Measurement and anticipation of territorial vulnerability to offshoring risks: An analysis on sectoral data for France

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Abstract – While economic studies generally conclude that there is little impact from offshoring at the macroeconomic level, offshoring generates significant asymmetric shocks at the local level, which it is important to accurately anticipate. This is what this study is about, with the construction of an original indicator of territories' vulnerability to the risks of offshoring manufacturing activity. Firstly, the factors of vulnerability are identified at a fine-grained level of activity. Using principal-component analysis at the sector level, four types of manufacturing industry sectors are brought out according to their potential for offshoring, which is a function of the characteristics of their jobs and their content in routine tasks, and product characteristics. Then, following the approach Aubert and Sillard (2005) implemented on data by establishment, an index of actual offshoring at the sector level is estimated. This makes it possible both to characterise the risk of offshoring in the four main types of sectors and to measure the economic vulnerability of employment zones.

JEL Classification : R12, R3, R58, C38
Keywords: Territory vulnerability, territory attractiveness, offshoring, employment, French employment zones

Reminder:

The opinions and analyses in this article are those of the author(s) and do not necessarily reflect their institution's or Insee's views.

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The authors warmly thank the journal's anonymous reviewers for their comments and very constructive suggestions that contributed to improving this article.

Received on 06 July 2016; accepted after revisions on 11 December 2017 https://doi.org/10.24187/ecostat.2017.497d.1921
Translated from « Mesurer et anticiper la vulnérabilité des territoires face aux risques de délocalisation : une analyse sur données sectorielles en France »

Public perceptions continue to place a high degree of importance on the effects of offshoring on employment. However, most economic studies on France show that offshoring is responsible only for a very small percentage of job destruction (Aubert & Sillard, 2005; Daudin & Levasseur, 2005; Barlet *et al.*, 2007, 2009). For instance, according to the *Global Value Chains* survey, carried out by Insee in 2012, offshoring, motivated mainly by the search for lower production costs, affected only 4.2% of the 28,000 non-financial retail companies with 50 employees or more in France between 2009 and 2011 (Fontagné & D'Isanto, 2013). The increase in job destruction in the manufacturing industry and the growing wage inequalities between skilled and unskilled workers are often associated with the effects of offshoring resulting from the fragmentation of global value chains by companies (Mouhoud, 2017). However, the reasons for these changes in employment and wage inequalities are more complex and underpinned by different factors.

As recent literature on the subject shows (Acemoglu & Autor, 2011; Autor & Dorn, 2013), job losses in industry are explained mainly by productivity gains that are higher overall in the production of manufactured goods than in that of services. Moreover, the increase in household income, which stems partly from this growth in industry productivity, has contributed to the change in the structure of consumption, to the benefit of services and at the expense of basic goods and industrial products (Demmou, 2010).

At the same time, a change can be seen in the sectoral distribution of French employment. In 2015, the manufacturing industry accounted for no more than 11% of jobs compared with more than 78% in services according to Insee data. Moreover, the share of skilled workers' employment increased in the labour market. Consequently, the share of managers and white-collar professionals doubled between 1982 and 2014, from 8.7% of the working population to 17.5% (Bisault, 2017). Over the same period, the share of unskilled manual workers in total employment fell from 15.6% to 8.4%.

Similarly, there has been a change in the wage distribution between the different groups of workers since the 2000s. In the United States, studies reveal a rise in wage growth at the bottom of the distribution (low-skilled workers skilled in services activities) and at the top of distribution (highly skilled workers) at the expense of workers in the middle of the range, consisting mainly of skilled and unskilled manual workers (Autor & Dorn, 2013). This so-called wage polarisation effect would also be observed in France, to a lesser extent (Charnoz *et al.*, 2013; Verdugo, 2014).

Two main explanations for these observations are found in the literature: first, information and automation technologies increase in particular the productivity of the most qualified workers (Levy & Murnane, 1996; Acemoglu, 1999; Acemoglu & Restrepo, 2017); secondly, offshoring and international subcontracting or outsourcing to low-wage countries reduce demand for unskilled labour in the manufacturing industry (Feenstra & Hanson, 1996; Leamer, 1996). The effect of the expansion of international trade and competition from low-wage countries is also often suggested.

Moreover, these two phenomena of technological progress and the expansion of international trade interact. The more international competition is intensifying as a result of globalisation, the more firms are encouraged to introduce processes and products innovations. Defensive innovation makes it possible to curb competition and preserve margins (Neary, 2002). Companies then seek to position themselves on processes that are more intensive in skilled labour. In addition, a selection effect of the most efficient firms leads to an increase in the sectors' average productivity level. In the case of France, Pak and Poissonnier (2016) show a decisive impact of technology on employment changes biased in favour of highly skilled workers, particularly in the production of business services (R&D, information and communication). The losers are also the least skilled workers employed in low technology-intensive production activities.

However, there is a discrepancy between the relative optimism that can be seen in empirical studies on the effects of offshoring in France and the public's very negative perceptions. Our assumption is that this is partly due to the highly localised nature of the impacts of offshoring. Some territories are more exposed to offshoring when they specialise in activities, particularly manufacturing, that are particularly vulnerable to international competition (Houdebine, 1999; Mora & Moreno, 2010). Nevertheless these territorial shocks are hardly offset by labour mobility to regions where

companies labour demand does not meet with adequate supply[1]. An annual survey run by the French Employment Agency including 400,000 companies shows that 191,100 jobs went unfilled in 2015[2]. These recruitment challenges can be explained in part by the low mobility of workers between regions affected by job destruction and territories experiencing difficulties in hiring workers in specific sectors and for specific professions (Donzeau & Pan Ké Shon, 2009; Fabre & Dejonghe, 2015).

The negative effects of this offshoring should be able to be better identified or even anticipated through an observation of the characteristics of territories and the activities they host. One of the first empirical reference studies measuring the effect of offshoring on employment at the production unit level in France is that of Aubert and Sillard (2005). The authors construct a variable of presumption for offshoring, at the production unit level, considering an increase in imports from the group holding the production unit, proportional to the production shutdown, and concurrent with a sharp reduction in the production unit's workforce. Offshoring in this context is defined as a firm's decision to give up production in France in order to produce or sub-contract abroad. This approach provides a measure of the number of jobs offshored, with a breakdown by sector and by employment zone (EZ)[3]. Barlet *et al.* (2009) take up the same methodology using national accounting data by sector, based on the Trade Balance job content method. Lastly, the study by Barlet et al. (2010) measures the degree of offshorability[4] of service activities at the level of the EZs, using the Insee's *CLAP* database (Knowledge of Local Production Structures), but does not include the manufacturing industry.

One recent study (Autor *et al.*, 2013), carried out on a division of the territory into 722 commuting zones, defined according to residence and job criteria, as in the case of French EZs, measures these zones' exposure to local technological and commercial shocks, attempting to distinguish the effect of technical progress from that of trade with China on the structure of employment. Two types of data are used: data on trade with China on the one hand and data on the intensity in routine tasks and office jobs (1980 data) on the other. A recent study is based on the same methodology, using, in the case of the French cantons and departments, an indicator of exposure to import shocks from six countries considered low-wage, to relate it to extremist votes recorded over the period 1995-2012 (Malgouyres, 2017).

In the same vein as these research, the contribution of this article[5] lies in the construction of an indicator of the vulnerability of EZs to offshoring risks, based on a typology of manufacturing activities, according to the characteristics of the relevant jobs and products and relevant manufacturing processes. The criteria for offshoring risk are not limited solely to trade with low-wage countries. Competitiveness, technological innovation and productivity and the intensity of local jobs in routine tasks or intellectual tasks are also taken into consideration.

The first section presents the theoretical determinants of manufacturing activity location decisions and analyses the risks of offshoring, based on the characteristics of jobs and tasks carried out by workers on the one hand, and the characteristics of the sectors and products on the other. The second section proposes a typology of activities based on their offshoring risk, using an analysis of the factors determining activity location decisions. In the third section, an index of offshoring of activities is constructed by connecting the trend in imports with that of jobs in each activity sector over the period 2008-2010 and taking into account the activity typology determined previously. An indicator of vulnerability to the risk of offshoring in the territories is then measured for French EZs. Lastly, a fourth section maps out the territories' specialisations, according to the typology of manufacturing activities more or less likely to be offshored. In conclusion, public aid policies for territories after restructuring or offshoring are discussed in light of the results of this analysis.

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1. As Insee shows, migration from one region to another remain rare: between 2001 and 2006, they occurred in only 6% of the population above age 5 (Fabre & Dejonghe, 2015).

2. See (in French) http://www.pole-emploi.org/actualites/les-offres-non-pourvues-@/543/view-article-139756.html?

3. Employment zones are defined periodically by Insee. This zoning is free from administrative divisions and is aimed at identifying territories within which most of the working population is active and resides, and in which production units can find the bulk of the workforce needed to occupy their positions.

4. The English term offshorability *has been translated into French as* "délocalisabilité".

5. This article draws inspiration from the study we conducted for the Ministry of Industrial Recovery (DGCIS), PIPAME and DATAR in 2013 (Offshoring of industrial activities in France, 2013).

Identifying offshoring risk in manufacturing activities: a literature review

It should be specified that we aim to consider the factors that are conducive or non-conducive to the vertical offshoring of production processes from the perspective of the fragmentation of global value chains and not that of foreign direct investment (FDI) in search of new markets. Two broad approaches can be used. The first focuses on the characteristics of jobs and tasks borne by workers in the different sectors of activity studied. The second also takes into consideration the nature and characteristics of products that can influence incentives for offshoring.

The approach based on characteristics of workers' jobs and tasks

According to a traditional approach, the key motivation behind offshoring lies in reducing unit wage costs by offshoring the assembly or mounting segments that require more unskilled labour (Dana *et al.*, 2007; Grossman & Rossi-Hansberg, 2008; Jabbour, 2010). Inversely, the potential substitution of capital for labour with robotised production processes discourages offshoring followed by end-product re-import. Firms make their choice between deploying labour-intensive technologies in low-wage countries and robotising their assembly segments in their home country.

However, the nature of the tasks and the degree of skill required for a job do not necessarily coincide. The fact that a job is described as skilled or unskilled is not enough to make it offshorable or non-offshorable. The association of the jobs' characteristics with the types of tasks performed by workers in each activity (routine tasks or execution tasks, versus interactive coordination tasks, etc.) play a crucial role in offshoring decisions (Reich, 1993; Grossman and Rossi-Hansberg, 2008; Muendler & Becker, 2010; Oldensky, 2012; Peri & Poole, 2012; Autor & Handel, 2013). These tasks can be more or less easily offshored and/or robotised.

Blinder and Krueger (2013) show that there is little relationship between the measure of job offshorability and the skills of the person employed. Highly skilled people can sometimes hold offshorable jobs in particular when they occupy positions directly connected with production and are in charge of more or less routine execution tasks[6]. This is often the case in industry, finance, insurance, information services, technical services and services to businesses. For instance, a study distinguishing professional from functional specialisation in industrial activities, shows that R&D engineers have benefited from greater growth in employment than "technical engineers in industry" who are assigned to more direct production tasks (Lainé, 2005).

To assess the potential for offshoring of activities, consideration must therefore be given to the characteristics of the tasks performed by the workers according to their codifiable versus tacit, routine versus non-routine, and manual versus grey-matter natures. A breakdown of employment by type of task in relation with workers' skills was made for the first time to our knowledge in the case of France, using a jobs/skills matrix inspired by the United States Bureau of Labor Statistics' *O*NET survey* (Laffineur, 2015; Charnoz & Orand in this issue). For each job, the different skills are grouped into five main categories of tasks: interactive, analytical, grey-matter, routine manual and non-routine manual[7]. Workers perform routine or non-routine tasks and engage or do not engage in interaction with employees and customers, as a result of which they are more or less vulnerable to the risk of offshoring (Becker *et al.*, 2013).

The losers and winners of offshoring can, based on the above, be identified in a more fine-grained manner. Managers and workers holding interactive and analytical jobs are positively affected by offshoring while those assigned to production and in charge of manual execution tasks are rather the losers in globalisation (Laffineur & Mouhoud, 2015).

In summary, while traditional analyses highlight the cost of labour, capital intensity and investment in company offshoring choices, recent literature emphasises the importance of the characteristics of the tasks performed by employees. Concurrent to this, product characteristics (volume, weight, technology, value

6. The same applies to certain job functions in administrative departments the tasks of which are routine and codifiable, albeit immaterial.

7. The skills required for "communication" include oral understanding and expression, clarity of discourse, etc. Complex tasks are carried out by skilled, administrative or office professionals who perform repetitive tasks in accordance with predefined procedures. Grey-matter tasks require responsiveness, creativity, decision-making and problem solving. Manual dexterity and responsiveness are among the skills required for manual tasks and can be non-routine or routine.

chain fragmentation, etc.) also play a significant part in these choices.

The approach based on product characteristics

The breakdown of productive processes is a significant variable in determining potential for offshoring. To analyse the determinants of vertical offshoring, the literature highlights the concept of value chain modularity[8] or fragmentation (Baldwin & Clark, 2000; Frigant & Layan, 2009). The final product is broken down into a series of sub-systems connected with one another by standardised interfaces. Technically, modularisation reduces the complexity of productive processes by organising their subdivisions into sub-sets, which can in turn be entrusted to subcontractors depending on the nature of their production process. The vertical fragmentation rationale in productive processes makes it possible to maximise the return to the production of each fragment. Decrease in transaction costs (transport, customs duties, exchange rates, etc.) promotes the manufacturing of fragments of productive processes in different countries. The international fragmentation of productive processes assumes, firstly, the possibility of breaking down production and, secondly, a specific gain sought in exploiting differences in comparative benefits between countries. International specialisations are then seen in the fragments of productive processes (Amador & Cabral, 2009).

However, there are interdependency and coordination constraints on the various fragments of the value chain, created by the product's final assembly. Managing this interdependency constraint entails costs, which often increase with distance, and can cancel out the benefits of exploiting differences in comparative advantages between countries. The weightier and bulkier the products, the more the cost of transportation and coordination between fragments of the value chain (productive process) before final assembly will have a bearing on total manufacturing costs. The same applies to products that need to be consumed quickly and therefore close to their place of production.

In addition, the degree of differentiation between products (varieties, qualities), the importance of territorial or national labels or brands ("Guaranteed of French Origin" label, AOC, AOP, IGP, etc.), are expected to reduce the benefits of offshoring. In knowledge- and capital-intensive areas of R&D, competition is paced by the product innovation dynamic. Competitiveness is then based on non-cost benefits that increase the added value of employee production and compensation but which, at the same time, make consumers little aware of price fluctuations and enable production to be maintained in countries and territories with higher wage levels.

In practice, both types of characteristics, tasks and products, combine to influence the decision in favour of or against offshoring (see Box 1). Taking into account the dominant characteristics of products and tasks in each sector, it should be possible to observe differences in their performance levels and degree of offshoring, as well as in the rationale for their offshoring (offensive, in order to access markets, or defensive in order to take advantage of differences in labour costs).

Classifying manufacturing activities by their offshoring potential

Data and methods used

During the first stage, a manufacturing industry typology [9] is constructed, using Principal Component Analysis (PCA), drawing upon variables that characterise the determinants of manufacturing activity location decisions. The data made available by the ESANE 2010 (Development of Annual Enterprise Data) system[10] and those of Insee's 2010 Population Census provide twelve variables (Table 1).

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8. The distinctive property of modular systems is to be "divisible into parts, with high interaction density between the components of each of the parts and lower interaction density between the components of the different parts" (Simon, 1962). Modular production is found in many industrial sectors: automotive, textiles, clothing, electronics, IT, etc.

9. Of the 732 activities identified in the NAF, we selected only the 258 manufacturing activities that can be freely-located (thus excluding energy, mining industries, construction, forestry, services, etc.) and which align with section C of the NAF entitled "manufacturing industry" and comprising divisions from Codes 10 to 33. From these 258 manufacturing activities, we have excluded four artisanal industries (delicatessen, bread-product baking, breads and bakery-pastries, and pastries) which cannot be displaced or exchanged and those for which no data are available. The result is a list of 229 manufacturing industry activities.

*10. The ESANE system has been a source of structural business statistics since 2008. It was instituted in replacement of two previous systems, which operated in parallel with each other: the EAEs (*Enquêtes Annuelles d'Entreprises*/Annual Business Surveys) and SUSE (*Système Unifié de Statistiques d'Entreprises*/Unified Business Statistics System). It is buttressed by two Administration-run sources: the annual business profit declaration registers (e.g., the BIC, for industrial and commercial P&L, the BNC, for non-commercial profits, and the BA, for agricultural-sector profits) which make it possible to collect accounting information about companies, and the Annual Social Data Declarations (DADS), supplemented by the Annual Sector Survey (ESA) which provide data respectively about the workforce, their compensation and on commercial equipment, customer type, etc.*

Box 1 – **The case of textiles and clothing**

The textiles and clothing sector effectively illustrates how these two approaches combine by product and by task to influence the potential for offshoring. As regards the characteristics of the branch's products, clothes are particularly light and small in size; the transport costs for conveying intermediate goods or finished goods assembled abroad are very low. At the same time, barriers to entry into these types of sectors are low (little R&D and patents, etc.). The logic of price or cost competitiveness dominates, even though the differentiation of products by brand image can be a significant competitiveness factor. As regards the characteristics of the tasks, the sewing activity consisting of working with flexible materials is still not very automated, and makes significant use of unskilled labour: labour costs account for more than two-thirds of production costs. While the weaving and spinning phases (upstream from the function) and cutting (laser) are largely automated, this is not true of the assembly activity (sewing). Although robot prototypes have been rolled out in an attempt to automate the sewing activity, they remain in the test phase and are used by only a few major companies. In addition, these robots are still used in a semi-automatic mode that requires manual intervention. The proportion of individuals employed in functions associated with low-skilled, routine, easily offshorable tasks is high. The export rates are relatively low and defensive vertical offshorings driven by differences in wage costs predominate.

Variables on jobs' and tasks' characteristics

Employment variables (labour costs, labour productivity, nature of tasks) and capital-related variables (cost, potential substitutability to work, etc.) are included as determinants of offshoring. The degree of automatisation, approximated by capital intensivity and investment rate variables, limits the decision to offshore in order to benefit from differences in unit wage costs with emerging countries.

The employment data from Insee's 2010 census and broken down by type of function (van Puymbroeck & Reynard, 2010), make it possible to approximate the tasks performed by employees (execution tasks, routine or cognitive tasks, etc.). These data are available at the level of the 732 sub-classes in the French Activities Nomenclature (NAF) and broken down by EZ. The "proportion of functions associated with routine tasks" variable offers an initial grasp on offshorable jobs. The "proportion of cognitive functions" and "proportion of cognitive socio-occupational categories" variables in employment reflect the search for specific skills that are more difficult to offshore[11].

The "annual compensation per employee" variable is a proxy for the high qualifications of workers and the quality of production. It differs from the "wage cost" variable insofar as sectors with a high wage bill/workers ratio are also sectors that employ more skilled workers, are more intensive in technology and file more patents. Contrary to the approach focused on so-called "pure" price competitiveness, the Kaldorian approach to competitiveness emphasises the paradox that the countries that export the most are also those with the highest relative prices (Kaldor, 1978). The explanation offered by the literature for this paradox lies in the increase in production costs, including wage costs, which, as it heightens the qualifications and skills of workers, reflects an increase in the relative quality of products and therefore in firms' performance (Fagerberg, 1988; 1996; Erkell-Rousse & Le Gallo, 2002). This variable is therefore connected both with the characteristics of work and those of products.

Variables related to products' characteristics

Three variables have been identified to characterise the sectors' performance and positioning in terms of quality: the export rate, the added-value rate, and number of patents filed, all relating to product characteristics through the search for innovation and product differentiation likely to reinforce non-cost competitiveness or the geographic anchoring of activities.

Lastly, the "customer payment terms" variable reflects physical proximity between suppliers and customers and expresses a constraint on the geographical dispersion connected with the fragmentation of value chains. As the data mobilised are sectoral and not individual, we cannot approximate the proximity constraint

11. The "proportion of grey-matter functions" variable is derived from census data (RP). The "proportion of grey-matter SOCs" variable is derived from SOC surveys taken at production unit-level, in the ESANE database. While these two variables may seem similar, in reality, higher socio-occupational categories may also include more or less routine functions, albeit in a lesser proportion than other SOCs.

using a mere geographical proximity indicator. The literature regarding services (Jensen Bradford & Kletzer, 2006; Barlet *et al.*, 2010) generally uses geographical distance on demand to define tradable services and thus their potential for offshoring, in line with Krugman's analyses (1991). This methodology is not adequate when it comes to manufacturing industry activities or branches. In the context of industry, the 'payment terms' variable offers an proxy for the trend toward the international fragmentation of value chains. Several studies have shown that, within manufacturing activities, payment terms turned out to be longer in the capital goods and intermediate goods industries, in other words upstream from the production chain (Insee, 2006). The same can be observed with firms whose products are intended for companies compared to firms focused on satisfying final demand (Souquet, 2014). These findings tend to show that a link exists between payment terms on the one hand and the nature of the demand on the other. However, satisfying final demand implies a more pronounced geographic proximity constraint and payment terms would make it possible to approximate this constraint. This relationship is confirmed by the work of the Banque de France's Observatory on Payment Terms which, by analysing in particular firms located in Corsica or overseas France, highlights that the geographic distance between customers and suppliers extends payment deadlines (Prost & Villetelle, 2017). In other words, payment terms and geographic proximity constraints appear to be negatively correlated.

A typology of manufacturing activities according to their potential for offshoring

The results of the PCA applied to twelve variables across the 229 manufacturing sectors are shown in Figure I. The first factorial axis (horizontal) reflects a net sector divergence in terms of task characteristics and innovation. The activities located to the left of the horizontal axis (manufacture of ceramic articles, processing and storage of poultry meat, book-binding activities, etc.) have a high proportion of functions associated with routine tasks. These sectors contrast with those characterised by a significantly high proportion of grey-matter functions, through the strong presence of cognitive SOCs and high staff salaries (manufacture of navigational assistance equipment, communication equipment, industrial gases, etc.).

Table 1
Variables and databases

Variables	Description	Sources
Patents - use of technology	Charges including royalty fees for patents, licenses / turnover excluding tax	ESANE (2010)
Customer payment times	Total trade receivables for the whole sector / total annual turnover, including VAT, divided by 360.	ESANE (2010)
Capital intensiveness	Amount of property, plant and equipment / value added excl. tax	ESANE (2010)
Proportion of cognitive SOCs	Proportion of executives and intellectual professions in employment	ESANE (2010)
Proportion of functions associated with routine tasks	Proportion of "manufacturing" and "management" functions in employment	Calculations based on 2010 Census data (INSEE)
Proportion of cognitive functions (Insee functions)	Proportion of "intellectual services", "research design" and "education – training" functions in employment	Census 2010 (INSEE)
Proportion of personnel costs	Personnel costs / turnover excluding tax	ESANE (2010)
Apparent labour productivity per capita	Added value excl. tax / workforce in full-time equivalent	ESANE (2010)
Annual compensation per employee	Annual compensation per employee	ESANE (2010)
Export rate	Turnover from export / turnover	ESANE (2010)
Investment rate	Amount of tangible investments / added value exc. VAT	ESANE (2010)
Added value rate	Added value excl. taxes / turnover	ESANE (2010)

The second factorial axis (vertical) shows another recurring opposition to the labour-capital substitution. At the top of the graph, activities entailing high personnel costs (manufacture of fibre-cement structures, raw oils and fats, paper pulps, etc.) are opposed to those, at the bottom of the graph, with capital intensity, high investment rate and labour productivity (manufacture of navigation assistance equipment, shipbuilding and the construction of floating structures, repair of electronic and optical equipment, etc.).

The construction of industrial classes

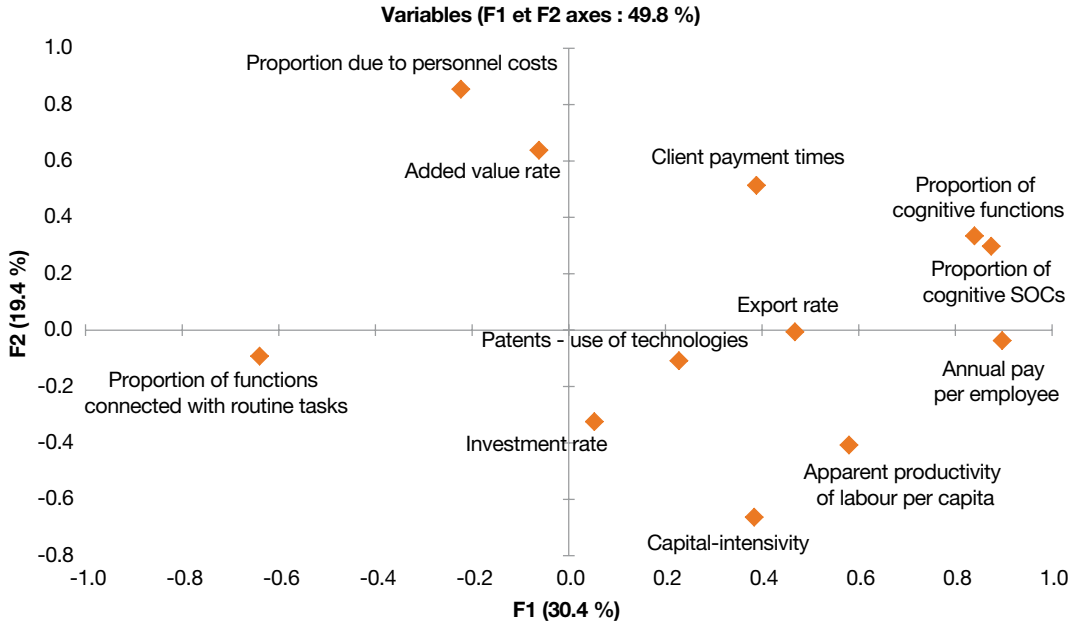
Based on this PCA, the *k*-means classification method, also known as the dynamic cloud method, is used on the first six significant factorial axes, accounting for 85.4% of the cumulative variance. This method refers to deterministic non-hierarchical models that sub-divide a population into disjoint *k* classes, the value *k* being set using a supplementary methodology such as Ascending Hierarchical classification (AHC), as in this article. Concretely, the AHC algorithm makes it possible to obtain a range of typological *k* groups. The AHC provides, as its best result, a four-class typology[12]. On this basis, the *k*-means methodology makes it possible to assign each of the 229 activities of the NAF manufacturing industry into four homogeneous classes, based on the offshoring variables.

Table 2 shows the correlations between the four classes and each of the twelve variables. Table 3 shows the relative weight of each class in total employment across the 229 manufacturing industry activities on the one hand and French total employment on the other. There is a clear initial separation between classes 2 and 4 (even-numbered classes) and classes 1 and 3 (odd-numbered classes) in accordance with the characteristics of the workforce and the types of tasks carried out by the workers.

The distribution of manufacturing jobs between the four classes of sectors shows that the categories 1 and 3 concentrate two thirds of the employment of the jobs in the

12. A range of 3 to 5 groups has been defined, taking into account the size of the sample (229 sectors). The algorithm makes it possible to show the change in intra-class variance (which decreases mathematically as the number of classes increases). If the data are distributed evenly, the negative growth observed is linear. If there is a group structure, a bend can be seen for the relevant number of classes. In this case, the algorithm identifies 4 classes as its best solution.

Figure I
Analysis of principal components, findings on the twelve variables



Scope: 229 manufacturing sectors from the nomenclature of activities (NAF 700 products), Mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2010; Census, 2010; authors' calculations.

229 manufacturing sectors studied[13]. Class 3, which comprises 90 activity sectors, accounts for 42% of manufacturing jobs, i.e. almost 5% of total employment in France. Class 1 accounts for 24% of manufacturing jobs and encompasses 69 sectors (Table 3).

The sectors belonging to these 'odd' classes are characterised by the presence of unskilled workers with routine tasks and low labour productivity rates (Table 2). Cognitive SOCs (–26.1% in class 1 and –38.1% in class 3) and intellectual functions (–30.4% in class 1 and –37.9% in class 3) are much less represented than on average in manufacturing activities. Export rates for these sectors are also lower than in 'even' classes.

The difference between classes 1 and 3 is due to the specific mix of unskilled labour and routine tasks with combined greater capital intensity for class 1 (investment rate of +15.6%), versus lower capital intensity in class 3, resulting in a higher share of personnel costs and low investment rates. Added-value levels are very low in class 1 and high in class 3. The proximity constraint for class 1 activities is higher, in that the payment terms needed to approximate it appear to be lower than the average (–21.1%). These include bulk-product sectors, more constrained by the proximity of demand and more focused on the domestic market, such as most agri-food industries[14] and the production of construction materials[15]. Conversely, the proximity constraints are looser in class 3 activities. The added-value rate in class 3 is higher insofar as it is rather the assembly phases that would be offshored, which is consistent with the low export rate. Traditional consumer goods sectors such as textiles and clothing are strongly represented there.

On the other hand, in the even-numbered classes, the higher socio-occupational categories employees and those engaged in cognitive tasks are over-represented and labour productivity rates are higher. As a result, the export rate is much higher than in the odd-numbered sectors.

The differences between classes 2 and 4 primarily are due to the geographic proximity constraints that are stronger for class 2 sectors than for class 4. In class 2, which has 31 sectors and 14% of manufacturing jobs (Table 3), the

13. In 2010, total French manufacturing industry accounted for only 12% of total employment. The activities of our four classes combined amounted to approximately 11% of total employment in 2010.
14. The presence of some agri-food in this category can be ascribed to the use of data related to industrial specifics. In sectors in this class, the share of exports is not so high, compared to other manufacturing sectors. Although in absolute terms, the amounts exported are significant, the local market, which itself is very sizeable, determines these companies' location decisions. The agribusiness branches posting the highest export (e.g. champagne) do not appear in this class.
15. Table 1 in Appendix presents examples of sectors for each class while online supplement C1 lists all sectors of each class.

Table 2
Correlations between sector classes and offshorability variables (%)

Variables	Classe 1	Classe 2	Classe 3	Classe 4
Patents - use of technology	- 9.3	19.1***	- 4.0	- 0.8
Customer payment terms	- 21.1***	- 11.3*	- 4.6	42.0***
Capital intensiveness	1.9	69.7***	- 35.3***	- 19.9***
Proportion of cognitive SOCs	- 26.1***	15.9**	- 38.1***	67.0***
Proportion of functions associated with routine tasks	5.1	- 16.5**	42.9***	- 47.0***
Proportion of cognitive functions (Insee functions)	- 30.4***	13.0**	- 37.9***	74.5***
Proportion of personnel costs	- 47.7***	- 42.5***	60.5***	18.3***
Apparent labour productivity per capita	- 16.7**	69.7***	- 34.8***	2.1
Annual compensation per employee	- 30.1***	55.1***	- 41.3***	40.2***
Export rate	- 15.7**	13.8**	- 24.4***	38.3***
Investment rate	15.6**	10.1	- 13.0**	- 11.2*
Added value rate	- 55.0***	- 13.5**	53.9***	9.4

Note: The values differ from 0 at the significance level: *** alpha=0.01; ** alpha=0.05; * alpha=0.1.
Scope: 229 manufacturing sectors in the nomenclature of activities (NAF 700 products), Mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2010; Census, 2010; authors' calculations

sectors are more focused on innovation (patents). Capital intensivity and apparent labour productivity there are far higher than in the other classes. It includes the chemical, metallurgy and automotive sectors[16].

In class 4, which includes 39 sectors and 19% of manufacturing jobs, the sectors are more internationalised, not only through higher export rates but also due to the possibility of international fragmentation in the value chain allowed by the limited proximity constraint. For example, it includes the electronics, aeronautics, luxury and perfumery sectors.

All in all, there are four categories of activity:

- activities entailing a high percentage of cognitive SOCs workers and with high export rates (class 2 and 4) with high capital- and patent-intensiveness (class 2) or low capital-intensity (class 4);

- activities entailing a low percentage of cognitive SOCs workers and characterised by low productivity (classes 1 and 3) and with medium capital-intensity and low internationalisation (class 1) or low capital intensity (class 3).

An index of activities offshoring to measure the territory vulnerability

We process in three stages. In the first, an index of offshoring of activities is constructed by linking up the trend in imports in the activity sectors with that of jobs during the period 2008-2010. In a second step, we analyse the positioning of each of our four manufacturing industry classes in relation to this offshoring index. In the third stage, we build an indicator of vulnerability to the risk of offshoring in the 321 EZs, as a sum of the index of offshoring for each sector weighted by its share in the EZ total employment.

A manufacturing industry sector offshoring index

To construct the index of actual offshoring in manufacturing industry sectors, we draw from the approach adopted by Aubert and Sillard (2005) at the level of the production units. In this approach, offshoring is presumed to have occurred when a sharp reduction in staff levels (at least 25% of the initial workforce) comes alongside an increase in imports proportional to the production shutdown in France.

In this article, to estimate how much each sector *s* has been subject to offshoring, we compute an offshoring index ($Ideloc_s$) based on the following two variables: the change in employment, measured by full-time equivalent workforce between 2008 and 2010 (in logarithm);

16. The automotive sector is internationalising in two ways:
- by FDI (foreign direct investment) to conquer markets, often through mergers and acquisitions (M&A) as illustrated by the Renault-Nissan Merger to conquer the Asian market. As the automotive sector is a bulk-product sector, companies often favour export FDI;
- via regional fragmentation of the value chain in different countries in the regional market, for example in Europe, to serve it through export.
The construction of motor vehicles belongs to class 2 because it is an export sector that does not rely on vertical offshoring followed by reimport of the final product. However, automotive electronic components are in class 4 (intermediate products, with a strong offshoring presumption, see Table 5, hereafter).

Table 3
Characteristics of jobs in four large groups of sectors in 2010

Type of industry sectors Manufacturing	Number of jobs	Proportion of manufacturing employment in %	Proportion of total employment as % (including services and other activities)
Class 1 (69 sectors)	699,571	24.2	2.7
Class 2 (31 sectors)	408,185	14.1	1.6
Class 3 (90 sectors)	1,229,853	42.6	4.7
Class 4 (39 sectors)	547,651	19.0	2.1
Total four classes	2,885,260	100	11.0

Reading note: Class 3 (comprising 90 sectors) has more than 1.2 million jobs, representing 42.6% of manufacturing employment and 4.7% of total employment.
Scope: 229 manufacturing sectors in the nomenclature of activities (NAF 700 products), Mainland France and Overseas Departments.
Sources: Insee, Census, 2010; authors' calculations.

the change in the share of imports in turnover excluding taxes (T excl. VAT) between 2008 and 2010[17].

Three linear regressions are estimated using ordinary least squares in the manufacturing sectors studied (Table 4). The first equation confirms the hypothesis of Aubert and Sillard (2005) and shows the existence of a negative and significant link between changes in employment and variations in imports. An analysis of the gap between the actual change in employment in a sector and the change in estimated employment makes it possible to understand the offshoring presumption in business sectors. When a sector experiences both an actual drop in employment and a decline in estimated employment due to the change in its imports, the sector is supposed to have effectively relocated over the period studied.

Based on this analysis, it is possible to estimate the potential for offshoring of each of the four manufacturing sectors in the typology. Equation (1) is supplemented by two other regressions equations : Equation (2) adds to the initial regression three manufacturing activity variables in classes 1, 3 and 4, with class 2 now being taken as reference to analyse the other three classes (Table 4). The negative and significant relationship between changes in employment and imports is confirmed overall (estimated coefficient of –0.00457). Moreover, classes 3 and 4 show a more negative and significant change in employment (respectively –0.167 and –0.119). When four variables are added, combining the sectors' belonging to each of the four classes with the change in

17. We will use Years 2008 (1st year of the existence of ESANE) and 2010 as the data mobilised in grey-matter and routine function content are derived from the 2010 Census, the most recent data available at the start of the study in 2013.

Table 4
Estimation of the offshoring potential of the four manufacturing sector classes. Change in employment and imports/turnover excl. tax

VARIABLES	(1) Change in employment (in log) 2010/08	(2) Change in employment (in log) 2010/08	(3) Change in employment (in log) 2010/08
Class 1		- 0.0800 (0.0521)	- 0.0880 (0.0536)
Class 2		*Reference*	*Reference*
Class 3		- 0.167*** (0.0500)	- 0.172*** (0.0524)
Class 4		- 0.119** (0.0576)	- 0.115* (0.0590)
Class 1 x var import/turnover excl. tax			0.00322 0.00427)
Class 2 x var import/turnover excl. tax			- 0.00409 (0.00302)
Class 3 x var import/turnover excl. tax			- 0.0107*** (0.00263)
Class 4 x var import/turnover excl. tax			- 0.00763* (0.00423)
Change in import/turnover excl. tax (log) 2010/08	- 0.00462** (0.00194)	- 0.00457** (0.00208)	
Constant	7.45e-09 (0.0137)	0.109** (0.0462)	0.110** (0.0484)
Observations	227	227	227
R2	0.029	0.102	0.137
Adjusted R2	0.0245	0.0857	0.109

Note: two sectors of activity with extreme values in terms of imports in 2008 were excluded from the regressions and the rest of the analysis: sector 2640Z (manufacture of consumer electronic products) and 2823Z (manufacture of office machinery and equipment, except computers and computer peripheral equipment). The variables are centred.
OLS. Significance threshold of coefficients: *** p<0.01, ** p<0.05, * p<0.1.
Scope: 227 manufacturing sectors in the nomenclature of activities (NAF 700 products), Mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2008, 2010; authors' calculations.

imports (equation (3)), this result is reinforced: classes 3 and 4 are the most affected by offshoring[18] (the estimated coefficient of variation in imports are, respectively, –0.0107 and –0.00763).

The offshoring index is computed from equation (3) as follows:

Ideloc = max (Observed change in employment, Estimated change in employment) if observed change in employment <0 and estimated change in employment < 0 (presumption of offshoring)

Ideloc = min (Change in employment, Estimated change in employment) if observed change in employment > 0 and estimated change in employment > 0 (presumption of offshoring)

Ideloc = 0 in all other cases (indeterminate)

When the observed change in employment, and the change in employment estimated based on variations in imports and belonging to the four classes are both negative, the activities show a high level of "presumption of offshoring". When the changes in actual employment and estimated employment are both positive, the activities show a "presumption of non-offshoring"[19]. Lastly, the index takes on zero value when, for a given sector, changes in employment on the one hand and estimated employment on the other show opposite signs.

By using only the lowest negative values (where *Ideloc* = max) and the lowest positive values (where *Ideloc* = min), this index avoids overweighting the impact of imports on employment and allows to avoid defining an arbitrary threshold with which the loss of jobs in a sector would be equivalent to offshoring[20].

The four manufacturing industry classes in the face of actual offshoring

The share of sectors affected by a presumption of offshoring in all the sectors of each class of activity is higher in class 3, where it reaches two-thirds of the sectors[21] (Table 5). These sectors include, unsurprisingly, textiles/clothing, furniture, tooling and light metals. This is the most vulnerable class of activity in terms of offshoring risk. In this class, only 4.5% of sectors show a presumption of non-offshoring such as, for example, footwear items, which are one of France's speciality niches.

Class 4 shows almost 30% of its sectors with presumed offshoring compared to less than 24% of sectors with no presumed offshoring. The sectors most affected by potential offshorings are the manufacture of electronic components, computers, electrical and electronic automotive equipment, and printing machines. The sectors carrying a non-offshoring presumption include, for example, luxury products (perfume, clothes), medical irradiation equipment, and portable hand-held power tools. These are generally sectors with a strong non-cost advantage and benefiting from a product differentiation effect.

The first two classes are little (7.2% of sectors in class 1) or not at all (class 2) affected by presumed offshoring (Table 5). The sectors with presumed non-offshoring in class 1 are represented by the agribusiness industries, bulky construction and public works products, agricultural and forestry machinery, etc. Lastly, 71% of the activities in class 2 show a presumed non-offshoring, as illustrated by the luxury agri-food products sectors (champagne, etc.), chemical and pharmaceutical products, etc.

Crossing the characteristics of the manufacturing industry resulting from Table 2 and the offshoring indices makes it possible to qualify the four classes in terms of exposure to the risk of offshoring. Class 1 encompasses the "domestic sectors little-suited to offshoring" dominated by moderately capital-intensive activities, with little grey-matter-job intensity, and a greater focus on the domestic market; class 2 comprises the "export sectors little-suited to offshoring", in which activities are more capital-intensive, more intensive in grey-matter functions and more likely to export; class 3 includes "defensive offshoring activities", the activities of which are labour-intensive and intensive in routine tasks, and considerably more involved in import; and lastly, class 4 aggregates "offensive offshoring sectors", the activities of which are labour-intensive,

18. A Fisher test leads to reject equation (1) for equation (2) with a probability <0.01. A likelihood ratio test leads to the rejection of equation (2) for equation (3) at the threshold of 0.05 (p=0.03).

19. It is helpful to recall that according to the INSEE Global Business Chain survey (Fontagné & D'Isanto, 2013) 3% of the 28,000 non-financial companies asked had decided against offshoring their activities, while 4.2% of them offshored their business.

20. A variation on this index was also tested. It used the offshoring index, Ideloc = average (change in observed employment, change in estimated employment). This variation tends to increase the index relative to that used. The correlation between this variation and the index used in the article is 0.782. The rank correlation (Spearman) is also high, exceeding 0.86. In both cases, the correlation is significant at 99%.

21. Online complement C1 shows the list of sectors with presumed offshoring and presumed non-offshoring, by relevant class.

Table 5
Proportion of manufacturing sectors affected by the presumption of offshoring and non-offshoring, by class

in %

	Non-offshoring presumption (*Idéloc* = min)	Offshoring presumption (*Idéloc* = max)
Class 1	52.2	7.2
Class 2	71.0	0.0
Class 3	4.5	69.7
Class 4	23.7	28.9

Reading note: 52.2% of the class 1 sectors show a non-offshoring presumption.
Scope: 227 manufacturing sectors in the nomenclature of activities (NAF 700 products), Mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2008, 2010; authors' calculations.

intensive in grey-matter jobs and largely export-oriented. Offshoring is said to be offensive, because the activities of this class 4 are characterised, as the PCA shows, by competitiveness factors other than costs (patents, cognitive SOC, labour skills, etc.), which stimulate exports (for more details, see Appendix and Online Complement C1).

An EZ vulnerability indicator for offshoring

An indicator of French EZ vulnerability to offshoring risk is proposed, drawing on two factors. The first is derived from the offshoring index $Idéloc_s$ estimated earlier for each sector s. The second measures vulnerability to offshoring in the regions by weighting the offshoring index for its share in the total employment of each of the 321 EZs[22]. In other words, the fragility of an EZ is the result of the offshoring index and the greater or lesser share of employment in the sector relative to total employment in the territory. This indicator allows to avoid overestimating the vulnerability of an EZ by excluding the situations in which changes in employment come from purely cyclical factors.

This vulnerability index is defined as follows:

$$vulner_i = \sum_{s=1}^{227} Ideloc_s \times \frac{N_i^s}{N_i^\bullet} \qquad (2)$$

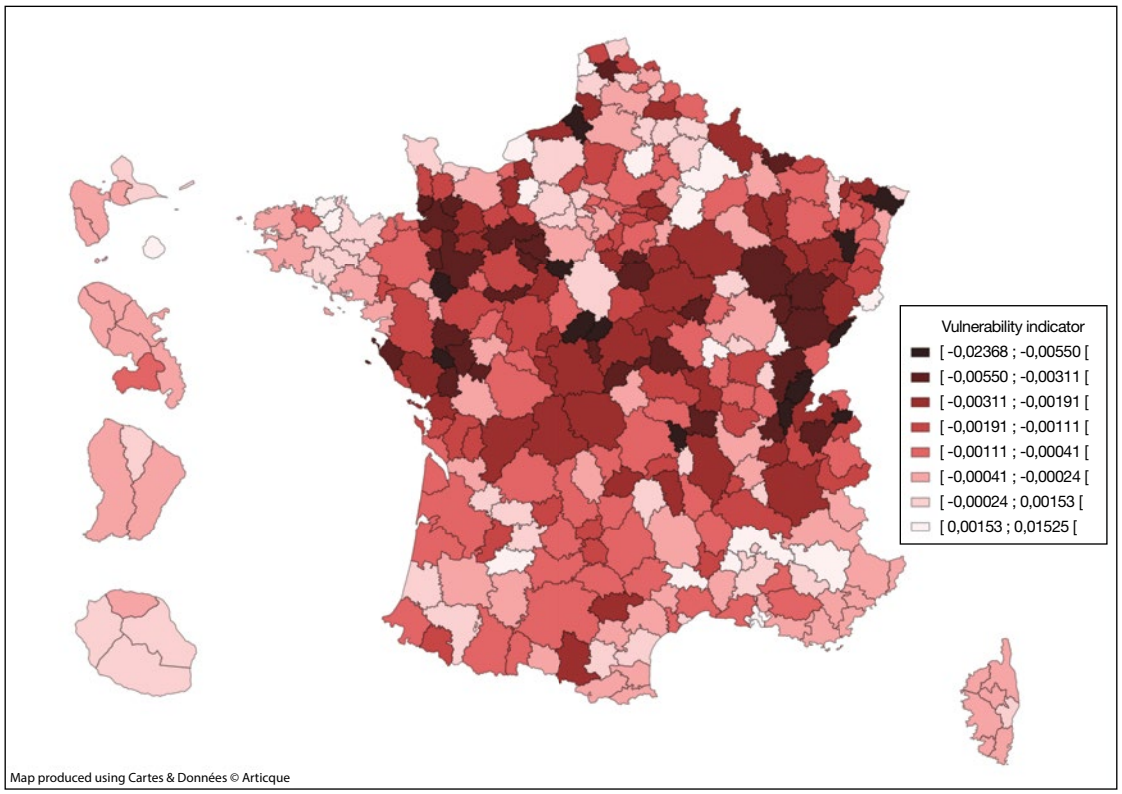
with $Ideloc_s$ the offshoring index of each sector of manufacturing industry s, N_i^s the employment of each EZ i in sector s and $N_i^\bullet$ total employment of this EZ i including services and other economic sectors. The more region is specialised in a sector considered more subject to offshoring, the more it is considered to be vulnerable.

Figure II illustrates the results of this vulnerability indicator for each EZ. Discretization is carried out using the nested average method, using an eight intervals classification. The vulnerability index allows highlighting the EZs the most affected by job-destroying defensive offshoring. The demarcation between a broad northern half and the southern half of France is quite clear, along a Nantes-Valencia axis. The northern half concentrates the most vulnerable areas with a high number of EZs actually affected by offshoring. The territories located in the north-east quarter of the country have already been hard hit by dis-industrialisation and business restructuring. During the period studied, offshoring most frequently occurred in the eastern territories, along an axis from Haguenau (Bas-Rhin) to Annecy, via Saint-Dié-des-Vosges, Morteau, Saint-Claude, Oyonnax and the Arve Valley. The latter, even though recognised as a dynamic industrial employment zone, shows the highest vulnerability index out of the 321 EZs.

Other zones encompassing several EZs are also affected: in the heart of the Auvergne-Rhône-Alpes region, the Thiers and Roanne EZs appear particularly vulnerable. The same applies to the Romorantin-Lanthenay, Vierzon and Issoudun EZs in the Centre-Val de Loire region. The other vulnerable territories are located in the west of the country along a vertical axis from the English Channel (Granville) to the Choletais region (Fontenay-le-Comte) via Segré

22. *For each EZ, the Population Census (2010) and its scope are used to measure employment in manufacturing industry, within the 227-sector selection, as well as including jobs in all sectors (732 sub-classes).*

Figure II
Comparative positioning of French EZs according to their vulnerability indicator



Note: the darker the EZs, the greater the vulnerability to offshoring. The results of the index vary from -0.0237 for the most vulnerable EZ (Arve Valley) to 0.0152 for the least vulnerable (Autun).
Scope: 227 manufacturing sectors for the nomenclature of activities (NAF 700 products), 321 EZs in mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2008, 2010; Census, 2010; authors' calculations.

and Les Herbiers. Some EZs in the Choletais region, which had been hit by the exacerbation of international competition in textiles-leather-clothing industry as a result of the dismantling of the World Trade Organisation Multi Fibre Agreement in 2005, remain relatively vulnerable.

Lastly, among the most vulnerable EZs, some isolated territories can be found within less exposed EZs. This is the case of the Bresle Valley in Normandy, Saint-Omer in Hauts-de-France and Avallon in Burgundy. The mapping also shows a more widespread fragility in peripheral areas around large cities such as Lille, Lyon, Rennes, Strasbourg, Dijon, Orléans and Rouen. Around the Paris Region, the most vulnerable zones are found beyond the outer suburbs, particularly in the south of the Île-de-France region: in the south-east with Montargis and Nemours and in the south-west with Châteaudun, and Nogent-le-Rotrou.

In the northern half of France, the regions of Brittany and Île-de-France seem to be less affected by offshoring. However, this does not mean that Brittany, for example, is not affected by exposure to other types of economic shocks than the potential offshoring measured by this index. The territories located in the southern half of France, more precisely in the south of the Nantes-Valence axis, show less vulnerability due to their specialisation in tertiary activities. Only two EZs in the south-west are more affected by offshoring: Foix-Pamiers and Castres-Mazamet.

The vulnerability index confirms the localised or even dispersed nature of the offshoring shocks: few EZs are actually affected, but their exposure to shocks is highly intensive. These more exposed zones are unsurprisingly located in the territories of the northern half of France, particularly in the Eastern part.

Having detected the most vulnerable EZs using the vulnerability indicator, the next step consists in taking into account the specialisation of the EZs in our four classes of activities with

varying degrees of offshorability, in order to map the weak points and industrial performance levels of our territories.

Predicting the risks and performance of territories based on their specialisation in the four types of activity

Measuring the specialisation of territories in the four main types of manufacturing activities

One of the interests of the typology lies in the ability to characterise the weaknesses or performance of the territories according to their specialisation in each of the four classes of activity. A Hoover relative specialisation index is calculated for each EZ and for each class of activity (Box 2).

Let us begin with the analysis of territorial fragility through the mapping of EZ specialisations in the odd-numbered classes of our activity class typology. Once again, these are activities entailing a low percentage of cognitive SOC workers and characterised by low productivity (classes 1 and 3) and with medium capital-intensity and low internationalisation (class 1: domestic sectors hardly offshorable) or with low capital-intensiveness (class 3: sectors with offensive offshoring).

The EZs most specialised in **domestic activities hardly offshorable** (class 1) tend to be rural and agricultural, peripheral to large conurbations and not densified (figure III). These rural EZs are host activities that are intensive in capital- and intermediate consumption, hence low labour skills requirements. This is the case of the ZEs in Brittany, Mayenne, Laon in Maubeuge, in the Dacquoise region, around Rodez and Brive, as well as in several Northeast territories. In fact, these territories are no less fragile than those specialised in defensive offshoring sectors (class 3), as agri-food activities with low added-value and dominated by price competitiveness make up the bulk of these specialisations. These activities are, for example, sensitive to exchange rate, changes in world commodity prices and possible changes to aid mechanisms relating to the common agricultural policy. It is not surprising that Brittany's ZEs are particularly affected.

Class 3 activities, in which **offshoring is defensive**, are characterised by relatively low labour intensivity and higher levels of routine production tasks (figure IV). The number of EZs housing such activities is particularly high. However, these activities are more prevalent in less diverse areas such as the Bresle Valley (manufacture of hollow glass, taps), Oyonnax (manufacture of plastic products), the Arve Valley (machining), Thiers (powder metallurgy, cutlery, ...), etc. While the large metropolises are spared, a number of average-size cities show a significantly high specialisation index in these activities, as illustrated by Saint-Etienne (technical and industrial textiles), Troyes (undergarments, pneumatics), or Laval (manufacture of assembled electronic parts, rubber articles, etc.). It is in the south of France and in the overseas municipalities that the least specialised EZs are found in this second class of activity.

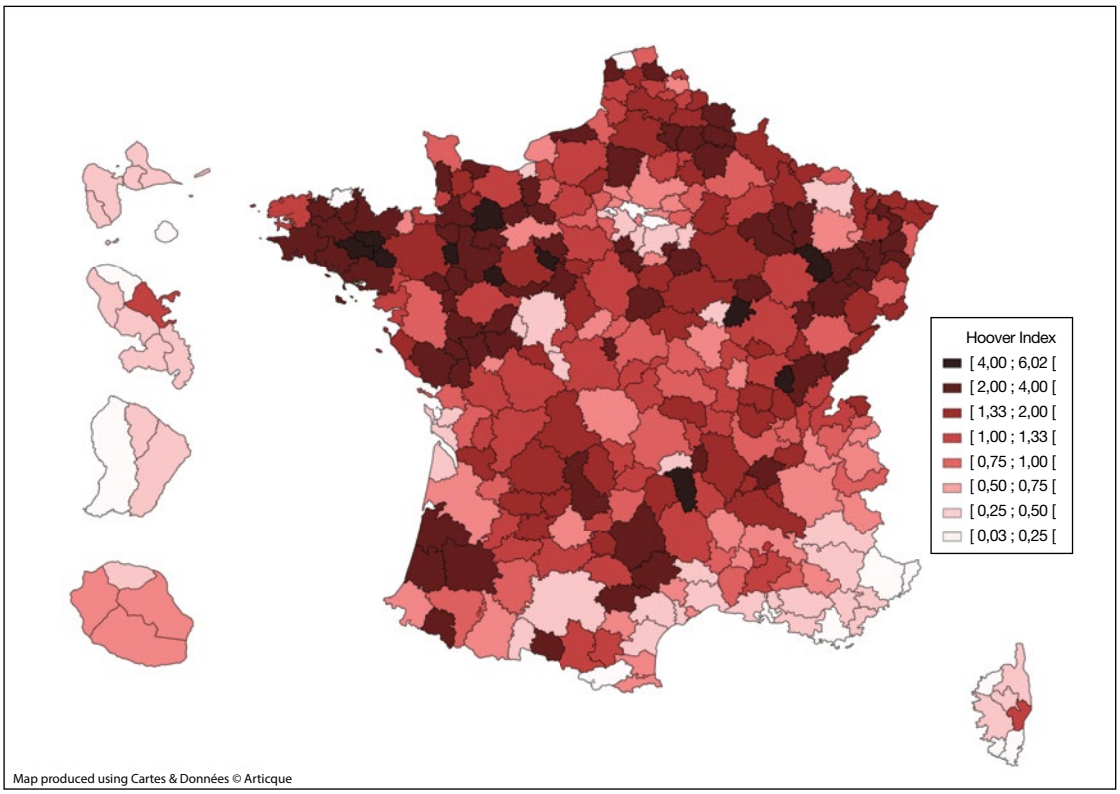
This brings us to the mapping of EZ specialisations in the **even-numbered activity classes**, i.e. in the exporting sectors with a high degree of capital intensity and patents (class 2: export activities little-suited to offshoring) or low capital intensity (class 4: activities with offensive offshoring).

Specialisation in class 2 **exports industries hardly offshorable** (Figure V) shows greater disparities between territories. Fewer EZs are affected. The most specialised territories are, with a few exceptions, located in the north of France (Seine axis, some EZs in the North and Pas-de-Calais, Dole, Mulhouse, etc.). In the Southern half, the zones are more geographically isolated (Istres-Martigues, Ambert, Issoire or Annonay), and are distinguished by a strong specialisation in this type of industrial activity.

With regard to activities involving **offensive offshoring** such as aeronautics, electronics, or luxury (class 4), the disparities are, as in the case of class 2 activities, much more prominent between the territories (Figure VI). A small number of EZs show a strong specialisation in these activities. They are found in certain large cities, such as in the south and west of Paris (Rambouillet, Évry, Melun) and Cergy, in the metropolitan areas of Toulouse, Grenoble or Aix-Marseille, or for instance outside certain large conurbations such as Ancenis, Châtellerault or Molsheim–Obernai.

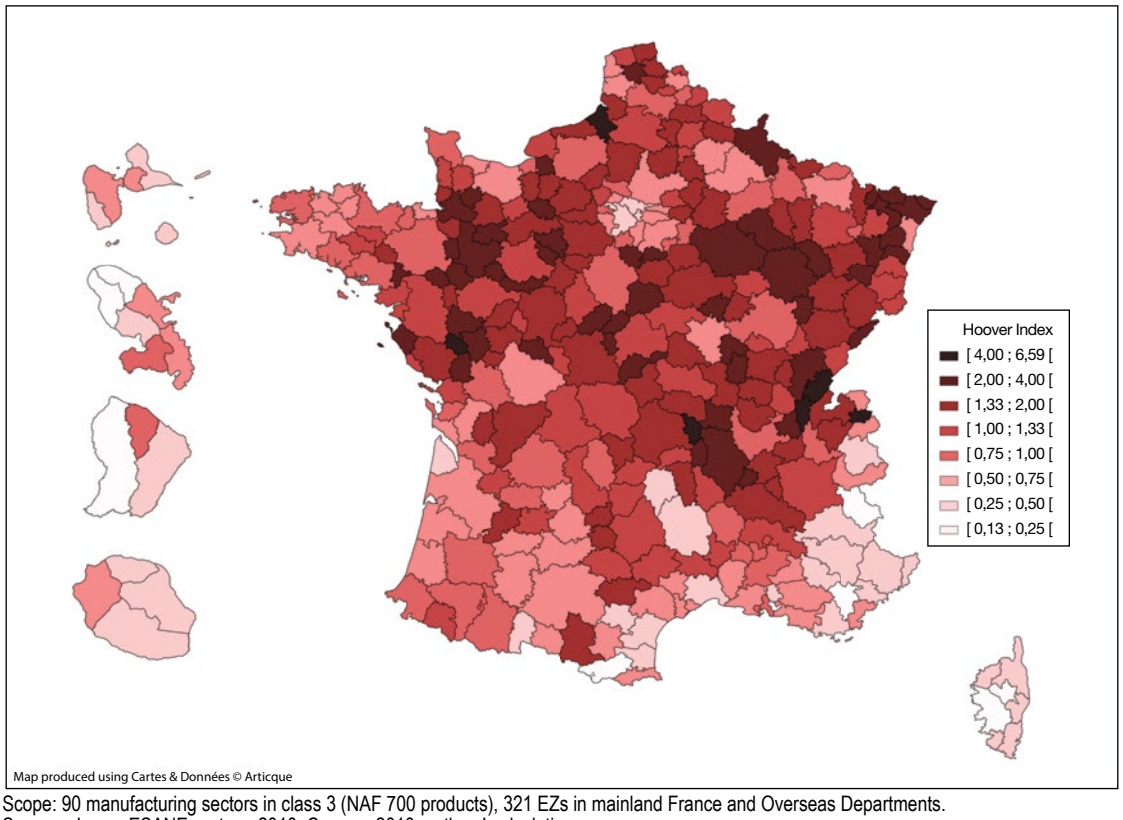
All in all, activities requiring more capital, grey-matter functions, high productivity and

Figure III
Specialisation of EZs in domestic sectors hardly offshorable



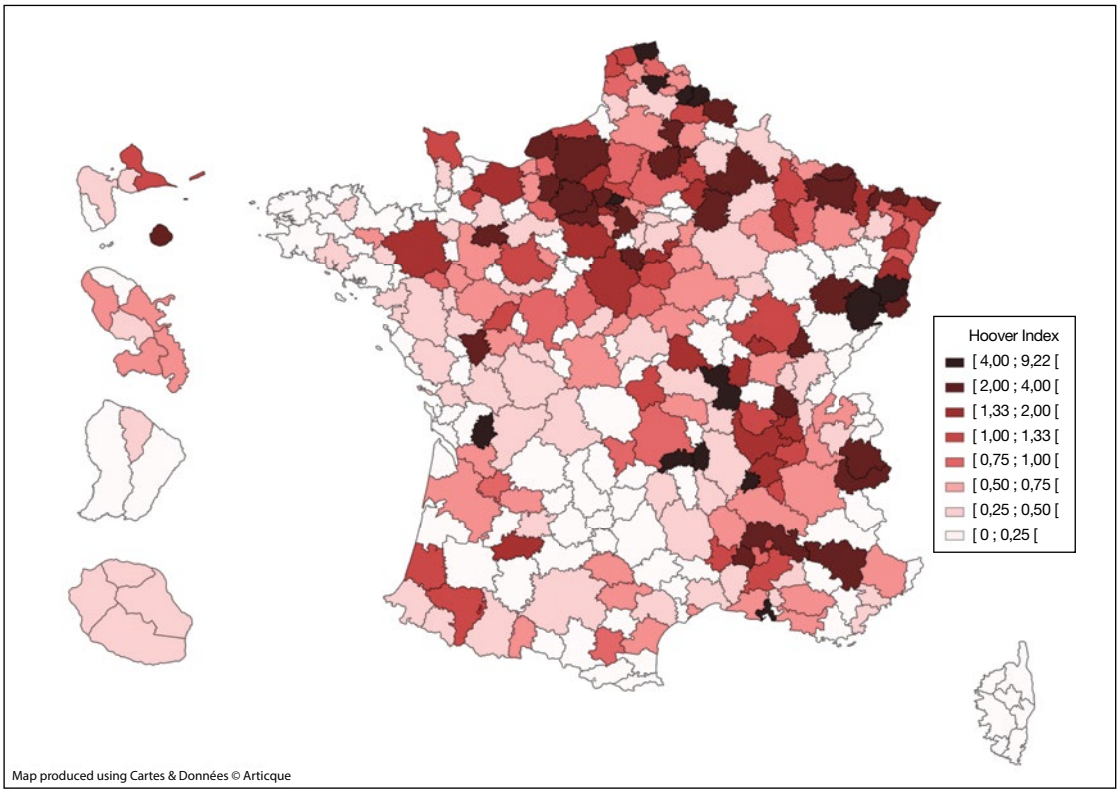
Scope: 69 manufacturing sectors in class 1 (NAF 700 products), 321 EZs in mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2010; Census, 2010; authors' calculations.

Figure IV
Specialisation of EZs in defensive offshoring sectors



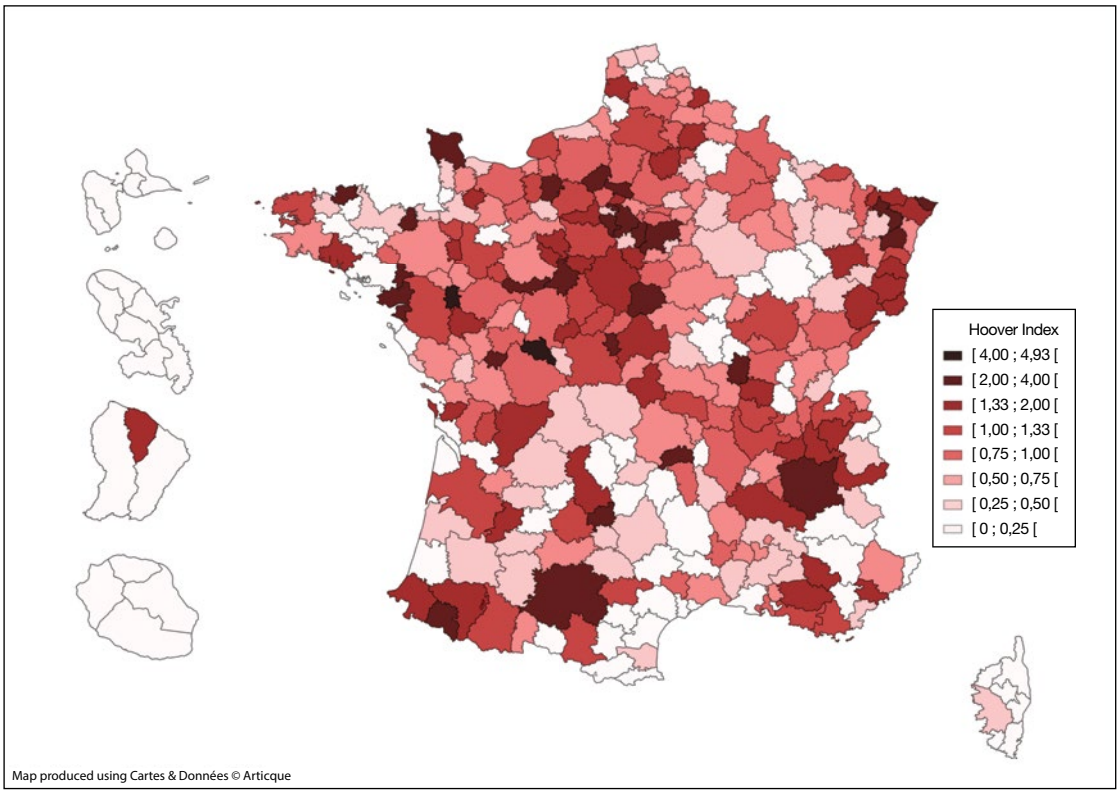
Scope: 90 manufacturing sectors in class 3 (NAF 700 products), 321 EZs in mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2010; Census, 2010; authors' calculations.

Figure V
Specialisation of EZs in exporting sectors hardly offshorable



Scope: 31 manufacturing sectors in class 2 (NAF 700 products), 321 EZs in mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2010; Census, 2010; authors' calculations.

Figure VI
Specialisation of EZs in the offensive offshoring sectors



Scope: 39 manufacturing sectors in class 4 (NAF 700 products), 321 EZs in mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2010; Census, 2010; authors' calculations.

Box 2 – Measuring EZ specialisation

To measure the relative importance of each manufacturing industry industry c*l* (c*l*=c1,...,c4) within an EZ *i* (i.e. its over-representation or under-representation in this class), we calculate the Hoover indicator (or the Balassa specialisation index). The weighting basis is total employment in the NAF's 732 sectors of activity for the 321 EZs taken into account in this study. The indicator is as follows:

$$HOOV_{i,cl} = \frac{N_{cl}^{i}}{N_{\bullet}^{i}} \Big/ \frac{N_{cl}^{\bullet}}{N_{\bullet}^{\bullet}} \qquad (1)$$

The first term is the ratio between the workforce of one of the 4 classes *cl* of the EZ *i* (N_{cl}^{i}) to the total workforce of the EZ *i* ($N_{\bullet}^{i} = \sum_{k=1}^{732} N_{k}^{i}$), by counting the NAF's 732 sectors *k*. This yields the proportion, i.e., the relative weight, of the class *cl* in the total employment of the EZ *i*. The indicator is relative insofar as a ratio is established between this first proportion, relative to an EZ *i*, and the total proportion of this class *cl* in the French economy (second term of expression with $N_{cl}^{\bullet} = \sum_{i=1}^{321} N_{cl}^{i}$ measuring the number of jobs in class *cl* in France and $N_{\bullet}^{\bullet}$, representing the total workforce in the French economy). The value of the index indicates whether, in terms of jobs, the proportion of a class in an EZ is moving significantly away from that of this same class in the French economy.

This makes it possible to identify the manufacturing classes that are relatively decisive in the production structures of each EZ. The values of the indicator theoretically go from zero to infinite. An upper (lower) value index for the unit on an EZ indicates that the class is more (less) present in this territory relative to the other EZs.

internationalised by exports (class 2) or by offensive offshoring (class 4) are more present in large conurbations and in EZs located close to medium-sized cities. Activities with lower levels of productivity, low export levels and where the jobs' structure requires more routine production functions, whether they are not very offshored (class 1) or highly offshored (class 3), most notably mark the industrial territories of northern France and the rural territories of the west and north-east.

* *
*

This article provides an initial empirical contribution to the construction of a methodology useful in anticipating the impacts of offshoring or competitiveness faced by territories. It addresses a gap in public debates between, on the one hand, the macroeconomic reality of observed offshoring, which, according to most empirical work, shows the limited effects of offshoring on job destruction, in contrast to productivity gains and, on the other hand, the massively destructive globalisation in which the general public believes. In reality, the offshoring has primarily micro-economic level and local effects, hence part of the disparity. Consequently, public policies should do more to take into account the lack of adjustment and inadequacy of the mechanisms used for offsetting the effects of territorial shocks due to offshoring.

While, for thirty years, public policies are introduced after the fact, in an attempt to save territories once offshoring or restructuring has occurred, it appears preferable in contrast to anticipate the shocks of offshoring. It can be recommended that State aid be focused on the most vulnerable territories by promoting vocational training, research and innovation, which help restore competitive advantages compared to low-wage countries and therefore relocation in the territories. The aim is also to promote the desired mobility of workers, all too often "locked" in areas highly vulnerable to offshoring and industrial restructuring, to external performance areas experiencing recruitment difficulties. While the effects of globalisation are heavily localised, as this article helps highlight, there appears to be a need for a true observatory to anticipate territorial shocks. This study is, in this regard, a first step that should be continued over time and extended to additional analyses. □

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APPENDIX

EXAMPLES OF SECTORS COMPOSING THE FOUR CLASSES

Domestic sectors hardly offshorable (69 sectors)	Exporting sectors hardly offshorable (31 sectors)	Sectors with defensive offshoring (90 sectors)	Sectors with offensive offshoring (39 sectors)
Manufacture of ready-mixed concrete	Construction of motor vehicles	Manufacture of knitted and crocheted hosiery	Manufacture of air and spacecraft and related machinery
Manufacture of liquid milk and fresh produce	Enrichment and reprocessing of nuclear materials	Manufacture of stationery	Manufacture of locomotives and other rolling stock
Manufacture of mattresses	Distilling, rectifying and blending of spirits	Manufacture of plastic packaging	Manufacture of electronic components
Manufacture of macaroni, noodles, couscous and similar farinaceous products	Manufacture of glass fibres	Manufacture of office and shop furniture	Manufacture of electricity distribution and control apparatus
Industrial manufacture of bread and fresh pastry	Manufacture of industrial gases	Manufacture of carpets and rugs	Manufacture of optical instruments and photographic equipment
Table water industry	Manufacture of pulp	Manufacture of hollow glass	Production of perfumes and toilet products
Copper production	Manufacture of pesticides and other agrochemicals	Casting of light metals	Manufacture of navigation assistance equipment
Processing and conservation of butchery meat	Manufacture of basic pharmaceutical products	Manufacture of watches and clocks	Manufacture of medical irradiation equipment, electromedical and electrotherapeutic equipment
Preparation of fruit and vegetable juices	Manufacture of sugar	Printing of newspapers	Manufacture of electrical and electronic automotive equipment
Milling	Production of effervescent wines	Preparation and spinning of textile fibres	Manufacture of scientific and technical instrumentation
Processing and preserving of potatoes	Production of crude oils and fats	Binding and related activities	Manufacture of computers and peripheral equipment

Scope: 229 manufacturing sectors in the nomenclature of activities (NAF 700 products), Mainland France and Overseas Departments.
Sources: Insee, ESANE system, 2008, 2010; Census, 2010; authors' calculations.