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ABSTRACT

Transport Cost Decline and Regional Inequalities: Evidence from France*

This Paper first develops a tractable economic geography model, which we use to investigate the decline of transport costs as a cause of regional inequalities. Next, we perform a structural estimation of this model using a new data set on road transport costs between the 341 French Employment Areas. We find that intermediate inputs and geographical features play a critical role in the concentration pattern of French economic activities. Estimations being consistent with plausible values for the structural parameters of the model, we finally provide simulations of French local sectoral employment and production conditions. We find a very strong core-periphery structure of short-run profits, which means that large concentration incentives exist in France. By contrast, a short-run analysis of the impact of a decline in transport costs reveals that, whereas dispersive forces become prevalent at the country level, agglomeration incentives strengthen specialization within a large number of the French regions. As regards profits, the emergence of a duo-centric structure confirms such a feature.

JEL Classification: F10, O10 and R30
Keywords: agglomeration, economic geography, infrastructure and transport costs

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NON-TECHNICAL SUMMARY

One of the most salient features of economic geography is the increase in regional inequalities stemming from ongoing economic integration. The decrease in interregional transaction costs, most of which consists of transport costs, combined with increasing returns, gives both capital and labour incentives to move outside peripheral regions and to locate in core regions. These regions benefit from a high diversity of goods, which increases both consumers' utility and firms' productivity, and from larger market sizes. Increased competition, in the labour market for instance, however, may create a U-shaped pattern: in a second step, the transaction cost decline would produce regional.

Few empirical studies have, however, actually established these theoretical statements according to positive issues. The aim of this Paper is thus to investigate how relevant are inter-regional and economic geography models are for explaining the observed spatial distribution of economic activities. Moreover, we wish to determine the degree to which a transaction cost decline affects the pattern of location choices concerning the deepening of regional inequalities.

The following three-region example illustrates some of the difficulties in deriving from these models some empirical assessments on real data. Consider the total employment of the 'Employment Areas' (EAs)[1] corresponding to the three biggest French cities. Paris, Lyon and Marseille accounted respectively for 11.0%, 3.6% and 1.8% of the total employment of France in 1978. Thus, economic geography predicts that the transport cost decline that took place between 1978–93 (around -35% between each of these EA) should have increased the size of Paris with respect to both Lyon and Marseille, and the size of Lyon with respect to Marseille. This last statement is confirmed: total employment in Lyon was 1.9 times greater than in Marseille in 1978, and the ratio is 2.4 in 1993. Total employment in Lyon and Marseille has, however, simultaneously grown faster than in Paris: Paris was 3.1 (respectively 5.9) times larger than Lyon (respectively Marseille) in 1978, and 2.3 (respectively 5.6) times larger than Lyon (respectively Marseille) in 1993, which seems to refute the theoretical predictions.

Theory and facts in economic geography do not, however, always reduce to this simple type of figures. First, Paris, Lyon and Marseille are not autarkic economies, but highly depend on the 338 other French EAs. The real geographical locations may also matter. The fact that Lyon lies between Paris and Marseille is certainly not innocuous. In this Paper, we simultaneously consider all French EAs, taking into account their real physical location. Moreover, location patterns may differ across economic variables. For

[1] These geographical units correspond to a division of the French metropolitan territory into 341 units.

instance, the employment agglomeration process may differ from the income one. Similarly, an improvement in infrastructure may embody only part of the induced transaction cost decline, both variations often being confused. In this study, we take serious care of data precision, and, among others, we use a very detailed measure of road transport costs. Last, agglomeration and dispersion forces that shape the spatial distribution of economic activities are very intricate and often indirectly affect firms' location choices. In order to capture such effects and beyond data constraint impediments, empirical studies should thus mirror the specifications that stem from theoretical models. For this reason, we use the exact specification derived from a fully specified model of economic geography to estimate the magnitude of transaction costs effects on employment inequalities.

The methodology we use is as follows. We first set up a multi-regional trade model in which firms produce goods for final and intermediate consumptions. This model underlines the role of both market locations and strategic interactions, captured by imperfect Cournot competition and endogenous regional incomes. Competition on goods markets gives firms incentives to locate in peripheral regions, but higher intermediate and final demands in central places lead to an opposite force, yielding agglomeration. Moreover, due to competition in intermediate goods, input costs are also lower in central regions. We derive from this model a key relationship between sectoral local employment levels, on the one hand, and transport costs, regional income and the number of firms on the other. We use this specification to perform a structural test of the model at the geographical level of the 341 French EAs, using a new data set on road generalized transport costs. These costs, computed using the real road network, include both a unit distance cost (fuel, tolls and others) and a unit time opportunity cost (vehicle depreciation and drivers' wages among others). The theoretical model is not rejected for most sectors, for various specifications, including different sectoral and geographical aggregation levels. Moreover, the corresponding estimated coefficients are consistent with plausible values for the structural parameters of the model.

We finally use the estimated model to provide simulations on the local sectoral employment and production conditions. We show, for instance, the very strong core-periphery structure of short-run profits in France, which means that large concentration incentives exist there. We also study the impact on employment inequalities, of a step by step decline in transport costs, as regards the short-run version of the model, that is, the number and location of firms being hold constant. By contrast, this short-run analysis reveals that a 30% transport costs decline induces a 21% decrease in the concentration of production and a 32% decrease in the corresponding concentration employment index. Whereas dispersive forces become prevalent at the country level, however, we show that agglomeration incentives strengthen employment specialization within a large number of the French administrative regions, yielding there the development of competitive and dense EAs at the expense of others. As regards profits, a duo-centric structure emerges and confirms the coexistence of decreasing interregional and increasing intraregional concentration.

1 Introduction

One of the most salient feature of economic geography is the increase of regional inequalities stemming from the ongoing economic integration. The decrease of inter-regional transaction costs, the most of which consists in transport costs, combined with increasing returns, gives both capital and labor incentives to move outside peripheral regions to locate in core regions. These regions benefit from a high diversity of goods, which increases both consumers' utility and firms' productivity, and from larger market sizes (Krugman [1991]). Increased competition, on labor market for instance, may, however, create a U-shaped pattern: in a second step, the transaction cost decline would produce regional convergence (Krugman and Venables [1995], Puga [1999]). The purpose of this paper is to determine if these economic geography models are relevant to explain the observed distribution of economic activities and to empirically assess the link between transaction costs and regional inequalities.

The three-region following example illustrates some of the difficulties in deriving from these models some empirical assessments on real data. Let consider the total employment of the "Employment Areas" (EAs)[1] corresponding to the three biggest French cities. Paris, Lyon and Marseille accounted respectively for 11.0%, 3.6% and 1.8% of the total employment of France in 1978. Thus, economic geography predicts that the transport cost decline that took place between 1978 and 1993 (around -35% between each of these EA) should have increased the size of Paris with respect to both Lyon and Marseille, and the size of Lyon with respect to Marseille. This last statement is confirmed: total employment in Lyon was 1.9 times larger than in Marseille in 1978, and the ratio is 2.4 in 1993. However, total employments in Lyon and Marseille have simultaneously grown faster than in Paris: Paris was 3.1 (respectively 5.9) times larger than Lyon (respectively Marseille) in 1978, and 2.3 (respectively 5.6) times larger than Lyon (respectively Marseille) in 1993, which seems to refute the theoretical predictions.

Confronting theory and facts in economic geography cannot, however, reduce to this simple type of figures. First, Paris, Lyon and Marseille are not autarkic economies, but highly depend on the 338 other French EAs. The real geographical locations may also matter. The fact that Lyon lays just in between Paris and Marseille is certainly not innocuous. In this paper, we simultaneously consider all French EAs, taking into account their real physical location. Moreover, location patterns may differ across economic variables. For instance, the employment agglomeration process may differ from the income one. Similarly, an infrastructure improvement may embody only part of the induced transaction cost decline, both variations often being confused. In this study, we seriously take care of data precision, and, among others, we use a very

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detailed measure of road transport costs. Last, agglomeration and dispersion forces that shape the spatial distribution of economic activities are really intricate and often indirectly a¤ect …rms' location choices. In order to capture such e¤ects and beyond data constraints impediments, empirical studies should thus mirror the speci…cations that stem from theoretical models. For this reason, we use the exact speci…cation derived from a fully-speci…ed model of economic geography to estimate the magnitude of transaction costs e¤ects on employment inequalities.

Numerous previous works focused on the productivity gains that could arise from public spending in transport infrastructures. However, disparate results have ‡owed from this literature (see Gramlich [1994]), which has been widely criticized (see Tatom [1993]). On the other hand, data constraints on transaction costs account for the lack of empirical studies in economic geography, which would allow yet to consider the network dimension of infrastructures in multi-regional contexts of trade and factors mobility. Some calibration attempts of these models have been performed (Smith and Venables [1988], Haaland and Norman [1992], Gasiorek et al. [1992], Forslid et al. [1999]). A …rst idea of the relocation e¤ects of economic integration is obtained. However, the authors assume for instance that transport costs account for 10 to 20% of the value of trade without using speci…c data for each region. The values of numerous other parameters are also assumed, without being based on real econometric estimations, which limits the exercise. Real estimations are provided by the recent studies on gravity models (McCallum [1995], Helliwell [1996, 1997], Wei [1996]). This literature shows that trade ‡ows sharply increase with trading partners' proximity, as measured by geodesic distance, language or adjacency. However, the measure of transaction costs and the consideration of the real geography remain crude. On the contrary, recent papers focus on the measure of oceans or air freight rates (Hummels [1999a and 1999b]), or point out the necessity to consider the access to coasts, as measured by the quality of transport and communication infrastructures (Limão and Venables [1999]). However, these studies lack of theoretical foundations or neglect some of the e¤ects stemming from underlying models. For this reason, a recent literature is designed to take economic geography models seriously for guiding empirical studies in this …eld (Hanson [1998], Head and Mayer [2000], Redding and Venables [2000]). These authors estimate equations directly derived from theoretical models, which allow them to provide much more precise statements, for instance on the impact of transport costs on trade ‡ows or on regional inequalities. Our study clearly turns towards these lines.

The methodology we use is as follows. We …rst set up a multi-regional trade model in which …rms produce goods for …nal and intermediate consumptions. This model underlines the role of both market locations and strategic interactions, captured by imperfect Cournot competition and endogenous regional incomes. Competition on the good markets gives firms incentives to locate in peripheral regions, but intermediate and final demands higher in central places lead to an opposite force yielding agglomeration. Moreover, due to competition on intermediate goods, input costs are also lower in central regions. We derive from this model a key relationship between sectoral local employment levels, on the one hand, and transport costs, regional incomes and the number of firms, on the other hand. We use this specification to perform a structural test of the model at the geographical level of the 341 French EAs, using a new dataset on road generalized transport costs. These costs, computed using the real road network, include both a unit distance cost (fuel, tolls, ...) and a unit time opportunity cost (truck depreciation, drivers' wages, ...). The theoretical model is not rejected for most sectors, for various specifications, including different sectoral and geographical aggregation levels. Moreover, the corresponding estimated coefficients are consistent with plausible values for the structural parameters of the model.

We finally use the estimated model to provide simulations on the local sectoral employment and production conditions. We show for instance the very strong core-periphery structure of short-run profits in France, which means that large concentration incentives exist there. We also study the impact on employment inequalities, of a step by step transport costs decline, as regards the short-run version of the model, that is, the number and location of firms being hold constant. By contrast, this short-run analysis reveals that a 30% transport costs decline induces a 21% decrease in the concentration of production and a 32% decrease in the corresponding concentration employment index. However, whereas dispersive forces become prevalent at the country level, we show that agglomeration incentives strengthens employment specialization within a large number of the French administrative regions, yielding there the development of competitive and dense EAs at the expense of others. As regards profits, a duo-centric structure emerges and confirms the coexistence of decreasing inter-regional and increasing intra-regional concentration.

The paper is structured as follows. Section 2 presents the economic geography model to be estimated and simulated. Section 3 describes the data and the empirical methodology, while section 4 sets out the results of structural estimations. Section 5 presents the simulations of the French local sectoral employment and production conditions as predicted by the model, as the effect on these variables of a transport cost decline. Section 6 concludes and opens new lines of research.

2 The inter-regional trade model

This section first presents the inter-regional trade model. At the end of the section, our assumptions are discussed and we present some interpretations of the firms' location choices in terms of agglomeration and dispersion forces.

We consider a J-region economy. S goods are produced in each region. Let $j = 1, ..., J$ and $s = 1, ..., S$, denote the regions and the goods, respectively.

Firms' technologies and intermediate inputs demands

In region j, sector s is made of n_j^s single-plant firms, which produce the good s. Each good s is assumed to be homogeneous. Labor and the S goods are used as inputs and technologies are Cobb-Douglas. Production functions are the same across regions but they differ across sectors. The production of a representative firm operating in sector s and located in region j, y_j^s, is given by:

$$y_j^s = \left(l_j^s\right)^{\alpha^s} \prod_{s'} \left(k_j^{s's}\right)^{\beta^{s's}}; \tag{1}$$

where l_j^s is the number of workers and $k_j^{s's}$ the quantity of good s' used by this firm. α^s and $\beta^{s's}$ are constant parameters such as, for any s, $\sum_{s'} \beta^{s's} + \alpha^s = 1$. Moreover, we assume that a fixed cost of production, f_j^s, is incurred when producing in region j and sector s.

As regards the labor market, we make some simplifying assumptions. First, labor is specific to each sector. Second, sectoral wages, w^s, are chosen at the national level. Last, the regional labor supply is such as this wage rigidity leads to some unemployment in all sectors and regions, in equilibrium.

Let p_j^s denote the price of good s in region j. The representative firm's cost minimization program is:

$$\begin{cases} \underset{l_j^s;\left(k_j^{s's}\right)_{s'=1,...,S}}{\operatorname{Min}} \left(w^s l_j^s + \sum_{s'} p_j^{s'} k_j^{s's} + f_j^s \right) \\ \text{s.t.} \quad y_j^s = \left(l_j^s\right)^{\alpha^s} \prod_{s'} \left(k_j^{s's}\right)^{\beta^{s's}}. \end{cases} \tag{2}$$

The cost function in sector s and region j is thus given by:

$$c_j^s\left(y_j^s\right) = c_j^s y_j^s + f_j^s; \tag{3}$$

where c_j^s is the constant marginal cost:

$$c_j^s = \frac{(w^s)^{\alpha^s} \prod_{s'} \left(p_j^{s'}\right)^{\beta^{s's}}}{(\alpha^s)^{\alpha^s} \prod_{s'} \left(\beta^{s's}\right)^{\beta^{s's}}}. \tag{4}$$

The representative firm's labor and input demands in sector s and region j are therefore:

$$l_j^s = \lambda^s \frac{c_j^s y_j^s}{w^s}, \tag{5}$$

$$k_j^{s's} = \beta^{s's} \frac{c_j^s y_j^s}{p_j^{s'}}. \tag{6}$$

Consumers' preferences and final demands

Consumers have the same preferences across regions. The utility is Cobb-Douglas:

$$U\left(Q_j^1, ..., Q_j^S\right) = \prod_s \left(Q_j^s\right)^{\gamma^s}, \tag{7}$$

where Q_j^s is the consumption of good s in region j. The γ^s are constant parameters that are normalized such as $\sum_s \gamma^s = 1$. Therefore, γ^s is the share of expenditure in good s in total consumer's expenditure. The total consumers' demand in region j is given by:

$$Q_j^s = \frac{\gamma^s R_j}{p_j^s}, \tag{8}$$

where R_j is the consumers' income in region j. Regional incomes are endogenous. They are given by the sum of firms owners' income and of workers' wages:

$$R_j = \overline{w}\bar{l}_j + \sum_{s'} w^{s'} n_j^{s'} l_j^{s'}, \tag{9}$$

where $\overline{w}$ is the firms owners' average income[2] and $\bar{l}_j$ is the number of firms owners in region j.

The total demand for good s in region j, D_j^s, is the sum of final and intermediate consumptions:

$$D_j^s = Q_j^s + \sum_{s'} n_j^{s'} k_j^{ss'}. \tag{10}$$

D_j^s can be written as:

$$D_j^s = \frac{R_j^s}{p_j^s}, \tag{11}$$

where R_j^s is the regional expenditure devoted to sector s in region j. From equations (6), (8) and (10), R_j^s is given by:

$$R_j^s = \gamma^s R_j + \sum_{s'} \beta^{ss'} c_j^{s'} n_j^{s'} y_j^{s'}. \tag{12}$$

[2] We assume that profits are shared at the national level. However, the number of firms owners may differ accross regions. Thus, $\overline{w}$ is the sum of the profits over all sectors and regions, divided by the total number of firms owners.

Firms' strategies under Cournot competition

We assume that good markets are segmented. Let t_{ji}^s denote the transaction cost for exporting one unit of good s from region j to region i and let y_{ji}^s denote the quantity of good s exported to region i by a firm located in region j. The market j equilibrium condition for good s is given by:

$$\sum_i n_i^s y_{ij}^s = D_j^s. \tag{13}$$

The profits of a representative firm of sector s located in region j can be written as:

$$\pi_j^s = \sum_i \left(p_i^s - c_j^s - t_{ji}^s \right) y_{ji}^s - f_j^s.$$

We assume that firms behave as Cournot-Nash oligopolists. Each firm chooses non-cooperatively and strategically the quantity produced for each market. It maximizes its profit with respect to $\left(y_{ji}^s\right)_i$, taking into account the demand function (11) and considering the quantities produced by all other firms as given. As usual in economic geography models, firms do not internalize the effect of their strategy on regional expenditures, R_j^s. These assumptions lead to the following first-order condition:

$$\frac{\partial \pi_j^s}{\partial y_{ji}^s} = p_i^s - c_j^s - t_{ji}^s - \frac{p_i^s y_{ji}^s}{D_i^s} = 0. \tag{15}$$

Short-run equilibrium

In the short-run, the number of firms operating in each region j and sector s is exogenously fixed. Let N^s be the total number of competitors in sector s. From equations (11) and (15), more explicit expressions for the interior equilibrium price and quantities can be derived:

$$p_j^s = \frac{\sum_i n_i^s t_{ji}^s + \sum_i n_i^s c_i^s}{N^s - 1}, \tag{16}$$

$$y_{ji}^s = \frac{p_i^s - c_j^s - t_{ji}^s}{(p_i^s)^2} R_i^s. \tag{17}$$

Note that, when transaction costs are high and/or asymmetries in the number of firms located in each region important, firms do not necessarily produce for all markets. Indeed, firms in region j produce for market i if and only if, $p_i^s - c_j^s - t_{ji}^s > 0$, that is:

$$\sum_j n_j^s t_{ji}^s - (N^s - 1) t_{ji}^s + \sum_j n_j^s c_j^s - (N^s - 1) c_j^s > 0. \tag{18}$$

If this condition is not fulfilled, the corner solution is given by $y^s_{ji} = 0$.

Thus, the short-run equilibrium is characterized by equations (4), (9), (12), (16), and (17), the quantity exported being zero if (18) is not fulfilled. Equations (4) and (16) allow to compute the price of each good on each market. Next, equations (9) (12), (17), and (18) allow to compute, for each good, the quantity exported from any region to any market. Equilibrium prices and quantities are parametrized by wages, by preference and technology parameters, by transaction costs, and, in the short-run, by the number of firms.

In the long-run, the numbers of firms are endogenous. They adjust such as profits are zero in all regions and sectors:

$$\pi^s_j = 0. \tag{19}$$

Comments and interpretations

Recent economic geography models rely in most cases on monopolistic competition à la Dixit and Stiglitz [1977]. Each good is differentiated in a large number of varieties. By assumption, there are no strategic interactions, which prevents one from capturing real competition effects in the good markets. By contrast, we consider Cournot competition with segmented markets, as first proposed by Brander [1981]. This leads to further intuitive interpretations dealing with strategic interactions and economic geography.

Let us analyze the spatial equilibrium as resulting from agglomeration and dispersion forces. On the one hand, competition effects tend to disperse firms across space. If regional demands and marginal costs were the same across regions, the more numerous the firms in a region (thus called the "highly competitive" region), the lower their size and average mark-up, and thus the lower their profits. This give firms incentives to locate in the regions where competition is low (thus called the "less competitive" regions). On the other hand, competition indirectly creates agglomeration incentives through its impact on local demand. Indeed, the total production of the region where more firms are located is higher, even if all markets were of the same size. When demands are endogenous as in our model, this leads both intermediate and final local demands to be greater in the highly competitive region, and this effect self-reinforces: the total production is even greater there and thus the demand. These demand effects increase the individual production of local firms relatively to the firms located in the less competitive regions. Thus, they give firms incentives to locate in the region where competition is strong.

In a two-region model without intermediate inputs, Combes [1997] shows that the endogenous final demand effects are liable to dominate the direct competitive ones, thus leading to higher short-run profits in the region where more firms are located. Firms' creation is stronger in this region, as long as the asymmetry between regions in the number of …rms is not too large. Without any exogenous cost or demand advantages, an asymmetric equilibrium can be achieved in the long-run, one region bene…ting from the location of more …rms. This is all the more true, the lower the transaction costs and the higher the economies of scale.

In comparison with Combes [1997], considering intermediary inputs …rst magni…es the endogenous demand e¤ects that now transit through both …nal and intermediate markets. However, an agglomeration force of another nature is worth noting. Indeed, inputs prices are lower in the region where more …rms are located. This acts as a new agglomeration incentive by creating an endogenous competitive advantage. The production costs of the …rms located in the region where the competition between input producers is stronger are lower. Their short-run pro…t is higher, since Cournot competition prevails.

Clearly, when the number of regions is greater than two, the story is more intricate. For instance, when transport costs decrease, medium competitive regions would loose …rms in favor of highly competitive regions, although attracting …rms from less competitive ones. As in the monopolistic competition framework (see for instance Krugman [1993]), we conjecture that full, partial or no agglomeration long-run equilibria may emerge, depending on the transaction and economies of scale parameters. Hence, hierarchical structures leading to the coexistence in the long-run of high, medium and low production areas may exist.

As regards labor markets, we mainly neglect two forces. First, congestion on local labor force in highly competitive regions would increase nominal wages there. By giving …rms incentives to locate in the less competitive regions, this acts as a dispersion force when the labor mobility is low, as in Krugman and Venables [1995] or Puga [1999]. However, this wage increase would attract new workers, if they are su¢ ciently mobile, since they would also bene…t from lower price index. Thus, this acts simultaneously as an agglomeration force, as in Krugman [1991]. These forces could be worth considering. However, on the one hand, an important labor market disequilibrium makes European wages more rigid than the US ones, and, on the other hand, the labor mobility is fairly low in Europe.[3] Thus, we believe that these dispersion and agglomeration e¤ects should not play a major role in Europe. Last, no reliable data on local wages exist in France. Thus, we choose to concentrate on the good market e¤ects.

[3] For instance, Eichengreen [1993] shows that the elasticity of inter-regional migrations with respect to local wages is twenty-…ve times higher in the US than in Great-Britain.

3 Data and econometric issues

This section first presents the data we use to perform the structural econometric tests of the model presented in section 2, and next, the econometric methodology is developed. The geographical unit we consider is the "Employment Area" (EA), which corresponds to a division of the French territory into 341 units.[4] The EAs entirely and continuously cover all of France, and thus include both urban and rural areas. The average size of an EA is 1570 km^2; which is fairly small (it corresponds to a circle of 22 km radius).

3.1 Data on labor, intermediate and final consumptions, and incomes

The EAs' labor employment is computed from a statistical survey (Enquête Structure des Emplois) of the French National Institute of Statistics and Economic Studies (INSEE). This survey includes employment for plants larger than 20 workers, for the INSEE NAP80 sector classification, from which we exclude agriculture, non-profit services and trade. Our sample thus corresponds to a panel of 341 EAs and 70 sectors for the 1978 and 1993 years.

The technology and preferences parameters are also obtained from INSEE. We associate the input-output matrix and the sectoral wage bills to compute the $(\lambda^s)_s$ and $(\mu^{s's})_{s',s}$ for the 70 sectors. The consumers' budget coefficients, $(\gamma^s)_s$; are evaluated on the basis of the annual series on French household consumption. Nominal wages paid by firms are obtained by dividing the national wage bill (which includes the firms' social security contributions) by the total number of wage earners in each sector. The workers' salaries are computed on the basis of gross salaries from which we subtract the relevant taxes, and firm owners' income on the basis of renters' pensions.

3.2 Data on transport costs

In order to capture transaction costs, we use a new dataset matrix on transport costs. This matrix provides a spatial measure of the road transport cost between all pairs of EAs for the years 1978 and 1993[5]. For the computation of such a matrix, we use a digitized road network which is a simplified representation of the 1996 French real road network, embodied in 10 490 arcs and the corresponding nodes.

[4] We excluded the overseas EAs because of their insular specificity.

[5] This new dataset is the result of a joint collaboration between the French Ministry of Transport, the MVA Consultancy and the authors.

We consider six arc classes with different speeds.[6] The comparison of the 1978 and 1993 paper road maps to the previous digitized network made it possible to infer the 1978 and 1993 digitized networks. They include 9 912 and 10 430 arcs for 1978 and 1993, respectively. Next, the EA zoning is associated with the digitized network. Each EA is defined on the basis of its geographical centre, which is linked to the closest nodes of the network with artificial connectors.

In order to compute transport costs, we first need to create a cost typology for our arc classification. Let define the cost per km, c_r, as the average charge paid per kilometer by a typical truck for the arc class r ($r = 1, \ldots, 6$). This cost includes gas, tires, maintenance, repairing charges of haulers, as well as highways tolls if any. On the other hand, let f denote the time opportunity cost per hour. This cost includes the truck driver's wages, haulers' charges (insurance, taxes and security contributions), as well as the interim payments for equipment depreciation and renewal. It may be interpreted as the savings due to the use of a particular itinerary one hour shorter than another, which results in increased work time and business output for the hauler.

Let d_{a_r} (t_{a_r}, respectively) define the distance (the time, respectively) needed for joining the extreme nodes of a given arc a_r of class r, given the truck average speed for this class. Let $DistC^I_{ij}$ ($TimeC^I_{ij}$, respectively) denote the distance (the time, respectively) cost of joining areas i and j using itinerary I. They are defined by:

$$\begin{cases} DistC^I_{ij} = \sum_{a_r \in I} c_r d_{a_r}, \\ TimeC^I_{ij} = f\left(\sum_{a_r \in I} t_{a_r} + t_l\right), \end{cases} \tag{20}$$

where t_l is the time needed to load and unload the truck.[7] Note that this last term induces an increasing return part in the transport cost, since it is incurred whatever the total time and distance of the itinerary. This corresponds to a standard feature of transport activities.

If $\pounds_{ij}$ denotes the set of existing itineraries between EAs i and j, the transport cost between i and j, which is computed using the transport modelization software TRIPS®, is:

$$t_{ij} = \underset{I \in \pounds_{ij}}{Min}\left(DistC^I_{ij} + TimeC^I_{ij}\right). \tag{21}$$

[6] Toll highways (75 km/h), free highways (75 km/h), 2-/3-lane national roads (75 km/h), single national lanes (55 km/h), secondary roads (50 km/h), and metropolitan roads, in which are also included tunnels and bridges (30km/h). Speeds are those of a 40-tons articulated truck, considered as representative for the transport of goods. They have been reduced by 30% in Ile-de-France, due to congestion effects.

[7] t_l is fixed to twice 30 minutes.

This cost is therefore a generalized transport cost whose variations embody time and distance savings due to the development of new road infrastructures, as well as the gains due to the changes in the transport industry (such as oil companies price fixing, transport technology innovations, government regulations on transport activities, ...). In order to underline the importance of considering such elements, we compare our results when using a transport cost matrix simply based on distance ($Dist_{ij} = \underset{l \in \pounds_{ij}}{Min} \left(\sum_{a_r \in l} d_{a_r} \right)$) or time ($Time_{ij} = \underset{l \in \pounds_{ij}}{Min} \left(\sum_{a_r \in l} t_{a_r} + t_l \right)$):

The reader would find further details on the methodology and the data used for the calculation of transport costs in Lafourcade (1998).

3.3 Some descriptive statistics on transport costs

Tables 1 and 2 report the values and the variations between 1978 and 1993 of the various elements used for the computation of c_r and f.

- Insert Tables 1 and 2 -

Regarding c_r, cars manufacturers have reacted to the oil crisis by developing new engines. Associated with the governmental measures on energy savings, haulers have also implemented new strategies such as training geared towards "economical driving". This led to a sharp decrease of the average fuel consumption. Fuel costs, which correspond to the most sensitive haulers' budget heading, have been subjected to significant fluctuations, including gas price changes[8] and new taxes regulations. However, they significantly decrease on average during the period. Moreover, the development of maintenance contracts as well as technological innovations in the transport equipment industry led to a decrease of haulers' tire and repairing charges, despite the sharp increase in the annual haulage mileage. These variations induce a decrease of c_r between 42% and 50% depending on the road class.

As regards the time cost reference, f, truck drivers' wage and other expenses variations embody the wages negotiations as well as the road transport deregulation context of the 1980s. Changes in the national tax and insurance system have also lowered the corresponding budget. The sharp decrease of renewal and financing service charges is mainly due to the growth in the average time use of trucks, as well as the road network quality gains. Between 1978 and 1993, f decreased by 27% in all.

Inter-EAs transport costs declined between 1978 and 1993 by 38% on average. Infrastructure improvements only account for xx% of this variation, the remaining being due to the sharp decrease of c_r and f.

[8] The relative price of gas climbed sharply before the 1980s and fell after 1984.

Map 1 (2 and 3, respectively) maps the average transport cost from any EA to the other EAs, based on the generalized cost (distance and time, respectively). As expected, whatever the matrix (generalized cost, distance, or time) used, the average transport cost monotonically decreases from the center to the periphery. However, note that the center does not correspond to the geographical center of France, but is located a bit norther, towards the Ile-de-France EAs. These are indeed well linked to other EAs, due to the strong centralization and hub structure of the French road network.

- Insert Maps 1, 2 and 3 -

The reader will …nd many further descriptive statistics on these transport costs in Combes and Lafourcade [2001].

3.4 Econometric issues

Our purpose is to determine whether the theoretical model developed in section 2 is relevant to explain the spatial distribution of economic activities in France. We carry out a structural estimation, that is to say, we perform regressions using the exact speci…cations derived from the theoretical model. We thus estimate those parameters of the model for which no data exist.

Estimated parameters

The generalized transport cost we just referred to, t_{ij}; is the total cost incurred by a representative truck going from i to j: However, depending on the transport technologies used in each sector, this cost may be relevant or not. We therefore assume that the transaction cost in the theoretical model, t^s_{ij}; can be associated to a parameter ^{os} such that:

$$t^s_{ij} = {}^{os} t_{ij}: \tag{22}$$

Two interpretations can be given to the parameter ^{os}: First, ^{os} may embody the di¤erences between sectors in the size of the batches which are exported using the truck. It corresponds thus to the inverse of the number of good s units that can be loaded in the truck, since t^s_{ij} is the transaction cost per unit. However, not all sectors use the road mode to transport their goods and transaction costs other than transport ones may be incurred. For instance, rail haulage prevails for heavy and extraction industries, tertiary industries may prefer to use air transport or commercial/private vehicles to provide the corresponding services. Therefore, ^{os} re‡ects the "correlation" between the true transaction cost incurred and the road transport cost. This is the second interpretation we give to the parameter ^{os}.

Parameter $(^{os})_s$ are those we estimate. If the ^{os} are signi…cantly positive, the theoretical model is not rejected for the particular transaction cost which corresponds to our generalized road transport cost. Non-significant or negative estimates mean either that this cost does not reflect the true transaction costs incurred by the sector, or that our Cournot competition economic geography model is not relevant to explain the French spatial distribution of economic activities. Real data are available for all other parameters of the model.

Linearization of the equilibrium conditions

Since we do not have any data on trade flows between EAs or on local sectoral production, the endogenous variable we estimate is the equilibrium sectoral EA employment per firm, l_j^s. However, in the theoretical model, this variable is not linear in $(\gamma^s)_s$. It is thus first necessary to linearize equations (5), (16), and (17), to be able to perform the structural estimation using simple econometric methods.

First, let p^s denote the price which would prevail if manufacturing goods were costlessly traded. From equations (4) and (16), we have:

$$p^s = \frac{N^s (w^s)^{\mu^s}}{(N^s - 1)\, B^s} P^s; \tag{23}$$

with $B^s = (\lambda^s)^{\mu^s} \prod_{s'} \left(\phi^{s's}\right)^{\phi^{s's}}$ and where $P^s = \prod_{s'} \left(p^{s'}\right)^{\phi^{s's}}$ would be the price index if markets were perfectly integrated.

The linearization is presented in the Appendix and leads to:

$$\begin{aligned} l_j^s \;=\; & \gamma^s \sum_i \left[E_i^s \left(X_i^{ss} - \sum_{s''} \phi^{s''s} X_j^{ss''} \right) - F_i^s t_{ij} \right] \\ & + \sum_{s' \neq s} \gamma^{s'} \sum_i E_i^s \left(X_i^{s's} - \sum_{s''} \phi^{s''s} X_j^{s's''} \right) + \sum_i G_i^s; \end{aligned} \tag{24}$$

with $E_i^s = \frac{R_i^s \left(2P^s (w^s)^{\mu^s} - p^s B^s - \lambda^s P^s \right)}{(p^s B^s)^2 (w^s)^{1-\mu^s}}$, $F_i^s = \frac{R_i^s \lambda^s P^s}{(p^s)^2 B^s (w^s)^{1-\mu^s}}$, $G_i^s = \frac{R_i^s \left(p^s B^s - P^s (w^s)^{\mu^s} - \lambda^s P^s \right)}{(p^s B^s)^2 (w^s)^{1-\mu^s}}$, and $X_j^{s's} = \frac{1}{p^{s'} (N^{s'} - 1)} \sum_i b_{ij}^{ss'} \sum_k n_k^{s'} t_{ik}$, where the parameters $b_{ij}^{ss'}$ are the generic terms of the inverse of the $(I_{J \times S} - M)$ matrix, $I_{J \times S}$ being the identity matrix of size $J \times S$; and M being the matrix given in equation (29) in the Appendix.

All variables in equation (24), apart from the $(\gamma^s)_s$; are computed using the data reported in section 3, that is to say, preferences and technology parameters, transport costs, total local sectoral employment and the number of firms. Equation (24) is thus the specification we use to estimate the $(\gamma^s)_s$.

Finally, the computation of the $b_{ij}^{ss'}$ parameters requires to invert a matrix whose size is the number of sectors times the number of geographical units, that is 23 870 $\times$ 23 870, for the sectoral and geographical levels we choose. This is not invertible in reasonable delays. Thus, for computational feasibility at the 70-sector level, we first restrict the input-output matrix to the intermediates which represent more than 10% of the cost expenditures and then invert the matrix by blocks.

Econometric methods

In the theoretical model, the $\left(R_i^s\right)_{i,s}$ are endogenous, whereas the $\left(t_{ij}^s\right)_{i,j,s}$ are exogenous. The $\left(n_j^s\right)_{j,s}$ are exogenous in the short-run and endogenous in the long-run. All of these assumptions are compatible with equation (24), equation (9) being used to compute $\left(R_i^s\right)_{i,s}$ and the $\left(n_j^s\right)_{j,s}$ being observed. We make the strong econometric assumption that errors terms, $\left(\varepsilon_j^s\right)_{j,s}$; are due to measurement errors on the local sectoral employment per firm. This assumption makes it possible to consider the independent variables as exogenous from an econometric point of view. Because of the linear specification of our model and considering this exogeneity assumption, which is tested below, we can use the Ordinary Least Squares to fit equation (24) on our panel of 341 EAs and 70 sectors, for any given year.

The availability of panel data gives us some flexibility in the econometric specification: both EAs and sectoral fixed effects may be included. The EA fixed effects capture those characteristics of the local sectoral employment per firm that are unobservable (or omitted in the equation), but do not vary across sectors. They may arise, for instance, from differences in the EAs' area or from the presence of mountains, seas, oceans or borders with foreign countries, that is to say, purely geographical effects. The sectoral fixed effects control for the characteristics that are common to all EAs, but specific to sectors. It may for instance capture sectoral differences in the business cycle or variations in the representativity of the employment plant survey, which depends upon the sector.

4 Structural estimations

In this section, we first move on to the 1993 estimation of various specifications of equation (24). Next, we present some estimations based on the 1978 data which we also use to perform some endogeneity tests. Last, some variants relative to a model without intermediate inputs, relative to the geographical aggregation level ("départements" instead of EAs) and to the transport cost matrix (distance or time instead of generalized cost) are studied to test for the robustness of results.

4.1 Full model estimations

The full version of the theoretical model, that is including intermediate inputs, is considered in this section. The estimations presented are based on the 1993 data and correspond to the EA geographical level. Two different levels of sectoral aggregation are considered, 70 and 10 sectors. Three econometric speci…cations are tested: including no geographical e¤ects, including eight geographical dummies (corresponding to the presence of seas, oceans or borders), or including …xed e¤ects for all geographical units. We include sectoral …xed-e¤ects in all regressions.

70-sector aggregation

When the 70-sector aggregation is considered, we carry out estimations over 64 sectors. Actually, six goods are neither used as …nal consumption, nor represent more than 10% of the intermediate consumption in any sector. As a consequence, they cannot be used for the estimations since we consider, for computational feasibility, that they have no demand. The estimation results are reported in Table 3.

- Insert Table 3 -

Recall that our data and theoretical model are not invalidated when the estimates are signi…cantly positive.[9] The solution which produces the best …t includes geographical …xed e¤ects (Table 3, column (3)). Even if the R^2 is not really high, 47 estimates are signi…cantly positive, 33 (over 46) in industry, 14 (over 18) in services. Only one estimate is signi…cantly negative, for the sector Gas and oil production. This is, however, a rather speci…c activity in France, as regards both the location of production and the retail organization. Only two other estimates are negative, non-signi…cantly.

Including geographical dummies improves the …t and this improvement is even stronger when geographical …xed e¤ects are used. Less and less estimates are negative and the signi…cance of the positive estimates is higher. The absolute value of the signi…cantly negative estimate is divided by two when considering geographical …xed e¤ects and its signi…cance reduces.

Thus, the theoretical inter-regional trade model we develop is quite relevant to explain the spatial distribution of sectoral employment in France. The degree of market segmentation and the transaction costs would be well captured by the generalized transport cost. The interaction between the resulting agglomeration forces (high …nal and intermediate demands and low input costs in the highly competitive region) and dispersion forces (competition on the good markets) would result in the observed spatial equilibrium. Note, however, that part of the spatial variability in employment is explained by geographical …xed e¤ects, that is to say, by constant local characteristics, exogenous to the model. One could for instance think to real geographical components, access to oceans, proximity to other European countries, mountains, climate amenities... Thus, even if geography is partly captured by the transport cost matrix and the strategic interactions on segmented markets model, other geographical e¤ects also matter in the shaping of economic activities. One requires both types of explanations,

[9] "signi…cant" means signi…cant at least at the 10% level.

the endogenous ones underlined in the economic geography models and the exogenous ones purely geographical, to understand the agglomeration process in France.

10-sectors aggregation

The simulations we perform in section 5 to illustrate on real data the working of the theoretical model, are possible under reasonable delays only at a less disaggregated sectoral level that considers 10 sectors. Corresponding estimations are reported in Table 4.

- Insert Table 4 -

Without geographical e¤ects, the estimates of only four sectors are signi…cantly positive. They are signi…cantly negative for the sector of Energy (sector 3), and non-signi…cantly, though positive, in other sectors. The precision of the estimation increases when considering geographical dummies. With geographical …xed e¤ects, all estimates are positive, signi…cantly for 9 sectors over 10. These are the results that are used for the simulations reported in section 5.

4.2 Sensitivity Tests

Tables 5 to 11 set out regressions designed to deal, …rst, with some potential econometric problems (endogeneity and heteroskedasticity), and, next, with the role of intermediate inputs (in comparison with a model where labor is the only input), the role of the generalized transport costs matrix (in comparison with the distance or time matrices) and the role of the geographical aggregation level (in comparison with the département level).

4.2.1 Endogeneity and heteroskedasticity

Some econometric problems may arise …rst from the fact that the right-hand-side variables of equation (24) may be correlated with the disturbance term ε_j^s. There are two possible sources of such an endogeneity. The …rst one occurs when the EA speci…c e¤ect is correlated with the error term, which can be addressed by using …rst-di¤erence regressions. The second one occurs when the $X_j^{s's}$ are correlated with the error term, and this can be addressed by instrumentation. We use the 1978 data to tackle such endogeneity problems.

As a preliminary step, we estimate equation (24) using the 1978 data. The 10-sector regressions are reported in Table 4 (columns (4), (5) and (6)) and the 70-sector ones in Table 5 (columns (1), (2) and (3)).

- Insert Table 5 -

Compared with 1993, there is a decrease in the explanatory power of the model, at least as long as a not sufficiently disaggregated sectoral classification is considered. Even if very few estimates are negative at the 10-sector level, very few are also significantly positive. On the contrary, the goodness of the fit is comparable with the 1993 estimation at the 70-sector level.

In order to address the possible correlation between the error terms and the EA fixed effects, we perform a first-difference estimation, both dependent and independent variables being the difference between the 1993 and the 1978 values. As can be seen in Table 5, column (4), the fit is fairly bad, many estimates being negative and most of them being non-significant. This can be due to the presence of some correlation between the fixed-effects and the error term, which would mean that the OLS estimates are biased. However, one must not forget that the first-difference specification assumes that the parameters γ^s are the same in 1978 and 1993. This could be false at least for two reasons. First, strong variations in the composition of each sector occurred during the period and their activity may have really changed. This problem was so important that INSEE modified the sectoral nomenclature in 1994. Second, such an assumption means that, in each sector, goods are transported in the same way in 1978 and 1993 (for instance, using the same proportion of road and rail modes), which is also probably false.

The second source of endogeneity may arise from the correlation of the $X_j^{s's}$ variables with the error term, even if the dependent variable, employment per firm, does not directly enter the definition of these variables (which are functions of total employment, incomes and the numbers of firms). Therefore, we instrument the 1993 variables by the 1978 ones. We perform the corresponding Hausman's tests by first regressing each 1993 variable on all 1978 ones (including fixed effects) and we next include the residual of each of these regressions as extra explanatory variables. Column (4) in Table 5 gives the estimates corresponding to the residuals, for each sector. All of them, except two, are non significant. We can thus consider the variables we use as exogenous in most cases.

The second econometric problem deals with possible spatially auto-correlated errors. First, a visual inspection of the residual plots does not indicate drastic positive heteroskedasticity. For instance, Map 4 presents such a plot for the sector of Equipment goods (sector 4).

- Insert Map 4 -

More precisely, we check out for possible spatial auto-correlation by computing the correlation between the absolute difference of the EAs' residual estimates, $\left\{\left|\hat{\epsilon}_j^s - \hat{\epsilon}_i^s\right|\right\}_{i,j=1,\dots,341}$ and the corresponding distance, $Dist_{ij}$. These correlations, reported in Table 6, are non-signi…cant for all sectors, which may be a second no sign of spatial auto-correlation.

- Insert Table 6 -

4.2.2 Labor as the only input

Are the agglomeration forces due to intermediate demands and input costs important in shaping the distribution of economic activities? To address this question, we compare the previous results to those obtained using a model in which production uses labor as the only input. This corresponds to a simpli…ed version of the model developed in Section 2, in which all intermediate consumptions are set to zero ($^{-s^0 s}_{s^0;s}$ = 0). Whereas all the $(^{o s})_s$ are simultaneously estimated in the previous estimations, in this simpli…ed model, for any given sector, equation (24) is independent from other sectors ones. Therefore, the $(^{o s})_s$ can be separately estimated. In this case, the number of observations is at most equal to 341, since each sector is not necessary present in all EAs. No panel dimension being available for these regressions, no sectoral nor EA …xed e¤ects are introduced.

We consider the 70-sector aggregation level. Since we do not consider intermediate consumptions, demand for the goods which are not sold for …nal consumption is zero, which lead us to exclude 13 sectors. Table 7 reports the results for the remaining 57 sectors.

- Insert Table 7 -

Estimates are non-signi…cant for 37 sectors, among which 23 are positive. The estimate is still signi…cantly negative for the Gas and oil production sector. Estimates are signi…cantly positive for 19 sectors, 9 industrial sectors (over 40), and 10 services sectors (over 17). Thus, the Cournot competition model and the use of the generalized transport cost as a spatial measure of transaction costs are not invalidated in a lower number of sectors (but still one third of the sectors present consistent estimates). Moreover, including intermediates strongly increases estimate levels, which are multiplied by 150 on average. Comparable results can be drawn from the estimations performed on the 1978 data (Table 7, column 1978) and at the 10-sector aggregation level (Table 8).

- Insert Table 8 -

Thus, the assumption of labor as the only production input, and of …nal consumption as the unique use for output, is relevant in some sectors, especially more in services, which makes sense. The simpli…ed model correctly describes the spatial distribution of sectoral employment in these cases. However, the increase in the level of estimates shows that the agglomeration and dispersion forces are magni…ed when taking into account the intermediate demand and cost e¤ects. Considering intermediate inputs is even absolutely necessary to obtain consistent estimations in many sectors.

4.2.3 Employment Areas vs "Départements"

Another interesting question arises from the in‡uence of the geographical aggregation level. We compute the estimations at the 94 départements level. This level should be less relevant than the EA one, since it corresponds to administrative units, whereas EAs' de…nitions rely on the density of the local economic activity. For instance, their borders are supposed to be consistent with daily migrations or upstream-downstream …rms' relationships. However, the decrease of the explanatory power of the model for the département geographical level is modest. When …xed e¤ects are introduced, a fairly satisfactory …t is obtained, as can be seen in Table 9.

- Insert Table 9 -

4.2.4 transport costs vs distance or time

We think that considering the generalized transport cost instead of the geodesic distance, as many authors do, really matters, since it permits to capture most of the real costs incurred when exporting goods. In order to sustain this statement, we compute the estimations using the distance and time matrices, at the 10-sector sectoral level. Note, however, that the distance and time considered are the real ones, that is corresponding to the real road network, which is a more sophisticated measure than the geodesic distance. Table 10 and 11 give the results for the distance and time matrix, respectively.

- Insert Tables 10 and 11 -

Actually, the quality of the …t in both cases is comparable to the one obtained with the generalized transport cost. The role of geographical dummies or …xed e¤ects is also similar. However, the generalized transport cost matrix remains the only one that allows to simulate the impact of the variations of the determinants of transport costs as, for instance, gas price, drivers' wages or taxes, on local activities. Real distance or time allow to only simulate the impact of developing new road arcs (which is not even allowed by the use of the geodesic distance) or of a uniform decline in transport costs.

5 The location of economic activities in France

In order to deeper understand the agglomeration and dispersion forces that shape the spatial distribution of economic activities in France, according to our model, we now conduct simulations on local economic variables (sectoral employment, production, trade, but also prices, marginal costs, demands or profits) for all the French EAs. We first provide and interpret some descriptive statistics and maps relative to these variables. As a second step, we also investigate the impact of a progressive decline in transport costs. Note that, in order to be consistent with the estimation procedure, we simulate the linearized model. Moreover, we simulate the short-run model, assuming that the number of firms is fixed to its real value. The firms' entry process is discussed at the end of the section. Moreover, the estimation procedure assumes that firms produce for all markets wherever they are located. However, we observe that the simulated marginal profits can be negative for a few EAs and markets. In such a case, we set the exports to zero, as the theoretical model predicts.

5.1 Simulations of the local economic conditions

We present the simulations for the 10-sector and the EA aggregation levels, for the model including EA fixed effects (Table 4, column (3)). Indeed, this is a good trade-off between computational feasibility, quality of the econometric fit and economic relevance.

Share of the transport cost in the marginal cost and average distance covered by goods

In order to be consistent with the theoretical model, estimated τ^s have to be positive. However, there is no guaranty that they are consistent with the real market segmentation in France, as measured for instance by the share of transport charges in the total marginal cost or the average distance covered by goods. Thus, we compute for each sector the average share of the transport cost in the marginal cost weighted first by the level of exports, and next by the total production of each EA:

$$\mathrm{Tshare}^s = \sum_i \left[\frac{n_i^s y_i^s}{\sum_k n_k^s y_k^s} \sum_j \left(\frac{y_{ij}^s}{\sum_k y_{ik}^s} \left(\frac{\tau^s t_{ij}}{\tau^s t_{ij} + c_i^s} \right) \right) \right].$$

Next, we also compute the average distance covered by goods, using the same weights:

$$\mathrm{Dist}^s = \sum_i \left[\frac{n_i^s y_i^s}{\sum_k n_k^s y_k^s} \sum_j \left(\frac{y_{ij}^s}{\sum_k y_{ik}^s} (\mathrm{Dist}_{ij}) \right) \right].$$

These figures are given in Tables 12 and 13.

- Insert Tables 12 and 13 -

Since absolutely no constraints have been considered for the parameters estimation, anything could have emerged as regards the share of the transport cost in the marginal cost, that is to say, either extremely high or low values. However, the share of the transport cost in the marginal cost ranges from 0.013% (Intermediate products) to 0.389% (Construction). Even if this is a bit low compared to real values that standardly go from 0.1% to a few percents for heavy goods such as cement or fertilizers, the correct interval is thus obtained. Note that the estimation at the 70-sector level gives for some sectors much higher o^s estimates, for which we would have obtained …gures even closer to the correct region. The average distance covered by goods, which ranges from 190.1 km (Construction) to 424.2 km (Energy), also corresponds to the admitted values for France.[10]

Employment and production

All results are now relative to sector 4, Equipment goods, a sector for which the agglomeration and dispersion forces we consider are *a priori* relevant. The patterns obtained in other sectors are qualitatively very comparable, unless mentioned. We …rst illustrate on Maps 5 and 6 the real employment per …rm and the employment per …rm, as predicted by the model, respectively.

- Insert Maps 5 and 6 -

The spatial variation of the predicted employment per …rm is lower than the real one. This rough …t stems from the low R^2 that is typical of panel regressions. However, …rst, the correlation between both variables is not so bad as it seems, since it is signi…cantly positive and equal to 0.42. Next, the spatial …t would be better with the 70-sector estimations that are more precise. Last, we could have arti…cially increased the R^2 by working on total sectoral employment, that is to say, by multiplying both the dependent and independent variables by the number of …rms, which is observed (Map 7). Indeed, as regards the real and predicted total employments, both maps (Maps 8 and 9) look, by contrast, very similar, and total employment is thus well predicted. This is con…rmed by the high positive correlation between both variables which is 0.9. Note also that total employment is highly correlated with total production (Map 10). We observe that the sector of equipment goods is thus more concentrated in North than in South and in East than in West. Big cities also clearly appear in more peripheral regions, as, for instance, Bordeaux or Toulouse in South-West, and Marseille in South-East.

- Insert Maps 7 to 10 -

Exports and imports

Our model also provides predictions on the good ‡ows traded between all EAs and for any sector. Since no such data exist in France, this is another application

[10] See Lafourcade [1998].

to our methodology. We map the exports (Maps 11 to 13) and imports (Maps 14 to 16) of three regions, Ile-de-France, Rhône-Alpes, and Midi-Pyrénées, to or from any other EA. Ile-de-France exports more to the northern EAs and to the biggest southern EAs (Nice, Marseille, Montpellier, Toulouse, Bordeaux). By contrast, Rhône-Alpes exports very few to the north-western EAs which are faraway. As Ile-de-France, it also exports a lot to the Ile-de-France, Alsace-Lorraine and Loire-Atlantique EAs. Demand is so high there (see below Maps 19 and 20) that all EAs export a lot towards them. Last, Rhône-Alpes exports more to the Rhône-Alpes EAs and to the southern EAs which are closer. Comparable statements can be drawn from the maps relative to the Midi-Pyrénées region which less exports to the north-eastern EAs and more to the south-westerns ones. Negative distance e¤ects and positive demand e¤ects, which are reminiscent of the standard gravity and accessibility e¤ects, are thus observed, however stemming from a fully-speci…ed economic geography model. Nevertheless, note that, even if our estimated parameters may be a bit low compared to real values, markets are yet too much segmented since, for instance, Midi-Pyrénées EAs do not export to many other EAs, which is not always consistent. This is due to the strong competition e¤ects dealing with the model.

- Insert Maps 11 to 13 -

Very similar conclusions can be drawn from Maps 14 to 16 relative to the imports of the same regions from any EAs.

- Insert Maps 14 to 16 -

Local market conditions

In order to go into these simulated location patterns more closely, it is worth mapping the upstream variables they depend upon, as prices, costs, and demands. As can be seen on Maps 17 and 18, both the marginal cost and the unit price present a really strong core-periphery pattern, with a unique center. The center is located between Ile-de-France and the geographical center of France which is souther. Both variables continuously decrease from this center to the periphery. Note however that the variations are low, the di¤erences between extremes values being lower than 2%.

- Insert Maps 17 and 18 -

The size of local demand, including …nal and intermediate demands, that is presented on Maps 19 and 20, may also play a critical role on the density of local activities. As can be seen, demand is concentrated in North and East, and in Loire-Atlantique. Some main cities in South also constitute high demand poles. The spatial variation of this variable is much more important than for the marginal cost or unit price and the pattern is rather a multi-centric one. Last, the correlation between demand in value and in quantity is extremely high, which is due to the low spatial variation of prices.

- Insert Maps 19 and 20 -

Local pro…tability

We now move on to the variable on which really depend the location choices, the individual variable pro…t earned when locating in a given EA. This variable is plotted on Map 23. This pro…t is the sum of the pro…ts realized on each market to which a …rm exports and of the local pro…t. It is highly dependent on two variables we also depict on Maps 21 and 22, the mark-up averaged on all markets and the total quantity produced per …rm.

- Insert Maps 21 to 23 -

As can be seen, the average mark-up presents a very interesting spatial pattern, since it is simultaneously high in the Ile-de-France EAs and in peripheral EAs, whereas low in between. Recall the trade-o¤ that works on this variable in our inter-regional Cournot competition trade model. On the one hand, the marginal cost and unit prices are both lower in Ile-de-France (Map 15 and 16), which acts as opposite forces on the mark-up. This variable also depends on the average transport cost, which is clearly increasing with the distance to the center (Map 1), and on the number of …rms, which is polarized, but in a multi-centric sense (Map 7). Thus, the marginal and transport cost e¤ects dominate the price and competition ones regarding the Ile-de-France EAs. They bene…t from low marginal and transport costs, without su¤ering from the proximity of an important number of …rms and from low prices. Conversely, marginal and transport costs are high in peripheral regions, but competition is simultaneously low. The average mark-up is also high in this case. On the contrary, EAs located between Ile-de-France and peripheral EAs are not extremely penalized by competition and prices, but do not bene…t either from low marginal costs nor from low transport costs.

Regarding the production per …rm, recall that exports are proportional to marginal pro…ts. However, they also depend on price (which is low, leading to a higher demand in central places), and on local demand, which, as seen before (Map 19), does not present the monocentric core-periphery pattern. However, the forces bene…ting to the central areas dominate, and the production per …rm presents a monotonic core-periphery pattern (Map 22).

Therefore, the total e¤ect on the variable local pro…t, that depends on both the average mark-up and the production per …rm, is ambiguous for peripheral EAs, whereas both e¤ects converge for Ile-de-France EAs. As can be seen on Map 23, the variable pro…t per …rm presents a strong core periphery pattern which means that the production e¤ect dominates. Note, moreover, that the spatial gradient of the pro…t is much more important than the marginal cost and price ones.

Thus, according to the model, the coexistence of transport costs and imperfect competition strongly affect the location of economic activities in France. Moreover, this result prevails although the predicted share of transport charges in marginal cost is lower than the usually admitted values. The demand and costs benefits, higher in central EAs, clearly dominate the competition dispersive effects.

High variable profits prevail in Ile-de-France EAs, but, more generally, in the most competitive and dense places, as shown by the correlation matrix reported in Table 14.

- Insert Table 14 -

Correlations are positive between the profit per firm and the number of firms, the total production, and the total employment. This means that strong agglomeration incentives prevail in France, the advantages of locating in dense EAs being huge. The level of transport costs remaining fixed, it can be expected that, in the long-run, new firms would prefer to locate in the areas which are already the most competitive and dense ones. Thus, deeper spatial concentration and regional inequalities could be expected in the future, simply due to this process of firms' creation. Only low fixed costs could reverse this trend in favor of the peripheral EAs. However, this advantage should prevail over the variable profit benefits of the central EAs, which is clearly unrealistic.[11]

5.2 Impact of a transport costs decline

This section finally provides simulations of a spatially uniform decline in the generalized transport cost, up to 30% by 2% steps. This cost reduction may be due to savings either in fuel, tires, or toll costs (reducing c_r) or in wages and insurance (reducing f), or due to road infrastructure improvements (reducing both distance and time costs). We still focus on the short-run model effects, that is holding the numbers of firm producing in each area to its real value. Thus, we capture the production variations of existing firms without considering the firm relocation or creation process, which is discussed at the end of the section.

Total employment and production concentration indices

As a measure of the degree to which more sectoral employment or production concentrations stem from a generalized transport cost decline, we study the variations of two different concentration indices: an Herfindhal gross index, HI^s; and the Ellison

[11] However, no data on such a variable exist.

and Glaeser [1997] index, EGI^s, given by:

$$HI^s = \sum_i \left(\frac{n_i^s l_i^s}{\sum_j n_j^s l_j^s} \right)^2 ;$$

$$EGI^s = \frac{G - \left(1 - \sum_i x_i^2\right) H}{\left(1 - \sum_i x_i^2\right)(1 - H)} ;$$

where $G = \sum_i \left(\frac{n_i^s l_i^s}{\sum_j n_j^s l_j^s} - \frac{\sum_s n_i^s l_i^s}{\sum_s \sum_j n_j^s l_j^s} \right)^2$, $x_i = \frac{\sum_s n_i^s l_i^s}{\sum_s \sum_j n_j^s l_j^s}$, and $H = \left[\sum_i \frac{1}{n_i^s} \left(\frac{n_i^s l_i^s}{\sum_j n_j^s l_j^s} \right)^2 \right]$:

The smaller the value of the indices, the less concentrated the employment. However, the Ellison and Glaeser index has the advantage of allowing comparisons across sectors in which the number of firms differ at the national level. Figures 1 and 2 (figures 3 and 4, respectively) plot the total employment (production, respectively) indices against the transport cost variations.

- Insert Figures 1 to 4 -

Production in the sector of Insurance (sector 9) is more concentrated than in other sectors, followed by the sector of Market Services (sector 8) and the sector of Finance (sector 10). The sector of Intermediate products (sector 3) is also more concentrated in the Ellison and Glaeser point of view, but less for the gross index. This means that the concentration of production is low in this sector.[12]

Whatever the sector, the concentration indices decline when the generalized transport cost declines. This means that, conditionally to the current location of firms and without considering the creation of new firms, declining transport costs make total production and employment less concentrated between EAs. Table 15 gives the average decline for each sector.

- Insert Table 15 -

Similar conclusions may be derived from studying employment concentration indices.

Correlation between profits and number of firms or total production

As mentioned above, a strong result of our short-run equilibrium simulations is the positive correlation between local profits and the number of firms or the total production. It is worth studying how these correlations vary when transport costs

[12] However, note that the ESE survey only accounts for the plants of more than 20 workers which may introduce some bias in the Ellison and Glaeser index.

decrease. We plot in Figures 5 and 6 the correlation between pro…ts and the number of …rms, on the one hand, and between pro…ts and total production, on the other hand.

- Insert Figures 5 and 6 -

The decreasing correlation between both variables is thus consistent with the observed decline in employment and production concentration indices.

Employment, production and pro…ts spatial patterns

Maps 24 to 26 report the employment, production and pro…ts induced by the transport costs decline.

- Insert Maps 24 to 26 -

As regards total employment and production, no clear evolution emerges, apart from a limited spatial dispersion which con…rms the results on concentration indexes variations. However, very interesting features emerge as regards pro…ts. Pro…ts are initially monocentrically concentrated around Ile-de-France EAs. When transport costs decrease, this central area narrows, pro…ts being even more concentrated there. However, a second pro…t concentration point emerges around Lyon. This means that, due to this decline, new location incentives are created in this area, while the pro…t gradient around Ile-de-France simultaneously increases. Thus, from a mono-centric spatial con…guration of variable pro…ts, we would change to a duo-centric con…guration, the local gradient around each peak being steeper after the transport costs decline. Pro…ts concentration would reduce at the national level, increasing at the same time inside sub-national geographical units.

This last feature leads us to compute concentration indices for each of the 21 French "Régions". Indeed, as can be seen in table 16, in many French regions and for many sectors, concentration increases due to the transport costs decline.

- Insert Table 16 -

This is all the more true as regards employment, whose concentration increases in more than 2/3 of the regions. By contrast, total employment or production concentrations increase in only 1/3 of the regions. These conclusions are illustrated by Map 27 in sector 4.

- Insert Map 27 -

We may thus infer from these results that, whereas dispersive forces prevail at the country level, agglomeration incentives may reinforce EAs' inequalities within a large number French regions, yielding there the development of highly competitive central EAs at the expense of less competitive peripheral EAs.

Discussion

A last simulation would be worth being carried out. What would one expect from a transport costs decline on the long-run equilibrium? However, a critical question, that makes the exercise di¢ cult, arises, besides more secondary issues. Do the …rms enter the market more or less rapidly that transport costs decrease? That is to say, would we have …rst to simulate the entry of …rms, until pro…ts are zero? (which means that we believe that the current observed situation is a short-run one). This would lead to the emergence of a much stronger concentration than the current one, if …xed costs are the same in all locations, since variable pro…ts are extremely concentrated. (A secondary issue would be here to determine if …xed costs are e¤ectively uniform or not). Next, we would simulate the impact of the decrease of transport costs. However, concentration would be so strong once the entry would have been simulated that the transport costs decline could only bene…t to the central EAs: almost no more production would take place in the peripheral EAs and demand would be close to zero there. The alternative would be to consider that the current situation is a long-run one, which means that …xed costs are equal to variable pro…ts and, thus, are much higher in the central EAs than in the peripheral ones. In this case, the reduction in transport cost implies a rather complex …rms' entry and exit process. If a multi-centric situation emerges, as it appears, for instance, on Map 27, France would maybe have two or three centers, apart from which very few activities would be located. Concentration could decrease at the national level, but would increase inside regions. Thus, the main problem is that the …rms' entry process and the transport cost decline are probably simultaneous, which prevents us from simulating the long-run equilibrium. In such a purpose, we should know the speed of …rms' reaction to positive pro…ts and to pro…t di¤erentials in comparison with the transport costs variations speed. Last, simulating the long-run equilibrium at the geographical and sectoral aggregation levels we choose would not be anyway feasible under reasonable computation delays.

6 Conclusions and extensions

This paper …rst develops a tractable inter-regional trade model in the economic geography spirit, that we use to investigate the decline of transport costs as a cause of regional inequalities. The model includes real strategic interactions and competition e¤ects through the use of Cournot competition. High …nal and intermediate demands and low input costs give …rms incentives to locate in the more dense and competitive regions, whereas competition on the good markets works the opposite. Next, we perform a structural estimation of this theoretical model using a new dataset on generalized transport costs between the 341 French Employment Areas. These costs, computed using the real road network, include both a unit distance cost (fuel, tolls, ...) and a unit time opportunity cost (truck depreciation, drivers' wages, ...). We …nd fairly strong evidence that our model well explain the sectoral employment spatial distribution. The role of intermediate inputs is critical. This result is robust across many speci…cations, including di¤erent sectoral and geographical aggregation levels. Including EAs …xed-e¤ects greatly improves the …t. Thus, even if geography is partly captured by the use of the transport cost matrix and our imperfect competition on segmented markets model, other real geography e¤ects (proximity to oceans, to foreign countries, climate amenities,...) may play a critical role on the spatial shaping of economic activities. As a …nal step, we present simulations on the spatial distribution of local sectoral economic variables, such as employment, production, but also costs, prices, and pro…ts. The mono-centric structure of variable pro…ts, and their high level in the most competitive and dense areas, show that …rms have strong incentives to concentrate over space in France, as long as …xed costs are not too high in these areas. Last, the impact of a transport cost decline is simulated, as regards the short-run version of the model, that is, the number and location of …rms being hold constant. Total employment and production concentration decrease at the national level, but increase in many regions. This outcome is particularly consistent with Esteban [1999]'s conclusion that regional inequalities have decreased between European countries, while increasing within them for twenty years. Thus, the level of inequalities, and the magnitude of a transport cost decrease e¤ects on it, drastically depend upon the geographical level considered. As regards pro…ts, a duo-centric structure emerges, which is a second illustration of the coexistence of both features in the short-run: lower inter-regional concentration and higher intra-regional concentration.

However, we hope that public authorities would …nd an interest in our step towards a better prediction of the real employment and production redistribution e¤ects of regional policies relying on transport networks. Indeed, it is surprising how neglectful calculations of infrastructure rates of return are, as regards these spatial and location e¤ects. With our methodology, the impact of a local improvement of the French road network could indeed be simulated. For instance, the impact of the creation of new highways based on what is planned in France for the next 20 years, of the improvement of the network of peripheral regions holding the central one identical, or the improvement of intra-regional arcs (secondary roads) as opposed to inter-regional ones (highways) could easily be studied.

Next, we would like to simulate the impact of a transport cost decline on the long-run distribution of …rms and employment. This is worth considering, since agglomeration in the model is really linked to the creation process of …rms in central locations. The problem in simulating the long-run equilibrium is to determine whether …rms react faster to regional pro…t di¤erentials than the transport costs decrease, which would imply that economic activities would only concentrate around Ile-de-France, or not, in which case they could distribute across a few other EAs. By the way, given the current computational capacities, such simulations are possible only at less disaggregated geographical and sectoral levels.

Some econometric extensions would consist in improving the speci…cation of the disturbance term structure. Even if our estimations have been shown to be fairly robust, it could be relevant, for instance, to consider that the error measure lies in regional di¤erences a¤ecting French wages, leading thus to the following wage expression:

$$w_i^s = w^s + w_i + u_i^s: \tag{25}$$

Under this error structure speci…cation, our estimates are, however, not consistent, because of endogeneity. Moreover, spatial correlation may also induce some bias. In order to overcome these problems, a maximum likelihood estimation should be used.

Finally, a monopolistic competition model with di¤erentiated inputs should also be estimated. We would study the robustness of our results on the link between transport costs decline and regional inequalities, as embodied in an alternative, and very standard, imperfect competition framework.

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Appendix: Linearization of the short-run equilibrium

This Appendix presents the methodology used for finding a tractable ν^s-linear expression of the sectoral local employment per firm. All following expressions are given for any $j = 1, \ldots, J$ and $s = 1, \ldots, S$.

From equation (23) given in the text, the explicit expressions of $(p^s)_{s=1,\ldots,S}$ are derived by solving the following system:

$$\begin{pmatrix} \log(p^1) \\ \vdots \\ \vdots \\ \log(p^s) \\ \vdots \\ \vdots \\ \log(p^S) \end{pmatrix} = \begin{pmatrix} \beta_{11} & \cdots & \beta_{s1} & \cdots & \beta_{S1} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \vdots & & \vdots & & \vdots \\ \beta_{1s} & \cdots & \beta_{ss} & \cdots & \beta_{Ss} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \vdots & & \vdots & & \vdots \\ \beta_{1S} & \cdots & \beta_{sS} & \cdots & \beta_{SS} \end{pmatrix} \times \begin{pmatrix} \log(p^1) \\ \vdots \\ \vdots \\ \log(p^s) \\ \vdots \\ \vdots \\ \log(p^S) \end{pmatrix} + \begin{pmatrix} \log(\frac{N^1 (w^1)^{\lambda^1}}{(N^1 - 1) B^1}) \\ \vdots \\ \vdots \\ \log(\frac{N^s (w^s)^{\lambda^s}}{(N^s - 1) B^s}) \\ \vdots \\ \vdots \\ \log(\frac{N^S (w^S)^{\lambda^S}}{(N^S - 1) B^S}) \end{pmatrix}. \tag{26}$$

Next, the equilibrium regional price may be written as:

$$p_j^s = p^s \bigl(1 + \delta_j^s\bigr), \tag{27}$$

where the parameter δ_j^s represents the relative gap between national and regional prices. We assume that δ_j^s is small enough (compared to 1) to let us only consider the first order terms in the linearization (we check ex post for this asumption to be true).

From equations (4), (16) and (27),we can now derive the following $J \times S$ system for the $(\delta_j^s)_{j,s}$:

$$\delta_j^s = \frac{1}{N^s} \sum_i n_i^s \sum_{s'} \beta_{s's} \delta_i^{s'} + \frac{\nu^s}{p^s (N^s - 1)} \sum_i n_i^s t_{ij}. \tag{28}$$

These expressions can be written in matrix form as follows:

$$
\begin{pmatrix}
\delta_1^1 \\ \vdots \\ \delta_J^1 \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \delta_1^S \\ \vdots \\ \delta_J^S
\end{pmatrix}
=
\underbrace{\begin{pmatrix}
\frac{\beta^{11} n_1^1}{N^1} & \cdots & \frac{\beta^{11} n_J^1}{N^1} & \cdots & \cdots & \frac{\beta^{S1} n_1^1}{N^1} & \cdots & \frac{\beta^{S1} n_J^1}{N^1} \\
\vdots & \cdots & \vdots & \cdots & \cdots & \vdots & \cdots & \vdots \\
\frac{\beta^{11} n_1^1}{N^1} & \cdots & \frac{\beta^{11} n_J^1}{N^1} & \cdots & \cdots & \frac{\beta^{S1} n_1^1}{N^1} & \cdots & \frac{\beta^{S1} n_J^1}{N^1} \\
\vdots & \cdots & \vdots & & & \vdots & \cdots & \vdots \\
\vdots & \cdots & \vdots & \cdots & \cdots & \vdots & \cdots & \vdots \\
\frac{\beta^{1s} n_1^s}{N^s} & \cdots & \frac{\beta^{1s} n_J^s}{N^s} & \cdots & \cdots & \frac{\beta^{Ss} n_1^s}{N^s} & \cdots & \frac{\beta^{Ss} n_J^s}{N^s} \\
\vdots & \cdots & \vdots & \cdots & \cdots & \vdots & \cdots & \vdots \\
\frac{\beta^{1s} n_1^s}{N^s} & \cdots & \frac{\beta^{1s} n_J^s}{N^s} & \cdots & \cdots & \frac{\beta^{Ss} n_1^s}{N^s} & \cdots & \frac{\beta^{Ss} n_J^s}{N^s} \\
\vdots & \cdots & \vdots & \cdots & \cdots & \vdots & \cdots & \vdots \\
\vdots & \cdots & \vdots & & & \vdots & \cdots & \vdots \\
\frac{\beta^{1S} n_1^S}{N^S} & \cdots & \frac{\beta^{1S} n_J^S}{N^S} & \cdots & \cdots & \frac{\beta^{SS} n_1^S}{N^S} & \cdots & \frac{\beta^{SS} n_J^S}{N^S} \\
\vdots & \cdots & \vdots & \cdots & \cdots & \vdots & \cdots & \vdots \\
\frac{\beta^{1S} n_1^S}{N^S} & \cdots & \frac{\beta^{1S} n_J^S}{N^S} & \cdots & \cdots & \frac{\beta^{SS} n_1^S}{N^S} & \cdots & \frac{\beta^{SS} n_J^S}{N^S}
\end{pmatrix}}_{M}
\times
\begin{pmatrix}
\delta_1^1 \\ \vdots \\ \delta_J^1 \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \delta_1^S \\ \vdots \\ \delta_J^S
\end{pmatrix}
+
\begin{pmatrix}
T_1^1 \\ \vdots \\ T_J^1 \\ \vdots \\ \vdots \\ T_1^s \\ \vdots \\ T_J^s \\ \vdots \\ \vdots \\ T_1^S \\ \vdots \\ T_J^S
\end{pmatrix};
\tag{29}
$$

with:

$$
T_j^s = \frac{\gamma^s}{p^s (N^s - 1)} \sum_i n_i^s t_{ij}. \tag{30}
$$

The solution of this linear system can be written as:

$$
\delta_j^s = \sum_{s'} \gamma^{s'} X_j^{s's}, \tag{31}
$$

where $X_j^{s's} = \frac{1}{p^{s'}(N^{s'}-1)} \sum_i b_{ij}^{ss'} \sum_k n_k^{s'} t_{ik}$. The parameters $b_{ij}^{ss'}$ are the generic terms of the inverse of the $(I_{J \times S} - M)$ matrix, where $I_{J \times S}$ is the identity matrix of size $J \times S$.

We can now write the linear expressions for the marginal cost of production and the regional price, given by:

$$
\begin{cases}
p_j^s = p^s \left(1 + \sum \gamma^{s'} X_j^{s's}\right) \\
c_j^s = \frac{(w^s)^{\lambda^s} P^s}{B^s} \left(1 + \sum_{s''} \gamma^{s''} \sum_{s'} \beta^{s's} X_j^{s''s'}\right)
\end{cases}
. \tag{32}
$$

Finally, equations (17) and (32) allow us to compute the linear expressions for the quantities sold in each market, from which we deduce the total production of a representative firm in each region and sector:

$$
y_j^s = \left(\frac{p^s B^s - P^s (w^s)^{\lambda^s}}{(p^s)^2 B^s}\right) \sum_i R_i^s \left[1 + \gamma^s \left(W_{ij}^{ss} - 2X_i^{ss}\right) + \sum_{s' \neq s} \gamma^{s'} \left(W_{ij}^{s's} - 2X_i^{s's}\right)\right]; \tag{33}
$$

with:

$$\begin{cases} W_{ij}^{s's} = \frac{B^s}{\left(p^s B^s - P^s (w^s)^{\sigma^s}\right)} \left[p^s X_i^{s's} - \frac{P^s (w^s)^{\sigma^s}}{B^s} \sum_{s''} \delta^{s''s} X_j^{s's''} \right] \\ W_{ij}^{ss} = \frac{B^s}{\left(p^s B^s - P^s (w^s)^{\sigma^s}\right)} \left[p^s X_i^{ss} - \frac{P^s (w^s)^{\sigma^s}}{B^s} \sum_{s'} \delta^{s's} X_j^{ss'} - t_{ij} \right] \end{cases} . \quad (34)$$

From equation (33) and from the linearization of equation (5), the final expression for the employment per firm given in equation (24) is obtained.

Table 1: Levels and variations of the cost per km components

Road category	Toll highways			Free highways			2-/3-lane roads			Single national lanes			Secondary roads			Metropolitan roads		
	1978	1993	Δ (%)	1978	1993	Δ (%)	1978	1993	Δ (%)	1978	1993	Δ (%)	1978	1993	Δ (%)	1978	1993	Δ (%)
Gas consumption (l/100km)	37	30.3	-18	37	30.3	-18	41	33.6	-18	49	40.2	-18	49	40.2	-18	50	41	-18
Gas price - VAT excluded (FF93/l)	3.87	3.09	-20	3.87	3.09	-20	3.87	3.09	-20	3.87	3.0868	-20	3.87	3.0868	-20	3.87	3.09	-20
Fuel cost (FF93/km)	*1.43*	*0.94*	*-34*	*1.43*	*0.94*	*-34*	*1.59*	*1.04*	*-35*	*1.89*	*1.24*	*-34*	*1.89*	*1.24*	*-34*	*1.93*	*1.27*	*-34*
Tires (FF93/Km)	0.45	0.26	-42	0.45	0.26	-42	0.45	0.26	-42	0.45	0.26	-42	0.45	0.26	-42	0.45	0.26	-42
Maintenance / Repairing (FF93/km)	1.76	0.62	-65	1.76	0.62	-65	1.76	0.62	-65	1.76	0.62	-65	1.76	0.62	-65	1.76	0.62	-65
Highway tolls (FF93/km)	0.72	0.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cost per km (FF93)	*4.36*	*2.53*	*-42*	*3.64*	*1.82*	*-50*	*3.8*	*1.91*	*-50*	*4.1*	*2.12*	*-48*	*4.1*	*2.12*	*-48*	*4.14*	*2.14*	*-48*
Average speed (km/h)	*75*	*75*	*0*	*75*	*75*	*0*	*75*	*75*	*0*	*55*	*55*	*0*	*50*	*50*	*0*	*30*	*30*	*0*

Table 2: Levels and variations of the time opportunity cost per hour components

	1978	1993	Δ (%)
Drivers wages (FF93/year)	258375	176798	-32
Drivers accomodation costs (FF93/year)	50995	46127	-10
Insurance (FF93/year)	37711	24009	-36
General charges, Taxes (FF93/year)	149497	110306	-26
Truck renewal (FF93/year)	177801	116666	-34
Total time opportunity cost (FF93/h)	*270*	*198*	*-27*

Table 3: Model with intermediate inputs
Sectoral aggregation: 70 sectors - Geographical aggregation: 341 employment areas
Matrix used: generalized transport costs - Year:1993

	(1)		(2)		(3)		(4)	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Res. Est.	Res. Std. Err.
Coking, Mineral combustible	281.9827****	(16.6656)	279.9714****	(16.6646)	288.2839****	(17.1003)	2.0003616E17	(1.4817031E17)
Gas, Oil production	-11.4896****	(3.2685)	-11.0864****	(3.2745)	-6.3432**	(3.5655)	5.3426	(24.3561)
Electricity	-47.7502	(45.3447)	-45.197	(45.3421)	-0.4842	(47.2222)	-238.0379	(454.495)
Gas retail	178.8514	(3384.0008)	406.7361	(3385.9012)	2497.3766	(3522.0614)	7595.8767	(16969.0966)
Water, Urban heating	-0.2478	(4.5259)	0.7666	(4.5573)	13.7623***	(5.6745)	10.804	(40.1252)
Metallurgy of Iron and Steel	1.2028	(3.3259)	1.2036	(3.3273)	3.8326	(3.4485)	7.3997	(11.3912)
Primary processing of steel	341.9841	(503.2549)	438.7759	(504.8748)	1366.6122***	(560.4897)	-921.0936	(4146.8153)
Extraction of non-ferrous metals	-25.7268	(51.6352)	-17.0694	(51.7375)	-31.0386	(52.8941)	-93.331	(151.58)
Metallurgy of non-ferrous metals	-32.0236*	(21.6832)	-28.497	(21.8059)	11.6571	(24.524)	-441.1375***	(188.8183)
Miscellaneous ores	-69.4379	(133.7888)	-49.5394	(134.2849)	147.0031	(148.2963)	-386.5366	(821.0837)
Construction, Ceramic materials	0.1073	(0.212)	0.1684	(0.2138)	0.8984****	(0.2802)	0.1873	(1.0477)
Glass	1.1411	(1.1883)	1.3647	(1.1918)	3.769****	(1.3533)	8.4654	(7.0962)
Basic chemics	4.3998*	(2.9504)	4.7093*	(2.9552)	10.0455****	(3.2404)	-15.7331	(20.2286)
Parachemics	8.0551	(13.7269)	11.1522	(13.7906)	49.0606****	(16.7549)	-29.2527	(87.4765)
Pharmaceutics	-1.8711	(20.4554)	1.9097	(20.5033)	44.3778**	(23.2861)	75.9196	(146.079)
Metalworking	0.0168	(0.0887)	0.0346	(0.0894)	0.3464****	(0.1171)	0.0655	(0.423)
Agricultural machinery	19.0684	(153.5366)	39.6747	(153.7876)	367.8226***	(173.4266)	-85.4318	(822.2985)
Machine-tools	-0.5297	(12.4571)	1.4849	(12.5048)	25.821**	(14.0825)	16.2392	(65.657)
Civil-engineering equipment	4.7668	(11.4103)	4.7807	(11.4379)	20.4533**	(12.1206)	-8.9065	(37.3389)
Office machinery, Computers	6.724	(8.1584)	8.2207	(8.1771)	22.2744***	(9.0464)	53.0095	(118.2802)
Electrical equipment	6.0538	(7.9938)	7.7793	(8.0361)	31.255****	(9.9614)	32.1555	(57.4078)
Electronic equipment	-0.0106	(0.5817)	0.1556	(0.5849)	1.7455***	(0.711)	-1.8676	(2.725)
Household equipment	0.5694	(5.2446)	1.3637	(5.2527)	9.0292*	(5.7411)	-71.6983**	(39.8967)
Automobile	1.6645****	(0.4172)	1.7648****	(0.4199)	2.8586****	(0.5034)	-2.0394	(2.5649)
Shipbuilding	17.3883	(36.0789)	21.1066	(36.1412)	35.804	(36.8087)	-24.1588	(83.5558)
Aeronautics	1.3058	(5.7942)	2.0222	(5.8075)	11.4152**	(6.3516)	49.6555	(61.8064)
Precision equipment	-0.4777	(3.3915)	0.2891	(3.4034)	8.2074***	(3.9614)	-8.4265	(10.3131)
Meat products	0.0867	(0.2235)	0.1453	(0.2245)	0.7642****	(0.2709)	-0.3594	(0.8821)
Milk products	1.4083	(1.377)	1.7421	(1.3868)	5.5075****	(1.6833)	0.9823	(5.4118)
Canned foods	1.8256	(3.8313)	2.6917	(3.8448)	11.1807***	(4.4497)	1.3361	(20.0865)
Bakery	0.0959	(1.3246)	0.1488	(1.3254)	0.9351	(1.3693)	2.3367	(8.4311)
Grain products	2.0076	(5.5765)	3.0999	(5.5912)	16.0241***	(6.3947)	9.7946	(22.7929)
Miscellaneous food products	0.5378	(2.0116)	0.9636	(2.0209)	5.7855***	(2.3944)	1.0303	(11.6202)
Beverages, Alcohol	0.8026	(3.6951)	1.4617	(3.7071)	9.142***	(4.28)	0.4344	(26.8097)
Tobacco	2.8161	(11.6742)	3.259	(11.6695)	9.5375	(12.1186)	9.1386	(63.4179)
Textile	0.2262	(0.4541)	0.3006	(0.4567)	1.4992****	(0.5442)	-0.6345	(2.5326)
Leather	-1.6662	(8.2548)	0.5723	(8.281)	13.0182*	(8.9061)	-4.97	(26.9284)
Shoes	2.2475	(3.1046)	2.2445	(3.1072)	4.3945	(3.2299)	-2.3671	(19.8127)
Wearing apparel, Dressing	-0.1291	(1.0625)	0.0733	(1.0664)	2.6138***	(1.2417)	0.6153	(5.6939)
Wood	0.0864	(0.518)	0.2589	(0.5213)	1.7347****	(0.6327)	0.0579	(1.9014)
Furniture	0.328	(1.8426)	0.6412	(1.8492)	4.8999***	(2.1427)	2.4444	(10.119)
Paper, Pulp	-0.1791	(0.5104)	-0.0724	(0.5136)	1.3415***	(0.6252)	-2.8045	(3.5698)
Printing, Press, Publishing	0.3937	(0.9331)	0.5668	(0.9358)	2.7174***	(1.0844)	1.22	(3.9703)
Rubber	63.0509***	(29.1105)	69.1848***	(29.2005)	128.8842****	(33.3447)	95.436	(186.2434)
Plastic	1.475	(9.2621)	3.6904	(9.3279)	32.6363****	(11.6148)	13.7606	(39.4428)
Miscellaneous industries	0.6501	(2.6117)	1.0234	(2.6194)	5.5747**	(2.8996)	1.7271	(13.842)
Construction	0.4617	(2.6622)	1.093	(2.6867)	10.7898****	(3.6083)	4.8864	(15.6482)
Reprocessing	1.2761	(19.1342)	3.6879	(19.1849)	34.8985**	(21.1374)	16.702	(104.083)
Repair, Trade of motor vehicles	0.0196	(0.5031)	0.137	(0.5073)	1.9177****	(0.6727)	0.8052	(2.9472)
Miscellaneous repair	0.4756	(10.8532)	2.2439	(10.8844)	14.1877	(11.507)	39.5393	(94.4642)
Hotel, Restaurant	0.0028	(0.0143)	0.0059	(0.0144)	0.0529****	(0.0189)	0.0201	(0.0917)

Table 3 (continued)								
Rail transport	3.8066****	(0.4027)	3.9086****	(0.4067)	5.2366****	(0.5238)	2.6802	(2.3323)
Road transport	2.2423	(2.87)	2.8487	(2.8891)	12.3529****	(3.7407)	3.9302	(16.6942)
Sea, Shipping transport	-11.7571	(400.6273)	35.2789	(401.7266)	243.3019	(418.942)	-87.4194	(2387.8502)
Air transport	175.5589****	(65.1564)	186.151****	(65.4)	261.8902****	(70.6149)	619.8637	(849.6539)
Warehouse	-0.0493	(0.1459)	-0.0117	(0.1469)	0.3884***	(0.1795)	0.6632	(1.0498)
Telecommunications, Mail	0.1379	(0.4084)	0.1927	(0.4095)	0.6409*	(0.4377)	654.4942	(819.5691)
Holdings	0.0021	(0.0189)	0.0065	(0.0191)	0.0719****	(0.0252)	0.0804	(0.1352)
Personal goods renting	1.4661	(8.0815)	2.9215	(8.1034)	20.4522***	(9.2457)	24.7587	(99.8032)
Education (market)	1.9748	(3.9954)	2.6328	(4.0077)	11.5702***	(4.6357)	16.6972	(54.5081)
Health (market)	-0.0556	(0.2607)	-0.0346	(0.2611)	0.3461	(0.2802)	-0.2753	(1.2421)
Social work (market)	0.0038	(0.0306)	0.0119	(0.0309)	0.1251****	(0.0417)	0.0374	(0.1632)
Insurance	0.7136	(1.7012)	1.0533	(1.7101)	5.2488***	(2.0408)	2.6831	(11.8739)
Finance	0.0856	(0.3826)	0.1814	(0.3857)	1.4018****	(0.4985)	0.7172	(1.8756)
Number of Observations	10274		10274		10274		8626	
R^2	0.13		0.14		0.16		0.24	

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.
Sectoral fixed effects in all regressions. (1): no geographical dummies; (2): geographical dummies (contiguity with Germany, Belgium or Luxembourg, Switzerland, Italy, Spain, the Atlantic Ocean, the Channel, the Mediterranean Sea); (3): EA fixed effects.
(4): residual estimates, Hausman test (1978 data used as instruments for 1993 variables).

Table 4: Model with intermediate inputs
Sectoral aggregation: 10 sectors - Geographical aggregation: 341 employment areas
Matrix used: generalized transport cost

	1993			*1978*		
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture Industry	1.1251**	1.3444***	8.5009****	0.1475	0.1682	0.8452
	(0.5871)	(0.5987)	(3.1901)	(0.1811)	(0.1813)	(0.6771)
Energy	-8.8976****	-8.4568****	9.3779	3.0554***	3.4498***	11.8126
	(1.9008)	(1.9215)	(8.1262)	(1.5547)	(1.5751)	(8.5859)
Intermediate Products	0.4334*	0.472**	2.7798****	-0.0818	-0.0778	0.4533
	(0.2751)	(0.277)	(1.0331)	(0.163)	(0.1629)	(0.5286)
Equipment Goods	1.0653***	1.1724****	6.2665****	0.5257**	0.5853**	2.5792
	(0.4324)	(0.4386)	(2.2605)	(0.2952)	(0.2995)	(1.9558)
Consumption Goods	0.4021	0.5017	4.249***	0.1127	0.1644	1.795
	(0.3438)	(0.3478)	(1.6499)	(0.2557)	(0.2587)	(1.6045)
Construction	2.4009	3.8956	70.2509***	0.5601	1.3865	25.8069
	(4.6977)	(4.8228)	(29.521)	(2.9907)	(3.0636)	(24.1215)
Transport Services	0.2917***	0.3217***	1.6611****	0.0497	0.0978	1.8103
	(0.1284)	(0.1297)	(0.6046)	(0.2939)	(0.2967)	(1.6915)
Market Services	-0.0233	-0.0185	0.1739**	-0.0353	-0.0259	0.3213
	(0.0427)	(0.0426)	(0.0943)	(0.0865)	(0.0866)	(0.3436)
Insurance	1.3827	1.6148*	11.3604***	1.3159	1.7991	11.2149
	(0.9964)	(1.0103)	(4.5161)	(2.1447)	(2.1614)	(10.1689)
Finance	0.652	0.957	12.0416***	-0.1022	0.1536	7.2789
	(0.9947)	(1.0123)	(5.1055)	(0.9356)	(0.9577)	(7.0763)
Number of Observations	2952	2952	2952	2895	2895	2895
R^2	0.07	0.08	0.18	0.09	0.10	0.19

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.
Standard errors in brackets.
Sectoral fixed effects in all regressions. (1), (4): no geographical dummies; (2), (5): geographical dummies (contiguity with Germany,Belgium or Luxembourg, Switzerland, Italy, Spain, the Atlantic Ocean, the Channel, the Mediterranean Sea); (3), (6): Employment Area fixed effects.

Table 5: Model with intermediate inputs
Sectoral aggregation: 70 sectors - Geographical aggregation: 341 employment areas
Matrix used: generalized transport costs - Year 1978

	(1)		(2)		(3)		(4)	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Coking, Mineral combustible	157.5343****	(6.1767)	156.6441****	(6.1818)	157.686****	(6.2931)	-360.3825****	(27.7518)
Gas, Oil production	-2.6017	(2.3106)	-2.2758	(2.3189)	0.8992	(2.5432)	10.538	(12.6882)
Electricity	-68.6039****	(11.2666)	-66.7507****	(11.2807)	-53.2854****	(11.9931)	382.6338****	(72.1875)
Gas retail	-0.7773	(2.9733)	-0.5102	(2.9811)	1.5753	(3.095)	-0.9964	(5.5701)
Water, Urban heating	-3.5869	(8.5919)	-2.7807	(8.634)	13.3837	(9.8727)	0.3401	(17.7613)
Metallurgy of Iron and Steel	-0.7471****	(0.2881)	-0.7753****	(0.2881)	-0.5818**	(0.298)	-1.8896****	(0.3137)
Primary processing of steel	950.7365	(988.3869)	1110.0111	(989.9646)	2569.9937***	(1058.8805)	-993.2139	(1796.4749)
Extraction of non-ferrous metals	-7.6681	(20.068)	-2.2749	(20.106)	-2.3074	(20.4476)	-19.7025	(34.3259)
Metallurgy of non-ferrous metals	-4.8951	(3.7451)	-4.2924	(3.7644)	2.614	(4.2038)	-3.8503	(5.2287)
Miscellaneous ores	-120.3346	(448.819)	-69.3951	(451.2262)	630.0614	(500.1044)	97.5296	(240.5092)
Construction, Ceramic materials	0.0168	(0.0363)	0.0251	(0.0366)	0.1282****	(0.0464)	-0.0022	(0.0507)
Glass	3.0868**	(1.6131)	3.3158***	(1.6185)	6.1771****	(1.8208)	-2.5829	(3.9477)
Basic chemics	0.0003	(1.1963)	0.1592	(1.2011)	2.341**	(1.3512)	-2.434	(2.7831)
Parachemics	8.1655	(21.3809)	11.8983	(21.4731)	57.3121***	(24.8907)	10.1382	(47.9727)
Pharmaceutics	21.4235	(43.8161)	28.2069	(43.8728)	93.5836***	(47.7411)	-52.9798	(59.634)
Smelting works	7.0751	(7.3578)	8.0096	(7.3771)	23.126****	(8.4271)	nd	nd
Metalworking	0.17	(0.1388)	0.1931	(0.1393)	0.4794****	(0.161)	-0.5399**	(0.3158)
Agricultural machinery	898.3422	(1135.9623)	1018.6427	(1138.5124)	3267.1583***	(1287.2727)	-99.2041	(215.1746)
Machine-tools	-0.1826	(0.5828)	-0.0892	(0.5842)	0.927	(0.6506)	-0.5428	(0.7647)
Industrial equipment	4.4972	(55.6296)	25.9342	(56.0015)	130.0947***	(63.41)	-11.2081	(29.1369)
Civil-engineering equipment	-1.2132	(11.013)	-2.051	(11.0264)	10.2904	(11.5619)	nd	nd
Office machinery, Computers	2.293	(4.0353)	2.8292	(4.0416)	7.6935**	(4.2905)	2.3328	(7.8211)
Electrical equipment	89.0019**	(45.6891)	95.5389***	(45.8748)	204.8405****	(54.6801)	-11.7159	(11.6918)
Electronic equipment	0.0899	(0.071)	0.1015	(0.0712)	0.2575****	(0.0829)	-0.0578	(0.0832)
Household equipment	-4.293	(5.9678)	-3.2524	(5.9832)	5.2135	(6.4715)	2.5214	(27.476)
Automobile	0.2745****	(0.0499)	0.2817****	(0.0502)	0.3963****	(0.0589)	0.0021	(0.0707)
Shipbuilding	-0.1946	(2.6038)	0.121	(2.6135)	1.9196	(2.7228)	-1.72	(4.8923)
Aeronautics	-2.1795****	(0.6208)	-2.1022****	(0.623)	-1.108*	(0.6847)	-3.2238****	(0.819)
Precision equipment	0.2004	(0.3426)	0.2363	(0.3434)	0.909***	(0.3827)	0.0316	(0.4717)
Meat products	0.0776	(0.2557)	0.1307	(0.2569)	0.7285***	(0.3066)	0.0285	(0.7911)
Milk products	0.1231	(0.2036)	0.1529	(0.2042)	0.6101***	(0.2402)	-0.0908	(0.2945)
Canned foods	0.6455	(0.9047)	0.7588	(0.9072)	2.3792***	(1.0127)	0.2147	(1.5291)
Bakery	2.035	(11.6597)	3.6527	(11.7114)	18.3857	(12.8871)	-0.2265	(2.6349)
Grain products	1.928	(4.233)	2.4963	(4.2544)	12.6762***	(4.9986)	2.8458	(16.9268)
Miscellaneous food products	0.6648	(1.0333)	0.7884	(1.0382)	2.7669***	(1.1865)	0.7703	(2.5171)
Beverages, Alcohol	0.0057	(0.0284)	0.005	(0.0284)	-0.0036	(0.0287)	0.0167	(0.0599)
Tobacco	2.7626	(9.0079)	3.4284	(9.0178)	9.8634	(9.3938)	47.2902	(39.423)

Table 5 (continued)								
Textile	0.0243	(0.0403)	0.0287	(0.0406)	0.1219***	(0.0486)	-0.0079	(0.0565)
Leather	-0.051	(2.0556)	0.4886	(2.0606)	2.4897	(2.1753)	-0.331	(4.066)
Shoes	1.0646	(2.095)	1.2217	(2.102)	4.9736***	(2.3683)	1.4585	(14.2804)
Wearing apparel, Dressing	-0.0595	(0.4448)	-0.0071	(0.4463)	1.1157***	(0.5419)	-0.3337	(1.0623)
Wood	0.0211	(0.1724)	0.0629	(0.1733)	0.4882***	(0.2093)	-0.0265	(0.3154)
Furniture	0.2804	(1.2591)	0.4394	(1.2655)	3.2789***	(1.5019)	-0.5584	(5.5289)
Paper, Pulp	-0.0484	(0.1706)	-0.0203	(0.1715)	0.3881**	(0.2043)	-0.0849	(0.2967)
Printing, Press, Publishing	0.4379	(0.8929)	0.569	(0.8963)	2.4453***	(1.0436)	-0.095	(2.9131)
Rubber	40.918*	(25.4021)	45.2641**	(25.483)	89.2899****	(28.6648)	-348.4576****	(120.6619)
Plastic	-4.9034	(78.4032)	7.8714	(78.7052)	197.9968***	(93.8058)	2.8415	(13.0821)
Miscellaneous industries	0.0093	(0.0639)	0.019	(0.0642)	0.1771***	(0.0773)	-0.0085	(0.0867)
Construction	0.6544	(3.7705)	1.2622	(3.8035)	12.6494***	(4.9474)	0.1107	(8.2882)
Reprocessing	0.7244	(13.8044)	1.957	(13.8516)	25.6308**	(15.2911)	4.5298	(76.1748)
Repair, Trade of motor vehicles	0.0044	(0.0705)	0.0167	(0.0712)	0.2259***	(0.0917)	-0.0007	(0.0925)
Miscellaneous repair	4.0618	(16.9589)	5.0794	(16.9745)	26.9373*	(18.1225)	-4.5288	(35.3989)
Hotel, Restaurant	0.0791	(0.6453)	0.1643	(0.6501)	1.8057***	(0.796)	-0.0001	(0.0167)
Rail transport	0.243	(0.899)	0.3953	(0.9066)	2.9077***	(1.1464)	8.3305****	(0.7568)
Road transport	1.6865	(4.9273)	2.4314	(4.9671)	16.5644****	(6.3244)	-1.585	(7.3636)
Sea, Shipping transport	1209.3626	(3883.9415)	1524.6927	(3894.4735)	4102.562	(4033.7743)	-189.6911	(548.9742)
Air transport	410.7573***	(189.5803)	429.0804***	(190.0736)	665.7517****	(201.5517)	39.8625	(127.4453)
Warehouse	0.0682	(0.1278)	0.0927	(0.1286)	0.364***	(0.1498)	0.5865	(0.6381)
Telecommunications, Mail	368.4456	(589.9003)	396.0964	(590.6997)	738.768	(608.8202)	0.1359	(1.8992)
Holdings	0.0045	(0.0256)	0.0085	(0.0258)	0.0769***	(0.0323)	-0.0128	(0.0731)
Personal goods renting	0.3093	(2.9107)	0.6789	(2.9186)	5.3224**	(3.1945)	-0.1748	(5.1605)
Education (market)	6.0297	(15.7807)	7.7914	(15.8339)	25.8623*	(16.9335)	0.1804	(11.8774)
Health (market)	0.0002	(0.0189)	0.0031	(0.019)	0.0592***	(0.0247)	-0.004	(0.0546)
Social work (market)	0.0035	(0.0345)	0.0101	(0.0348)	0.1022***	(0.0432)	0.0492	(0.1202)
Insurance	2.2395	(4.858)	2.8045	(4.8728)	10.5359**	(5.4243)	-0.3881	(4.1509)
Finance	-0.0796	(1.6693)	0.1827	(1.6832)	4.8559***	(2.1345)	0.0402	(0.5383)
Number of Observations	10779		10779		10779		8626	
R^2	0.26		0.27		0.27		0.05	

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.

Sectoral fixed effects in regressions (1,) (2) and (3). (1): no geographical dummies; (2): geographical dummies (contiguity with Germany, Belgium or Luxembourg, Switzerland, Italy, Spain, the Atlantic Ocean, the Channel, the Mediterranean Sea); (3): EA fixed effects.

Regression (4): First-differences 1993-1978.

Table 6: Correlation matrix between the distance ($Dist_{ij}$) and the absolute difference between estimated residual ($|e_i - e_j|$)

Agriculture Industry	0.009
Energy	0.064
Intermediate Products	0.036
Equipment Goods	0.016
Consumption Goods	0.030
Construction	0.053
Transport Services	-0.005
Market services	0.068
Insurance	-0.021
Finance	0.038

Table 7: Model with labor as the only input
Sectoral aggregation: 70 sectors - Geographical aggregation: 341 employment areas
Matrix used: generalized transport costs

	1993				*1978*			
	Estimate	Std. Error	Nb. of Obs.	R^2	Estimate	Std. Error	Nb. of Obs.	R^2
Coking, Mineral combustible	-47.39	(278.7865)	13	0.01	178.5251	(661.8098)	5	0.02
Gas, Oil production	-0.3276****	(0.109)	48	0.16	-0.2406***	(0.1059)	71	0.07
Electricity	-0.6897	(0.5472)	28	0.06	6.8389***	(3.3012)	94	0.04
Gas retail	-27.5339	(118.2809)	13	0.01	-0.7773*	(0.5005)	23	0.10
Water, Urban heating	-0.0162	(0.043)	180	0.01	-0.2772*	(0.1878)	125	0.02
Primary processing of steel	3.9445***	(1.758)	118	0.04	14.5423**	(7.8788)	101	0.03
Metallurgy of non-ferrous metals	-32.241	(25.6202)	99	0.02	-37.7401	(30.6156)	107	0.01
Miscellaneous ores	-5.2601	(11.6621)	57	0.01	-5.8392	(45.6642)	73	0.01
Construction, Ceramic materials	0.7593****	(0.276)	288	0.03	0.1623***	(0.0684)	316	0.02
Glass	1.1411	(1.474)	126	0.01	3.0868*	(2.08)	131	0.02
Basic chemics	-5.8258	(19.4053)	164	0.01	-29.8099	(57.6026)	177	0.01
Parachemics	0.0944	(0.0715)	184	0.01	0.0867	(0.0946)	166	0.01
Pharmaceutics	-0.0006	(0.0419)	117	0.01	0.1407*	(0.0907)	99	0.02
Metalworking	0.069	(0.0495)	316	0.01	-0.0424	(0.0837)	309	0.01
Agricultural machinery	0.5581	(1.1546)	118	0.01	26.9516	(21.3903)	154	0.01
Office machinery, Computers	30.5416	(37.9865)	66	0.01	72.6245	(283.9811)	46	0.01
Electrical equipment	0.3286	(0.232)	237	0.01	1.4856***	(0.7326)	206	0.02
Electronic equipment	-0.0099	(0.0965)	214	0.01	0.2317	(0.1836)	190	0.01
Household equipment	0.0208	(0.1813)	78	0.01	-0.1431	(0.2181)	112	0.01
Automobile	0.0809****	(0.0311)	239	0.03	0.4381***	(0.2061)	229	0.02
Precision equipment	-0.045	(0.1585)	153	0.01	0.089	(0.2153)	148	0.01
Meat products	0.0058	(0.0052)	250	0.01	0.006	(0.0057)	227	0.01
Milk products	0.0707****	(0.0229)	215	0.04	0.0433***	(0.017)	245	0.03
Canned foods	0.0539	(0.0436)	143	0.01	0.0938***	(0.0441)	116	0.04
Bakery	0.0167**	(0.0089)	147	0.02	0.0157***	(0.0064)	118	0.05
Grain products	0.1019	(0.0859)	214	0.01	0.1167****	(0.0429)	241	0.03
Miscellaneous food products	0.0404	(0.0368)	160	0.01	0.0573**	(0.0344)	157	0.02
Beverages, Alcohol	0.0527	(0.1126)	121	0.01	0.0005	(0.0005)	159	0.01
Tobacco	0.136	(0.2873)	20	0.01	0.3394	(0.6219)	25	0.01
Textile	0.0143	(0.0127)	202	0.01	0.0169***	(0.0071)	231	0.02
Leather	0.2982	(0.2155)	110	0.02	0.0178	(0.1017)	147	0.01
Shoes	0.0565***	(0.0263)	83	0.05	0.0562*	(0.0371)	125	0.02
Wearing apparel, Dressing	-0.0011	(0.005)	244	0.01	-0.0027	(0.0041)	286	0.01
Wood	0.1373	(0.1225)	274	0.01	0.0705	(0.2404)	286	0.01
Furniture	0.0131	(0.0111)	223	0.01	0.0114	(0.0098)	251	0.01
Paper, Pulp	-0.0947	(0.085)	224	0.01	-0.1113	(0.2495)	217	0.01
Printing, Press, Publishing	0.0343****	(0.0132)	247	0.03	0.1035****	(0.0382)	234	0.03
Rubber	1.4928**	(0.8123)	138	0.02	1.1298	(1.4529)	140	0.01
Plastic	0.0702	(0.0535)	270	0.01	-0.0364	(0.1573)	235	0.01
Miscellaneous industries	0.018**	(0.0107)	195	0.01	0.0093	(0.0137)	244	0.01
Construction	0.0168****	(0.0054)	340	0.03	0.0267****	(0.0077)	341	0.03
Reprocessing	nd	nd	nd	nd	0.1221	(0.1364)	118	0.01
Repair, Trade of motor vehicles	0.0025	(0.0022)	317	0.01	0.0044*	(0.0028)	316	0.01
Miscellaneous repair	0.0453***	(0.0199)	47	0.10	0.1932***	(0.082)	57	0.09
Hotel, Restaurant	0.0028**	(0.0016)	244	0.01	0.0025***	(0.0013)	234	0.02

Table 7 (continued)								
Rail transport	3.8066**	(2.1415)	251	0.01	0.243**	(0.1421)	288	0.01
Road transport	0.0395****	(0.0091)	326	0.06	0.0431****	(0.0145)	305	0.03
Sea, Shipping transport	-2.7142	(8.4726)	20	0.01	7.774	(9.7224)	26	0.03
Air transport	2.6166***	(1.3111)	35	0.11	10.5726**	(5.4441)	23	0.15
Warehouse	-0.1175*	(0.0784)	199	0.01	0.6409***	(0.2894)	189	0.03
Telecommunications, Mail	0.0505**	(0.028)	33	0.10	1.7126	(1.6858)	8	0.15
Holdings	0.0292	(0.0228)	286	0.01	0.0884***	(0.0359)	263	0.02
Personal goods renting	0.2232***	(0.1024)	104	0.04	0.9969	(0.8932)	90	0.01
Education (market)	0.1161****	(0.0309)	129	0.1	0.4115***	(0.1883)	51	0.09
Health (market)	0.0007	(0.0035)	305	0.01	0.0002	(0.0028)	323	0.01
Social work (market)	0.0012*	(0.0008)	326	0.01	0.0038	(0.0038)	266	0.01
Insurance	0.0517**	(0.0266)	148	0.03	0.2282**	(0.1342)	101	0.03
Finance	0.1134	(0.1033)	252	0.01	-0.0796	(0.2533)	272	0.01

nd: no demand.

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.

Separate regressions for each sector, no fixed effects.

Table 8: Model with labor as the only input
Sectoral aggregation: 10 sectors - Geographical aggregation: 341 employment areas
Matrix used: generalized transport costs

	1993				*1978*			
	Estimate	Std. Error	Nb. of Obs.	R^2	Estimate	Std. Error	Nb. of Obs.	R^2
Agriculture Industry	0.004****	(0.0012)	327	0.04	0.0006****	(0.0001)	325	0.04
Energy	-0.0515	(0.0371)	205	0.01	0.0985	(0.1773)	186	0.01
Intermediate Goods	0.0142	(0.0114)	341	0.01	0.0103	(0.0225)	339	0.01
Equipment Goods	0.0123***	(0.005)	332	0.02	0.0468***	(0.0201)	324	0.02
Consumption Goods	0.0028****	(0.0006)	335	0.05	0.0031****	(0.0008)	339	0.05
Construction	0.0168****	(0.0055)	340	0.03	0.0269****	(0.008)	341	0.03
Transport Services	0.0153****	(0.0041)	333	0.04	0.0341****	(0.0087)	328	0.05
Market Services	0.0004*	(0.0003)	339	0.01	0.0003	(0.0005)	340	0.01
Insurance	0.0269**	(0.0139)	148	0.03	0.157**	(0.0937)	101	0.03
Finance	0.1133	(0.1045)	252	0.01	-0.0864	(0.2594)	272	0.01

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.

Table 9: Model with intermediate inputs
Sectoral aggregation: 70 sectors - Geographical aggregation: 94 Départements
Matrix used: generalized transport costs - Year: 1993

	(1)		(2)		(3)	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Coking, Mineral combustible	294.4577****	(17.4088)	293.8076****	(17.4038)	307.0177****	(17.5925)
Gas, Oil production	-22.4139****	(4.5462)	-21.9954****	(4.5484)	-13.6959****	(4.8618)
Electricity	-50.241	(53.3824)	-47.8537	(53.3738)	30.0943	(54.949)
Gas retail	186.1913	(3162.8989)	475.2701	(3163.3793)	4860.2359*	(3308.3802)
Water, Urban heating	0.237	(6.902)	1.2875	(6.9124)	24.7506****	(8.2772)
Metallurgy of Iron and Steel	-0.7961	(3.6097)	-0.6782	(3.6088)	4.893	(3.7336)
Primary processing of steel	358.3731	(605.0526)	446.7929	(605.7068)	2120.9378****	(682.1998)
Extraction of non-ferrous metals	-47.1182	(69.0538)	-39.8456	(69.0731)	-26.8607	(68.8319)
Metallurgy of non-ferrous metals	-39.8058	(29.1706)	-35.1483	(29.2139)	36.0521	(32.5329)
Miscellaneous ores	-79.4872	(153.5342)	-63.9505	(153.6225)	323.4578**	(172.1632)
Construction, Ceramic materials	0.0921	(0.3665)	0.1598	(0.3673)	1.4643****	(0.4444)
Glass	1.4	(1.4592)	1.5445	(1.4595)	5.9428****	(1.6846)
Basic chemics	9.4637***	(4.2617)	9.895***	(4.2628)	18.8623****	(4.563)
Parachemics	7.9474	(20.3862)	10.6996	(20.4083)	76.3492****	(24.0588)
Pharmaceutics	-1.393	(26.4418)	1.4724	(26.4542)	78.1848****	(30.1848)
Metalworking	0.0054	(0.1534)	0.0314	(0.1537)	0.552****	(0.1842)
Agricultural machinery	30.3992	(197.2664)	54.2746	(197.3875)	592.2945****	(222.0836)
Machine-tools	-0.9969	(15.74)	1.4571	(15.7567)	44.2978***	(17.7396)
Civil-engineering equipment	4.2074	(16.6762)	7.4451	(16.7108)	38.9558***	(17.8001)
Office machinery, Computers	-0.4298	(10.0245)	0.8644	(10.0338)	26.7068***	(11.2462)
Electrical equipment	3.021	(11.925)	4.9044	(11.9476)	45.6961****	(14.3406)
Electronic equipment	0.1846	(0.9211)	0.314	(0.9223)	3.2682****	(1.0842)
Household equipment	1.3259	(6.82)	2.0577	(6.8231)	16.2722***	(7.393)
Automobile	1.3758***	(0.6137)	1.4501***	(0.6141)	3.3316****	(0.714)
Shipbuilding	14.8247	(38.8805)	12.9357	(38.8726)	56.7146	(39.2253)
Aeronautics	3.1497	(6.5136)	3.9758	(6.5221)	20.3638****	(7.2)
Precision equipment	0.5825	(4.5757)	1.1982	(4.5792)	15.4042****	(5.3087)
Meat products	0.0705	(0.3456)	0.121	(0.3463)	1.2805****	(0.4082)
Milk products	1.3694	(1.9927)	1.6336	(1.9952)	8.2326****	(2.3678)
Canned foods	1.5956	(5.4141)	2.1547	(5.4203)	17.9114****	(6.2181)
Bakery	0.4083	(1.8487)	0.5124	(1.8484)	2.1	(1.8712)
Grain products	0.7917	(7.9513)	1.5153	(7.9589)	24.0736****	(8.9456)
Miscellaneous food products	1.3721	(2.9445)	1.7967	(2.9482)	10.3885****	(3.4125)
Beverages, Alcohol	0.3601	(4.7895)	0.9979	(4.7941)	15.2639****	(5.5511)
Tobacco	2.0956	(11.4986)	2.8273	(11.4975)	18.7713*	(11.9557)

Table 9 (continued)

Textile	0.0903	(0.642)	0.208	(0.6433)	2.273****	(0.7558)
Leather	-1.8264	(10.0196)	0.0745	(10.0411)	24.76***	(10.9309)
Shoes	2.3461	(3.8311)	2.4322	(3.8298)	6.4952**	(3.9032)
Wearing apparel, Dressing	0.0184	(1.5935)	0.1969	(1.5944)	4.5839***	(1.8045)
Wood	0.1214	(0.8193)	0.2772	(0.8212)	3.1208****	(0.9717)
Furniture	0.4921	(2.6044)	0.7904	(2.6061)	8.0921****	(2.9667)
Paper, Pulp	-0.0826	(0.7406)	0.0384	(0.7417)	2.4632****	(0.8794)
Printing, Press, Publishing	0.2179	(1.4212)	0.3701	(1.4221)	4.213****	(1.5994)
Rubber	72.2075**	(40.5208)	76.4517**	(40.5337)	181.7935****	(45.5698)
Plastic	1.8637	(15.1313)	4.3019	(15.1496)	53.3532****	(17.76)
Miscellaneous industries	0.4025	(3.7824)	0.7813	(3.7847)	8.7533***	(4.093)
Construction	0.6768	(4.8224)	1.4031	(4.8301)	18.0852****	(5.8233)
Reprocessing	0.7234	(23.4281)	3.612	(23.4418)	63.2231***	(26.1212)
Repair, Trade of motor vehicles	0.0465	(0.8801)	0.1802	(0.8816)	3.2408****	(1.0645)
Miscellaneous repair	0.1566	(12.3574)	1.4037	(12.3618)	25.0947**	(13.1277)
Hotel, Restaurant	0.0025	(0.0238)	0.0062	(0.0238)	0.0903****	(0.0289)
Rail transport	11.5689****	(0.6638)	11.6757****	(0.6651)	13.9888****	(0.8041)
Road transport	4.0289	(5.0377)	4.7422	(5.0446)	21.2253****	(5.9715)
Sea, Shipping transport	56.8651	(418.0514)	77.1695	(417.9844)	734.738**	(441.7923)
Air transport	218.6549****	(74.194)	228.5755****	(74.2694)	387.593****	(81.6641)
Warehouse	-0.0516	(0.2157)	-0.0179	(0.2161)	0.7104****	(0.258)
Telecommunications, Mail	0.1031	(0.4719)	0.1434	(0.472)	1.082***	(0.5093)
Holdings	0.0044	(0.0322)	0.0091	(0.0322)	0.1225****	(0.0392)
Personal goods renting	1.2853	(10.4785)	2.5424	(10.4853)	33.5632****	(12.0437)
Education (market)	1.7435	(5.0531)	2.5046	(5.0599)	18.1347****	(5.9199)
Health (market)	-0.0266	(0.4353)	0.004	(0.4353)	0.644	(0.4503)
Social work (market)	0.0081	(0.0555)	0.0174	(0.0556)	0.2141****	(0.0675)
Insurance	0.8788	(2.2336)	1.2042	(2.2366)	8.9323****	(2.6883)
Finance	0.2357****	(0.0903)	0.333****	(0.1004)	2.5608****	(0.4501)
Number of Observations	8742		8742		8742	
R^2	0.26		0.26		0.28	

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.

Sectoral fixed effects in all regressions. (1): no geographical dummies; (2): geographical dummies (contiguity with Germany, Belgium or Luxembourg, Switzerland, Italy, Spain, the Atlantic Ocean, the Channel, the Mediterranean Sea); (3): EA fixed effects.

Table 10: Model with intermediate inputs
Sectoral aggregation: 10 sectors - Geographical aggregation: 341 employment areas
Matrix used: distance cost

	1993			*1978*		
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture Industry	5.6636**	6.7152***	43.3773***	1.2121	1.4055	6.8032
	(3.0555)	(3.1173)	(17.2617)	(1.5181)	(1.5195)	(5.9078)
Energy	-49.677****	-47.5781****	43.3477	20.2277*	23.7201**	90.4759
	(9.882)	(9.9961)	(43.8168)	(13.079)	(13.2648)	(75.4856)
Intermediate Products	2.3839**	2.5713**	14.3819***	-0.4909	-0.4665	3.774
	(1.436)	(1.4458)	(5.5843)	(1.3746)	(1.3736)	(4.6105)
Equipment Goods	5.3673***	5.8752***	31.9632****	4.4363**	4.9379**	21.0288
	(2.2531)	(2.2864)	(12.2401)	(2.4814)	(2.5194)	(17.3176)
Consumption Goods	2.1076	2.5874	21.7369***	0.8575	1.3085	14.3727
	(1.7872)	(1.8086)	(8.9099)	(2.1464)	(2.1723)	(14.0887)
Construction	10.9522	17.9152	357.3797***	3.884	10.9065	207.0152
	(24.4766)	(25.136)	(159.7388)	(25.1174)	(25.7594)	(212.426)
Transport Services	1.4194***	1.5615***	8.4128****	0.3974	0.8015	14.5287
	(0.6672)	(0.6744)	(3.2637)	(2.4712)	(2.4956)	(14.8532)
Market Services	-0.1208	-0.099	0.8799**	-0.3129	-0.2352	2.5414
	(0.2223)	(0.2219)	(0.5036)	(0.7288)	(0.7299)	(2.9979)
Insurance	7.0257	8.1242*	57.6757***	10.8553	14.9797	90.2394
	(5.2153)	(5.2932)	(24.3942)	(18.1485)	(18.3188)	(89.8006)
Finance	2.6918	4.092	60.5692***	-0.9413	1.2047	58.2463
	(5.1853)	(5.2798)	(27.5665)	(7.8592)	(8.0543)	(62.3436)
Number of Observations	2952	2952	2952	2895	2895	2895
R^2	0.07	0.08	0.18	0.09	0.10	0.19

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.
Standard errors in brackets.
Sectoral fixed effects in all regressions. (1), (4): no geographical dummies; (2), (5): geographical dummies (contiguity with Germany,Belgium or Luxembourg, Switzerland, Italy, Spain, the Atlantic Ocean, the Channel, the Mediterranean Sea); (3), (6): Employment Area fixed effects.

Table 11: Model with intermediate inputs
Sectoral aggregation: 10 sectors - Geographical aggregation: 341 employment areas
Matrix used: time cost

	1993			*1978*		
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture Industry	6.4006**	7.7966***	50.3016****	1.185	1.373	9.3946*
	(3.3466)	(3.4084)	(17.697)	(1.5698)	(1.57)	(6.2633)
Energy	-47.2673****	-44.3669****	61.063	30.3587***	34.0275***	133.4273**
	(10.901)	(10.9985)	(44.8708)	(13.3039)	(13.4543)	(78.9375)
Intermediate Products	2.3838*	2.6386**	16.2535****	-0.7342	-0.7204	5.5004
	(1.562)	(1.5721)	(5.6891)	(1.4)	(1.3988)	(4.8343)
Equipment Goods	5.4654***	6.1822***	36.3928****	4.3148**	4.8343**	28.5774*
	(2.458)	(2.4911)	(12.5081)	(2.5546)	(2.5891)	(18.1947)
Consumption Goods	2.2187	2.8599	25.0826****	0.9428	1.3965	20.8461
	(1.9544)	(1.9751)	(9.1473)	(2.2093)	(2.2335)	(14.9361)
Construction	16.5477	26.7101	421.227***	6.32	13.5585	305.8029
	(26.79)	(27.4652)	(163.681)	(25.8257)	(26.3937)	(224.8201)
Transport Services	1.8058***	2.0057****	9.936****	0.5119	0.9148	21.2655
	(0.7326)	(0.7399)	(3.3434)	(2.5308)	(2.5531)	(15.6822)
Market Services	-0.1323	-0.0982	1.0377***	-0.3241	-0.2435	3.8565
	(0.2435)	(0.2431)	(0.5231)	(0.7458)	(0.7468)	(3.1732)
Insurance	8.2874*	9.8091**	67.9068****	11.6538	15.9106	131.4285
	(5.7003)	(5.7664)	(25.0503)	(18.476)	(18.5729)	(94.617)
Finance	4.7991	6.8625	73.0385***	-0.6748	1.5377	87.1129
	(5.6862)	(5.7789)	(28.362)	(8.0909)	(8.2579)	(66.0167)
Number of Observations	2952	2952	2952	2895	2895	2895
R^2	0.07	0.08	0.18	0.09	0.10	0.19

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.
Standard errors in brackets.
Sectoral fixed effects in all regressions. (1), (4): no geographical dummies; (2), (5): geographical dummies (contiguity with Germany,Belgium or Luxembourg, Switzerland, Italy, Spain, the Atlantic Ocean, the Channel, the Mediterranean Sea); (3), (6): Employment Area fixed effects.

Table 12: Average share of transportation cost in marginal cost and average distance covered by goods in 1993

Sector	1	2	3	4	5	6	7	8	9	10
Transportation share (%)	0.05	0.047	0.013	0.03	0.023	0.389	0.037	0.004	0.246	0.059
Distance covered (km)	281.4	424.2	293.5	228.9	236	190.1	242.2	285.3	205.6	310.9

Table 13: Average share of transportation cost in marginal cost and average distance covered by goods in 1978

Sector	1	2	3	4	5	6	7	8	9	10
Transportation share (%)	0.011	0.087	0.005	0.03	0.02	0.294	0.04	0.009	0.403	0.378
Distance covered (km)	343.0	360.4	269.7	149.5	166.4	150.5	176.3	174.8	129.7	139.8

Table 14: Correlation matrix between local variables

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Number of plants	(1)	1	0.12	0.38	0.96	0.89	0.89	-0.21	-0.21	0.88	0.88	0.19	0.26	0.35
Employment per plant (real)	(2)	0.12	1	0.43	0.14	0.41	0.11	-0.14	-0.15	0.12	0.12	0.07	0.15	0.15
Employment per plant	(3)	0.38	0.43	1	0.45	0.42	0.39	-0.5	-0.52	0.44	0.44	0.32	0.5	0.49
Total employment (real)	(4)	0.96	0.14	0.45	1	0.9	0.94	-0.24	-0.24	0.94	0.94	0.22	0.29	0.38
Total employment	(5)	0.89	0.41	0.42	0.9	1	0.85	-0.2	-0.21	0.82	0.82	0.19	0.26	0.33
Total Production	(6)	0.89	0.11	0.39	0.94	0.85	1	-0.35	-0.35	0.89	0.89	0.36	0.45	0.54
Marginal cost	(7)	-0.21	-0.14	-0.5	-0.24	-0.2	-0.35	1	0.99	-0.2	-0.2	-0.87	-0.9	-0.83
Unit price	(8)	-0.21	-0.15	-0.52	-0.24	-0.21	-0.35	0.99	1	-0.2	-0.2	-0.85	-0.9	-0.83
Demand (value)	(9)	0.88	0.12	0.44	0.94	0.82	0.89	-0.2	-0.2	1	0.99	0.19	0.27	0.35
Demand (quantity)	(10)	0.88	0.12	0.44	0.94	0.82	0.89	-0.2	-0.2	0.99	1	0.19	0.27	0.35
Average mark-up	(11)	0.19	0.07	0.32	0.22	0.19	0.36	-0.87	-0.85	0.19	0.19	1	0.89	0.85
Production per plant	(12)	0.26	0.15	0.5	0.29	0.26	0.45	-0.9	-0.9	0.27	0.27	0.89	1	0.97
Profit	(13)	0.35	0.15	0.49	0.38	0.33	0.54	-0.83	-0.83	0.35	0.35	0.85	0.97	1

Figure 1: Total employment gross concentration index variations

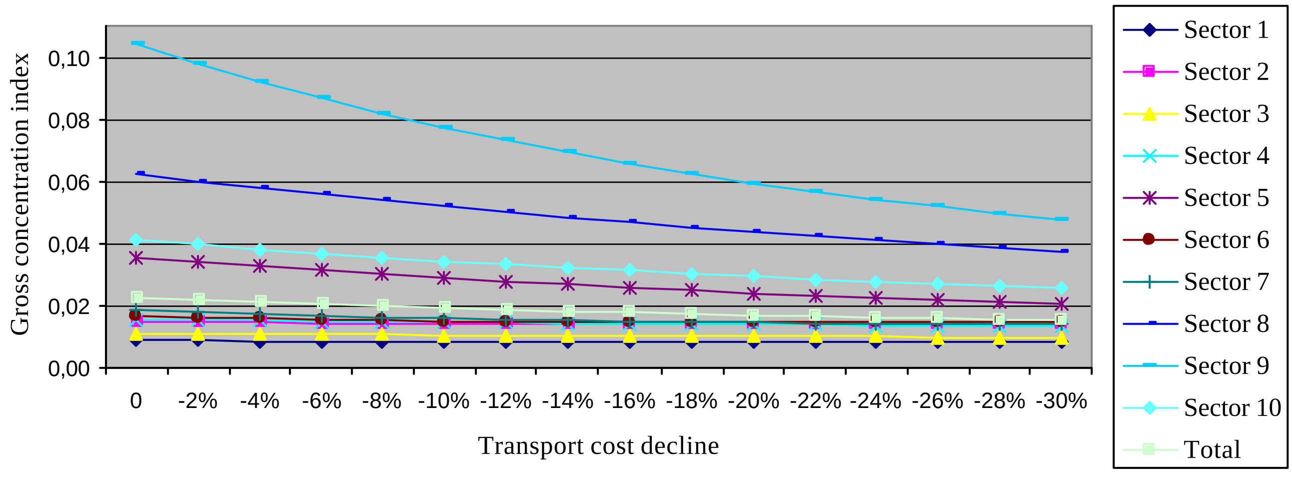


Figure 2: Total employment EG concentration index variations

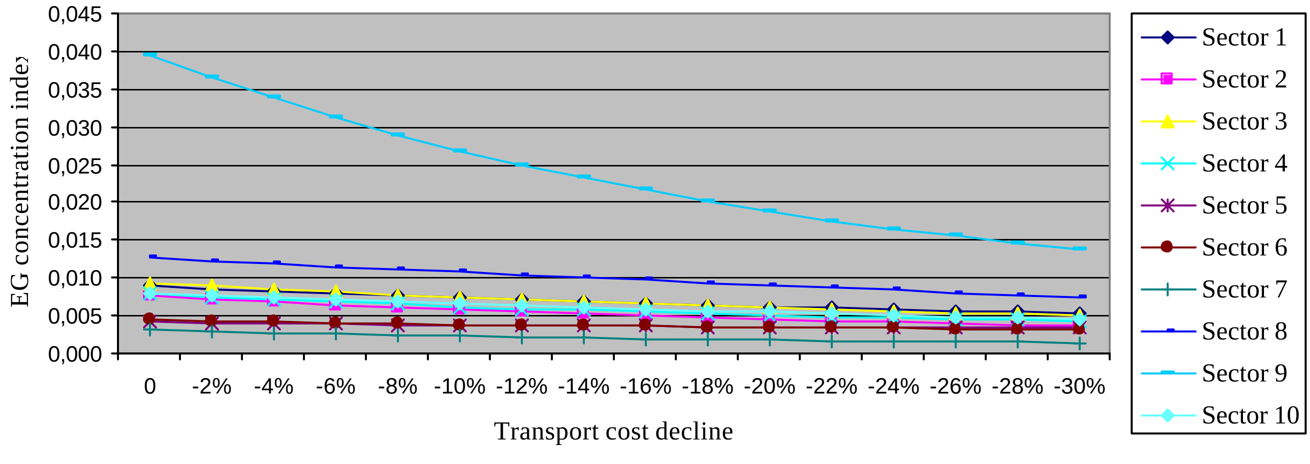


Figure 3: Total production gross concentration index variations

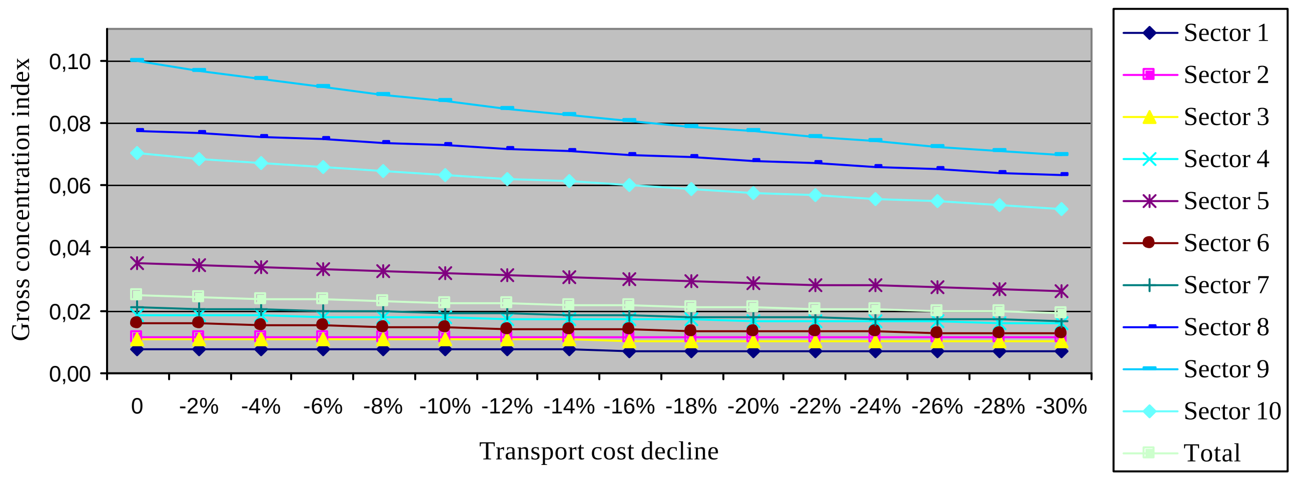


Figure 4: Total production EG concentration index variations

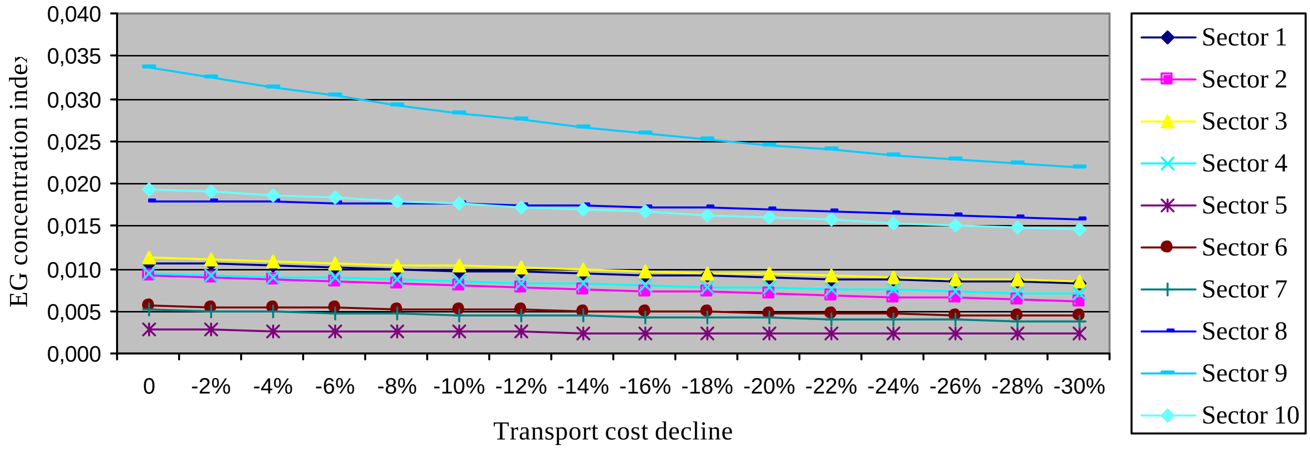


Table 15: Average variation of concentration indices for a 30% transport cost decline

Sector	1	2	3	4	5	6	7	8	9	10	Total
Production HI (%)	-12.31	-3.95	-10.84	-13.56	-25.24	-20.32	-20.19	-18.45	-29.78	-24.71	-21.02
Production EGI (%)	-22.71	-32.2	-25.3	-25.36	-18.35	-20.73	-27.13	-11.29	-34.9	-24.68	-
Employment HI (%)	-7.59	-5.41	-11.24	-14.6	-42.93	-11.95	-25.09	-40.06	-54.13	-37.66	-32.02
Employment EGI (%)	-40.55	-51.48	-46.66	-45.4	-17	-27.67	-53.08	-41.06	-64.95	-42.7	-

Figure 5: Correlation between profits and number of firms

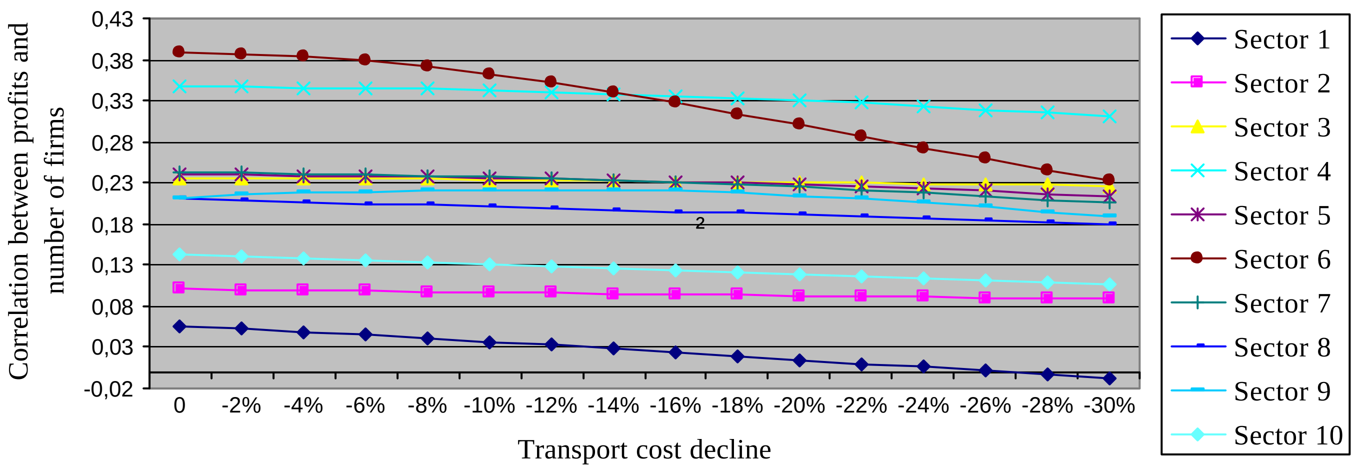


Figure 6: Correlation between profits and total production

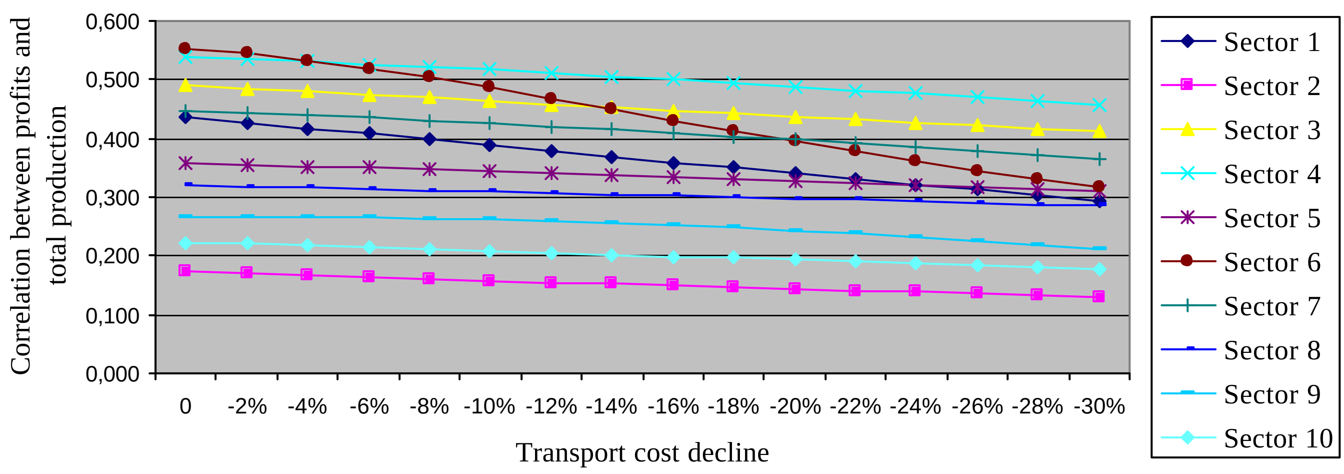
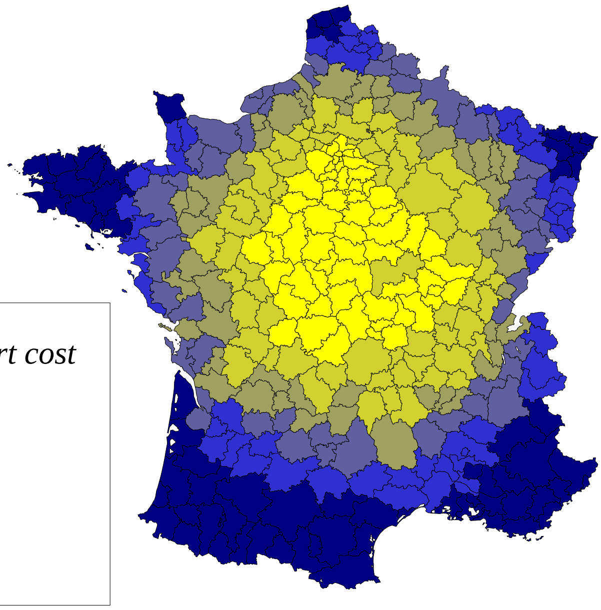


Table 16: Number of regions in which the EG index increases (over 21) due to a 30% transportation cost decline

Sector	Employment	Production
Agriculture Industry	15	10
Energy	17	13
Intermediate Products	15	7
Equipment Goods	18	10
Consumption Goods	15	9
Construction	18	11
Transport Services	14	10
Market services	17	11
Insurance	15	10
Finance	17	9
Total*	7	5

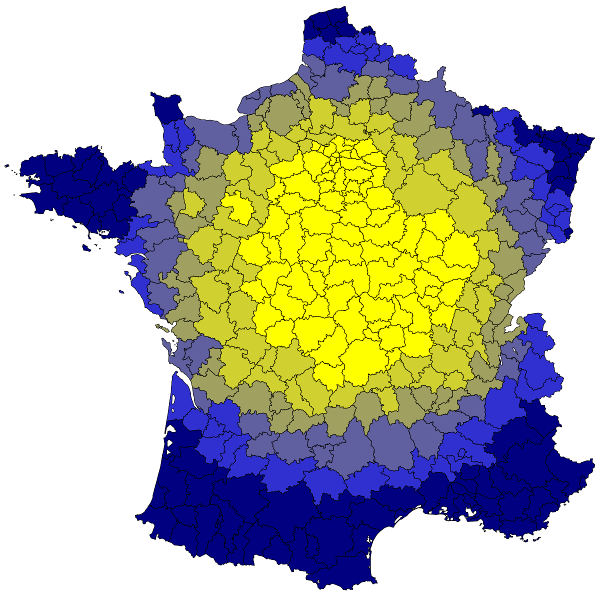
*: Gross concentration index



Map 1: Average generalized transport cost

Average = 100

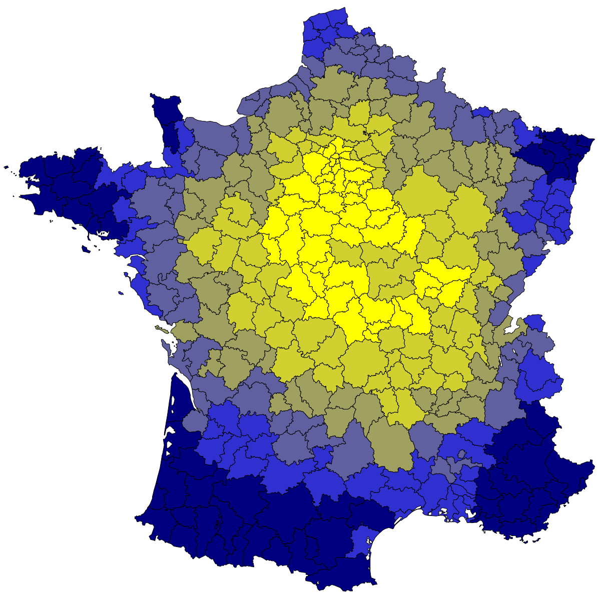
113 - 156 (66)
105 - 113 (54)
99 - 105 (48)
92 - 99 (49)
84 - 92 (63)
73 - 84 (61)



Map 2: Average distance

Average = 100

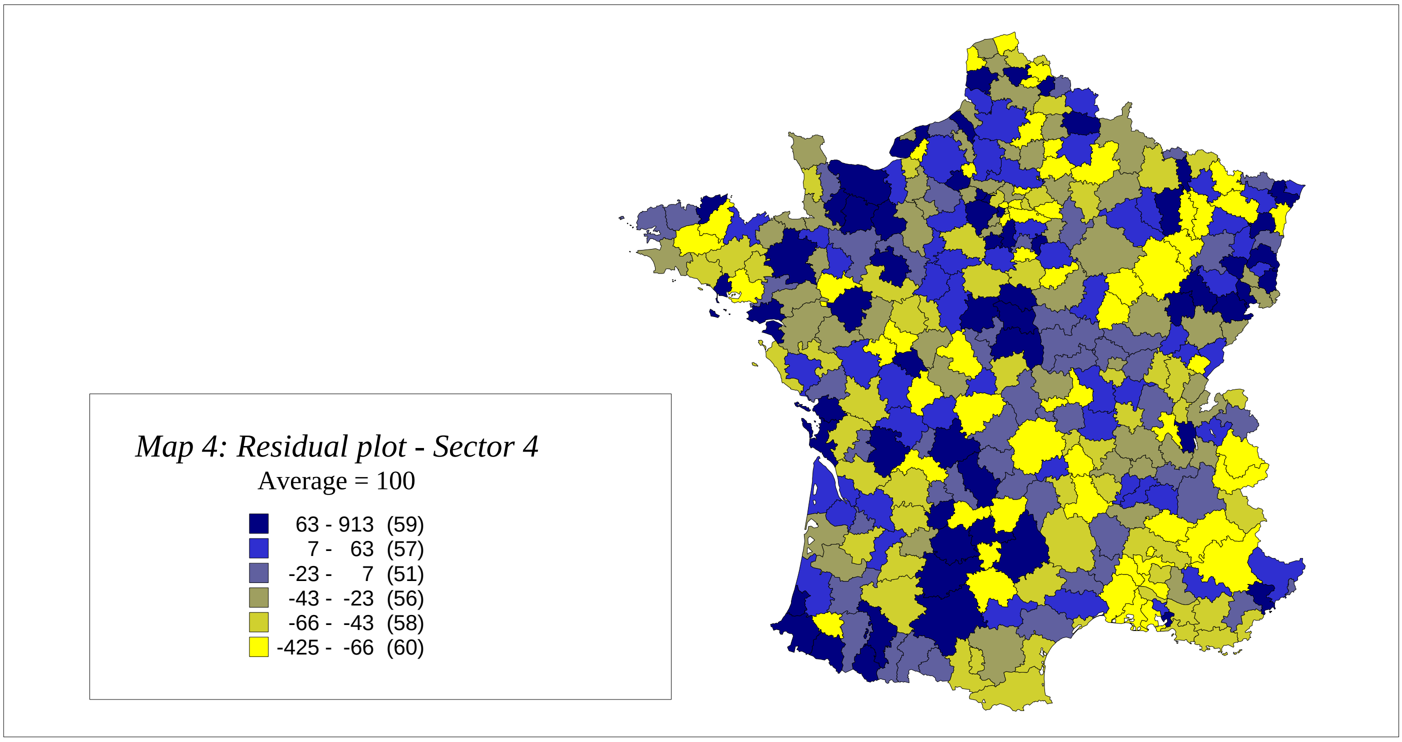
113 - 156 (77)
105 - 113 (46)
99 - 105 (42)
92 - 99 (45)
84 - 92 (52)
73 - 84 (79)



Map 3: Average time

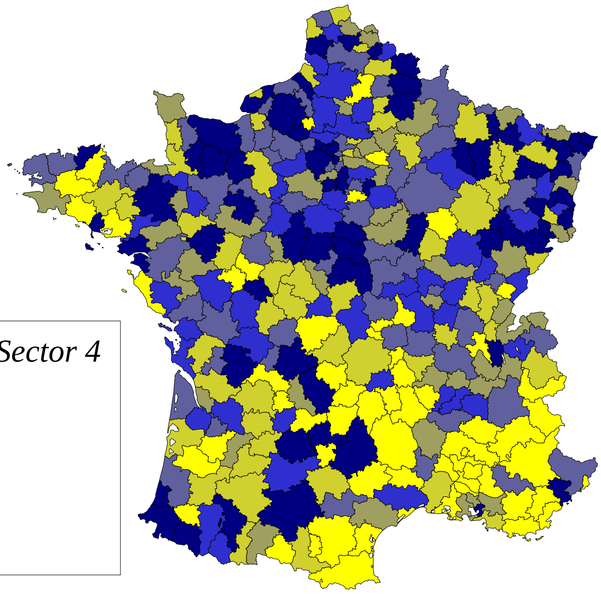
Average = 100

113 - 156 (57)
105 - 113 (57)
99 - 105 (58)
92 - 99 (60)
84 - 92 (61)
73 - 84 (48)



Map 4: Residual plot - Sector 4

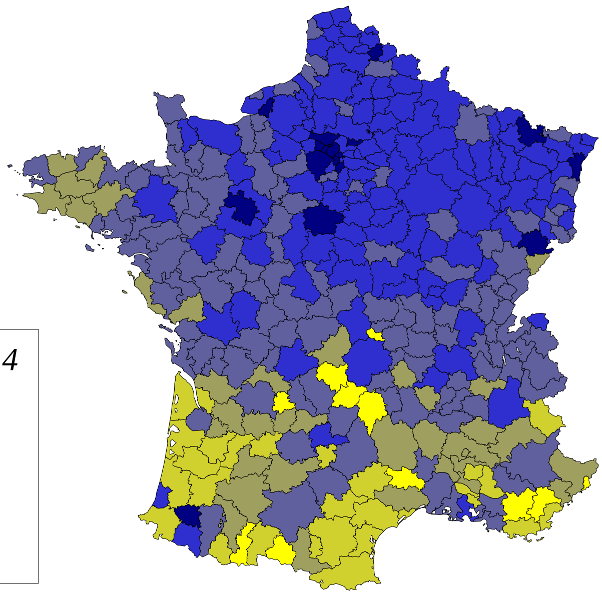
Average = 100



Map 5: Employment per firm (real) - Sector 4

Average = 100

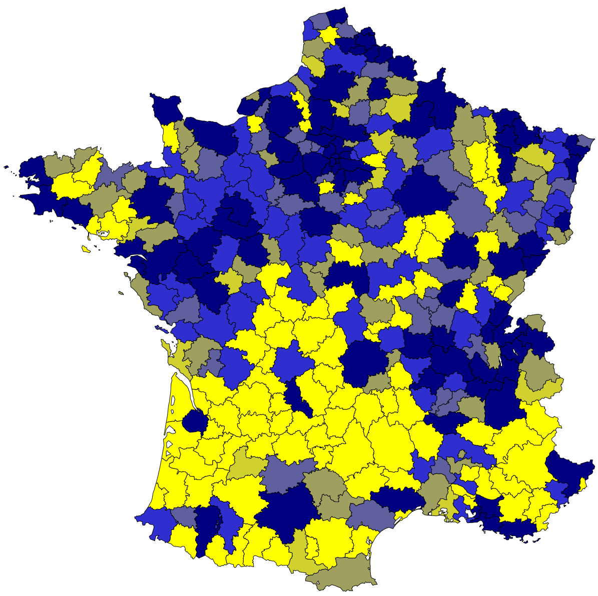
145 - 826 (65)
107 - 145 (51)
79 - 107 (59)
63 - 79 (50)
42 - 63 (55)
0 - 42 (61)



Map 6: Employment per firm - Sector 4

Average = 100

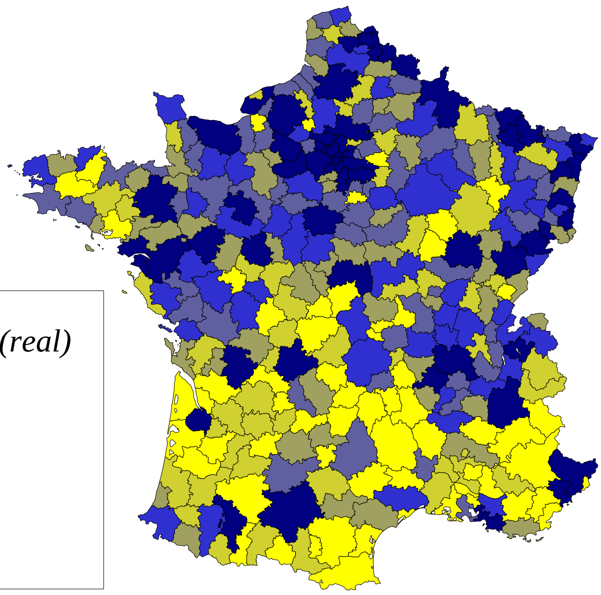
145 - 826 (17)
107 - 145 (119)
79 - 107 (130)
63 - 79 (36)
42 - 63 (28)
0 - 42 (11)



Map 7: Number of firms - Sector 4

Average = 100

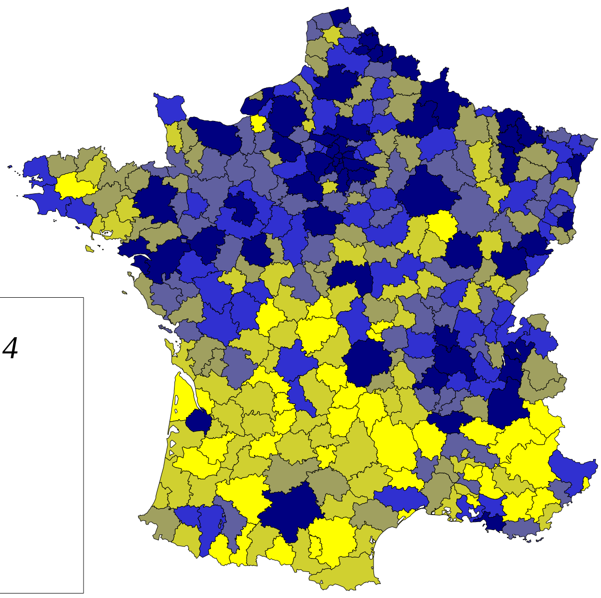
105 - 1 610 (86)
71 - 105 (59)
48 - 71 (38)
29 - 48 (47)
24 - 29 (14)
0 - 24 (97)



Map 8: Total employment - Sector 4 (real)

Average = 100

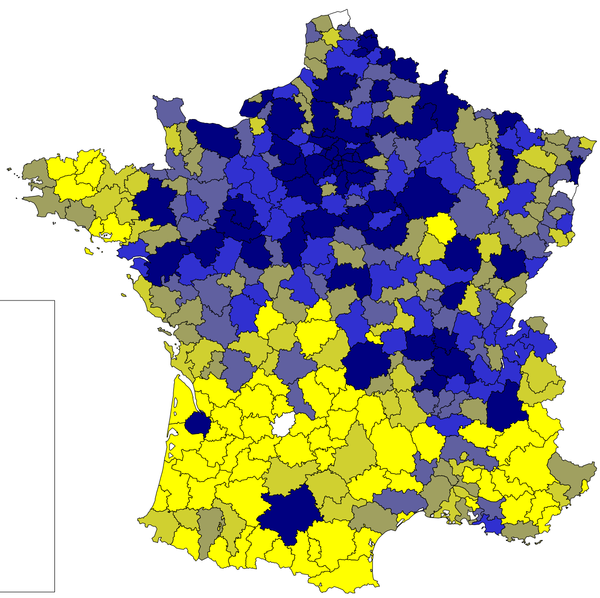
135 - 2 502 (62)
69 - 135 (54)
42 - 69 (59)
21 - 42 (53)
8 - 21 (51)
0 - 8 (62)



Map 9: Total employment - Sector 4

Average = 100

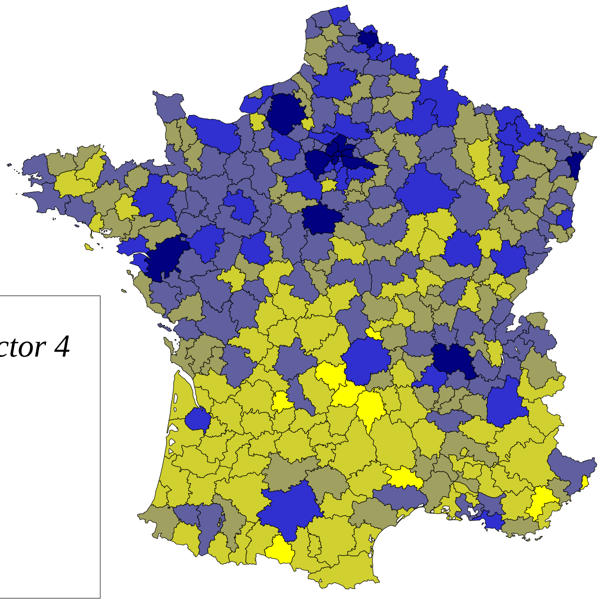
135 - 2 502 (58)
69 - 135 (62)
42 - 69 (60)
21 - 42 (60)
8 - 21 (60)
0 - 8 (41)



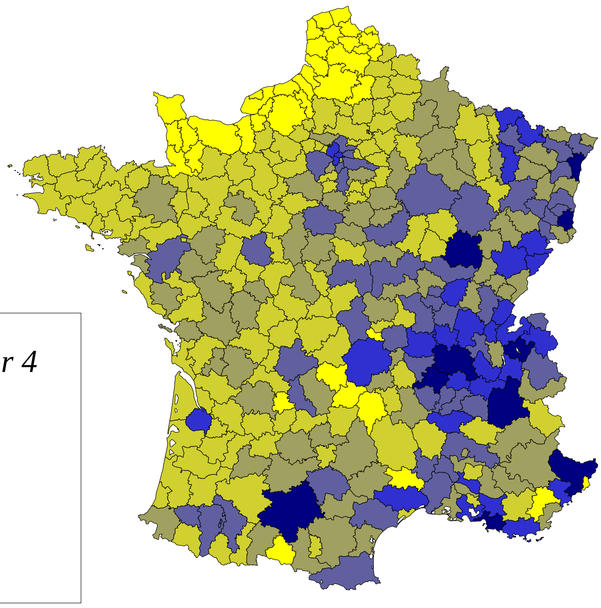
Map 10: Total production - Sector 4

Average = 100

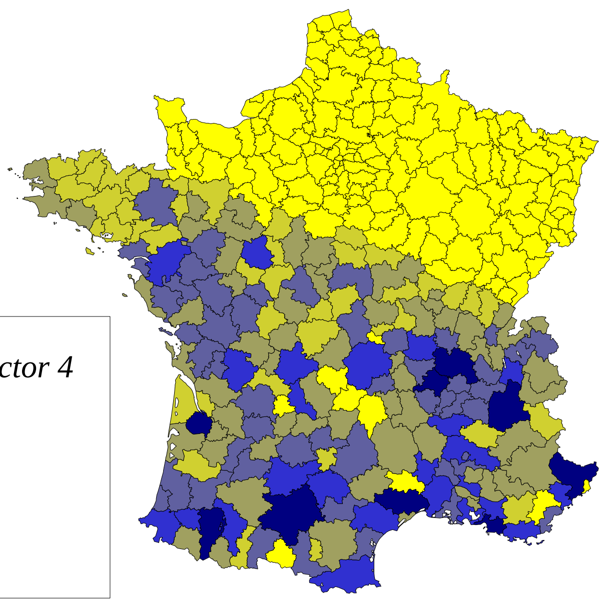
128 - 2 595 (61)
71 - 128 (57)
39 - 71 (56)
19 - 39 (57)
8 - 19 (43)
0 - 8 (67)



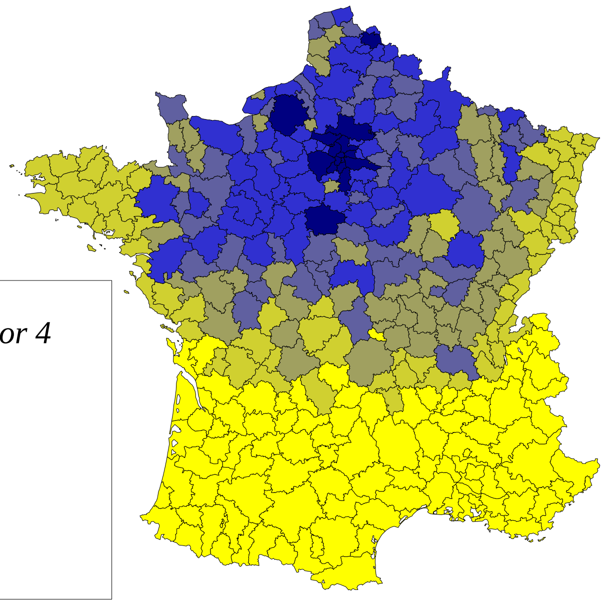
Map 11: "Ile-de-France" exports - Sector 4



Map 12: "Rhône-Alpes" exports - Sector 4

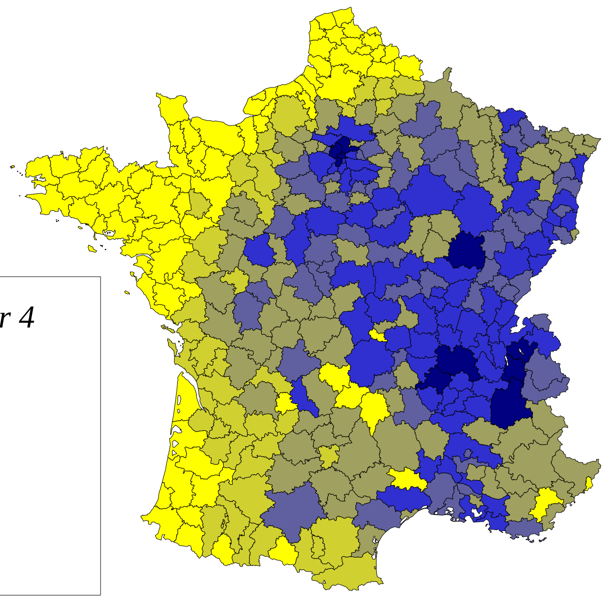


Map 13: "Midi-Pyrénées" exports - Sector 4



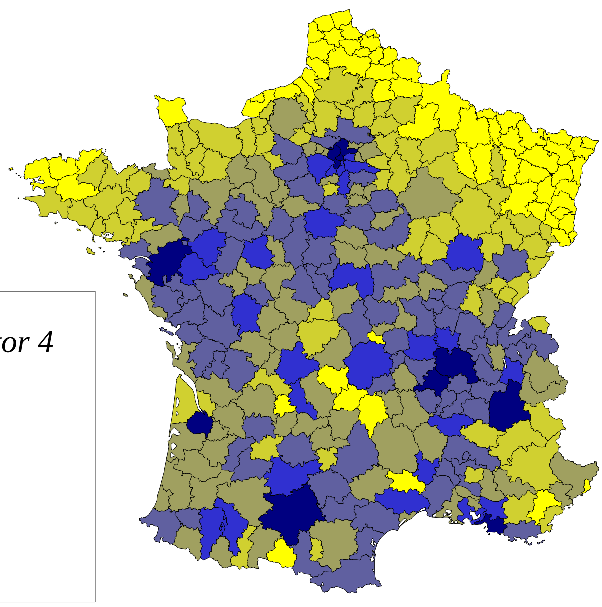
Map 14: "Ile-de-France" imports - Sector 4

Average = 100



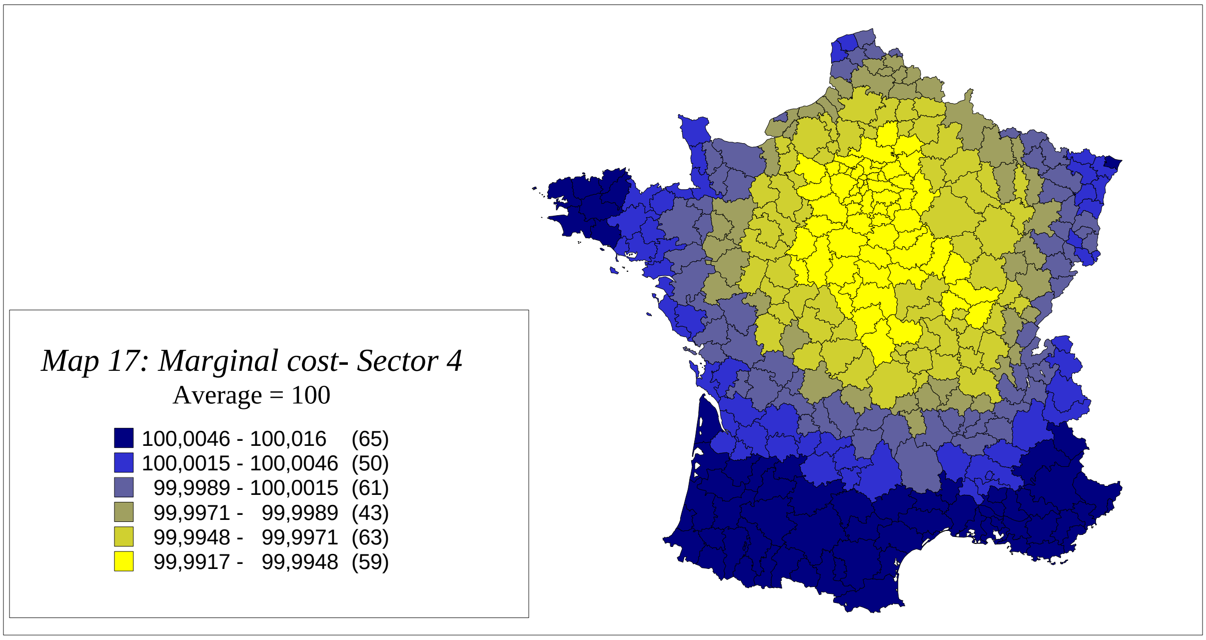
Map 15: "Rhône-Alpes" imports - Sector 4

Average = 100

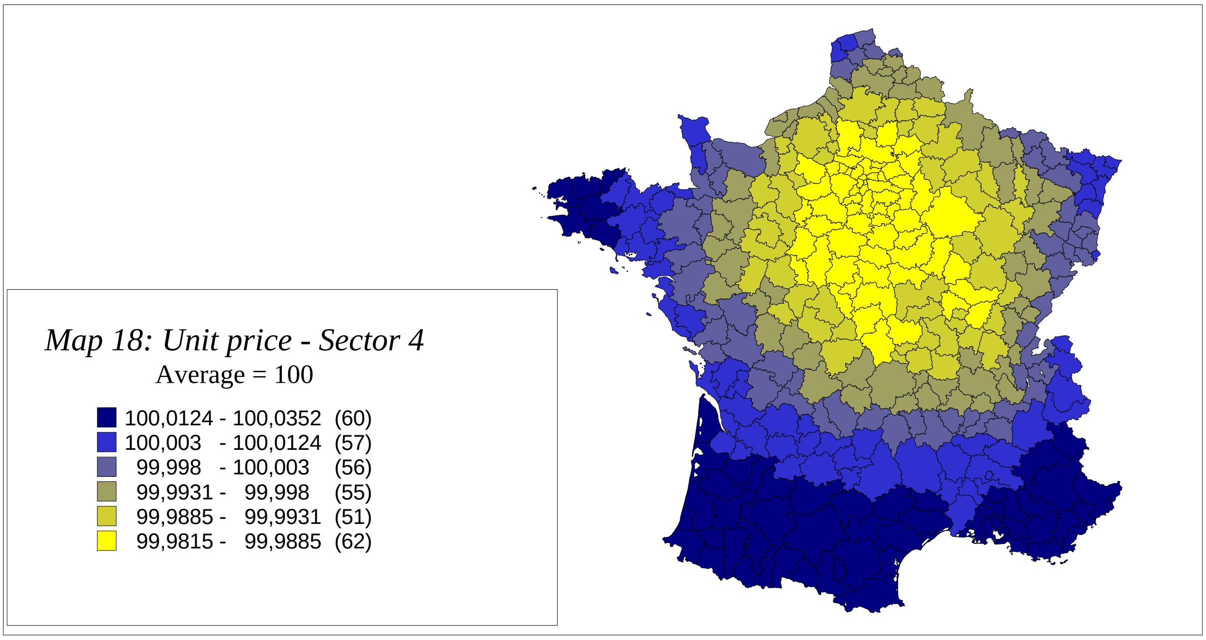


Map 16: "Midi-Pyrénées" imports - Sector 4

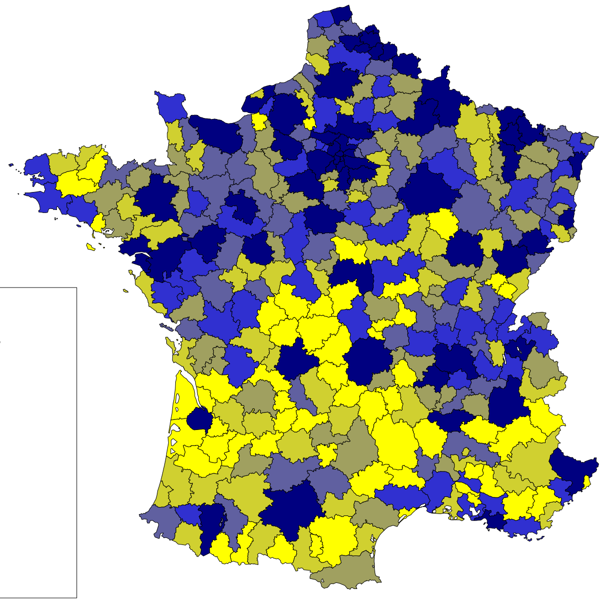
Average = 100



Map 17: Marginal cost- Sector 4
Average = 100

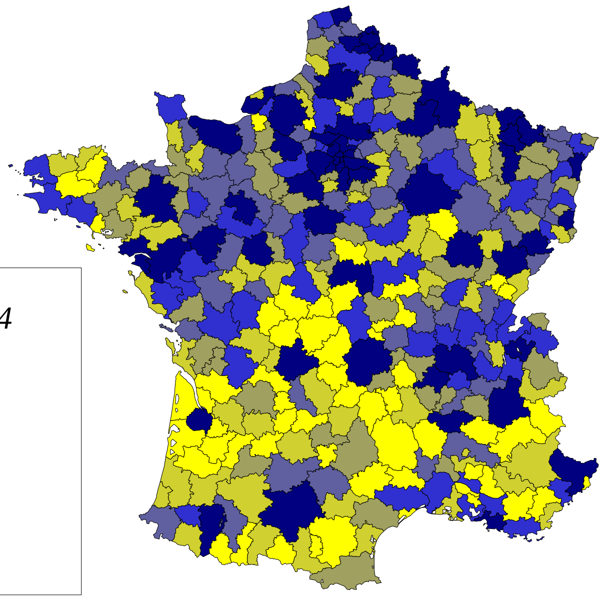


Map 18: Unit price - Sector 4
Average = 100



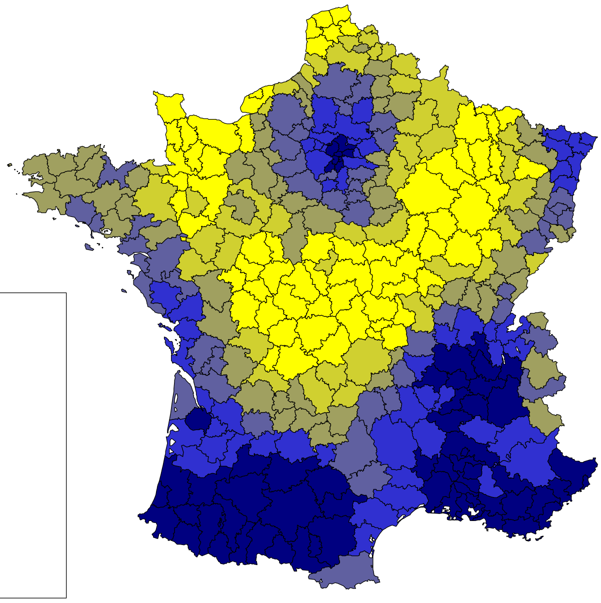
Map 19: Demand (value) - Sector 4

Average = 100



Map 20: Demand (quantity) - Sector 4

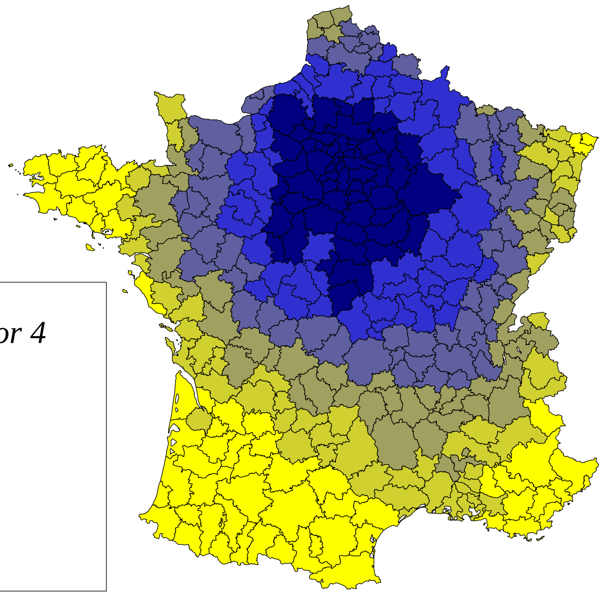
Average = 100



Map 21: Average mark-up - Sector 4

Average = 100

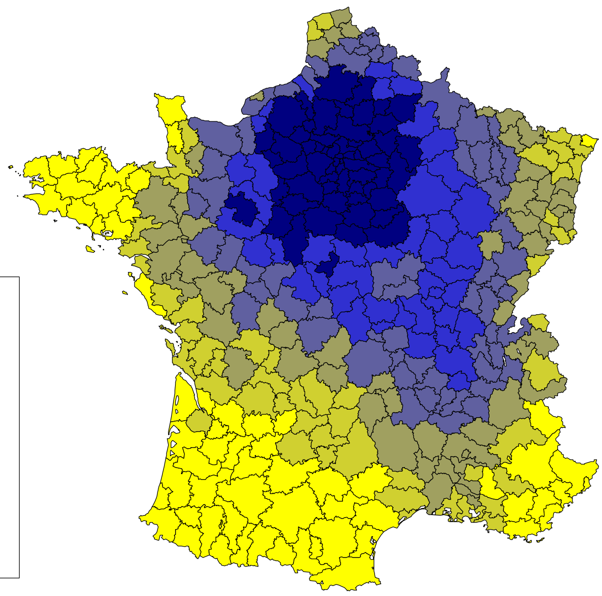
115 - 134 (63)
106 - 115 (56)
100 - 106 (48)
92 - 100 (61)
86 - 92 (45)
66 - 86 (68)



Map 22: Production per firm - Sector 4

Average = 100

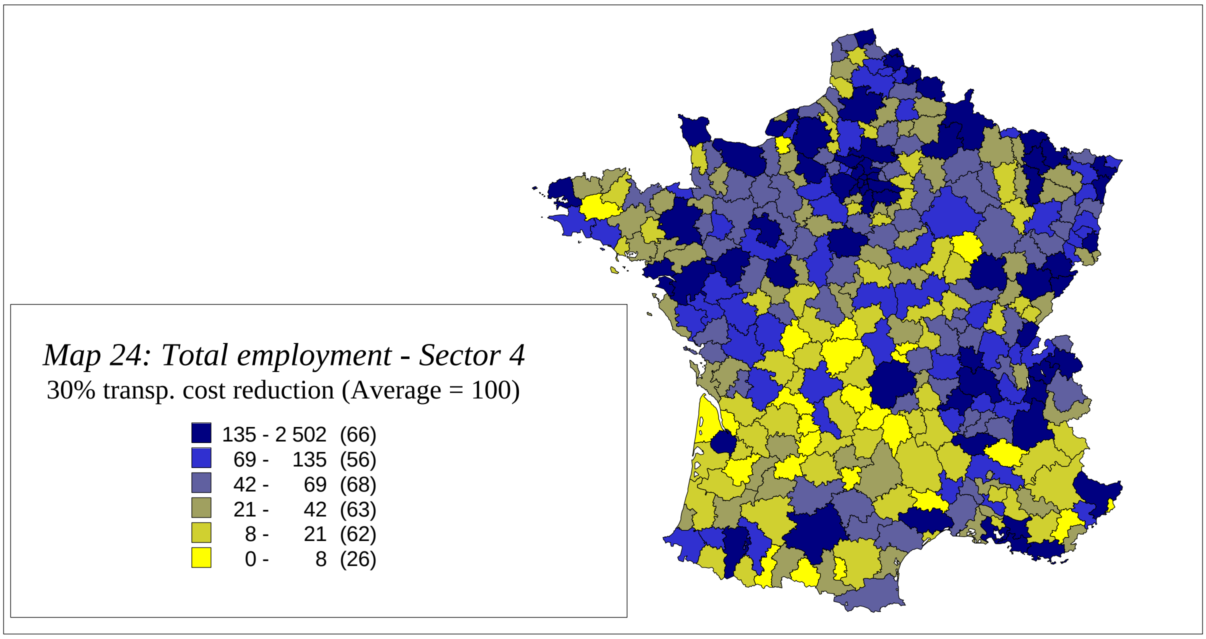
161 - 238 (59)
120 - 161 (55)
86 - 120 (58)
61 - 86 (54)
43 - 61 (55)
15 - 43 (60)



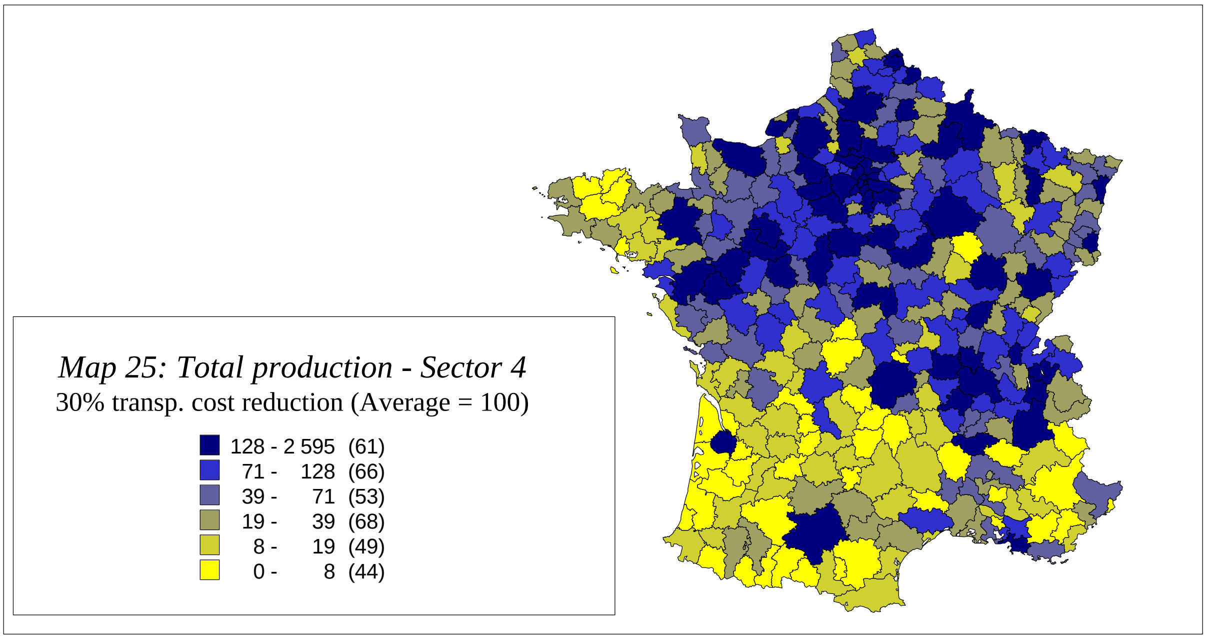
Map 23: Profit per firm - Sector 4

Average = 100

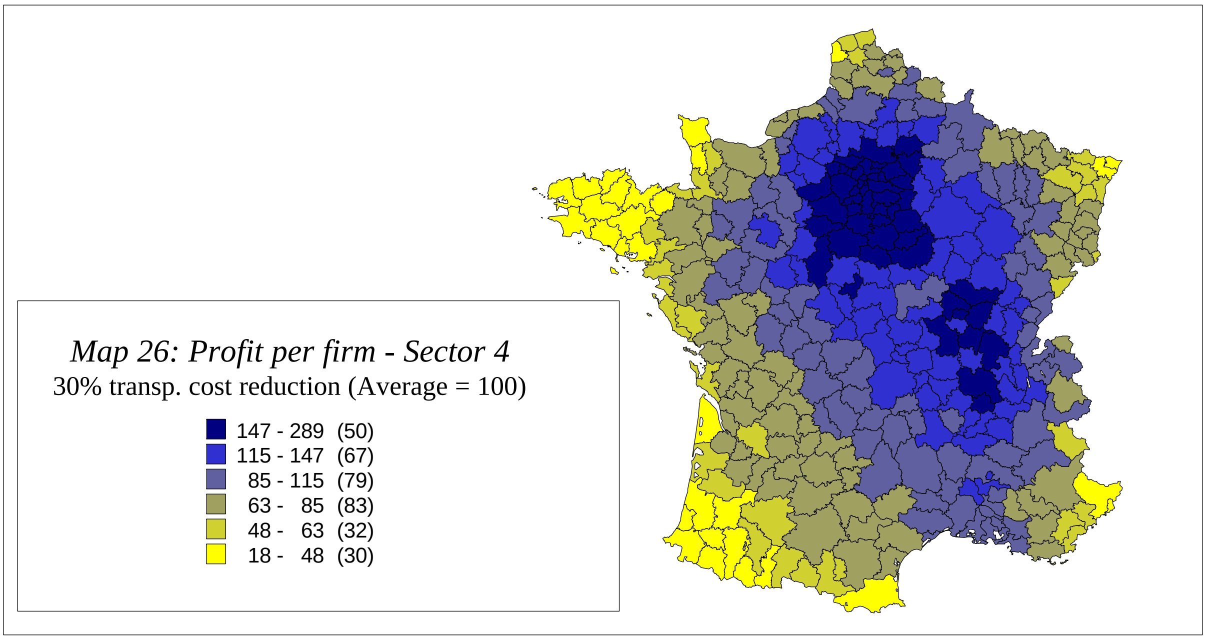
147 - 289 (60)
115 - 147 (44)
85 - 115 (63)
63 - 85 (58)
48 - 63 (53)
18 - 48 (63)



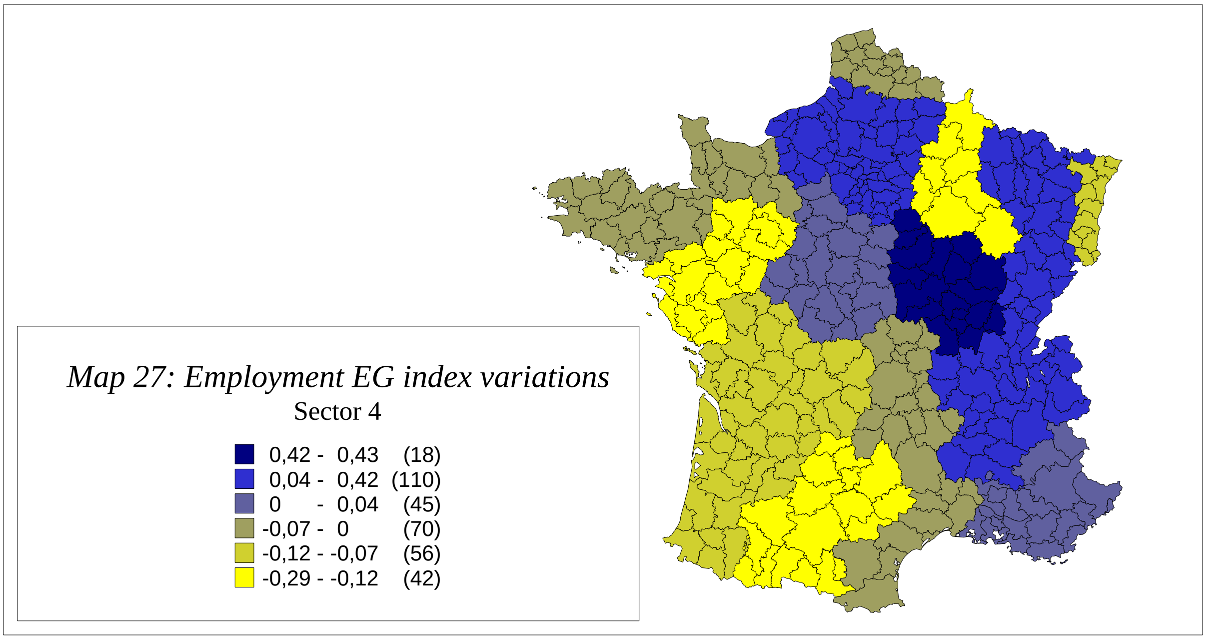
Map 24: Total employment - Sector 4
30% transp. cost reduction (Average = 100)



Map 25: Total production - Sector 4
30% transp. cost reduction (Average = 100)



Map 26: Profit per firm - Sector 4
30% transp. cost reduction (Average = 100)



Map 27: Employment EG index variations

Sector 4