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The evolution of tradable and non-tradable employment: evidence from France *

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Abstract

Technological advances in information and communication, transportation, as well as falling formal barriers to trade enlarged the number of goods and services that can be traded internationally. This provided employment opportunities and risks. In this paper, we analyse employment growth trends across tradable and non-tradable industries in France over the period 1999-2013. We classify industries into tradable and non-tradable categories using an index of geographic concentration, since for tradable industries production tends to be geographically separated from consumption. First, we show that tradable employment is in the minority and decreased significantly as a proportion of total employment, from 30% to 26.8%. Second, we observe a shift among tradable jobs towards tertiary activities: jobs in tradable services now represent more than half of tradable employment and are rising faster than jobs in non-tradable services. Third, the fall in tradable employment was accompanied by widening wage and labor productivity gaps between tradable and non-tradable workers. Labor productivity and wages are indeed higher for tradable jobs while the structure of skills is similar in the two sectors. Lastly, we examine how tradable jobs are distributed across French employment areas (local labor markets) and how their development impact non-tradable employment locally. We observe that employment growth in tradable services mostly benefits major cities and tourist areas. In contrast, the employment decline in the rest of the tradable sector disrupts a great number of less-dense areas. Those local variations in tradable employment are crucial for the non-tradable sector which is highly dependent on local demand. According to our estimates, from 2004 to 2013, for every 100 new tradable jobs that emerged in an employment area in mainland France, 64 additional non-tradable jobs were created in the same area.

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1 Introduction

The distinction between primary, secondary and tertiary sectors, initially made by Fisher (1935), forms the basis of classification of economic activities. Nevertheless, it has lost some of its relevance due to the blurring of the line between industrial activities and service activities. Manufactured goods involve a growing share of services required to produce them or sold with them (Crozet and Milet, 2014). Symmetrically, some services are produced on an "industrial mode" (Fontagné et al., 2014) and require infrastructures and equipment, such as communication networks, to be delivered. On the other hand, the sharp growth in international trade in recent decades has made it increasingly necessary to make a distinction between industries exposed to international competition and those not exposed to it, found in primary, secondary and tertiary sectors. This distinction between the tradable and non-tradable sectors has been widely used in international economics, with special relevance for, inter alia, the effects of devaluation, the purchasing-power-parity theory of exchange rates, the determination of inflation in open economies, and the specification and estimation of international trade flows (Goldstein and Officer, 1979). To date, the vast majority of empirical studies associate the tradable sector with the primary and secondary sectors, implicitly assuming that services are not tradable (Gervais and Jensen, 2015). Yet recent advances in information and communication technologies have increased the tradability of a great number of products and especially services, providing employment opportunities and risks. Surprisingly, only a very few studies - Jensen and Kletzer (2005); Hlatshwayo and Spence (2014) for the United States, and Eliasson et al. (2012); Eliasson and Hansson (2016) for Sweden - have made a detailed study of tradable and non-tradable jobs. We contribute to this recent literature and to the debate on the effects of increased globalization on the employment structure of our economies by analysing employment, wages, skills, and labor productivity patterns across tradable and non-tradable industries in France from 1999 to 2013.

The distinction between tradable and non-tradable jobs stems from the division of a country's economy into two parts. The tradable sector produces goods and services that can be produced in one country and consumed in another - in the specific case of tourism, it is foreign consumers that do the moving. The non-tradable sector produces to satisfy exclusively domestic demand. Jobs in the tradable sector, which are usually called *tradable jobs*, compete with jobs in other countries. This does not just involve jobs in the manufacturing and agricultural sectors, but also all jobs engaged in producing remotely deliverable services. Thus, we can expect the tradable sector to include, e.g., automobile workers, call centre employees, milk producers, and software engineers. It also includes jobs in tourism, which are partly supported by the movement of foreign consumers. International tourists clearly consume in the territory where production takes place. But in choosing between sev-

eral destinations, they put jobs located in different countries into competition.

Regarding jobs in the non-tradable sector, referred to as *non-tradable jobs*, they only directly compete with jobs in the same country, and often even in the same town. High tariffs can explain why some jobs are sheltered from international competition. Others are sheltered for reglementary or institutional reasons, e.g. soldiers and politicians. However, most often it is transport costs that constitute a barrier to international trade, in particular for activities that require physical proximity between consumers and producers. A typical example is hairdressing, which is not yet automated or remotely controllable, and for which the international differences in price and quality does not justify cross-border movement of consumers. This observation is also valid for other non-tradable jobs like bakers and physiotherapists.

In practice it is not easy to precisely identify tradable and non-tradable jobs. This distinction is not made in national accounts and no consensual method has emerged in the academic literature. Moreover, the boundary between the two categories is not fixed because of technical and regulatory changes. We identify four main methods, not mutually exclusive, to classify tradable and non-tradable jobs. The first divides jobs subjectively. The three others use indicators, i.e. respectively, trade of goods and services, characteristics of occupations, and geographic concentration of activities or occupations. This will be examined in more depth in our literature review. Barlet et al. (2010) compute geographic concentration indexes for 36 service activities in order to identify tradable services in France for the year 2005. Tradable firms can serve remote clients and it is therefore in their interest to take advantage of geographic concentration of production, in particular increasing returns to scale and agglomeration economies. Conversely, non-tradable firms need to produce close to their clients. Thus, high concentration of production reflects high tradability of products. A minimum concentration threshold separates tradable jobs from non-tradable jobs. We take up this method to classify employment as tradable or non-tradable for 86 industries in 2012. We also use export/import data as additional check, and make a few minor adjustments. Our work differs from that of Barlet et al. (2010) in the sense that they focus on the tradability of services, while we are interested in the evolution of all tradable and non-tradable jobs in the French economy and analyze not only employment but also wages, skills, labor productivity, geography, and the local employment multiplier effect of tradable jobs on non-tradable jobs.

According to our classification of tradable and non-tradable industries, tradable employment is still the minority in France. And increasingly so: its share of total employment has significantly de-

creased, from 30% in 1999 to 26.8% in 2013. In fifteen years, non-tradable employment increased by 2.37 million, while tradable employment dropped by 204,000. Interestingly, tradable employment has become more tertiary: jobs in tradable service activities now represent more than half of tradable jobs, and have experienced a higher employment growth rate than jobs in non-tradable services. This has not however been sufficient to compensate for the decline in the manufacturing, agricultural and mining industries. The fall in tradable employment has also been accompanied by a widening wage gap between the two groups. In 2013, the annual gross wage for tradable workers was on average 25% higher than for non-tradable workers. This gap grew by 3.8 points from 1999, and does not seem to reflect a difference in the skill structure which is remarkably similar in the two sectors. In terms of labor productivity, differences are once again significant: the tradable sector is much more dynamic than the non-tradable sector.

We also analyze how employment has evolved at the local labor market level (French employment areas). We show that the increase in tradable services primarily benefits metropolitan and tourist areas. In contrast, the erosion of manufacturing employment destabilizes a great number of less-dense local economies. Strikingly, we observe that the employment areas in which tradable employment has shrunk the most have often also been affected by the destruction of non-tradable jobs, and vice-versa. To identify a causal relationship, we follow the econometric approach proposed by Moretti (2010) to estimate *local multipliers*, i.e. the impacts of employment changes in the tradable sector on employment in the non-tradable sector. We departs from Moretti (2010) by including services in the tradable sector and focusing on France. Our results confirm the significant local multiplier effect of tradable employment. From 2004-2013, for every 100 additional jobs created in the tradable sector in an employment zone in mainland France, 64 jobs were also generated in the non-tradable sector within the same area.

The remainder of this paper is organized as follows. Section 2 provides a review of the literature on methods for classifying tradable/non-tradable jobs. Section 3 presents the classification used in this article and the methodology from which it is derived. In section 4 we present the main evolutions and characteristics of tradable and non-tradable jobs, while section 5 is devoted to an estimate of local multipliers based on our classification of tradable and non-tradable jobs. Section 6 concludes.

2 Literature review

Although the distinction between tradable and non-tradable appears quite intuitive, a difficulty arises in trying to establish an operational procedure to quantify the two groups. Occupations and indus-

tries are not defined on the basis of a tradability criterion in national accounts, so that even at a relatively low level of aggregation, both tradable and non-tradable activities (jobs) may belong to the same industry (occupational) group. On the academic side, no consensual methodology is employed in empirical studies focusing on the quantification of the two spheres.

A traditional approach - the so-called "assumption method" - relies on an ad hoc classification of jobs or sectors based on a subjective evaluation of their degree of tradability. Manufacturing, agriculture and mining are often included in the tradable sector while all other industries are considered as non-tradable.[1] Although this was a reasonable proxy a few decades ago, this is no longer the case, since trade liberalization, ICT development, and the specialization of rich countries in services have greatly enhanced service tradability.[2] Besides being imprecise, this approach generally results in a different assignment of industries across studies for the same country, as shown by Knight and Johnson (1997) in the case of Australia.

Another branch of the literature, in a less subjective way, uses trade statistics to classify as tradable industries that produce goods and services of which a sufficient portion are traded. De Gregorio et al. (1994) consider that an industry is tradable when the ratio of exports to gross output is higher than 10%. Taking a sample of 14 OECD countries and 20 sectors between 1970 and 1985, they classify as tradable agriculture, mining, manufacturing, and the transportation industry. Recently, Mano and Castillo (2015) applied this methodology to estimate productivity (real value added per worker) in the tradable and non-tradable sectors for a large panel of countries from 1989-2012. Perhaps more convincing criteria have been proposed by Dwyer (1992), who also includes in the tradable sector industries for which the ratio of competing imports to total usage of the corresponding industries exceeds 10%. According to Dixon et al. (2004), this work was pivotal in the development of a systematic approach to classify industries.[3] The use of trade statistics for the delineation of sectors was undeniably a step in the right direction. However, statistics on trade in services are available at a much lower level of disaggregation than for trade in goods, and measurement issues are significant due to the intangible nature of services flows (Lipsey, 2009). We identified two main approaches in the literature that do not require the use of trade data, namely a classification based on job characteristics, and a classification

[1] This is the classification used for instance by Goldstein and Officer (1979) although they developed one of the first comprehensive criterion to distinguish between tradable and non-tradable goods and services, that is: "we suggest the use of both trade flows and market behavior - particularly the degree of independence between domestic and foreign prices - in identifying tradable and nontradable commodities or industries". Goldstein and Officer (1979), p.415. More recently, Moretti and Thulin (2013) used the assumption method to estimate the elasticity of non-tradable local employment with respect to local tradable employment for the US and Sweden.

[2] See Francois and Hoekman (2010) for an extensive survey of the literature on services trade.

[3] A review of this literature is proposed by Dixon et al. (2004) and Knight and Johnson (1997) who use a methodology largely based on the work of Dwyer (1992)) to the case of New Zealand and Australia, respectively.

based on the geographic concentration of industries or occupations.

A growing strand of the literature focuses on the task content of occupations to determine *offshorability*. It should be noted, first, that the concept of offshorability - the ability to perform the work from abroad - differs slightly from our definition of tradability as it does not include jobs in tourism, which cannot properly be offshored but depend partly on foreign demand. Bardhan and Kroll (2003) consider that jobs requiring for instance no face-to-face customer servicing, low social networking, or high information content, are more likely to be offshorable than others. On the basis of these listed attributes, the occupations at risk are those where at least some outsourcing has already taken place or is being planned according to business literature, and represent 11% of total US employment according to their estimates. However, the authors do not take into account potential insourcing. Blinder (2009) makes subjective rankings of 817 occupations using information on employment to estimate the number of offshorable jobs, in the case of the US. He uses the O*NET database, which provides rich information on tasks, knowledge, skills and abilities, among others, at a six-digit occupational level. To establish a ranking, the central question is whether the service is amenable to electronic delivery and, if so, whether its quality is seriously degraded when so delivered. For instance, childcare does not meet the criteria, as it requires close physical proximity, while computer programmers figure at the top of the ranking. He estimates that the share of the American workforce holding offshorable jobs lies between 22% and 29%. Blinder and Krueger (2013) propose alternative estimates, after asking trained coders to re-code a pre-existing survey on the basis of an offshorability criterion (i) and conducting their own survey in which participants self-reported their perception of the offshorability of their jobs (ii). These new estimates are globally in line with Blinder (2009). Finally, Jensen and Kletzer (2010), who also use a methodology based on job task content, note a considerable overlap between this measure and a measure based on geographic concentration that we present in the next paragraph.[4] An important limitation, as shown by Lanz et al. (2011), is that workers performing tasks considered tradable also tend to perform non-tradable tasks. In addition, different offshorability measures coexist even among authors using the same database (Püschel, 2013). Finally, information on job characteristics and tasks performed is much more limited in the French survey on working conditions[5] than in the O*NET database.

Jensen and Kletzer (2005) compute geographic concentration indexes (locational Gini coefficients) for industries and occupations to estimate the number of tradable jobs in the United States, paying

[4]See Boockmann (2014), Brändle (2014), and Püschel (2013) for additional references on classifications based on occupational task content and analysis in the case of Germany.

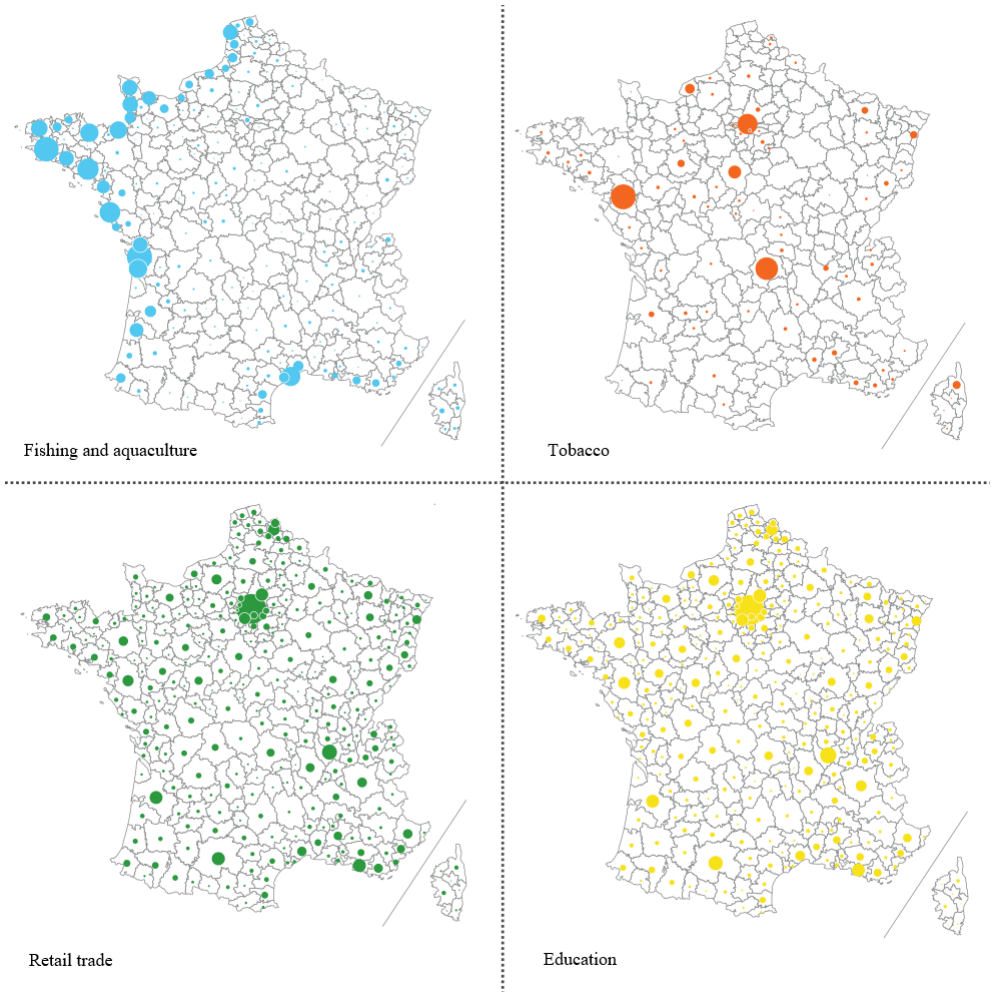
[5]*Enquête sur les conditions de travail, Insee & Dares*

particular attention to the tradability of services. Industries producing tradable goods and services need to be geographically concentrated in order to take advantage of increasing returns to scale and agglomeration economies, or accessing transportation nodes and natural resources. Conversely, non-tradable activities are more spatially dispersed as they tend to follow the geographical distribution of population and income. Indeed, trade costs are so high for non-tradable industries that supply and demand necessarily converge domestically. For instance, bakeries tend to be highly dispersed, as they almost exclusively serve local customers, while car manufacturers are more concentrated, as the tradability of their output allows them to take advantage of concentration. Helpman and Krugman (1985) demonstrated this intuition in a formal model, while Krugman (1991) computed locational Gini coefficients for 106 three-digit U.S. manufacturing industries.[6] From a methodological standpoint, the approach of Jensen and Kletzer (2005) differs in the sense that they do not study pure geographical concentration of supply as in Krugman (1991), but geographical concentration of supply relative to local demand. A few studies have since used this approach to classify industries and occupations. Eliasson et al. (2012) and Barlet et al. (2010) focus on the tradability of services in the case of Sweden and France respectively. Hlatshwayo and Spence (2014) study the evolution of the tradable and non-tradable sectors in the United States. The latter start with Jensen and Kletzer (2005)'s classification and make some value judgements about the classifications of certain industries. They consider that in some cases high geographic concentration indicates more *domestic* tradability than *international* tradability. For instance, they include legal services, for which the Gini coefficient is above the tradability threshold, in the non-tradable sector as trade data indicates that this type of service is generally not internationally tradable. In this paper we choose to use geographic concentration indexes as the main indicator of tradability. Figure 1 depicts the distribution of employment across French employment areas for four industries. It illustrates the significant heterogeneity in the geographic concentration of production. Fishing and aquaculture jobs are concentrated in costal areas, while fish are consumed throughout France and even abroad. Although the presence of natural ressources is determined by geography, those jobs are exposed to foreign competition as long as other countries propose similar or substitution products. Similarly, 58% of jobs in "Tobacco products" are concentrated in three areas (Nantes, Clermont-Ferrand and Paris). In contrast, and as expected, jobs in "Retail trade" and "Education" are much more evenly distributed throughout France. However, this methodology has some shortcomings that we should mention. First, the calculated indexes may vary depending on the geographic unit used. This modifiable areal unit problem (MAUP), however, has only a limited impact in the work of Barlet et al. (2010) who use three different geographic units. A second limitation when calculating Ginis for only one period is that we assume static tradability over time. Third, as

[6]More recently, Gervais and Jensen (2015) proposed a theoretical framework formalizing the idea that the disparity between local supply and local demand is an indicator of the extent of trade in an industry.

pointed out by Jensen and Kletzer (2010), production can be tradable and dispersed when not in an increasing return activity. Fourth, Collins (2010) notes that domestic tradability does not necessarily imply international tradability as transportation and transaction costs may differ domestically versus internationally. In particular, differences in language and legal frameworks are significant barriers to trade. In the spirit of Hlatshwayo and Spence (2014), we will try to deal with these last two limitations by using trade data as a subsidiary indicator. Lastly, it is difficult to draw comparisons between countries, as detailed sectoral breakdown data are not available at the level of local labor markets for a panel of countries.

Figure 1: Spatial distribution of employment, 2012



Source : Insee, population census 2012. Made with Philcarto : http:\\philcarto.free.fr

3 Classification of tradable and non-tradable industries

3.1 Data and methodology

To measure geographic concentration, we compute Gini coefficients following the methodology of Barlet et al. (2010) based on the approach developed by Jensen and Kletzer (2005). Note that we use a different database. Our database includes more services (46 versus 36) than in Barlet et al. (2010), and contains information on gender and skill level by industry for the period 2009-2012. In addition, the french classification of economic activities (NAF) and the number of employment areas have changed since their publication. In the rest of the paper we indicate the NAF code in parenthesis when referring to a particular industry.

We compute geographic concentration indexes to determine whether or not employment - a proxy for supply - in industry i is more concentrated than the demand it faces at the local level. If supply exceeds demand in a given area, it necessarily means that part of the production is consumed outside the area, i.e. the output is tradable. Following Jensen and Kletzer (2005) and Barlet et al. (2010) we first compute the share of demand addressed to each industry in each employment area. Local demand for a given industry will vary depending on the amount of local household income and intermediate consumption from other industries.

All data come from the INSEE (French National Institute for Statistics and Economic Studies). We use 2012 census data on local employment at the two-digit level (88 industries[7]) - the most disaggregated level for computing Gini coefficients and tracking long term evolutions of employment - for 304 employment areas[8] (EA), and data on local population and median income for 2009[9]. We also use 2012 national Input-Output Supply and Use tables.[10] The demand share for industry i in employment area ea ($IDS_{i,ea}$) is calculated as follows:

$$IDS_{i,ea} = \sum_{j=1}^{J} \left(\frac{IC_{i,j}}{D_i} . \frac{EMP_{j,ea}}{EMP_j} \right) + \frac{HC_i}{D_i} . \frac{MInc_{ea}}{MInc_{tot}} . \frac{Pop_{ea}}{Pop_{tot}} \tag{3.1}$$

[7]Due to data availability we drop two industries from the initial 88 industries defined at this level of aggregation. The two industries not covered in national accounts are: undifferentiated goods and services producing activities of private households for own use (NAF code 98) and, activities of extraterritorial organizations and bodies (NAF code 99), which are very small in terms of employment so that their omission should not have a significant impact on results.

[8]An employment area is a geographic area within which most of the labor force resides and works and in which employers can find most of the labor needed to fill available jobs. Due to data availability we consider only metropolitan France, that is, 304 EA over 322.

[9]Data are taken from the *Atlas des zones d'emploi 2010* (Dares, Insee, Datar, 2012)

[10]We thanks the INSEE for providing access to this detailed data

-$IC_{i,j}$: output of industry i used by sector j (intermediate consumption),

-D_i: demand for industry i's products,

-$EMP_{j,ea}$: industry j employment in employment area ea,

-EMP_j: total employment in industry j,

-HC_i: total household consumption of industry i products[11],

-$MInc_{ea}$: median income per consumption unit in employment area ea,

-$MInc_{tot}$: median income in metropolitan France,

-Pop_{ea}: population in employment area ea,

-Pop_{tot}: population in metropolitan France.

The first term represents local demand for intermediate consumption. Importantly, with this term we take into account the fact that some non-tradable input providers might be concentrated *because* the downstream industry is itself concentrated. The second term is household local demand, which is assumed to be proportional to the employment area's population and median income. The higher the demand of employment area ea for industry i's products in , the higher the value of $IDS_{i,ea}$. Note that using this methodology we make three implicit assumptions, namely (i) as input-output tables are only available at the national level, there are no local variations in the sectoral intermediate consumption structure, (ii) output per worker is similar for local workers and national workers, and (iii) income elasticity of final consumption is equal to 1.

We then compute a Gini coefficient (G_i) to determine whether or not an industry is more concentrated than the demand it faces. To compute the Ginis we need first to sort employment areas by increasing order of local employment to local demand ratio, $\lambda_{i,ea} \backslash IDS_{i,ea}$, with $\lambda_{i,ea} = EMP_{i,ea} \backslash EMP_i$. Then we define the cumulative share of employment in industry i as

$$\lambda_{i,ea(n)} = \sum_{ea=1}^{n} \lambda_{i,ea}$$

and the cumulative industry demand share as

$$IDS_{i,ea(n)} = \sum_{ea=1}^{n} IDS_{i,ea}$$

The Ginis can be written as

[11]Total household consumption is the sum of household final consumption plus individual general government consumption expenditure in the supply and use table. We use public national account data on households' actual final consumption to complete the database when information is missing. Due to the lack of data on retail trade, except for motor vehicles and motorcycles, we assume that demand for this industry comes exclusively from households.

$$G_i = 1 - \sum_{n=1}^{EA} [IDS_{i,ea(n)} - IDS_{i,ea(n-1)}][\lambda_{i,ea(n)} + \lambda_{i,ea(n-1)}] \tag{3.2}$$

with $\lambda_{i,ea(0)} = IDS_{i,ea(0)} = 0$. Compared to a standard Gini coefficient, the baseline is the distribution of demand and not the uniform distribution of employment. In the case where employment in industry i strictly follows the spatial distribution of demand, the value of G_i is 0. On the contrary, a Gini coefficient equal to one corresponds to a situation where employment in industry i is concentrated in a single employment area while demand comes from other employment areas.

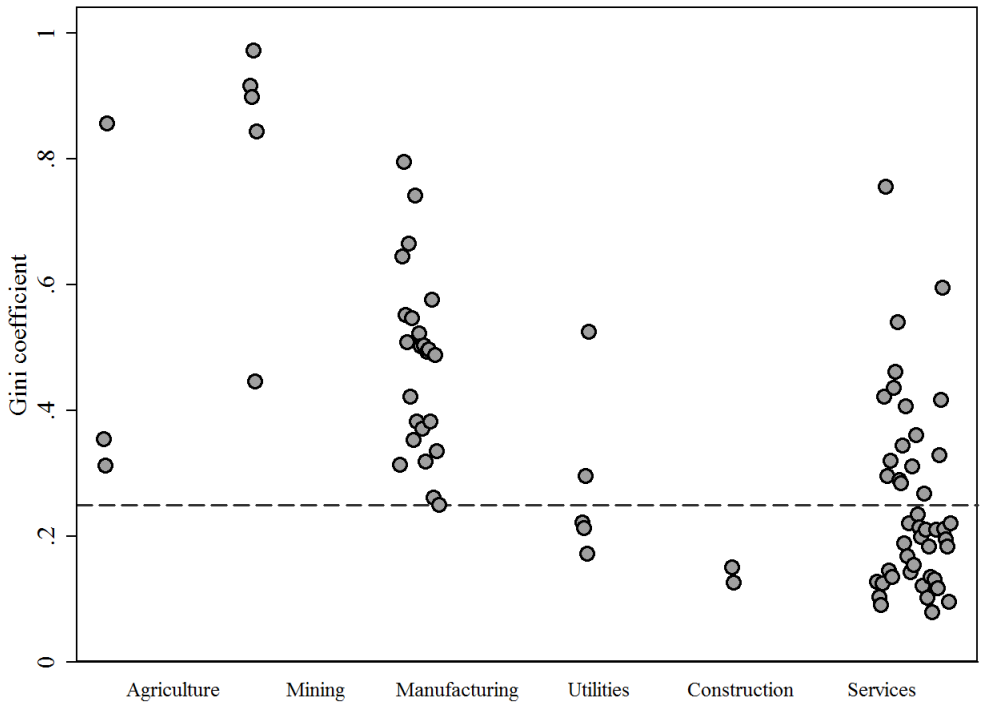
3.2 Choice of a tradability threshold

The Gini coefficients inform us on a sector's degree of geographic concentration, but we still need to determine a threshold that separates the tradable and non-tradable sectors. This necessarily involves a degree of subjectivity. Jensen and Kletzer (2005) consider that any activity with a Gini coefficient of over 0.1 is tradable. However, this threshold seems fairly irrelevant to our case since only 3 of the 86 sectors studied are situated below it. In other words, the levels of concentration measured are on average higher in our estimations. This can be explained by the different sizes of the geographic units selected. The geographic division employed by Jensen and Kletzer (2005) for the United States (Metropolitan State Areas) corresponds to much larger areas. Yet the Gini coefficient tends to decrease as the size of the geographic unit increases (Barlet et al., 2008). The tradability threshold of Barlet et al. (2010), which involves taking a threshold value corresponding to the Gini coefficient of the wholesale trade sector, is also unsuitable. It would lead us to include industries like public administration and human health in the tradable sector.

Since the tradibility of the manufacturing sector has been well identified in the empirical literature, the threshold value we select is the Gini coefficient of the least concentrated industry in that sector, i.e. "Repair and installation of machinery and equipment" (33). Therefore, industries with a Gini coefficient greater than or above 0.25 are considered as tradable. When the coefficient is below 0.25, then jobs in the industry are non-tradable. This way of establishing the threshold value is similar to that used by Eliasson et al. (2012) for Sweden. Admittedly, at a more disaggregated level we should see that not all manufacturing activities are tradable - take, for instance, cement and concrete manufacturing. But at our level of sectoral disaggregation, this threshold seems rather conservative. As expected, high relative concentration of supply not only concern the primary and secondary sectors (Table 1). Some service industries also show very high Gini coefficients (Figure 2), in particular "Gambling and betting organization" (92), "Programming and broadcasting activities" (60), "Insurance" (65), and "Publishing activities" (58). "Air transport" (51) is for example the seventh

most concentrated activity, with an openness to trade of almost 45%. Such a degree of concentration can be explained by the presence of scale economies and the need to be close to major cities. Other industries are located close to their clients or users (Table 2). Industries with a Gini coefficient lower than 0.25 include notably "Education" (85), "Human health activities" (86), "Retail trade" (47), "Public administration" (84), "Other personal service activities" (dry cleaning-laundering, hairdressing, funeral services, etc., 96), or "Services to buildings and landscape activities" (81). Obviously, a significant share of non-tradable employment corresponds to core services provided by the government throughout the country. Consequently, in what follows we sometimes break down non-tradable employment into a non-market component, grouping codes 84 to 88 of the French classification of activities (NAF), and a market component, grouping all of the other divisions in the non-tradable sector.

Figure 2: Gini coefficients, 2012



Note: The X-axis corresponds to the NAF code of each industry but we report only six broad sectors.

It could be argued that some tradable activities may not find geographic concentration particularly advantageous, e.g. because they do not benefit from increasing returns. In order to consider this case, and despite our reserves regarding the reliability of data on trade in services, we automatically classified industries with a trade openness ratio (trade as percentage of output) above 15% as tradable. Only two industries are added in the tradable sector following this correction and, overall, data on trade confirm that the most concentrated industries are also those having the highest trade

openness ratios.[12] The fact that, in our input-output table, foreign tourist expenditure in France is not recorded in exports justifies treating "Food and beverage service activities" (56) differently. Although this industry displays a low rate of concentration (Gini = 0.14), it is crucial to tourist employment. We decided to integrate 30% of jobs in this industry into the tradable group. This corresponds to the proportion of jobs in "Food and beverage service" (56) that depend on tourism (Le Garrec, 2008).[13]

We classify "Scientific research and development" (72) in the tradable sector without reporting a Gini coefficient. Since 2010, R&D has no longer been considered as intermediate consumption expenditure, but as investment expenditure. Given that households do not consume this service, the demand measured at local level by the equation is zero, as is the Gini coefficient given by equation (2). Barlet et al. (2010) have nevertheless shown that, with a Gini coefficient of 0.59 (well above our 0.25 threshold), this is one of the most concentrated sectors. In addition, the I-O table shows significant international trade for this activity. The same problem arises for "Construction of buildings" (41). We consider this sector's employment, which is highly dispersed over the territory, as non-tradable.

Lastly, we consider that "Sewerage" (37), and "Remediation activities and other waste management services" (39) mostly fulfill domestic demand, despite the fact that they exhibit quite high concentration. They do not correspond to our theoretical definition of tradable activities and are therefore classified in the non-tradable sector.

Overall, only 5 of the 86 industries studied, representing 4.4% of total employment, have a different classification from that determined by the 0.25 threshold for the Gini coefficient. A classification based on Gini coefficients only would not change the main conclusions derived from our classification. A complete list of the 86 sectors industries and their classification can be found in Appendix C.

[12] Figure 8 in Annex A shows that at the 15% threshold, two sectors stand apart in the group of sectors below the 0.25 value of the Gini coefficient. They are: "Rental and leasing activities" (77), and "Office administrative, office support and other business support activities" (82). Our input-output table reports no trade flows for mining support service activities (09), which is the fifth most concentrated industry. This appears to come under statistical confidentiality and it is likely that in reality a significant share of the industry fulfils foreign demand.

[13] The five other industries connected to tourism, "Accommodation" (55), "Travel agency and tour operator activities, and other reservation service and related activities" (79), "Creative, artistic and entertainment activities" (90), "Libraries, archives, museums and other cultural activities" (91), "Gambling and betting activities" (92), all have sufficiently high Gini coefficients to be included in the tradable group.

Table 1: The 15 most concentrated industries

NAF code	*Industry*	*Gini*
07	Mining of metal ores	0,97
05	Mining of coal and lignite	0,92
06	Extraction of crude petroleum and natural gas	0,90
03	Fishing and aquaculture	0,86
09	Mining support service activities	0,84
12	Manufacture of tobacco products	0,80
51	Air transport	0,76
19	Manufacture of coke and refined petroleum products	0,74
15	Manufacture of leather and related products	0,67
11	Manufacture of beverages	0,64
92	Gambling and betting activities	0,60
29	Manufacture of motor vehicles, trailers and semi-trailers	0,58
13	Manufacture of textiles	0,55
17	Manufacture of paper and paper products	0,55
60	Programming and broadcasting activities	0,54

Table 2: The 15 less concentrated industries

NAF code	*Industry*	*Gini*
85	Education	0,08
47	Retail trade, except of motor vehicles and motorcycles	0,09
96	Other personal service activities	0,10
81	Services to buildings and landscape activities	0,10
46	Wholesale trade, except of motor vehicles and motorcycles	0,10
88	Social work activities without accommodation	0,12
78	Employment activities	0,12
49	Land transport and transport via pipelines	0,13
43	Specialised construction activities	0,13
45	Wholesale and retail trade and repair of motor vehicles and motorcycles	0,13
86	Human health activities	0,13
56	Food and beverage service activities	0,14
84	Public administration and defence; compulsory social security	0,14
69	Legal and accounting activities	0,14
53	Postal and courier activities	0,15

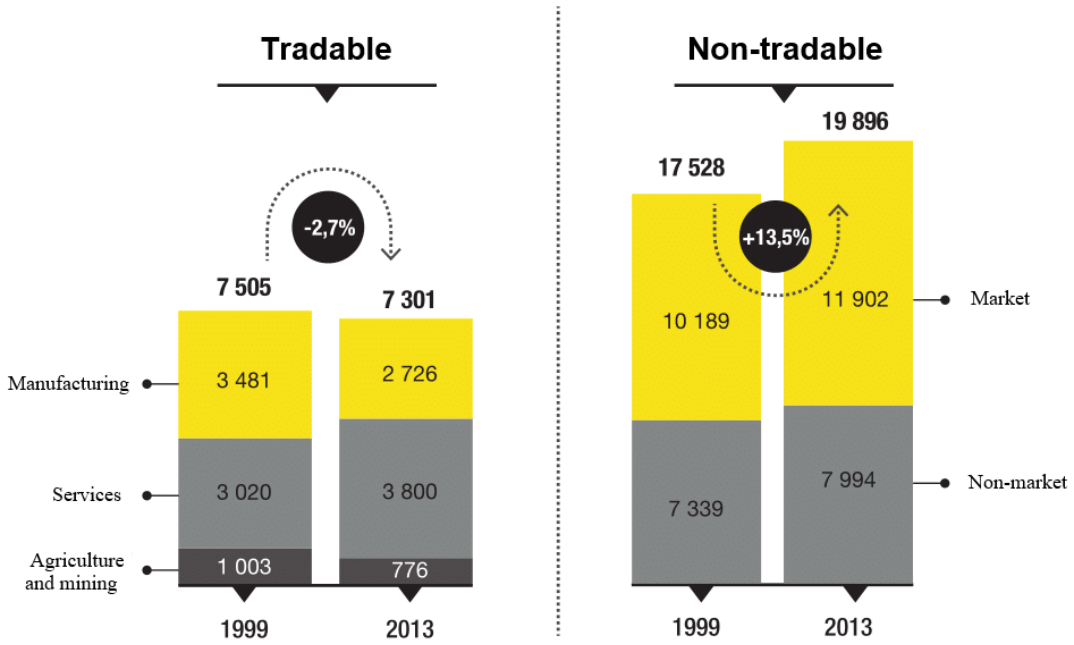
4 Tradable and non-tradable jobs in France: evolutions, characteristics and geography

4.1 Evolutions from 1999 to 2013

To study the evolutions of tradable and non-tradable employment in France, we use national accounts data (Insee) on total employment by industry. We assume that the classification of sectors established for 2012 does not vary throughout the period 1999-2013. Due to a change in the French classification system in 2008, it would be impossible for us to compare the Gini coefficients calculated for 1999 with those of 2012.

Our results indicate that the share of tradable jobs significantly decreased, dropping from 30% to 26.8% of total employment between 1999 and 2013. This drop was very sharp from 2001 up to the financial crisis (2009-2010), and then less pronounced. In volume, the tradable sector lost 204,000 jobs, while the non-tradable sector increased by 2.37 million (Figure 3).[14]

Figure 3: Employment changes in tradable and non-tradable sectors (thousands), 1999-2013



Source : Insee, National accounts. Author's calculations.

Perhaps more interesting is the increasingly tertiary nature of tradable jobs (Table 1). Currently, over one tradable job in two (52%) is in services, compare to 40,2% in 1999. While manufacturing, agriculture and the mining industry saw a considerable drop in their workforce, tradable services cre-

[14]The tradable sector's share of added value is also dropping. It represented 29.7% of GDP in 2013 compared to 34.4% in 1999.

ated a total of 780,000 jobs. Job creations in tradable services accelerated sharply starting from 2006 and slowed down very little during the crisis. Moreover, from 1999 to 2013, they increased much faster than non-tradable services and the non-tradable market sector (+26% compared to +12% and +17%). The most dynamic tradable services were "Activities of head offices, management consultancy activities" (70), +172,000; "Office administrative, office support and other business support activities" (82), +137,000; "Computer programming, consultancy and related activities" (62), +130,000; "Scientific research and development" (72), +63,000; and activities connected to tourism such as "Creative, artistic and performance activities" (90), +69,000, or "Accommodation" (55), +41,000. While concerns have been raised about the recent increased tradability of services, our results suggest that it has not lead to massive offshoring.

The growth in tradable service jobs has not, however, compensated for the drop in other areas of the tradable sector. "Crop and animal production, hunting and related services" (1) dropped the most (-203,000), followed by traditional industries such as "Manufacture of wearing apparel" (14), -89,000, and "Manufacture of textiles" (13), -59,000, but not only: "Manufacture of motor vehicles, trailers and semi-trailers" (29) and "Manufacture of computer, electronic and optical products" (26) also contracted considerably (respectively -63,000 and -57,000). The drop in manufacturing employment, which explains three-quarters of the loss of jobs in the tradable sector, results from a combination of well-known factors, i.e. a much faster productivity increase in industry than in services, combined with consumers' reduced sensitivity to price reductions of manufactured goods (low price elasticity of demand for manufactured goods); a change in the structure of household expenditure, which comprises an increasingly large amount of services; outsourcing of some activities to specialized companies in the tertiary sector; and lastly, international competition, in particular from emerging countries.[15]

In the non-tradable sector, the greatest increases in employment were recorded in the construction sector (41-43), +402,000, "Human health activities" (86), +300,000, "Retail trade" (47), +268,000, the social sector (87-88), +419,000, and "Food and beverage service activities (56), 149,000. "Activities of membership organisations" (94) and "Public administration and defence"(84) are the two non-tradable industries that have destroyed the most jobs (respectively -184,000 and -64,000). The non-tradable market sector, with 1.7 million jobs created (+17%), was overall more dynamic than the non-market non-tradable sector, where employment increased by 655,000 (+9%).

The evolution of the structure of employment in France is highly similar to that observed in the

[15]See Demmou (2010) for an evaluation of the significance of these structural determinants in the decline of manufacturing employment in France from 1980 to 2007.

United States. During the same period, Hlatshwayo and Spence (2014) estimate that US tradable employment went from 30% to 26.3% of total employment, and decreased in volume (-3.4 million units). Like in France, the drop in manufacturing and agricultural employment is not compensated by more jobs in the tradable service sector. Eliasson and Hansson (2016) estimate a much larger tradable sector in the case of Sweden (almost 40% of total employment in 2010). Between 1990 and 2005 they do not find significant change in employment, neither in the tradable secor nor in the non-tradable sector. However, there has been significant restructuring within the Swedish tradable sector with a shift towards tradable services.

4.2 Characteristics of tradable and non-tradable jobs

4.2.1 Wages

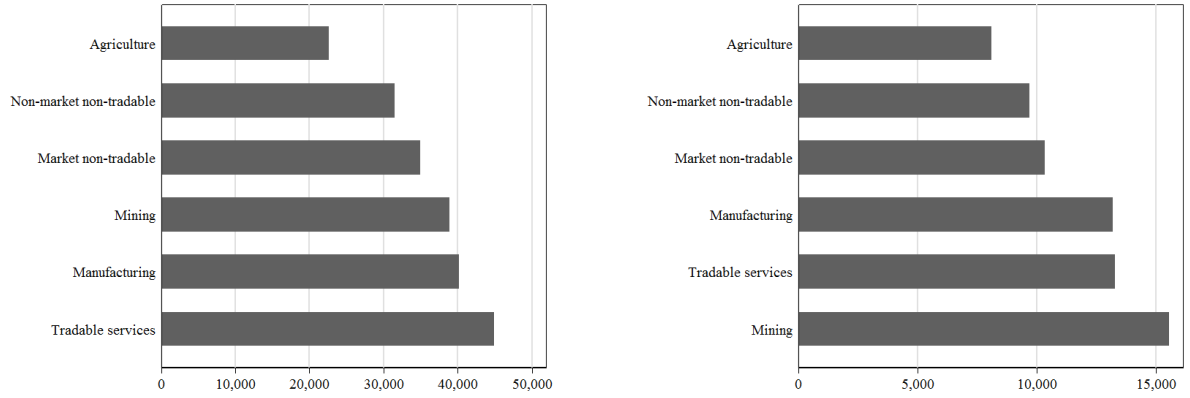
There is a significant wage gap between tradable and non-tradable workers. In 2013, the gross annual wage of workers (full-time equivalent) in the tradable sector was on average 25% higher, i.e. an annual difference of around 8,300 euro.[16] This gap widened by 3.8 points from 1999 to 2013. Naturally, these aggregated figures often hide clear heterogeneity (Figure 9 in Annex). For example, the gross annual wage per worker is on average lower in agriculture than in market and non-market non-tradable sectors (Figure 4). Nevertheless, average pay is higher in tradable services, industry and mining, which represent 90% of tradable employment, than it is in the non-tradable sector. Workers are best paid in tradable services, with an average annual gross wage of 44,942 euro, ahead of workers in the manufacturing and extractive industries (Figure 4). Jensen and Kletzer (2005) and Eliasson et al. (2012) make similar observations for the United States and Sweden, respectively.

Perhaps surprisingly, this wage gap does not reflect a difference in skills. On the contrary, the skill structure is fairly similar in the two groups (Table 2). Other structural characteristics could explain these differences. For example, the proportion of male workers is higher in tradable activities (63.4% compared to 48% for non-tradable).[17] Similarly, the public and non-profit-making sectors on average offer lower wages and are all non-tradable. To examine this, we estimate a wage equation using data at the level of individual workers (annual declaration of social data, DADS) for 2013. The data description and results are presented in Annex B. A wage premium persists in the tradable sector of around 3% even after controlling for observable worker and firm characteristics like age, gender, socio-professional category, employment contract, size and location of employer. Note however that

[16] In the absence of detailed industry-level data for the self-employed (2.5 million people in France) at this level of sectoral disaggregation, we cannot generalize this result to all workers.

[17] There is a large share of men in agriculture and manufacturing, but the gender balance is not assured in tradable services either (55% men), particularly in transport, telecommunications and computing.

Figure 4: Average gross annual wage in euro (per worker in full-time equivalent



(a) 2013 (b) Variation 1999-2013

Source : Insee, national accounts. Authors' calculations.

this premium seems small in the case of France: Jensen and Kletzer (2005) for the US and Eliasson et al. (2012) for Sweden identify a respective wage premium of 6% and 7%. This premium may correspond to a compensation for the fact that workers whose activities are exposed to international competition are more likely to lose their jobs (Eliasson and Hansson, 2016), or that working conditions are harder in some tradable sectors (industrial and agricultural), or that labor productivity is higher in tradable sectors - even though this effect is partially captured by the variable size of the establishment.

4.2.2 Productivity and prices

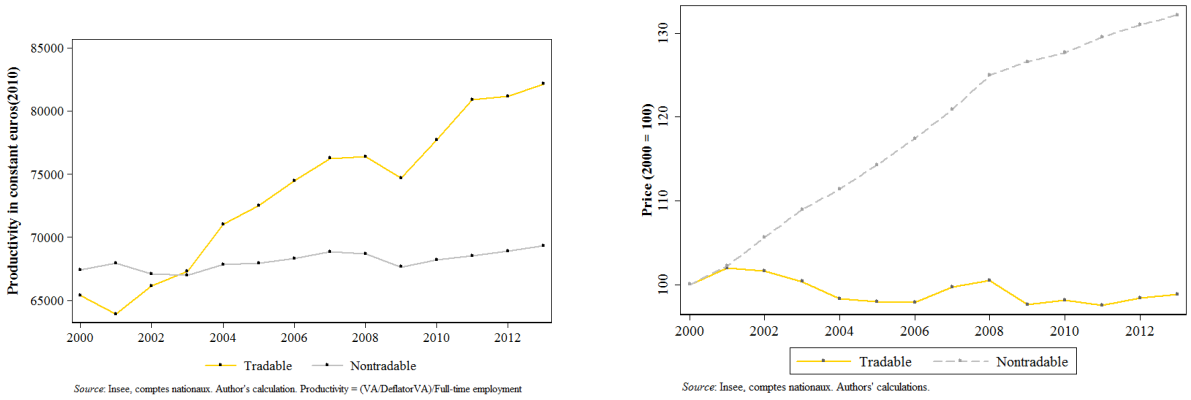
Like for wages, the distinction between tradables and non-tradables reveals significant differences in labor productivity, which we define as real value added per worker in full-time equivalent. We see that labor productivity is significantly higher in the tradable sector (Figure 5a). The productivity differential may be explained by a rationalization effect of international trade: in Meltitz-type models (Melitz, 2003) with heterogeneous firms, trade leads to the intra-sectoral reallocation of resources. Put simply, foreign competition pushes out the least productive domestic firms out of the market, and allows the most productive ones to extend their market shares.[18] In addition, Timmer et al. (2014) showed that, within global value chains, advanced nations increasingly specialize in high value added activities. It may also be because the shrinking tradable sector shed the least able workers (Young, 2014). Perhaps even more important in our opinion, this productivity gap may largely reflect the fact that numerous non-tradable service activities are still difficult to automate because they involve a high degree of social interaction (home carer, psychiatrists, beauticians, etc.) or precision (hairdressers, cooks, decorators).

[18]For a review of the literature on heterogeneous firms and trade, see Melitz and Redding (2014).

Although significant productivity gains in the tradable sector may partially explain part of the wage differential, they have mainly benefited non-tradable workers. The wage gap between tradable and non-tradable employees has in fact grown at a much slower pace than the productivity differential. From 2003, the productivity differential between tradable and non-tradable activities went up by 18%, while the difference in wages only increased by 3.1%.[19]

A classic "Balassa-Samuelson" effect (Balassa, 1964; Samuelson, 1964) can explain this phenomenon. According to this effect, greater productivity growth in tradable industries translates into a rise in the relative price of non-tradable goods and services. Indeed, when the productivity of the tradable sector increases, the wages of tradable workers go up because prices for tradables are set in international markets. Therefore companies in the non-tradable sector also have to increase wages to prevent their employees from looking for work in the tradable sector where wages are higher. These wage rises for non-tradable workers can only be achieved through price increases, since productivity has remained the same in the non-tradable sector. As shown by Figure 5b, prices in the non-tradable sector did in fact increase sharply while they went down slightly in the tradable sector.

Figure 5: Price and labor productivity in tradable and non-tradable sectors, 2000-2013



(a) Labor productivity

(b) Price

The impact of a productivity shock in the tradable sector on relative prices is closely dependent on labor mobility. When intersectoral mobility is high, non-tradable firms have to increase significantly their prices to align their wages with that of the tradable sector. Consumer preferences for non-tradable goods and services are also important. If consumers have strong preferences for non-tradable products, then the additional income generated by the increased productivity in the tradable sector will disproportionately benefit the non-tradable sector, pushing up the price of these products

[19]The coal and lignite mining industry, which had an added value of nil in 2009, is excluded in the calculation of tradable sector productivity.

even higher. The dynamics of relative prices may also be explained by the intensity of competition in the non-tradable sector. Due to greater protection of non-tradable markets, companies are freer to fix their prices and therefore tend to set high prices. Bénassy-Quéré and Coulibaly (2014) show for instance that the divergence of relative prices within the European Union is explained in part by differences in the degree of regulation of product and labor markets. Lastly, a drop in real interest rates can trigger a faster increase in the prices of non-tradable goods and services. Piton et al. (2016) identifies three mechanisms: (i) a higher demand for non-tradable products, following a drop in interest rates, cannot be satisfied by imports (Dornbusch, 1983); (ii) the non-tradable sector is often more dependent on bank loans, especially in real estate (Reis, 2013); (iii) the non-tradable sector may be more labor-intensive than the tradable sector and therefore benefit less from the drop in the cost of capital (Piton, 2016).

4.2.3 Skills

Although education is an imperfect proxy for skills, we consider that workers without an high school diploma are low-skilled. High school graduates are medium-skilled, and college graduates are high-skilled. Table 3 shows that tradable and non-tradable sectors have a very similar skill structure. Note that the structure is similar even when decomposing in 11 education levels. In the tradable sector, high-skilled workers are principally employed in services. In the non-tradable sector, the share of high-skilled workers is higher in non-market industries, with 45% of workers holding a college degree, particularly concentrated in health, education and administration, while residential social-medical and social institutions and non-residential social action mostly use low-skilled labor. The skill structure of the market non-tradable sector is similar to the manufacturing sector, with fewer than 30% high-skilled workers.

Strikingly, net destructions of jobs between 2009 and 2012 only concern low-skilled workers, while the number of high-skilled workers increased in both tradable and non-tradable activities. This evolutions are in line with those reported by Jensen and Kletzer (2005) who indicate – but for 1998-2002 – a general drop in low-skilled employment in the US and a steep rise in skilled employment in tradable services and the non-tradable sector. The erosion of low-skilled employment appears to be less pronounced in the non-tradable sector. While low-skilled jobs are rapidly declining in a large number of tradable sectors due to automation and competition from countries with low labor costs, some non-tradable industries are relatively spared. For instance, waste activities (38-39), services to buildings and landscape activities (81), along with social work activities without accommodation (88), are a

kind of refuge for low-skilled workers.

Table 3: Skills in tradable and non-tradable sectors - share (2009) and variation (2009-2012)

	Low-skilled		**Medium-skilled**		**High-skilled**	
	Share	*Variation*	*Share*	*Variation*	*Share*	*Variation*
Tradable	43,2	-10,9	19,3	1,4	37,5	7,0
Manufacturing	53,3	-13,8	17,9	-1,7	28,8	1,3
Services	29,2	-5,4	19,4	3,7	51,4	10,2
Non-tradable	43,7	-5,4	20,1	5,6	36,2	7,9
Market	48,8	-6,5	21,6	5,8	29,6	10,8
Non-market	36,8	-3,4	18,1	5,2	45,1	5,4

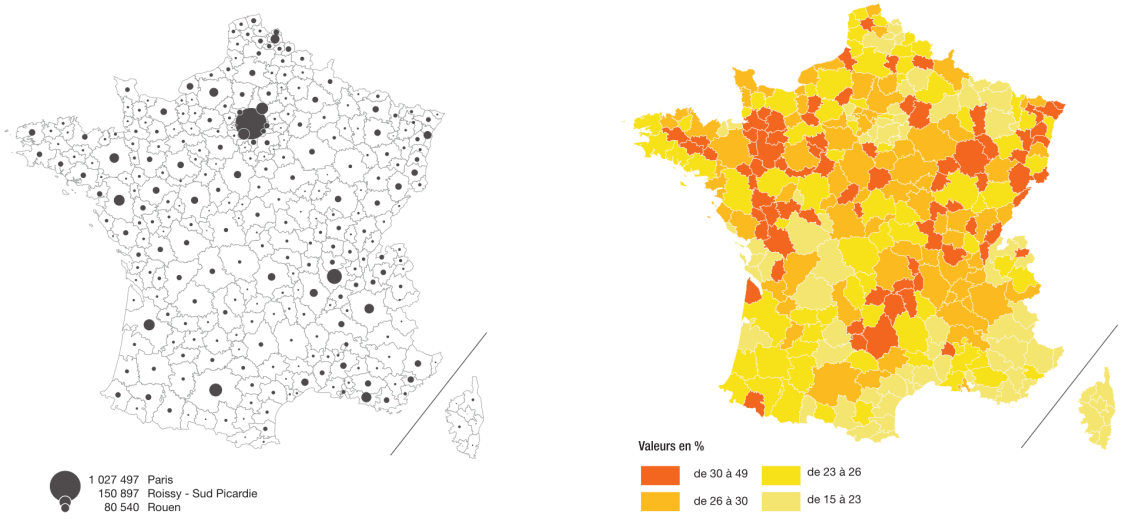
Note : In 2012, 53,3% of workers in manufacturing were low-skilled. The number of low-skilled workers in manufacturing has decreased by 13,8% between 2009 and 2012.
Source: Insee, population census 1999-2012.

4.3 Geography

Let us recall that non-tradable jobs more or less follow the geographic distribution of their clients, unlike tradable jobs, which can produce far from the final consumer and therefore tend to be concentrated. The employment areas that feature the greatest number of tradable jobs are urban zones corresponding to the main French metropolitan areas, i.e. Paris, Lyon, Toulouse, Nantes, Marseille, etc. (Figure 6a). The leading ten zones thus concentrate one third of French tradable jobs. On the other hand, in relative terms, most tradable jobs are found in employment areas with few inhabitants. These are located in western France (Figure 6b), on a long strip of land going from Cognac (Charente), which specializes in producing brandy, to Vire (Calvados) in the northeast, which specializes in dairy processing, and in Auvergne and the Midi-Pyrenees. These zones are usually characterized by a high share of manufacturing jobs.

The Mediterranean coast is, on the contrary, the area in which tradable jobs have the lowest shares in total employment. In this area, the tradable sector employment is mainly composed of jobs in tradable services (Figure 7). Along with services linked to tourism, numerous of workers are engaged in activities with higher added value (digital, R&D, corporate headquarters, etc.) in towns like Aix-en-Provence, Cannes-Antibes, and Marseille-Aubagne. However, this is insufficient to counterbalance the proportion of non-tradable jobs in the region.

Figure 6: Number and share of tradable jobs, employment areas (2012)



(a) Number (b) Share

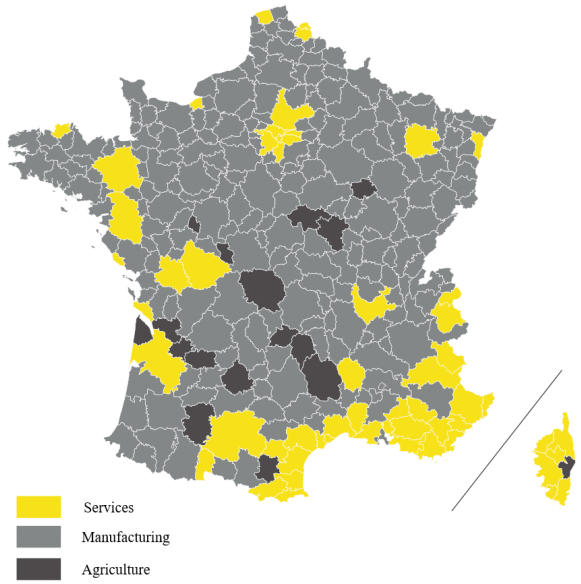
Source : Insee, population census 2012. Authors' calculations. Made with Philcarto : http:\\philcarto.free.fr

Tradable services nationally represent over one tradable job in two, but they are the majority component in tradable employment in only 58 of the 304 employment areas (Figure 7). They are concentrated around the major French cities, tourist areas, and on the Mediterranean coast. These 58 employment areas together account for the two thirds of national employment in tradable services. Agricultural employment only dominates tradable employment in a handful of rural employment areas, mostly located in the south of France. In the rest of the country, i.e. in three-quarters of employment areas, the manufacturing industry dominates the tradable sector.

This suggests that the continued drop in manufacturing employment, and to a lesser extent agricultural employment, is likely to destabilize a great number of local economies. Conversely, the growth of tradable services is likely to mostly benefit a reduced number of dense employment areas. Indeed, this is what we observed from 2004 to 2013 (see Annex A, figures 14 and 15).[20] Only 35 out of 304 employment areas have seen an increase in manufacturing employment. These zones of industrial resistance include for example Toulouse (aerospace), Sablé-sur-Sarthe (agrifood), and Bagnols-sur-Cèze (metallurgy). Deindustrialization is thus affecting most employment areas. Unsurprisingly, the traditional French industrial regions (Hauts-de-France, Grand-Est, and Ile-de-France) are undergoing the deepest reorganization, while industrial employment is resisting better in the west. A non-negligible number of these areas are also experiencing a drop in employment in tradable services. In other areas, employment in tradable services is sufficiently dynamic to compensate for deindustrialization. This

[20]We used Insee's Clap database (Connaissance locale de l'appareil productif – local knowledge of production systems) that we employ to study the geographic evolutions of jobs from 2004 to 2013. Note that it only concerns payroll employment and not total employment.

Figure 7: Dominant industry within tradable employment, employment areas (2012)



Source : Insee, population census 2012. Authors' calculations. Made with Philcarto : http:\\philcarto.free.fr

includes several metropolitan areas (Nantes, Bordeaux, Toulouse, and Montpellier), and more generally the west and Mediterranean coasts. Overall, though, only 29% of employment areas experienced an increase in tradable jobs from 2004-2013.

By contrast, non-tradable employment is increasing in most of the country, in particular in metropolitan areas. More generally, we can identify three major dynamic zones: the Atlantic coast, the Mediterranean coast and the former Rhone-Alpes region. These zones are particularly sought-after for their high quality of life, which partly explains their vitality. Strikingly, the employment areas where non-tradable employment has dropped (Centre-Val de Loire, Grand-Est) are often also areas that were subject to a significant destruction of tradable jobs (see Annex A, figures 12 and 13). This relation may be causal. Indeed, non-tradable jobs are highly dependent on the evolution of aggregated local income because their clients are mostly local, unlike tradable jobs which satisfy scattered demand. We look at this issue in the next section.

5 The local multiplier effect of tradable employment in France

Although very different, tradable and non-tradable jobs are closely interdependent. Moretti (2010, 2011) has developed an econometric approach for estimating local employment multipliers in the US, i.e. the number of non-tradable jobs created in a given area following an exogenous increase in the number of tradable jobs within the area. We contribute to this recent literature by estimating the local

employment multiplier effect for French employment areas between 2004 and 2013. Local employment multipliers of tradable employment for France between 1995 and 2007 are estimated in Malgouyres (2016), but he identifies tradable industries with manufacturing while, we also include agriculture, mining and part of the service sector. The theorical basis of Moretti's empirical approach builds upon the Rosen-Roback spatial general equilibrium model (Rosen, 1979; Roback, 1982) and is briefly outlined below.

5.1 Conceptual framework

We assume each employment area is a competitive economy that uses labor to produce tradable and non-tradable goods and services. Prices for tradables are set in international markets, whereas prices for non-tradables are determined locally. Workers are perfectly mobile across industries within an employment area, so that marginal product and wages are equalized locally in the long run. Workers' indirect utility depends on the local wage net of living costs and on idiosyncratic preferences for location. Idiosyncratic preferences for location hamper labor mobility across areas, implying a finite elasticity of local labor supply (upward sloping local labor supply curve). The elasticity of local labor supply is also affected by local unemployment rates. Therefore, if local unemployment and geographical mobility of labor are low, then an increase in local labor demand mostly results in higher local wages and not in higher employment. Finally, we assume that local housing supply is not fixed; it depends on geography and land use regulations. With upward sloping local labor and housing supply curves, Moretti (2010, 2011) departs from the Rosen-Roback framework in which any shocks to local labor markets are fully capitalized in the price of land.

Let us consider the case of a permanent increase in labor demand of tradable industry j in employment area ea. This could occur e.g. if the local economy manages to attract a new firm or if the labor productivity of an existing firm increases. With these new tradable workers, the number of local jobs increases (direct effect). Therefore, the local aggregate income must increase triggering additional demand for tradable and non-tradable goods and services (indirect effect). It also pushes up local prices as local labor and housing supply curves are upward sloping (general equilibrium effects).

The multiplier effect on non-tradable employment is unambiguously positive and translates into a lower local unemployment rate and/or labor migration from other employment areas. The magnitude of the multiplier depends on several factors. First, if households have strong preferences for non-tradable goods and services they will spend a large fraction of additional income on those products.

Second, the magnitude of the local employment multiplier depends on technology in the non-tradable sector. Labor-intensive technology implies that additional demand is met principally by hiring new workers. Third, the magnitude of the local employment multiplier also depends on the type of new jobs created in the tradable sector. We expect a higher local multiplier when skilled jobs are created because earnings for these workers are generally higher than for unskilled workers. Fourth, it depends on the offsetting general equilibrium effects on local prices. Higher wages and housing costs will increase production costs, reducing the supply of non-tradable products. Low elasticities of local housing and labor supplies imply large offsetting general equilibrium effects and hence a low multiplier. But since we assume that labor and housing supply are not perfectly inelastic, negative general equilibrium effects only partially undo the first positive income effect. The increase in labor costs also negatively impacts tradable employment in firms that are not directly affected by the increase in demand. Indeed, they cannot increase their prices to compensate for higher labor costs as tradable prices are set in international markets. This lowers their competitiveness, unless agglomeration economies are sufficiently large to compensate for the increase in factor prices. Of course, tradable intermediate input suppliers may benefit from an increase in tradable industry j's production. However, these suppliers are not necessarily located in the same employment area. Therefore, the local multiplier effect on tradable employment should be quantitatively smaller than the local multiplier effect on non-tradable employment.

5.2 Econometric approach

Moretti (2010) estimates a multiplier of 1.6 for U.S. cities between 1980 and 2000. Implementing an econometric approach that allows for the endogenous reallocation of factors and adjustment of prices, he departs from local multipliers estimates based on regional input-output tables.

Following Moretti (2010), we estimate the elasticity of non-tradable local employment with respect to tradable local employment using the following model (Model 1) :

$$\Delta NT_{ea,t} = \alpha_1 + \beta_1 \Delta T_{ea,t} + \gamma_1 d_t + \varepsilon_{ea,t} \tag{5.1}$$

where $\Delta NT_{ea,t}$ and $\Delta T_{ea,t}$ are, respectively, the change over time in the log number of jobs in the non-tradable and tradable sector in employment area ea. The period covered in this paper runs from 2004 to 2013. For each employment area we have three observations, corresponding to the time intervals 2004-2007, 2007-2010, and 2010-2013. We introduce period-specific effects d_t to control for time-varying national shocks to the non-tradable sector, and an error term $\varepsilon_{ze,t}$. The β_1 coefficient is the elasticity of non-tradable to tradable employment.

To obtain the value of the local multiplier, we simply multiply the estimated β_1 in equation (5.1) by the relative size of the non-tradable sector over all three periods:

$$Multiplier = \hat{\beta}_1 \times (\frac{NT_{2004} + NT_{2007} + NT_{2010}}{T_{2004} + T_{2007} + T_{2010}})$$

The local multiplier gives the number of jobs created in the non-tradable sector for one additional job in the tradable sector.

Alternative specifications are estimated. The effect of tradables on other tradables (Model 2) is estimated by randomly splitting tradable industries in two parts:

$$\Delta T^1_{ze,t} = \alpha_2 + \beta_2 \Delta T^2_{ze,t} + \gamma_2 d_t + \varepsilon_{ze,t} \tag{5.2}$$

In Model 3 we allow the effect of adding jobs in medium - high / high-tech tradables industries to differ from the effect of adding jobs in medium-low / low-tech tradable. Tradable industries are split according to the classification on technological intensity used by Eurostat (NACE Rev.2). In Moretti and Thulin (2013) the multiplier is larger for high-tech than low-tech tradable sectors, reflecting higher wages in high-technology and stronger agglomeration economies.

Unlike other studies we estimate separate elasticities for the market and non-market non-tradable sectors (Model 4). Indeed we anticipate that the multiplier effect of tradable jobs is lower on non-market non-tradable jobs than on market non-tradable because part of the non-market non-tradable sector is funded from national taxation.

OLS estimation will likely lead to inconsistent estimates if there are unobserved time-varying local shocks affecting the size of both sectors. As pointed out by Moretti and Thulin (2013), shocks to the labor supply of an employment area due for instance to changes in crime rates, schools or air quality, public services, or taxes, may induce bias. Another potential concern is that of reverse causality. For instance, the creation of a new university campus in a given employment area may induce some tradable firms to locate in this area to benefit from a pool of skilled workers and local knowledge spillovers. To estimate the causal effect of tradable employment growth on non-tradable employment growth, we need to isolate exogenous shifts in demand for tradable employment. Following Moretti and Thulin (2013) we use a classic "Bartik instrument" (Bartik et al., 1991). The idea is to isolate local variations in tradable employment caused by national shocks from the variations resulting from

local specificities. The instrumental variable for Model 1 is constructed as

$$\sum_{j \in J} \left\{ \frac{T^{j}_{ea,t}}{T^{J}_{ea,t}} \left[ln \left(\sum_{ea' \in EA_t} T^{j}_{ea',t+3} \right) - ln \left(\sum_{ea' \in EA_t} T^{j}_{ea',t} \right) \right] \right\} \tag{5.3}$$

where $\frac{T^{j}_{ea,t}}{T^{J}_{ea,t}}$ denotes the share of tradable industry j in total tradable employement of employment area ae at period t. The term in brackets is the nationwide change in employment between t and $t+3$ in tradable industry j (excluding employment area ea). Thus an employment area is affected by national trends in proportion to its initial industry mix composition. Arguably, as long as national changes are not driven by specific economic conditions in a given employment area, the instrument captures exogenous changes in local labour demand.

5.3 Data and results

We use the CLAP database[21] which provides data on payroll employment for the period 2004-2013. Industries are defined at the five-digit level for all French municipalities. We aggregated them at the two-digit industry and employment area level. Activities of households as employers of domestic personnel (97) are not covered by our database. Finally, we classifiy all jobs in food and beverage service activities (56) in the non-tradable sector (previously 70%). Each of the 304 employment areas of mainland France is observed over three time intervals (2004-2007, 2007-2010, and 2010-2013), that is our database contains 912 observations. With three years time intervals we estimate medium-term local multipliers and therefore depart from Moretti (2010) who uses two 10-year intervals between 1980 and 2000.

Table 3 displays the results for the local multiplier in France between 2004 and 2013. We estimate that, over the period, for every 100 tradable jobs created in an employment area in mainland France, 64 additional non-tradable jobs were created within the main area (i.e. a local multiplier of 0.64). We find a significant but lower multiplier effect of tradable jobs on other tradable jobs (0.25). This result is consistent with the theory. First, the demand (intermediate consumption and final households demand) for tradable goods and services mainly comes from firms and households located in other areas in France or abroad. Secondly, employment growth in part of the tradable sector pushes up local prices and may cause firms in the rest of the tradable sector to relocate or even disappear. As expected, the local multiplier is lower on non-market non-tradable jobs (0.21) than on market non-tradable jobs

[21] Connaissance Locale de l'Appareil Productif (CLAP) : Tabulation sur mesure, version PSM - (INSEE). The database was provided by Réseau Quételet and follow the NAF rév. 2.

Table 4: Synthesis of estimated local multipliers for french employment areas between 2004 and 2013

	OLS	**IV**	**Multiplier**
Model 1			
Tradable on non-tradable	0.062**	0.233***	0.64
	(0.029)	(0.051) [64.96]	
Model 2			
Tradable on other tradable	-0.034	0.328***	0.25
	(0.067)	(0.114) [87.18]	
Model 3			
Low-tech on non-tradable	0.053**	0.188***	0.89
	(0.024)	(0.044) [12.98]	
High-tech on non-tradable	-0.003	0.071	-
	(0.010)	(0.062) [12.98]	
Model 4			
Tradable on market non-tradable	0.046	0.265***	0.42
	(0.038)	(0.064) [64.96]	
Tradable on non-market non-tradable	0.091***	0.181***	0.21
	(0.026)	(0.048) [64.96]	

Robust standard errors clustered by employment area reported in parentheses. Kleinbergen-Paap Wald rk F statistic in brackets. The multiplier is calculating using the IV estimator. *Significance at the 10% level; **significance at the 5% level and ***significance at the 1% level.

(0.42). This arguably reflects the fact that non-market non-tradable jobs partly depend on national taxation. More unexpectedly, on the other hand, the multiplier is higher for low-tech (0.89) than for high-tech tradable jobs (not significantly different from 0). One interpretation is that increases in the number of high-skilled workers induce large crowding out effects, due to a local boom in housing prices and wages.

Our local multiplier of tradable on non-tradable jobs is 2.5 times less than that estimated by Moretti (2010) in the case of the United States. But our results are not entirely comparable since he estimates long-term multipliers and includes only manufacturing jobs in the tradable sector. Gerolimetto and Magrini (2015), who include the period 2000-2010, tradable services, and spatial interdependencies, find a lower local multiplier of 0.53 for the US. In the case of France, from 1995-2007, Malgouyres (2016) find a large local multiplier of 1.46. Like most of the studies on local multipliers, only manufacturing jobs are included in the tradable sector. However, our two studies suggest quite large local multiplier for France, i.e. larger than in other studies including e.g. Moretti and Thulin (2013) in the case of Sweden, Wang (2016) using Chinese data, or de Blasio and Menon (2011), and Auricchio (2015) for the case of Italy. Finally, perhaps more comparable is the work of van Dijk (2016) who includes tradable services to provide an improved estimate for the US. He also includes controls for city size, education and unemployment, and find a multiplier equivalent to that of Moretti (2010). As a robustness check we control for other covariates, namely local unemployment rate, employment area size (total employment), and share of non-tradable employment in total employment at the beginning of each period. This has no significant impact on the estimated size of the multiplier, as shown by Table 5. It even slightly increases the value of the local multiplier.[22]

Admittedly, we need to remain cautious about the exact value of the multiplier. Our database covers only payroll employment and not total employment or total hours worked. As the majority of French self-employed workers is in the non-tradable sector (personal services, health and social action, construction)[23], we may underestimate the value of the local multiplier. On the other hand, some long term effects may not be taken into account since we are studying three-year intervals. This could potentially reduce de size of the multiplier if crowding out effects take time to occur.

[22]In unreported estimates we exclude Paris (15 % of French employment) when calculating instrumental variables, as it could influence national trends. The results are not different from our baseline. Estimates are available upon request.

[23]See Omalek and Rioux (2015)

Table 5: Synthesis of estimated local multipliers for french employment areas between 2004 and 2013 after controlling for unemployment rate, total employment, and initial share of non-tradable workers

	OLS	**IV**	**Multiplier**
Model 1			
Tradable on non-tradable	0.056*	0.251***	0.69
	(0.031)	(0.061) [54.305]	
Model 2			
Tradable on other tradable	-0.025	0.281**	0.21
	(0.065)	(0.113) [93.112]	
Model 3			
Low-tech on non-tradable	0.050*	.209***	0.98
	(0.026)	(0.053) [12.49]	
High-tech on non-tradable	-0.004	.0642847	-
	(0.010)	(0.064) [12.98]	
Model 4			
Tradable on market non-tradable	0.027	0.266***	0.42
	(0.040)	(0.087) [51.041]	
Tradable on non-market non-tradable	0.094***	0.209***	0.24
	(0.026)	(0.054) [56.314]	

Robust standard errors clustered by employment area reported in parentheses. Kleinbergen-Paap Wald rk F statistic in brackets. The multiplier is calculating using the IV estimator. *Significance at the 10% level; **significance at the 5% level and ***significance at the 1% level.

6 Conclusion

In this paper, we first examine the evolutions and characteristics of tradable and non-tradable jobs in France over the period 1999-2013. We establish a classification of 86 industries, mostly based on their degree of geographic concentration. We show that tradable jobs are in the minority and decreasing. They make significant productivity gains with faster wage increases than for non-tradable jobs. Non-tradable jobs, however, make up a clear majority, are growing, and currently make low productivity gains. Contrary to what one might expect, they are not less skilled than tradable jobs. We also show that tradable service jobs now make up the majority of tradable jobs in France. Unlike the remainder of the tradable sector, the number of these jobs has grown, and at a faster pace than non-tradable service jobs. Geographically speaking, we observe that they are mostly concentrated in metropolitan and tourist areas. In general, the different employment areas evolve in very different ways, reflecting their sectoral specializations. We note in particular that the areas where non-tradable employment has decreased have, for the most part, also destroyed a high number of tradable jobs. Using an econometric approach developed by Moretti (2010), we show that tradable jobs do appear to have a significant local multiplier effect on non-tradable jobs. According to our estimations, from 2004-2013, for every 100 additional jobs created in the tradable sector in an employment zone in mainland France, 64 jobs were also generated in the non-tradable sector within the same area. This result may explain why local governments grant numerous subsidies to attract or simply maintain tradable activities in their territory. It also suggests that trade shocks spill over beyond jobs directly exposed to foreign competition. But obviously, the relationship between the two categories of jobs is twofold, since price evolutions in the non-tradable sector partly condition the development of the tradable sector. For example, according to Sy (2014) and Le Moigne and Ragot (2015) there is no doubt that the relative price of non-tradable goods and services hinders the cost-competitiveness of the French tradable sector vis-à-vis Germany. On the one side, the French government could therefore want to attract tradable firms by limiting increases in wages, profits and rent in the non-tradable sector. On the other side, keeping prices down in the non-tradable sector could result in widening the already visible gap between employees in the two groups, which can be socially and politically unsustainable. Another approach would involve achieving larger productivity gains in the non-tradable sector. Identifying the source of the productivity gap between tradable and non-tradable sectors, and determining how to combine different policies to achieve this (e.g. more intense competition, support for innovation and diffusion of technologies) constitute for France some of the main challenges of the future.

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Appendices

A Additional figures

Figure 8: Gini coefficient and trade openness

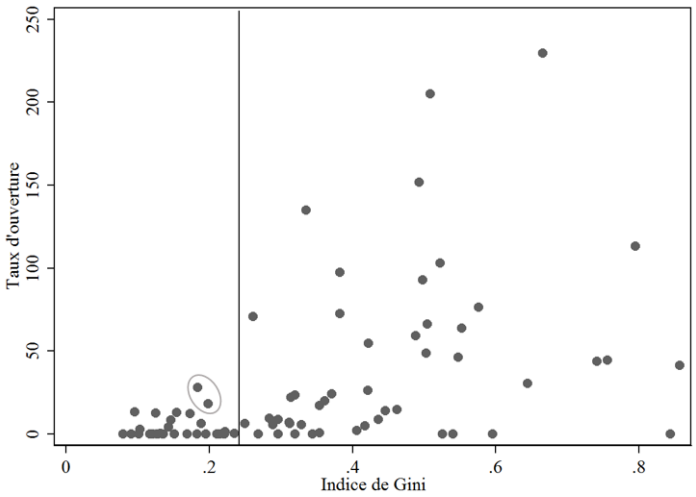
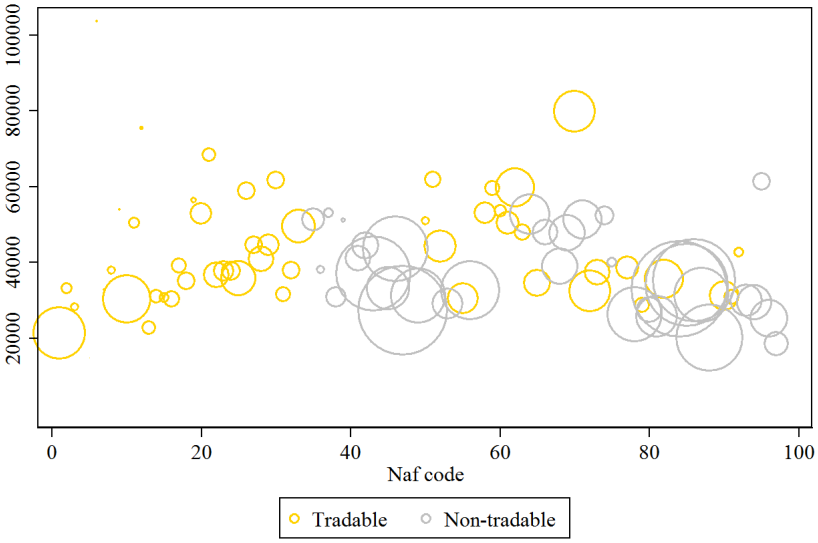
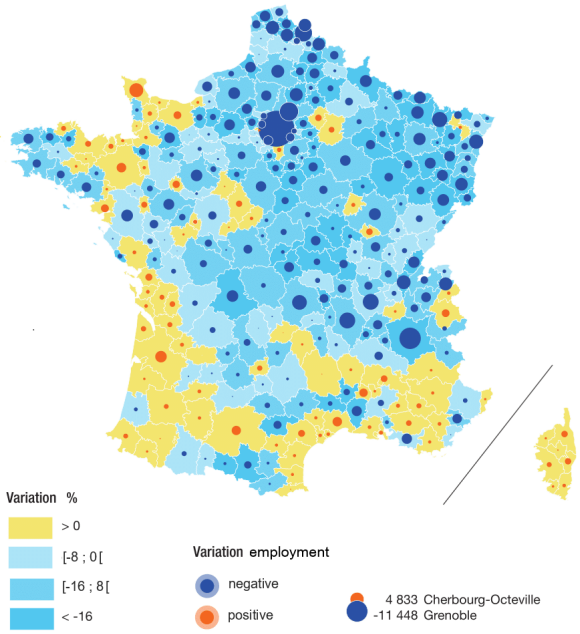


Figure 9: Average gross annual wage in euro, 2013



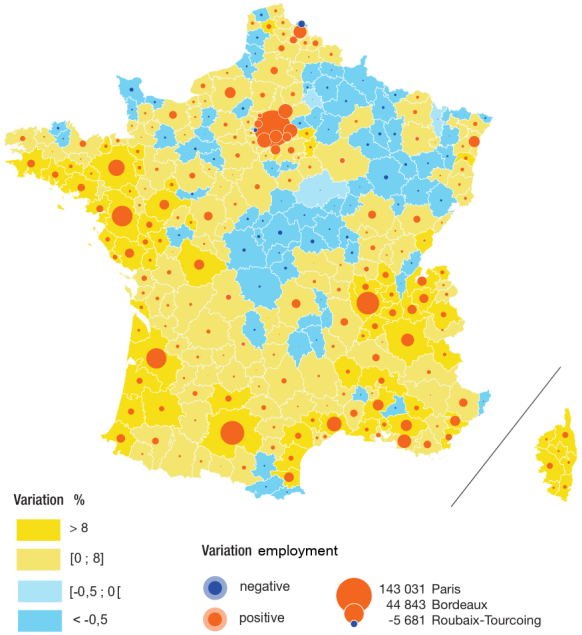
Source: Insee, national accounts
Area of symbol proportional to employment size in 2013

Figure 10: Change in tradable payroll employment, 2004-2013



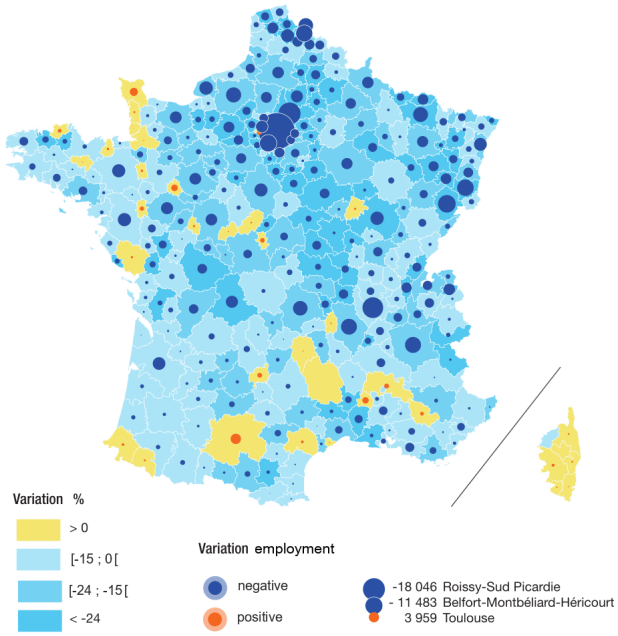
Source: Clap, Insee. Made with Philcarto : http:\\philcarto.free.fr

Figure 11: Change in non-tradable payroll employment, 2004-2013



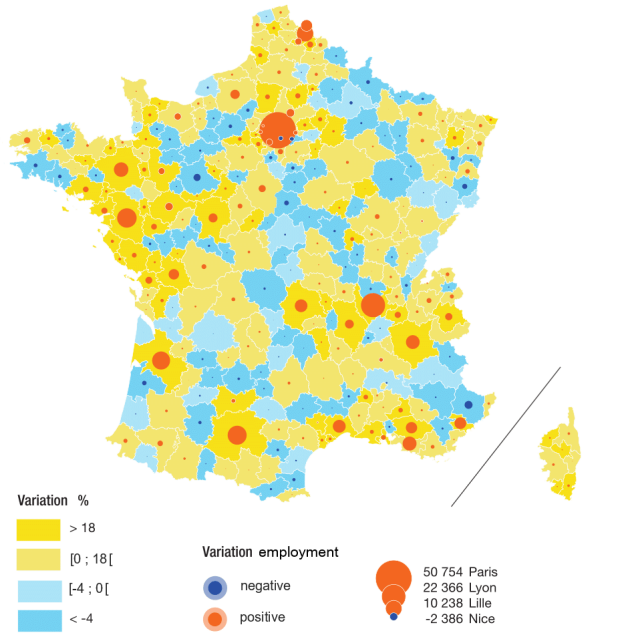
Source: Clap, Insee. Made with Philcarto : http:\\philcarto.free.fr

Figure 12: Change in manufacturing payroll employment, 2004-2013



Source: Clap, Insee. Made with Philcarto : http:\\philcarto.free.fr

Figure 13: Change in tradable services payroll employment, 2004-2013



Source: Clap, Insee. Made with Philcarto : http:\\philcarto.free.fr

B Wage premium in the tradable sector

We estimate a wage equation using the DADS database (annual declaration of social data) for 2013 on net annual wages by payroll employee. The annual declaration of social data (DADS) is a declaratory formality that all companies with employees must carry out. The scope of the DADS covers all employers and their employees, with the exception of employees of ministries, tenured or not, domestic services (division 97-98 of the NAF rev. 2) and extra-territorial activities (division 99 of the NAF rev. 2). The DADS database gives 1/12 of total observations, which corresponds to 2,28 million payroll employees. We restrict the sample to workers aged from 16 to 25, who worked full-time full-year and received a net annual wage between 7000 and 200,000 euros. With these restrictions, the sample now contains only 1.24 million observations. To examine whether there is a wage premium in the tradable sector even after controlling for some observable firm and worker characteristics, we estimate a wage equation using ordinary least squares. In the wage equation, wage is determined by : age, age-squared, sex, and dummy variables for socio-professional category (29 categories), employment contract, field of activity (central government, hospital public service, individual company, etc.), size and region of the employing firm, tradable sector. The most disaggregated classification available in DADS follows a breakdown into 38 activities (A38), a much more aggregated level than the one (A88) used in the rest of the study. This is problematic for tradable services which are sometimes aggregated with non-tradable services. We decided to classify as tradable service industries including at least 50% of tradable jobs. For instance if industry X is composed of sub-industry Y (non-tradable) and sub-industry Z (tradable), and employment in Z is larger than Y, then we consider X as tradable. One consequence is to underestimate the number of employees in tradable services. The impact of working in a the tradable sector is therefore probably underestimated as tradable services industries pay higher wages.

Table 6: Wage premium in the tradable sector.
Dependent variable : ln(net annual wage)

Variable	**Coefficient**	**(Ecart-type)**
Tradable	0.031	(0.001)
Man	0.132	(0.001)
Age	0.028	(0.000)
Age-squared	-0.000	(0.000)
N	1239940	
R^2	0.593	

Source : Annual declaration of Social Welfare (DADS) - 2013, INSEE [producer], ADISP-CMH [diffuser].

C Gini coefficients, classification, and employment in industries

NAF code	*Industry*	*Gini*	*Tradable / Non-tradable*	*Employment 2013*
01	Crop and animal production, hunting and related service activities	0,35	T	708,56
02	Forestry and logging	0,31	T	29,80
03	Fishing and aquaculture	0,86	T	18,22
05	Mining of coal and lignite	0,92	T	0,02
06	Extraction of crude petroleum and natural gas	0,90	T	0,25
07	Mining of metal ores	0,97	T	0,55
08	Other mining and quarrying	0,45	T	18,11
09	Mining support service activities	0,84	T	0,17
10	Manufacture of food products	0,31	T	593,37
11	Manufacture of beverages	0,64	T	30,63
12	Manufacture of tobacco products	0,80	T	1,32
13	Manufacture of textiles	0,55	T	43,15
14	Manufacture of wearing apparel	0,51	T	44,13
15	Manufacture of leather and related products	0,67	T	23,63
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0,42	T	66,15
17	Manufacture of paper and paper products	0,55	T	61,59
18	Printing and reproduction of recorded media	0,35	T	75,45
19	Manufacture of coke and refined petroleum products	0,74	T	8,80
20	Manufacture of chemicals and chemical products	0,38	T	119,68
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	0,52	T	46,43
22	Manufacture of rubber and plastic products	0,50	T	162,66
23	Manufacture of other non-metallic mineral products	0,37	T	106,08
24	Manufacture of basic metals	0,50	T	85,69
25	Manufacture of fabricated metal products, except machinery and equipment	0,32	T	314,24
26	Manufacture of computer, electronic and optical products	0,49	T	82,50
27	Manufacture of electrical equipment	0,50	T	83,49
28	Manufacture of machinery and equipment n.e.c.	0,38	T	164,04
29	Manufacture of motor vehicles, trailers and semi-trailers	0,58	T	123,17
30	Manufacture of other transport equipment	0,26	T	80,57
31	Manufacture of furniture	0,49	T	53,12
32	Other manufacturing	0,33	T	75,44
33	Repair and installation of machinery and equipment	0,25	T	280,63
35	Electricity, gas, steam and air conditioning supply	0,22	N	137,12
36	Water collection, treatment and supply	0,21	N	19,37

NAF code	*Industry*	*Gini*	*Tradable / Non-tradable*	*Employment 2013*
37	Sewerage	0,30	N	25,83
38	Waste collection, treatment and disposal activities; materials recovery	0,17	N	107,94
39	Remediation activities and other waste management services	0,53	N	4,62
41	Construction of buildings	n.r.	N	168,20
42	Civil engineering	0,15	N	181,85
43	Specialised construction activities	0,13	N	1488,23
45	Wholesale and retail trade and repair of motor vehicles and motorcycles	0,13	N	483,17
46	Wholesale trade, except of motor vehicles and motorcycles	0,10	N	1109,67
47	Retail trade, except of motor vehicles and motorcycles	0,09	N	2093,05
49	Land transport and transport via pipelines	0,13	N	791,46
50	Water transport	0,42	T	15,20
51	Air transport	0,76	T	66,81
52	Warehousing and support activities for transportation	0,30	T	260,94
53	Postal and courier activities	0,15	N	237,50
55	Accommodation	0,32	T	237,69
56	Food and beverage service activities	0,14	N (70%)	905,76
58	Publishing activities	0,44	T	119,19
59	Motion picture, video and television programme production, sound recording and music publishing activities	0,46	T	58,10
60	Programming and broadcasting activities	0,54	T	35,06
61	Telecommunications	0,29	T	137,08
62	Computer programming, consultancy and related activities	0,28	T	403,44
63	Information service activities	0,34	T	70,16
64	Financial service activities, except insurance and pension funding	0,19	N	422,06
65	Insurance, reinsurance and pension funding, except compulsory social security	0,41	T	180,89
66	Activities auxiliary to financial services and insurance activities	0,17	N	177,93
68	Real estate activities	0,22	N	351,18
69	Legal and accounting activities	0,14	N	331,38
70	Activities of head offices; management consultancy activities	0,31	T	447,26
71	Architectural and engineering activities; technical testing and analysis	0,15	N	387,87
72	Scientific research and development	n.r	T	446,90
73	Advertising and market research	0,36	T	168,55
74	Other professional, scientific and technical activities	0,23	N	92,94
75	Veterinary activities	0,21	N	25,95
77	Rental and leasing activities	0,20	T	139,23
78	Employment activities	0,12	N	801,38

NAF code	*Industry*	*Gini*	*Tradable / Non-tradable*	*Employment 2013*
79	Travel agency, tour operator and other reservation service and related activities	0,27	T	55,08
80	Security and investigation activities	0,21	N	166,70
81	Services to buildings and landscape activities	0,10	N	462,31
82	Office administrative, office support and other business support activities	0,18	T	382,08
84	Public administration and defence; compulsory social security	0,14	N	2392,57
85	Education	0,08	N	1825,31
86	Human health activities	0,13	N	1824,16
87	Residential care activities	0,21	N	782,69
88	Social work activities without accommodation	0,12	N	1168,88
90	Creative, arts and entertainment activities	0,33	T	224,19
91	Libraries, archives, museums and other cultural activities	0,42	T	55,90
92	Gambling and betting activities	0,60	T	24,18
93	Sports activities and amusement and recreation activities	0,21	N	272,37
94	Activities of membership organisations	0,20	N	314,93
95	Repair of computers and personal and household goods	0,18	N	83,85
96	Other personal service activities	0,10	N	374,15
97	Activities of households as employers of domestic personnel	0,22	N	155,16