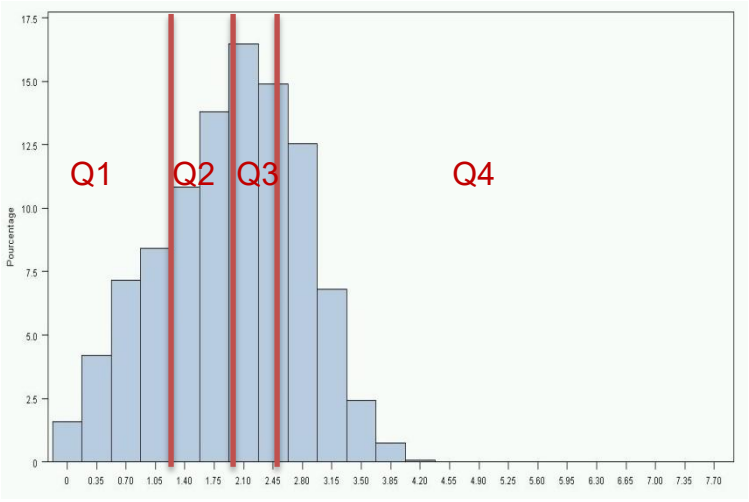
Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2009-2014 balanced panel of 1,189 firms employing 5 workers coming from the private non-farm business sector.
Notes: Considered CICE intensities are quartiles of the apparent CICE rate that are computed over 2013.
Reading: Between 2012 and 2013, the increase in total R&D expenditures was greater among firms that benefited more form the CICE tax credits (5.37 percent) in 2013 than among firms that benefited less from the CICE tax credit (1.38 percent).

Identification strategy

The CICE is a general measure with a very broad salary base that has not been tested and has applied to all companies in France since 2013. Only 6% of companies have not benefited at all from the CICE and these companies have very specific characteristics. Therefore there is no suitable control group, i.e. of firms that would not have been affected by the treatment.

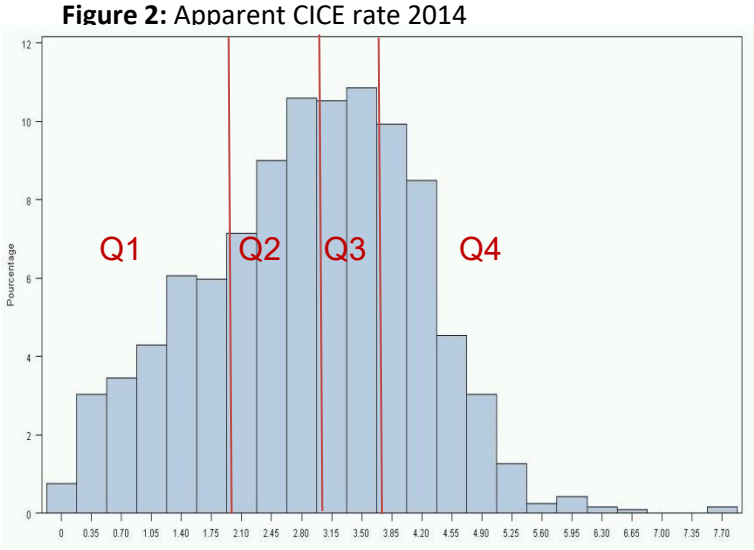
But a second characteristic of the CICE can make it possible to overcome this difficulty. The CICE is a general measure but it is also a targeted measure, i.e. on wages below 2.5 Smic. While it affects all companies, it does not affect them all with the same intensity (figure 1 and 2). Some companies will benefit greatly from the CICE, while others will only marginally benefit from it. A company that pays low wages will benefit from the maximum tax credit rate (its apparent CICE rate will be 4% in 2013 and 6% in 2014) while a company that includes a significant proportion of workers paid over 2.5 Smic will benefit less from the measure. At its lowest, the apparent CICE rate is zero for companies that do not include any employees paid less than 2.5 Smic. It should be noted that the 2.5 Smic threshold is a high wage distribution threshold. According to data published by INSEE and coming from the DADS, this threshold is between the 8th and 9th decile of wage distribution. It should be emphasize that our sample of R&D firms display rather small CICE rates because they employ an important proportion of high skilled workers characterize by high wages.

Figure 1: Apparent CICE rate 2013



Sources: BRC (Acoss), DADS-FARE (Insee), and MVC (Dgfip).
Field: Balanced panel of 1189 companies with 5 or more employees during the 2009-2014 period.

Figure 2: Apparent CICE rate 2014



Sources: BRC (Acoss), DADS-FARE (Insee), and MVC (Dgfip).
Field: Balanced panel of 1189 companies with 5 or more employees during the 2009-2014 period.

These differences in exposure to the treatment are entirely due to a single factor: differences in wage structure and more precisely the share of wages below 2.5 Smic. In each company, the apparent CICE rate, linking the amount of the CICE with the payroll, is obtained by multiplying the maximum CICE rate (for example 4% in 2013) by the sum of salaries below 2.5 Smic (wage earners *i*) in relation to the total payroll (the sum of salaries below 2.5 Smic (wage earners *i*) and above 2.5 Smic (workers *j*)):

$$T_{CICE} = \overline{T_{CICE}} * \frac{\sum w_i}{\sum w_i + \sum w_j}$$

$$\text{With } \overline{T_{CICE}} = \ 0.04 \ in \ 2013; 0.06 \ in \ 2014$$

It is therefore conceivable to use these variations in the intensity of treatment for evaluation purposes. To do so, it suffices to carry out a partition within companies by creating different classes of exposure to the treatment. Following the methodology proposed in Florens *and alii* (2008), the evaluation is based on the difference in the intensity of the treatment rather than whether the treatment is applied. This approach has been successfully used to evaluate the French general exemptions from social security contributions. Those payroll tax cuts are close to the CICE in the sense that they are general, massive, and unconditional (Bunel *et al.* 2009 and 2012). This is the approach used in the present article.

The problem with this approach is that the companies benefiting most from the CICE do not have the same characteristics as those benefiting only a little. A control group composed of companies that have least benefited from the CICE is not the result of random selection and is not spontaneously a good counterfactual. It mainly brings together high-wage companies that are unique from the point of view of all the determinants of employment, wages, and competitiveness.

In this study, we carried out parametric estimates by regressing the relative variation from our outcome variables on treatment indicators, taking into account the initial level of our outcome

variables in the control variables. We considered a wide range of control variables by combining economic activity indicators coming from FARE and indicators on employment structure from the DADS. This approach is equivalent to a difference-in-difference evaluation with multiple intensities of treatment and control for the observables characterizing the economic situation of companies prior to implementing the CICE. To the extent that the dependent variables of our equations are growth rates (i.e. dimensionless indicators), our regressions are weighted by an indicator that is consistent with the outcome variable.

An additional difficulty lies in the potential existence of an endogeneity bias. In the case of the CICE, the wage structure completely determines intensity of exposure to the treatment. However, it is also determined by the outcome variables that interest us: employment, wages, and competitiveness. For example, one can expect that a highly competitive company creates many jobs and more frequently pays high wages. It will then have little exposure to the CICE. It is important to consider this potential bias to evaluate a causal effect of the treatment (CICE). The instrumental variables method serves as a resource to overcome these difficulties.

To control for treatment endogeneity, we combine difference-in-difference with instrumental variable methods. From a large number of potential instruments among all the variables from our databases, we finally chose the simulated values of the apparent CICE rate for 2013 and 2014 on the basis of data from the years prior to the establishment of the CICE (2009-2012), following the method used in Auten and Carroll (1999).

Econometric specifications

We consider the usual framework to evaluate the effects of a treatment (the CICE) on different outcome variables (different indicator R&D expenditures, number and wages of worker involved in R&D activities, number of patents).

First, we consider the following equation for company i:

$$\ln(Y_{it}) = \alpha_0 + \alpha I(t) + \beta T_{it} + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

The dependent variable of the model is sometime the logarithm of the outcome variable Y_{it} observed at time t, with T_{it} referring to the treatment variable. X_{it} refers to a set of observable control variables (variables that are potentially correlated with the outcome and treatment variables). $I(t)$ is a time dummy. ε_{it} represents the error term that is written as $\varepsilon_{it} = v_i + u_{it}$, in which v_i is an individual unobserved fixed effect differentiating companies and is potentially correlated with X_{it} , while u_{it} is a random term that is independent of the control variables.

In order to estimate the effect of the CICE on the variables of interest, we differentiate the equation (1):

$$\Delta\ln(Y_{it}) = \alpha + \beta\Delta T_{it} + \gamma\Delta X_{it} + \epsilon_{it} \text{ with } \epsilon_{it} = \Delta\varepsilon_{it}=\Delta u_{it} \quad (2)$$

where: $\Delta X_{it} = X_{it} - X_{it-1}$ and $\Delta T_{it} = T_{it} - T_{it-1}$ and for 2013 $\Delta T_{it} = T_{it}$ insofar as $T_{it-1} = 0$. $\Delta\ln(Y_{it}) = \ln(Y_{it}) - \ln(Y_{it-1})$ which is approximately equal to the growth rate of the outcome variable.

However, some companies have benefited more from the CICE than others. Moreover, the effect of the CICE can vary depending on the benefit generated by the treatment. To take into account the non-linearity of the effect of the treatment, indicators are introduced for different treatment intensity in equation (2):

$$\Delta\ln(Y_{it}) = \alpha + \sum_{j=2}^{j=J} \beta_j I_j(\Delta T_{it}) + \gamma \Delta X_{it} + \epsilon_{it} \text{ with } \epsilon_{it} = \Delta\varepsilon_{it} = \Delta u_{it} \quad (3)$$

In which $I_j(T_{it})$, *j=1,…J (with J=4)* is a set of dummies corresponding to quartiles of the treatment intensity.

Then, to avoid simultaneity between the controls and the dependent variable, we controlled for past variations in X_{it}, i.e. for ΔX_{it-1}, rather than considering current values, ΔX_{it} . As this may not be enough, we add levels X_{it-1} and also Y_{it-1}. In addition, a set of dummies is introduced to take into account sectoral effects or those related to company size in *t-1*:

$$\Delta\ln(Y_{it}) = \alpha + \sum_{j=1}^{j=J} \beta_j I_j(\Delta T_{it}) + \gamma_0 Y_{it-1} + \gamma \Delta X_{it-1} + \delta X_{it-1} + \sum_{k=1}^{k=K} \delta_k size_{ik} + \sum_{l=1}^{l=L} \delta_l sector_{il} + \epsilon_{it} \quad (4)$$

Thus, for 2013, we use the information from 2011-2013 and the estimated equation is

$$\Delta\ln(Y_{i2013}) = \alpha + \sum_{j=2}^{j=J} \beta_j I_j(T_{i2013}) + \gamma_0 Y_{i2012} + \gamma \Delta X_{i2012} + \delta X_{i2012} + \sum_{k=2}^{k=K} \delta_k size_{ik,2012} + \sum_{l=2}^{l=L} \delta_l sector_{il,2012} + \epsilon_{i2013}$$

In which: $\Delta X_{i2012} = X_{i2012} - X_{i2011}$ and $\Delta\ln(Y_{i2013}) = Y_{i2013} - Y_{i2012}$.

For 2014, we consider the same equation, but to estimate the effect of the CICE variation perceived in 2014 on the evolution of employment between 2013 and 2014. To avoid other endogeneity problems, exactly the same controls are considered as for the equation estimated in 2013 (level of the *Xs* in 2012 and variation of the *Xs* between 2011 and 2012). Finally, a last model is considered to estimate the effect of the average CICE rate over 2013 and 2014 (variation of the CICE rate between 2013-2014 and 2012 on the evolution of the outcome variable between 2012 and 2014).

Treatment variable

The apparent rate of the CICE tax credit relates the amount of CICE from the MVC database to the gross wage bill from the DADS. Its distribution is shown in Figure 1 and 2. The median is 2% in 2013 and 2.95% in 2014. We distinguish between companies based on how much they have benefited from the CICE by creating four groups composed of the same number of companies from those that benefit least from the CICE to those that benefit most, thus establishing four different classes of companies.

Outcome variables

To evaluate the impact the CICE on R&D activities, we consider the 7 seven following variables: total amount of R&D expenditures, internal and external R&D expenditures, current expenditures, number of workers involved in R&D activities, their wage and the number of patents. We consider two kinds of comparisons: between 2012 and 2013 or between 2012 and 2014.

Control variables

By merging several exhaustive administrative sources it is possible to consider a large number of control variables in the estimates, and this seems necessary given the differences between the characteristics of the companies that benefit most from the CICE and the others. We have therefore considered a wide range of control variables by combining management indicators from the FARE and indicators on the structure of employment from the DADS. Box 1 provides details on the control variables we have considered.

Box 1. Control variables

For each outcome variable in relative variation, a control is carried out by the initial level of the variable in 2012.

Sector of activity (NAF 2008), in 88 positions.

Company sizes categories (11 classes) from the BRC on 31/12/2012.

Taken from the FARE (year 2012): Initial value of the profit margin (in 2012), as well as of return rate, productivity, capital intensity, share of exports in gross sales, investment rate, debt ratio, and financial levy rate.

Taken from the DADS (year 2012): The share of women, workers, employees, intermediate professions, executives, engineers and technicians in R&D; the share of persons under 30 years of age and 50 and over; the share of CDIs, CDDs, and persons working on a full-time basis.

We complete the set of control variables by the following R&D variables: the share of R&D expenditures in the added value, the share of internal R&D expenditures in the total amount of R&D expenditures and the share of workers involved in R&D activities.

For all the aforementioned time-varying variables, we finally consider as control variables their variations between 2011 and 2012.

Results

The tables 3 report the CICE impact on R&D activities variables in 2013 considering three samples: the longest balance sample from 2009 to 2014 with 1,189 firms (table 3.a), a shorter balance sample from 2011 to 2014 containing 1770 firms (table 3.b) and the shortest one from 2011 to 2013 with 2001 firms (table 3.c). For the first two samples (tables 3.a and 3.b), we have no significant impact of CICE on R&D activities outcomes. For the shortest sample (table 3.c) average wage for workers involved in R&D activity seems to be negatively affected by the CICE for the third quartile compared

to the first one. This result could be related to negative impact of the CICE on the average wage per worker for firms belonging to the second, third and fourth quartiles using FARE and DADS datasets for wages and only for firms in the second and third quartiles when we consider data on average wage from BRC (table 3.d). This negative impact of CICE on average wage can be related to a composition effect: the firms in Q3 have increased the proportion of blue collars and reduced the proportion of executive (in Q4). The same composition effect could be at the origin of this wage decrease. It should be noted that the wage decrease is modest, with an elasticity of -0.05, one point of CICE have decreased in 2013 the average wage of workers involved in R&D activities only by 0.05%.

During the period 2013-2014, we have no significant impact of the CICE on R&D activities if we consider the first sample from 2009 to 2014 (table 4.a). But if we use a shorter sample from 2011 to 2014, we have a significant negative impact of CICE on the number of patents for firms belonging to the second, third and fourth quartiles. In other worlds, compared to the firms that benefit the less of the CICE (first quartile), the other firms (in Q2, Q3 and Q4) more exposed to the CICE have reduced significantly the number patents. This negative effect on patent is also observed on the descriptive statistics (table A1.b appendix 1)

Table 3.a: Parametric estimation results for 2013 (2009-2014 sample)

		Total R&D expenditures[(1)]	Internal R&D expenditures[(1)]	External R&D expenditures[(1)]	Current R&D expenditures[(1)]	R&D employment	Wage for R&D workers	Number of patents[(1)]
Coefficients	Q2	3292,733 (0,238)	870,076 (0,443)	2965,879 (0,166)	1029,534 (0,318)	2,030 (0,775)	-0,050 (0,366)	-1,340 (0,655)
	Q3	1194,209 (0,538)	-141,684 (0,868)	1309,632 (0,226)	335,004 (0,660)	0,403 (0,949)	-0,055 (0,301)	-0,228 (0,934)
	Q4	2805,046 (0,242)	755,684 (0,456)	1602,591 (0,228)	842,433 (0,352)	1.775 (0.819)	-0.097 (0.185)	0,103 (0,974)
Elasticities	Q2	0.37	0.11	2.47	0.15	1.93	-0.05	-0.09
	Q3	0.17	-0.02	1.37	0.06	0.26	-0.03	-0.05
	Q4	0.52	0.16	2.37	0.19	0.80	-0.04	0.03
Test of weak instruments (*)		Rejected	Rejected	Not rejected	Rejected	Rejected	Rejected	Not rejected

Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2009-2014 balanced panel of 1,189 firms employing 5 workers coming from the private non-farm business sector.
Notes: dependent variables are differences in logarithms between 2012 and 2013. Coefficients refer to difference-in-difference instrumental variables estimates. Considered instruments are quartiles of the simulated apparent CICE rate on the periods 2011 and 2012. Elasticities are computed by dividing the coefficients by the gap between the highest and the lowest average apparent CICE rates. Average apparent CICE rates are 0.68 percent in the first, 1.73 percent in the second, 2.26 percent in the third, and 2.90 percent in the fourth quartiles. In bold: significant coefficients (or valid instruments) at a 5 percent level. P-values stand within parentheses. (*) H0: Instrumental variables not correlated with the treatment.
Reading: Between 2012 and 2013, the increase in total R&D expenditures is smaller by 8.025 percentage points in firms that benefit from the largest tax credits (fourth quartile) than in firms that benefit from the smaller tax credits (first quartile). Corresponding elasticities are computed by dividing the coefficients by the gap between the Q4 and Q1 average apparent CICE rates.

Table 3.b: Parametric estimation results for 2013 (2011-2014 sample)

		Total R&D expenditures[(1)]	Internal R&D expenditures[(1)]	External R&D expenditures[(1)]	Current R&D expenditures[(1)]	R&D employment	Wage for R&D workers	Number of patents[(1)]
Coefficients	Q2	2039,429 (0,233)	55,383 (0,932)	1847,393 (0,110)	255,173 (0,665)	0,979 (0,863)	-0,03139 (0,435)	-0,522 (0,765)
	Q3	705,468 (0,534)	-435,158 (0,425)	992,405 (0,168)	-62,165 (0,580)	7,382 (0,148)	-0,07502 (0,065)	-0,536 (0,753)
	Q4	1504,433 (0,278)	-15,840 (0,978)	1207,665 (0,189)	114,618 (0,822)	2,324 (0,714)	-0,04606 (0,426)	0,930 (0,615)
Elasticities	Q2	0.00	0.01	2.03	0.05	1.00	-0.03	-0.05
	Q3	0.01	-0.09	1.64	-0.02	4.76	-0.05	-0.19
	Q4	0.02	0.00	2.31	0.03	1.04	-0.02	0.42
Test of weak instruments (*)		Rejected	Rejected	Not rejected	Rejected	Rejected	Rejected	Not rejected

Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2011-2014 balanced panel of 1,770 firms employing 5 workers coming from the private non-farm business sector.
Notes: dependent variables are differences in logarithms between 2012 and 2013. Coefficients refer to difference-in-difference instrumental variables estimates. Considered instruments are quartiles of the simulated apparent CICE rate on the periods 2011 and 2012. Elasticities are computed by dividing the coefficients by the gap between the highest and the lowest average apparent CICE rates. Average apparent CICE rates are 0.73 percent in the first, 1.71 percent in the second, 2.28 percent in the third, and 2.97 percent in the fourth quartiles. In bold: significant coefficients (or valid instruments) at a 5 percent level. P-values stand within parentheses. (*) H0: Instrumental variables not correlated with the treatment.
Reading: Between 2012 and 2013, the increase in total R&D expenditures is smaller by 13.950 percentage points in firms that benefit from the largest tax credits (fourth quartile) than in firms that benefit from the smaller tax credits (first quartile). Corresponding elasticities are computed by dividing the coefficients by the gap between the Q4 and Q1 average apparent CICE rates.

Table 3.c: Parametric estimation results for 2013 (2011-2013 sample)

		Total R&D expenditures[(1)]	Internal R&D expenditures[(1)]	External R&D expenditures[(1)]	Current R&D expenditures[(1)]	R&D employment	Wage for R&D workers	Number of patents[(1)]
Coefficients	Q2	1859,323 (0.215)	83,000 (0,885)	1653,784 (0,101)	237,859 (0,648)	2,563 (0,663)	-0,049 (0,240)	0,082 (0,958)
	Q3	757,407 (0,570)	-353,884 (0,463)	804,546 (0,190)	-10,692 (0,980)	8,754 (0,091)	**-0,082** **(0,043)**	0,104 (0,955)
	Q4	1333,758 (0,241)	50,464 (0,915)	110,486 (0,144)	123,342 (0,769)	4,999 (0,422)	-0,056 (0,313)	-0,687 (0,605)
Elasticities	Q2	0.35	0.02	2.20	0.06	2.44	-0.05	0.01
	Q3	0.16	-0.09	1.48	0.00	5.54	-0.05	0.04
	Q4	0.40	0.02	0.33	0.04	2.25	-0.03	-0.39
Test of weak instruments (*)		Rejected	Rejected	Not rejected	Rejected	Rejected	Rejected	Not rejected

Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2011-2013 balanced panel of 2,001 firms employing 5 workers coming from the private non-farm business sector.
Notes: dependent variables are differences in logarithms between 2012 and 2013. Coefficients refer to difference-in-difference instrumental variables estimates. Considered instruments are quartiles of the simulated apparent CICE rate on the periods 2011 and 2012. Elasticities are computed by dividing the coefficients by the gap between the highest and the lowest average apparent CICE rates. Average apparent CICE rates are 0.73 percent in the first, 1.72 percent in the second, 2.31 percent in the third, and 2.97 percent in the fourth quartiles. In bold: significant coefficients (or valid instruments) at a 5 percent level. P-values stand within parentheses. (*) H0: Instrumental variables not correlated with the treatment.
Reading: Between 2012 and 2013, the increase in total R&D expenditures is smaller by 14.360 percentage points in firms that benefit from the largest tax credits (fourth quartile) than in firms that benefit from the smaller tax credits (first quartile). Corresponding elasticities are computed by dividing the coefficients by the gap between the Q4 and Q1 average apparent CICE rates.

Table 3.d: Parametric estimation results for 2013 wages (2011-2013 sample)

		Average wage per worker			Average Hourly wage
		BRC	FARE	DADS	
Coefficients	Q2	**-2,680 (0,033)**	**-9,310 (0,001)**	**-5,050 (0,001)**	0,441 (0,731)
	Q3	**-4,092 (0,007)**	**-9,226 (0,002)**	**-4,890 (0,008)**	-0,187 (0,899)
	Q4	-3,060 (0,126)	**-10,993 (0,003)**	**-6,934 (0,005)**	0,575 (0,771)
Elasticities	Q2	*0.25*	*-1.12*	*-0.53*	*-0.53*
	Q3	*-0.08*	*-0.13*	*0.55*	*0.55*
	Q4	*0.49*	*0.47*	*0.62*	*0.62*

Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2011-2013 balanced panel of 2,001 firms employing 5 workers coming from the private non-farm business sector.
Notes: dependent variables are differences in logarithms between 2012 and 2013. Coefficients refer to difference-in-difference instrumental variables estimates. Considered instruments are quartiles of the simulated apparent CICE rate on the periods 2011 and 2012. Elasticities are computed by dividing the coefficients by the gap between the highest and the lowest average apparent CICE rates. Average apparent CICE rates are 0.73 percent in the first, 1.72 percent in the second, 2.31 percent in the third, and 2.97 percent in the fourth quartiles. In bold: significant coefficients (or valid instruments) at a 5 percent level. P-values stand within parentheses. (*) H0: Instrumental variables not correlated with the treatment.
Reading: Between 2012 and 2013, the increase in total R&D expenditures is smaller by 14.360 percentage points in firms that benefit from the largest tax credits (fourth quartile) than in firms that benefit from the smaller tax credits (first quartile). Corresponding elasticities are computed by dividing the coefficients by the gap between the Q4 and Q1 average apparent CICE rates.

Table 4.a: Parametric estimation results for 2013-2014 (2009-2014 sample)

		Total R&D expenditures[(1)]	Internal R&D expenditures[(1)]	External R&D expenditures[(1)]	Current R&D expenditures[(1)]	R&D employment	Wage for R&D workers	Number of patents[(1)]
Coefficients	Q2	-586,378 (0,713)	247,893 (0,810)	-1146,364 (0,374)	436,246 (0,642)	17,652 (0,131)	0,030 (0,753)	-6,757 (0,167)
	Q3	-707,095 (0,552)	663,124 (0,427)	-1399,102 (0,123)	474,278 (0,562)	20,955 (0,262)	-0,228 (0,077)	-5,568 (0,212)
	Q4	179,758 (0,885)	-130,446 (0,885)	-386,151 (0,704)	35,834 (0,967)	1,317 (0,922)	-0,039 (0,708)	-3,842 (0,330)
Elasticities	Q2	-0.06	0.03	-0.93	0.06	12.17	0.02	-0.42
	Q3	-0.09	0.10	-1.16	0.08	9.19	-0.10	-0.98
	Q4	0.02	-0.02	-0.45	0.01	0.39	-0.01	-0.99
Test of weak instruments (*)		Rejected	Rejected	Rejected	Rejected	Not rejected	Not rejected	Rejected

Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2009-2014 balanced panel of 1,189 firms employing 5 workers coming from the private non-farm business sector.
Notes: dependent variables are differences in logarithms between 2012 and 2013. Coefficients refer to difference-in-difference instrumental variables estimates. Considered instruments are quartiles of the simulated apparent CICE rate on the periods 2011 and 2012. Elasticities are computed by dividing the coefficients by the gap between the highest and the lowest average apparent CICE rates. Average apparent CICE rates are 0.86 percent in the first, 2.11 percent in the second, 2.80 percent in the third, and 3.59 percent in the fourth quartiles. In bold: significant coefficients (or valid instruments) at a 5 percent level. P-values stand within parentheses. (*) H0: Instrumental variables not correlated with the treatment.
Reading: Between 2012 and 2013, the increase in total R&D expenditures is smaller by 16.336 percentage points in firms that benefit from the largest tax credits (fourth quartile) than in firms that benefit from the smaller tax credits (first quartile). Corresponding elasticities are computed by dividing the coefficients by the gap between the Q4 and Q1 average apparent CICE rates.

Table 4.b: Parametric estimation results for 2013-2014 (2011-2014 sample)

		Total R&D expenditures(1)	Internal R&D expenditures(1)	External R&D expenditures(1)	Current R&D expenditures(1)	R&D employment	Wage for R&D workers	Number of patents(1)
Coefficients	Q2	662,840 (0,513)	-3,767 (0,395)	416,053 (0,571)	-0,987 (0,999)	10,874 (0,252)	0,106 (0,315)	**-7,980 (0,011)**
	Q3	1268,902 (0,185)	244,523 (0,632)	765,472 (0,340)	59,709 (0,908)	16,361 (0,271)	-0,121 (0,170)	**-5,941 (0,057)**
	Q4	1625,038 (0,175)	-58,577 (0,917)	1156,264 (0,277)	-110,023 (0,842)	3,009 (0,798)	0,084 (0,463)	**-5,915 (0,036)**
Elasticities	Q2	0.09	0.00	0.41	0.00	10.36	0.10	**-0.72**
	Q3	0.20	0.04	0.88	0.01	10.36	-0.08	**-1.57**
	Q4	0.26	-0.01	1.75	-0.02	1.36	0.04	**-2.12**
Test of weak instruments (*)		Rejected	Rejected	Rejected	Rejected	Not rejected	Not rejected	Not rejected

Sources: BRC (Acoss), DADS-FARE (Insee), MVC (Dgfip) and R&D survey (MENSER).
Fields: 2011-2014 balanced panel of 1,773 firms employing 5 workers coming from the private non-farm business sector.
Notes: dependent variables are differences in logarithms between 2012 and 2013. Coefficients refer to difference-in-difference instrumental variables estimates. Considered instruments are quartiles of the simulated apparent CICE rate on the periods 2011 and 2012. Elasticities are computed by dividing the coefficients by the gap between the highest and the lowest average apparent CICE rates. Average apparent CICE rates are 0.89 percent in the first, 2.08 percent in the second, 2.83 percent in the third, and 3.64 percent in the fourth quartiles. In bold: significant coefficients (or valid instruments) at a 5 percent level. P-values stand within parentheses. (*) H0: Instrumental variables not correlated with the treatment.
Reading: Between 2012 and 2014, the increase in total R&D expenditures is smaller by 29.086 percentage points in firms that benefit from the largest tax credits (fourth quartile) than in firms that benefit from the smaller tax credits (first quartile). Corresponding elasticities are computed by dividing the coefficients by the gap between the Q4 and Q1 average apparent CICE rates.

Conclusions

The CICE is a major tax credit that has a very broad base: all the wages below 2.5 times the French minimum wage. This tax credit is not targeted. Firms can use this tax credit for a large spectrum of uses, among them the R&D activities. This tax credit differs deeply from the CIR which is precisely targeted on R&D activities. The results of this first evaluation of the CICE impact on R&D activities are not surprising: there is no direct effect of CICE on R&D expenditures nor on employment involved in R&D activities. The only significant negative effects of the CICE have been located on wages for 2013 and on the number of patents for 2013 and 2014.

The lack of significant impact of CICE on R&D activities could be related to the weak exposition of firms involved in R&D activities to the CICE. In our sample of firms involved in R&D activities with at least 5 workers the median CICE rate is 2% in 2013 and is 2.95% for 2013-2014, compared to 3.26% in 2013 and 4.09% in 2013-2014 for all firms with 5 workers or more. An alternative explanation could be found in the results of Mulkay and Mairesse (2015), where the effects of the CIR reform in 2008 has produced its most important positive effects on R&D activities only 7 years after (in 2015). In this case we need more time after the introduction of the CICE to consider its impact on R&D activities.

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Appendix 1 : descriptive statistics for 2013-2014 periods

Table A1.a. Descriptive statistics. Average apparent CICE rate in 2013-2014 and firms features in 2012.

Features / Average app. CICE rate in 2014	CICE<1.70%	1.70<=CICE<2.49	2.49<=CICE<3.18	CICE>=3.18
Number or firms	297	297	298	297
Average nb of workers (BRC)	505	462	386	547
Average nb of workers (DADS)	406	463	383	539
Average nb of workers (FARE)	471	436	361	499
Average wage bill (BRC, K€)	30 538	20 148	14 589	17 156
Average wage bill (DADS, K€)	30 409	20 268	14 609	17 265
Average wage bill (FARE, K€)	29 841	19 734	14 575	16 827
Average wage rate (BRC, K€)	60.44	43.61	37.78	31.38
Average wage rate (DADS, K€)	60.04	43.73	38.18	32.03
Average wage rate (FARE, K€)	63.41	45.28	40.41	33.70
Average sales (K€)	182 975	125 400	101 408	128 610
Labour productivity (K€)	135.08	90.91	82.59	66.55
Mark up rate	24.09%	20.72%	22.68%	21.41%
Return rate	14.93%	9.55%	9.23%	10.42%
Capital intensity (K€)	106.71	126.33	131.21	100.92
Abroad sales / Overall sales	44.77%	45.42%	45.26%	24.08%
Investment / Added value	7.05%	11.68%	11.66%	10.78%
Indeptness rate	15.50%	29.63%	40.90%	40.93%
Financial exp. rate	4.27%	7.72%	9.28%	6.35%
R&D expenditure / Added value	36.38%	20.77%	13.03%	7.73%
Share of internal R&D exp.	75.19%	87.28%	85.14%	87.96%
Share of external R&D exp.	24.81%	12.72%	14.86%	12.04%
Share of R&D workers	23.82%	13.60%	8.25%	4.65%
Number of patents	11.56%	13.61%	2.72%	1.39%
Business sector				
Manufacturing	30.72%	63.00%	75.83%	74.17%
Construction	1.31%	1.00%	1.51%	0.30%
Services	67.97%	36.00%	22.66%	25.53%
R&D business sector	9.81%	3.33%	5.71%	5.71%
Categories of workers				
Blue collar workers	13.55%	31.72%	44.79%	33.98%
Employees	7.15%	7.79%	7.55%	31.37%
Profession intermédiaires	22.64%	24.69%	26.65%	14.02%
White collar workers	56.42%	35.58%	20.71%	20.48%
R&D engineer	21.10%	15.34%	5.22%	9.92%
R&D technician	4.22%	4.69%	3.75%	1.76%
Women	33.27%	28.59%	27.83%	35.90%
Workers younger than 30	15.83%	17.89%	17.24%	27.43%
Workers aged 50 and more	27.74%	27.10%	27.00%	19.82%
Not fixed term contract	91.49%	92.07%	91.57%	85.52%
Fixed term contract	5.34%	5.48%	6.06%	12.44%
Full time workers	85.51%	87.11%	90.48%	81.77%

Table A1.b. Descriptive statistics. Average apparent CICE rate in 2013-2014 and evolutions in outcome variables between 2012 and 2014.

Outcome / Average app. CICE rate in 2014	CICE<1.70%	1.70<=CICE<2.49	2.49<=CICE<3.18	CICE>=3.18
Number of firms	297	297	298	297
Average nb of workers (BRC)	-0.09%	-1.14%	-1.12%	0.48%
Average nb of workers (DADS)	-0.06%	-0.56%	-0.04%	0.12%
Average nb of workers (FARE)	0.05%	-0.25%	0.11%	5.11%
End of year nb of workers (BRC)	0.06%	-2.07%	-2.22%	0.74%
End of year nb of workers (DADS)	0.35%	-0.51%	-1.05%	0.04%
End of year nb of workers (FARE)	-0.24%	-0.13	-1.17%	4.35%
Wage bill (BRC)	4.26%	4.40%	4.82%	2.57%
Wage bill (DADS)	4.99%	4.55%	5.35%	2.06%
Wage bill (FARE)	7.07%	4.21%	3.77%	11.06%
Average wage rate (BRC)	4.35%	5.60%	6.01%	2.07%
Average wage rate (DADS)	5.06%	5.14%	5.39%	1.94%
Average wage rate (FARE)	7.01%	4.47%	3.66%	5.66%
Labour productivity (K€)	0.48	3.51	3.76	1.23
Sales	4.88%	-0.95%	-1.06%	4.47%
Added value	0.41%	3.61%	4.66%	7.06%
Gross operating surplus	-26.53%	5.58%	11.63%	-3.39%
Mark up rate	-6.46pp	0.39pp	1.51pp	-2.09pp
Return rate	-5.16pp	-0.22pp	0.27pp	-1.81pp
Investment	-8.61%	-3.64%	0.35%	37.99%
Total R&D expenditures	6.83%	4.81%	29.66%	4.94%
Internal R&D expenditures	3.42%	3.78%	5.76%	4.51%
External R&D expenditures	15.36%	11.86%	166.62%	8.07%
Current R&D expenditures	3.95%	4.28%	8.54%	7.83%
Number of R&D workers	-0.29%	-1.07%	0.66%	9.72%
Number of patents	6.12%	-72.58%	-23.11%	-8.58%
R&D wage bill	2.78%	3.89%	5.44%	11.28%
Categories of workers				
Blue collar workers	-9.17%	-5.48%	-1.66%	-3.28%
Employees	7.50%	5.91%	2.80%	3.66%
Interm. professions	1.05%	0.26%	1.30%	4.67%
Executives	1.32%	1.28%	1.07%	-1.58%
R&D engineers	-2.43%	-1.22%	6.63%	3.73%
R&D technicians	-1.54%	0.62%	-2.64%	1.63%
Women	1.51%	1.23%	0.72%	0.10%
Moins de 30 ans	-3.66%	-3.33%	-2.62%	0.61%
50 ans et plus	9.79%	3.32%	7.00%	9.45%
Not fixed term labour contract	0.44%	-0.65%	-0.17%	0.36%
Fixed term labour contract	-8.37%	-8.92%	-12.25%	-2.62%
Full time workers	0.34%	0.86%	0.58%	-0.45%