Cluster policy and firm performance: A case study of the French optic/photonic industry

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Abstract

This study empirically analyzes the effects of a cluster policy on firms' productivity, exports, employment and capital in the French optic/photonic industry. Exploiting firm-level data, we first analyze the selection process of the French cluster policy through a logit model, before combining a propensity score matching procedure and a differences-in-differences estimation in order to capture its impact on firms' performance in the optic/photonic industry. We first show that larger firms are more likely to be selected by the French public policy in the optic/photonic industry. Second, the firms that have received the competitiveness cluster label have become more productive. We also found a positive and significant impact of the public policy on exports, total fixed assets and employment, but no evidence has been found localization economies. Third, when compared to an industrial cluster that only benefits form agglomeration economies, we found that firms from the competitiveness clusters have experienced a labor productivity gain, greater employment and an increase in total fixed assets.

Keywords: Cluster policy, productivity, difference-in-difference, optic/photonic industry

JEL: L25, L52, R12

1. Introduction

Cluster initiatives have attracted attention among policymakers, and have been justified by the existence of agglomeration externalities, suggesting that a government intervention could be useful and efficient. Firms' competition and collaboration are more intense within an industrial cluster and are expected to enhance competitiveness. The proximity demonstrated by a cluster is considered as a competitive advantage, as competition and collaboration between firms are intensified. Firms have access to a local labor market adapted to the cluster's needs, which increases their productivity. Clustering also fosters productivity growth, innovation and entrepreneurship.

Industrial cluster formation is largely caused by the existence of agglomeration

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economies. These agglomeration externalities reflect the overall benefits resulting from a concentrated spatial structure. Economic agents' behaviors, and especially their location choices, will therefore be altered by the emergence of formal or informal social interactions. Marshall's model (1890), completed by Arrow (1962) and Romer (1986), stated that firms generate specialization externalities, essentially received by competitors, and gather in clusters of economic activity. Agglomerated firms are expected to be more productive. Geographical concentration allows access to a broader pool of competent labor to satisfy the firms' expectations in terms of required qualifications (labor market pooling). The local labor market promotes contacts between employers and employees, and between suppliers and buyers, which fosters the productivity of agglomerated firms.

The cluster also fosters the performance of agglomerated firms through non-pecuniary externalities, thanks to formal and informal transfers of knowledge, information and *savoir-faire*. Firms also benefit from socialization, which is facilitated by geographical proximity (knowledge spillover). Technology spillovers – knowledge transfers from research and development (R&D) efforts – improve other economic agents' efficiency through market monitoring. These exchanges can lead to mimetic behaviors, as some firms might consider that the location choice of a leading enterprise is a sufficient signal and that the pioneer firm had performed an extensive market study beforehand.

Public initiatives aim to stimulate clusters' competitiveness and growth, and seek to strengthen success factors for some of them, with the Silicon Valley as a model. Public authorities expect from cluster policies a return on investment in the form of improved performances from recipient firms. These cluster policies apply to three major fields: regional policy (where lagging regions are targeted), science and technology policy (priority is given to R&D in promising sectors) and industrial policy. Porter's analysis (1998) identifies a cluster as a self-reinforcing system that improves competitiveness. Developing clusters is therefore a justifiable policy goal and it would be advisable to establish specific policies for each type of cluster, as some are less sensitive to concentration gains. Unlike Japan, European firms in financial hardship are often the beneficiaries of public aid for clusters (e.g. infrastructure financing, aid scheme for R&D…), to the detriment of rapidly growing industries. Both empirical and theoretical literatures have analyzed governments' choices of picking "losers" and their apparent difficulty to select promising firms (Beason & Weinstein 1996; Corden 1974; Martin et al. 2011a). It appears that it is more accommodating for policymakers to identify declining sectors affected by job losses, rather than new promising sectors (Krueger 1990). As declining firms have a greater incentive to lobby, public policies do not necessarily pick "losers" but rather "losers" are picking government subsidies (Baldwin & Robert-Nicoud 2007).

In this paper, we analyze the effects of the French cluster policy on firms' productivity, export, employment and total fixed assets in the optic/photonic industry. The French cluster policy – known as the "*pôles de compétitivité*" policy or the "Competitiveness cluster" policy – is based on financial subsidies from calls for tender. It was launched in 2005 and had been extended in 2009 for a three-year period. Three optic/photonic clusters (*Route des Lasers* in the Aquitaine region, OPTITEC in the Languedoc-Roussillon region and ELOPSYS in the Provence-Alpes-Côte d'Azur region) were selected in July 2015, following the first call issued in 2004. Photonics is a fast-growing business sector and has been identified by the European Commission as one of the six “key enabling technologies” of the 21^{st} century (the other sectors being micro-/nanoelectronics, nanotechnology, advanced materials, industrial biotechnology and advanced manufacturing technologies). With 71 competitiveness clusters in 2007, the French initiative, which demonstrates at its best a “bottom-up” industrial policy, appears to be ambitious and fairly costly compared to the previous 1998 cluster policy, called “Local Productive Systems”.

The paper is structured as follows. In Section 2, we describe a literature review. Section 3 describes the database used in the estimations. In Section 4, we set out the empirical strategy. We describe the results in section 5. Last, Section 6 concludes.

2. Literature review

2.1. *Geographical agglomeration and firms’ performance*

Evaluating the effects of geographical agglomeration on firms’ performance has attracted much attention and the results have been used by policymakers to support cluster policies. Cluster effects’ estimations are facing two technical problems that have not been integrated into pioneer empirical studies (as Shefer, 1973 or Sveikauskas, 1975). Based on aggregate and cross-sectional data, first estimations of agglomeration externalities did not take into account endogeneity issues, like unobserved heterogeneity or simultaneity bias (Ciccone & Hall 1996). The causal link between geographical concentration and productivity cannot be easily demonstrated. Cluster areas that are taken into account could be well endowed with specific resources related to the activity (e.g. the wine-growing industry around the region of Bordeaux could be stimulated by a prosperous land and an appropriate climate and not necessary by industries' agglomeration). Moreover, a macroeconomic shock, like an increase of national or global demand, could affect firms' productivity and lead to an intensification of geographical concentration (i.e. an increase in the number of employees and enterprises). Individual data are therefore needed to estimate cluster effects.

Studies carried out on individual data confirm a significant positive effect of clustering on firms' productivity and exports. In many empirical studies, a productivity gain comprised of between 3% and 8% is found when a cluster’s size doubles, as reported in Rosenthal and Strange's survey (2004). Henderson's study (2003) focused on United States industrial firms between 1972 and 1992, with a five-year interval. It showed that cluster effects were more significant in high-technology activities and that a doubling in the number of high-tech companies would lead to an 8% increase in firms' productivity. Sectoral specialization and local market size are supposed to be the main determinants of productivity growth, while sectoral diversification has no significant impact (Cingano & Schivardi 2004). Productivity, innovation and exports are closely related. The positive relationship between productivity and exports can be explained by firms’ decisions in terms of innovation (Cassiman & Golovko 2011). Export levels as well as added-value per employee are greater within an Italian district than for enterprises that do not belong to the cluster (Becchetti et al. 2007). Exporters’ agglomeration also had a positive impact on French firms’ export behaviors, confirming the presence of local export spillovers (Koenig 2009; Koenig et al. 2010). Firms are on average more productive in larger cities, thanks to agglomeration externalities but also firm selection. As larger cities tend to toughen competition, only the most productive can survive. However, Combes et al. (2009) showed that productivity gaps between French areas can mainly be explained by agglomeration externalities and not by selection. No effects of local competition on productivity are found for members of a French cluster (Barbesol & Briant 2008). However, the existence of a cluster helps to promote the economic development of a region, allowing existing firms to grow and the new industries to be created (Delgado et al. 2012).

Even though significant externalities emerged from various studies, the localization of a firm in a cluster alone cannot have an impact on its performance (Camisón 2004; Hendry & Brown 2006). Only the joint effect of specific and shared competences (external knowledge acquisition, reputation, collective learning) would create a comparative advantage. Individual performances, firms' status and age should be taken into consideration to evaluate the impact of clustering. As young firms – or small and medium-sized enterprises (SME) in general – have different needs, externalities associated to their geographical concentration will generate more benefits in terms of performance and innovation. However, economic costs associated to geographical concentration can be deemed too high (land prices increase as the cluster is widening) and could discourage enterprises, especially SMEs, even though survival rates of firms are greater within science parks than outside (Ferguson & Olofsson 2004). Clusters are particularly heterogeneous; some are too small or too big depending on the importance of congestion costs and gains associated to geographical concentration. Using firm-level data in the global video game industry, De Vaan et al. (2013) found a positive effect of clustering only once a critical size was reached. Even though cluster firms benefit from a local environment of competing enterprises, specialized resources and institutions fostering knowledge transfers, a strong specialization may be hazardous. Only mature activities with a well-established production process will benefit more intensely from specialization than sectorial diversity (Duranton & Puga 2005; Henderson et al. 1995).

2.2. Cluster policies and firms' performance

The limited mobility of enterprises and workers hinders the development of "natural" clusters (without public intervention). A subsidy or external incentive could be inefficient and costly, compared to externalities generated by geographical concentration. Measures aiming to reduce mobility barriers need to be strengthened to foster cluster development. The presence in the same region of several firms belonging to a specific sector tends to increase the likelihood of a foreign firm to establish a branch (Crozet et al. 2004; Devereux et al. 2007; Head et al. 1999). According to Porter (1998), clusters have to be sufficiently significant and have already proven their worth to receive public aid. Only a few clusters have been able to assure their durability thanks to public intervention. In the study led by Van der Linde (2003), only one cluster has shown success following a public intervention from over 700. Measures taken to attract firms in distant clusters have rarely had the anticipated effect. A per-firm subsidy aimed to foster production in the periphery tends to induce an adverse selection. Only the least efficient firms are willing to relocate in the periphery and therefore benefit from the public aid as they have the least to lose, while growing enterprises will rather stay in a dense area (Baldwin & Okubo 2006). There is also an information asymmetry, as enterprises are more aware of their development potential and performance level than policymakers. Therefore, it seems even more difficult for public authorities to pick the "winning" sectors that should be fostered. A public subsidy policy may not take into consideration cluster diversity, and could be harmful for territories whose advantages are their low production costs.

Some cluster policies have been econometrically evaluated in the literature. Using firm-level data provided by annual business surveys, the first French cluster policy, called "Local Productive Systems" has been analyzed to show that the policy did not succeed in fostering productivity for the targeted enterprises (Martin et al. 2011a). The cluster policy did not have a significant impact on firms' productivity, cluster's size, nor exports. Using French annual business surveys data and customs data, Fontagné et al. (2010) found that, beyond agglomeration externalities, French firms that have received public aid have had better export levels than those from the same region and sector. The "best" firms are self-selected within the cluster. The French 2005 competitiveness cluster policy has also been analyzed in Fontagné et al. (2013). They found that "winners" were self-selected and that firms belonging to national clusters were exporting more than others. Several German companies have benefited from a cluster policy. Falck et al. (2010) used firm-level data and applied a difference-in-difference model to evaluate the success of a German cluster policy in high-technology industries. Engel et al. (2011) analyzed the performance of two German cluster initiatives in biotechnology. Both these studies found a positive impact on R&D and innovation within the region. The "Regional Selective Assistance" initiative has been implemented in the United Kingdom (UK) to subsidize firms in backward areas. While Criscuolo et al. (2007) found no effect of grants on UK firms' productivity, Devereux et al. (2007) found a positive but very weak effect of the British policy. Nishimura and Okamuro (2011) conducted a firm-level study to assess the viability of the Japanese "Industrial Cluster Project". Their findings suggest that the participation of SMEs in the cluster initiative alone has no significant impact on their R&D productivity. Another study analyzed the cluster policy implemented to renew the economic structure of Barcelona (Viladecans-Marsal & Arauzo-Carod 2012). They concluded that the public policy had an impact on the decision of knowledge-intensive enterprises to locate within the city. Crozet et al. (2004) also measured the impact of a French subsidy on firms' location choice and found a positive but very weak effect.

Results need to be interpreted with caution, given the difficulty to assess firms' performance if they had not received such subsidies. Cluster diversity and the nature of public intervention cannot give an unequivocal justification of these policies. While clusters are playing an important role in the competitiveness of the European industry, policy approaches differ across the European Union. Since 2008, a commitment has been made by the European Commission to establish a new strategy, with the aim of promoting the emergence and development of clusters and to foster world-class clusters within the EU.

3. Data

3.1. Sources

The main database used in this study is the French census FICUS (*Fichier complet unifié de Suse*). It covers over 4 million French firms from both manufacturing sector and services, therefore including nearly all enterprises. FICUS gathers financial statements and provides detailed information on balance sheets and income statements of French companies. Specifically, the database contains information about firms' value added, nominal gross output, number of employees, intermediate inputs, tangible and intangible capital, investment goods and exports. These variables are used to compute the Total Factor Productivity (TFP) of firms using the semi-parametric method developed by Levinsohn and Petrin (2003). The FICUS database is published by the French National Institute for Statistics and Economic Studies (INSEE) and covers the period 1996-2007. The identification codes (SIREN codes) make it possible to follow the evolution of firms' characteristics over time and, thus, allow us to construct a unique panel data set of French firms. We also use the information provided by the INSEE on industry-level price indexes and the price index of the gross fixed capital formation, in order to deflate value added and capital. The FICUS database also provides information about the French industry classification (NAF 2-digit) and the regional classification (NUTS-3) for each firm.

In a first analysis, we focus our study on three competitiveness clusters (Optitec, Route des Lasers and Elopsys) including 61 firms, and only choose firms belonging to the same NAF 2-digit industries for the matching procedure. We assume that firms belonging to the same industries have a higher probability to be affected by the 2005 public policy. According to Fontagné et al. (2013), "winners" of the French cluster policy were previously self-selected.

Additionally, we run an *ad hoc* matching procedure and use the data provided by the industrial cluster "Optique Rhône-Alpes". The cluster was not concerned by the public policy but shows the same specialization as the three competitiveness clusters retained in our study.

3.2. Descriptive statistics

Table 1 presents the descriptive statistics prior to the competitiveness cluster policy (in the pre-treatment period). It shows that the three clusters are not representative of the average French firms in the same industry. They seem to be larger in terms of employment, total sales, value added and exports. Furthermore, the firms belonging to these three clusters also evolve in regions where the other enterprises from the same industries are larger than the average. However, they record greater sales, value added and exports than the other firms of the same regions and industries.

Table 1. Summary statistics in 2004 (prior to the cluster policy)

Variables	Competitiveness cluster	Other firms (same NAF 2-digit)	Other firms (Same NAF 2-digit and same NUTS-3 regions)	"Optique Rhône-Alpes"
Total sales	5977.03	1842.10	2226.01	8782.39
Value added	2621.06	470.57	518.05	3937.57
Number of employees	47.60	8.02	8.49	62.44
Exports	3413.2	369.29	538.73	903.67
Number of firms	61	768359	383006	18

Note: The table presents the mean value for each variable.

If we compare the descriptive statistics of the three competitiveness clusters with those from the "Optique Rhône-Alpes" cluster (ORA), we find different conclusions. Indeed, firms from the ORA cluster are larger in terms of employment, value added and total sales, however, companies from the three competitiveness clusters have recorded greater exports than those from the ORA.

4. Empirical strategy

The main goal of the cluster policy launched in France in 2005 was to foster and increase firm's competitiveness, innovation and productivity by promoting cooperation and by intensifying external and internal economies of scale. We therefore aim at evaluating the impact of this policy on selected firms' productivity, employment and exports. In order to achieve this, we apply the difference-in-difference (DD) method used in the empirical literature to evaluate the effectiveness of public policies (such as in Falck et al. 2010; Martin et al. 2011; Viladecans-Marsal & Arauzo-Carod 2012; Sissoko 2011). In its simplest form, this method distinguishes two groups of firms for two time periods. One of the groups is exposed to a treatment (i.e. the Competitiveness cluster policy) in the second period but not in the first period. The second group – known as the "control group" – has never been exposed to the treatment, whatever the period considered. The choice of this control group is, therefore, crucial for the validity of our empirical study. The control group should have observable characteristics as similar as possible to those of the Competitiveness cluster firms. To build this control group, the empirical literature refers to a matching procedure. The method consists of matching each firm benefiting from the public policy with a non-treated "twin" firm that shares similar observable characteristics. This procedure allows identifying the causal relationship between the implementation of the public policy and the targeted firms' performance. Furthermore, a matching procedure reduces the endogeneity bias associated with the selection of firms by the cluster policy. Indeed, the selection of firms by the public policy could be the result of better performances in terms of productivity or employment.

In this paper, as in Sissoko (2011), we combine a propensity score matching (PSM) procedure and a DD estimation in order to capture the real impact of the Competitiveness cluster policy on firms' performance in the optic/photonic industry. The simplest and most widely used matching estimator in the literature is nearest neighbor matching. In this case, the firm from the control group is chosen as a matching partner for a firm benefiting from the public policy that is closest in terms of propensity score. Traditionally, the Mahalanobis distance is chosen to determine the nearest neighbor. Matching can be conducted with replacement (i.e. using each time the entire sample which allows pairing with a same firm) or without (i.e. firms from the control group can only be paired once with a firm from the treated group). The use of matching without replacement requires a large control sample, as is the case in our study.

Another important feature when using a propensity score matching is that both the population average treatment effect (ATE) and the average treatment effect on the treated (ATT) are only defined in the region of common support (Caliendo & Kopeinig 2008). The violation of this condition entails a significant evaluation bias, as mentioned in Heckman et al. (1997). Therefore, it is important that the propensity score distributions of both groups overlap. As shown in Bryson et al. (2002), imposing the common support condition ensures that each characteristic observed in the treatment group are also observed in the control group. As a consequence, we implement the full Mahalanobis matching without replacement using the one-to-one nearest neighbor method to construct our control group. We impose a common support condition by dropping treatment observations for which the propensity score is higher than the maximum value of the propensity score of the control group, or lower than the minimum value[3].

In a first step, we analyze the selection process of the Competitiveness cluster policy relying on firms' characteristics and performance. We estimate a logit model of the probability of firm *i*, from sector *s* and located in region *z*, to be concerned by the public policy. For the binary treatment case, logit and probit models seem to yield very similar results (Caliendo & Kopeinig 2008). We opt for a logit model rather than a probit model as the logit distribution has thinner tails compared to the normal distribution. The logit models are run on the pre-treatment period. In the regression, we take into account firm-level characteristics prior to the Competitiveness cluster policy, as well as the employment areas where the firms are located, as in (Martin et al. 2011a). Indeed, the French cluster policy, launched in 2005, has been justified by the existence of agglomeration. The logit model has the following form:

$$\begin{aligned}\Pr(CC_{iszt}) = \alpha + \beta_1\, Ln(LabProd_i)_{t-1} + \beta_2\, Ln(Empl_i)_{t-1} + \beta_3\, \Delta Ln(LabProd_i) \\ + \beta_4\, \Delta Ln(Capital_i) + \beta_5 Loc_{iszt-1} + \beta_6 Urb_{szt-1} + \lambda_s + \phi_z + \varepsilon_{iszt}\end{aligned}$$

where CC_{iszt} equals unity if firm *i* is part of a Competitiveness cluster at year *t*, 0 otherwise; $LabProd_i$ represents the labor productivity[4] measured as the ratio between the value added of firm *i* and its number of employees; $Empl_i$ indicates the number of employees of firm *i*; $\Delta LabProd_i$ is the growth rate of labor productivity; $\Delta Capital_i$ represents the growth rate of fixed assets of firm *I*; Loc_{iszt-1} measures localization economies, Urb_{szt-1} represents urbanization economies. λ_s and ϕ_z are respectively the industry and region fixed effects. We estimate this

[3] The Stata command *psmatch2* is used to calculate the propensity score and to construct the control group.
[4] In the first step of the analysis, we use the labor productivity rather than the TFP, as it can only be computed for 33 firms concerned by the public policy in 2004.

logit model in 2004, i.e. before the implementation of the Competitiveness cluster policy. We therefore obtained a cross-sectional estimation.

The two measures of agglomeration economies are the same used in Martin et al. (2011a; 2011b). The localization economies index captures the intra-industry externalities. It is measured for each firm as the number of other employees working in the same industry and in the same area:

$$Loc_{iszt} = Ln(employees_{szt} - employees_{iszt} + 1)$$

The variable computed to capture urbanization economies is defined as the number of workers in other industries and in the area *z* where the firm *i* is located:

$$Urb_{szt} = Ln(employees_{zt} - employees_{szt} + 1)$$

We use the FICUS database to calculate the number of workers by year, industry (at the NAF 2-digit) and area.

In a second step, the estimated probability of being involved in the competitiveness cluster is derived from the logit estimation and used to construct the control group. After selecting the firms of the control group, it is important to assess the quality of the matching by performing tests that check whether the propensity score adequately balances characteristics between the competitiveness cluster firms and the matched firms. In other words, after the application of the matching procedure, there should be no statistically significant differences between the covariate means of the treatment and control units. We therefore conduct two types of balancing tests. First, we use univariate t-tests of equality of means between the two groups to evaluate if the PSM was a success. Second, we perform Hotelling's T-squared multivariate test to analyze whether a set of means is zero or, alternatively, equal between two groups. The multivariate balancing test is supposed to be more efficient than the univariate ones (Sissoko 2011).

Finally, in a third step, we use a standard "difference-in-difference" method (DD) to evaluate the impact of the Competitiveness cluster policy on firms' TFP, labor productivity, employment, capital and exports. The DD equation is as follow (Martin et al. 2011a):

$$y_{it} = \sigma CC_i + \theta InCC_{it} + \delta_t + \epsilon_{it}$$

Where y_{it} represents the outcome variables: logarithm of labor productivity, logarithm of TFP, logarithm of the number of employees, logarithm of the physical capital and logarithm of exports. CC_i is a dummy variable which equals 1 if the firm *i* has benefited from the competitiveness cluster policy in 2005. This dummy captures all time-invariant unobservable characteristics. $InCC_{it}$ is a dummy variable which equals 1 for firms belonging to a *pôle de compétitivité* after the implementation of the public policy (i.e. after 2005). δ_t controls for time effects and ϵ_{it} is the residual error term. In this equation, θ represents the DD estimator of the effect of the competitiveness cluster policy on firms' performance if ϵ_{it} is orthogonal to the regressors (Martin et al. 2011a). It compares the performance of firms targeted by the competitiveness cluster policy before and after the implementation of the public policy and the performance of other firms during the same period. As in Martin et al. (2011a), we had several fixed effects (time, individual region) to correct for several sources of bias in the estimation of σ and θ. If individual fixed effects are added to the model, the variable CC_i is dropped from the estimation as the fixed effects capture it.

5. Results

5.1. Characteristics of the competitiveness cluster firms

Table 2 summarizes the estimation results of logit models, which compare firms that have benefited from the competitiveness cluster policy prior to their selection, with firms belonging to the same industries. Column (1) displays results from a simple logit model in which we do not control for region and industry fixed effects. It should be stressed from this simple specification that firms benefiting from the competitiveness cluster policy appear to be bigger in terms of employment than the other firms. The results suggest that larger firms are more likely to be concerned by the public policy in the optic/photonic industry. One explanation of this phenomenon is that bigger firms employ more workers, which is more valuable for a cluster policy. They also tend to have a bigger lobbying power than smaller firms (Martin et al. 2011a). This result is robust to the inclusion of fixed effects.

Table 2. Competitiveness cluster determinants

	(1)	(2)	(3)	(4)
$Ln(LabProd_i)_{t-1}$	0.600***	0.678***	0.315	0.394**
	(0.168)	(0.174)	(0.204)	(0.189)
$Ln(Empl_i)_{t-1}$	0.477***	0.558***	0.495***	0.615***
	(0.069)	(0.069)	(0.075)	(0.078)
Δ $Ln(LabProd_i)$	0.066***	0.096***	0.048*	0.078***
	(0.024)	(0.030)	(0.025)	(0.030)
Δ $Ln(Capital_i)$	0.420***	0.484**	0.462**	0.417*
	(0.113)	(0.219)	(0.187)	(0.222)
Loc_{iszt-1}	-0.642***	-0.643***	-0.137	-0.020
	(0.064)	(0.084)	(0.169)	(0.252)
Urb_{szt-1}	0.419***	1.122***	-0.200	0.285
	(0.112)	(0.256)	(0.211)	(0.316)
Intercept	-11.222***	-18.291***	-4.346**	-9.844***
	(1.100)	(2.722)	(2.110)	(2.995)
Region FE	No	Yes	No	Yes
Industry FE	No	No	Yes	Yes
Number of firms	291639	131786	286422	130132
Pseudo R^2	0.083	0.200	0.130	0.248

*Note: The table reports the estimation results of the logit models based on a cross-section of firms in 2005. Standard erros in brackets are clustered by firm in order to take into account potential autocorrelation. *, **, *** denote significance at the 10 %, 5 % and 1 % level, respectively.*

The estimation results also show that firms targeted by the public policy are more productive and have a higher growth rate of labor productivity than the other firms of the optic/photonic industry. The inclusion of region fixed effects (columns 2 and 4) and NAF 2-

digit industry fixed effects (column 4) does not significantly modify these outcomes. This means, as depicted in Table 1, that firms belonging to the three competitiveness clusters considered in this analysis are productive firms and are located in productive regions.

Moreover, we find evidence that growth rates of fixed assets influence the probability for a firm to be concerned by the cluster policy. It should be noted that agglomeration variables are only significant when industry fixed effects are not controlled for. We find that the number of employees working in the same industry and in the same region negatively influences the probability for a given firm to be part of a competitiveness cluster (columns 1 and 2). This result goes against the prediction of the model. Indeed, the proxy for localization economies should positively influence the probability of belonging to a competitiveness cluster. When industry and region fixed effects are controlled for, the variable is positive and non-significant. The proxy for urbanization economies is however highly significant and positive in the first two columns of the results.

The preferred specification for the estimation of the propensity score is the one reported in column 4, as it controls for both industry and region fixed effects. As mentioned in the previous section, we use the estimated probability of being involved in the competitiveness cluster, derived from the logit estimation, to build the control group. As we use a one-to-one nearest neighbor matching procedure without replacement and impose a common support condition, we end up with 55 firms. Each firm belongs to one of the three competitiveness clusters in the optic/photonic industry (Elopsys, Route des lasers, Optitec). The control group also includes 55 firms. We implement two types of balancing tests in order to check for the quality of the PSM (tests for a difference in means). Results are presented in table 3. We can notice that there is no imbalance between the two groups according to the Hotelling test. Univariate tests also confirm this conclusion.

Table 3. Results of balancing tests

Hotelling's multivariate test

T^2	F-stat	P-value
5.436	0.486	0.817

Univariate tests

	Mean *(CC firms)*	Mean *(Control group)*	T-test	P-value
$Ln(LabProd_i)_{t-1}$	4.00	3.86	-1.347	0.181
$\Delta Ln(LabProd_i)$	0.05	0.07	0.359	0.720
$Ln(Empl_i)_{t-1}$	2.77	2.86	0.263	0.793
$\Delta Ln(Capital_i)$	0.17	0.13	-0.505	0.614
Loc_{iszt-1}	8.32	8.50	0.601	0.548
Urb_{szt-1}	11.85	12.0	0.927	0.326
Number of firms	*55*	*55*	-	-

5.2. Competitiveness cluster and productivity

We estimate the DD equation for productivity using data from the 55 targeted firms and the 55 matched firms from 1997 to 2007 using the ordinary least squares (OLS) estimator. Table 4 reports the results of the DD approach using the labor productivity as a dependent variable, while table 5 focuses on the TFP computed using the semi-parametric method developed by Levinsohn and Petrin (2003).

Table 4. Competitiveness cluster policy and labor productivity

$Ln(LabProd_i)$	(1)	(2)	(3)	(4)	(5)	(6)
CC firm	0.067*	0.074*	0.051	0.058		
	(0.033)	(0.034)	(0.035)	(0.035)		
Being in a CC	0.112**	0.116**	0.112**	0.116**	0.113**	0.112**
	(0.041)	(0.044)	(0.043)	(0.045)	(0.038)	(0.041)
Intercept	3.712***	4.017***	3.044***	3.388***	3.148***	4.788***
	(0.017)	(0.085)	(0.164)	(0.188)	(0.165)	(0.374)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	Yes	No	Yes	No	Yes
Industry FE	No	No	Yes	Yes	No	Yes
Firm FE	No	No	No	No	Yes	Yes
Observations	1038	1038	1038	1038	1038	1038

*Note: Standard errors in brackets are clustered to take into account potential autocorrelation. *, ** and *** denote significance at the 10 %, 5 % and 1 % level respectively.*

Table 5. Competitiveness cluster policy and Total Factor Productivity (TFP)

$Ln(TFP_i)$	(1)	(2)	(3)	(4)	(5)	(6)
CC firm	-0.342	-0.326*	-0.033	-0.012		
	(0.170)	(0.146)	(0.079)	(0.086)		
Being in a CC	0.267***	0.277***	0.322***	0.335***	0.236***	0.117***
	(0.056)	(0.061)	(0.069)	(0.072)	(0.056)	(0.024)
Intercept	5.005***	4.155***	4.484***	4.498***	2.910***	0.611**
	(0.114)	(0.223)	(0.200)	(0.253)	(0.009)	(0.270)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	Yes	No	Yes	No	Yes
Industry FE	No	No	Yes	Yes	No	Yes
Firm FE	No	No	No	No	Yes	Yes
Observations	696	696	696	696	696	696

*Note: Standard errors in brackets are clustered to take into account potential autocorrelation. *, ** and *** denote significance at the 10 %, 5 % and 1 % level respectively.*

The simple OLS regression with time fixed effects (column 1 of tables 4 and 5) does not confirm that firms targeted by the competitiveness cluster policy ("CC firm") are "structurally" more productive than the others. Surprisingly, when both industry and region fixed effects are taken into account in the regression (column 4 of tables 4 and 5), the coefficient on competitiveness cluster firms is not significant at the 1% level. However, we find evidence that the coefficient of the variable "being in a competitiveness cluster" is positive and significant, regardless of the productivity measure retained in the analysis. These results suggest that firms which have benefited from the public policy have experienced, two years after the implementation of the policy, an average gain in TFP of 12% and an average gain in labor productivity of around 11 %, compared with firms from the control group. Therefore, firms that have received the competitiveness cluster label became more productive after the implementation of the public policy (i.e. after 2005).

5.3. Further issues

We also investigate the impact of the public policy on other indicators of firm performance. First, as the 2005 public policy aimed at promoting firms' competitiveness, we focus our analysis on firms' exports. Indeed, French firms' export competitiveness is directly targeted by the policy. Moreover, France, unlike Germany, has lost export market shares on the global market and the debate about the weakness of French export competitiveness is still ongoing. As a consequence, a public policy that targets firms' competitiveness could help small and medium-sized enterprises to overcome the fixed cost of exporting, and could also encourage firms to increase their exports. In other words, the competitiveness cluster policy could have a significant impact of the intensive margin of trade.

To assess the impact of the French public policy on firm-level exports, we use an export equation in which the level of exports is regressed on the TFP and the size of firm, in terms of employment. Since the pioneering work of Melitz (2003), it is well known that only the most productive firms would be able to face fixed costs of exporting. Our results (columns 2 and 3 of table 6) confirm that productivity has a strong positive impact on the intensive margin of trade. Furthermore, the competitiveness cluster policy seems to have a positive and significant impact on firm-level exports even when we control for firm, industry, region and time fixed effects. In other words, the policy has allowed targeted firms to record higher exports two years after the implementation of the policy.

Table 6. Competitiveness cluster policy and firm's exports, employment and total fixed assets

	$Ln(Exp_i)$		$Ln(Empl_i)$		$Ln(Capital_i)$	
	(1)	(2)	(3)	(4)	(5)	(6)
$Ln(TFP_i)$	0.869**	1.372***				
	(0.289)	(0.201)				
$Ln(Empl_i)$	0.374	0.471*				
	(0.209)	(0.220)				
Being in a CC	0.392**	0.418***	0.169*	0.154*	0.266**	0.243**
	(0.149)	(0.124)	(0.089)	(0.086)	(0.124)	(0.121)
Intercept	1.269**	-11.362***	4.152***	0.723**	4.552***	4.015***
	(0.442)	(2.187)	(0.075)	(0.287)	(0.089)	(0.143)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	Yes	Yes	Yes	No	Yes
Industry FE	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	No	Yes	Yes	Yes
Observations	435	435	1046	1046	1041	1041

*Note: Standard errors in brackets are clustered to take into account potential autocorrelation. *, ** and *** denote significance at the 10 %, 5 % and 1 % level respectively.*

Another key aspect of the public policy is its effect on firms' labor demand. Indeed, policymakers are particularly interested in the impact of a given industrial policy in terms of employment. To evaluate the impact of the competitiveness cluster policy on targeted firms' employment, we also refer to the DD approach. Results are reported in columns 4 and 5 of table 6. We notice that the coefficient associated with the variable "Being in a CC" is positive and significant at the 10% level. In conclusion, our findings put forth the evidence that the public policy had a significant impact on firms' employment.

We also assess the impact of the competitiveness cluster policy on firms' total fixed assets. Our results (columns 5 and 6 of table 6) indicate a positive and significant effect of the public policy on targeted firms' total fixed assets, suggesting that after the implementation of the public policy, firms from the competitiveness cluster in the optic/photonic industry have expanded their equipment in order to produce more.

Finally, we test whether the implementation of the public policy had a significant effect on the size of the clusters. For the dependent variable, we use the number of firms belonging to the same NAF 2-digit industries and the same region as firm *i*. Table 7 reports the results of the DD approach applied to localization economies. First, we find that once region fixed effects are controlled for, the variable capturing if the firm was selected by the competitiveness cluster policy ("CC firm") becomes positive and significant at the 1% level. It suggests that firms targeted by the 2005 policy were already involved in an industrial cluster. Therefore, the policy has only revealed pre-existing clusters. However, we find no evidence that the policy had a significant impact on localization economies.

Table 7. Competitiveness cluster policy and localization economies

$Ln(firms)_{iszt}$	(1)	(2)	(3)	(4)	(5)	(6)
CC firm	0.111	0.155***	-0.018	-0.009		
	(0.333)	(0.040)	(0.122)	(0.016)		
Being in a CC	0.003	-0.015	0.028	-0.003	-0.066	0.008
	(0.112)	(0.050)	(0.053)	(0.028)	(0.058)	(0.028)
Intercept	6.914***	7.338***	7.764***	6.989***	1.631***	7.778***
	(0.256)	(0.051)	(0.110)	(0.045)	(0.059)	(0.137)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	Yes	No	Yes	No	Yes
Industry FE	No	No	Yes	Yes	No	Yes
Firm FE	No	No	No	No	Yes	Yes
Observations	1056	1056	1056	1056	1056	1056

*Note: $Ln(firms)_{iszt}$ represents the logarithm of the number of firms belonging to the same NAF 3-digit industries and the same region as firm i. Standard errors in brackets are clustered by firm to take into account potential autocorrelation. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.*

5.2. A comparison with the "Optique Rhône-Alpes" cluster

In a second analysis, we use an *ad hoc* control group comprising firms of the "Optique Rhône-Alpes" (ORA) industrial cluster, specialized in optic/photonic activities. Unlike Elopsys, Optitec and Route des Lasers, this cluster has not been selected by the competitiveness policy in 2005. The aim of this second study is to evaluate if the cluster policy has had a significant impact on targeted firms' performance compared to firms from the ORA cluster. Results of the DD approach, estimated by the OLS using data from 60 firms of the three competitiveness clusters and 16 firms of the ORA industrial cluster as the control group, are reported in table 8.

Table 8. Comparison with the ORA industrial cluster

	Ln(TFP_i)		Ln($LabProd_i$)		Ln(Exp_i)		Ln($Capital_i$)		Ln($Empl_i$)	
Being in a CC	-0.008	-0.032	0.195***	0.211***	0.357	0.341	0.341***	0.279**	0.223**	0.187**
	(0.139)	(0.141)	(0.073)	(0.075)	(0.356)	(0.344)	(0.124)	(0.113)	(0.094)	(0.090)
Ln(TFP_i)					0.698**	1.081***				
					(0.296)	(0.331)				
Ln($Empl_i$)					0.109	0.217				
					(0.274)	(0.267)				
Intercept	3.100***	5.397***	4.639***	3.544***	2.628	0.320	5.354***	8.604***	1.725***	3.631***
	(0.123)	(0.150)	(0.073)	(0.290)	(1.757)	(0.775)	(0.079)	(0.094)	(0.072)	(0.606)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Region FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	546	546	736	736	372	372	752	752	761	761

*Note: Standard errors in brackets are clustered by firm to take into account potential autocorrelation. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.*

First, we find no evidence that after being granted the competitiveness cluster label, targeted firms have performed better than those from the ORA cluster in terms of TFP. However, this conclusion does not hold when we use labor productivity as the outcome. Our results show that two years after the implementation of the policy, firms from competitiveness clusters have experienced a gain of around 18 % of labor productivity compared to firms from ORA. Our results also show that targeted firms have experienced greater employment and total fixed assets than ORA firms after the implementation of the French policy. Nevertheless, we do not find evidence that targeted firms have experienced better export performance on the global market compared to ORA firms.

6. Conclusion

Cluster initiatives are popular among policymakers. We however find mixed results concerning the French cluster policy launched in 2005 when only focused on the optic/photonic industry.

Using a simple logit model, we first showed that larger firms are more likely to be concerned by the French public policy in the optic/photonic industry. The estimation results also show that firms targeted by the public policy are more productive and have a higher growth rate of labor productivity than the other firms.

Secondly, our results suggest that the firms belonging to the 2005 competitiveness clusters have experienced, two years after the implementation of the policy, an average gain in TFP of 12% and an average gain in labor productivity of around 11 %, compared with firms in the control group. Firms that have received the competitiveness cluster label became more productive. Furthermore, our results confirm that the public policy has also allowed targeted firms to record higher exports and expand their equipment two years after the implementation of the policy. However, the policy seems to have only supported pre-existing clusters in the optic/photonic industry..

Finally, we have compared the competitiveness clusters with the firms belonging to the industrial cluster “Optique Rhône-Alpes” (ORA), which only benefits from agglomeration economies. We find no evidence that after being granted the competitiveness cluster label, targeted firms have performed better than those from the ORA cluster in terms of TFP. However, when we focus on labor productivity instead of the TFP, we find that two years after the implementation of the policy, firms from competitiveness clusters have experienced a gain of around 21 % of labor productivity compared to ORA firms. Our results also showed that targeted firms have experienced greater employment and total fixed assets than ORA firms after the implementation of the French policy. However, we did not find evidence that targeted firms have experienced better export performance on the global market compared to ORA firms. These results suggest that, beyond agglomeration economies, the French public policy have increased labor productivity, employment and total fixed assets.

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