Transport Costs, Geography, and Regional Inequalities *

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Abstract

This paper empirically investigates the predictions of economic geography models regarding the role of transport costs on regional inequalities. We perform a structural estimation of such a model on French data at detailed geographic and industry levels (341 "employment areas", 64 manufacturing and service industries). Transport costs, intermediate inputs, and real geography are shown to play a critical role in the spatial concentration of French activities.

Next, we present the estimated model predictions regarding the local economic conditions. For instance, the mark-up per unit is higher either at the France centre (low transport and unit costs even if high competition) or at the extreme periphery (low competition even if high costs), and low in between. However, due to large inequalities in production per plant, our model predicts a decrease in total profit from the center towards the periphery: because of these large concentration incentives at the center, regional inequalities are therefore expected to further increase in the future.

Last, we show that, in the short-run, decreasing transport costs may counterbalance the process of spatial concentration at the country level (leading for instance to the emergence of a duo-centric structure of profits). This is not the case at the regional level. Indeed, due to agglomeration mechanisms arising inside the country sub-geographical units, specialization is simultaneously strengthened within a large number of the 22 French " administrative regions".

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1 Introduction

One of the most salient feature of economic geography is the increase of regional inequalities stemming from economic integration. The decrease of inter-regional transaction 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]). Even though more than ten years of theoretical literature assesses these results, almost no empirical study has attempted to confront them to real data yet. The purpose of this paper is to determine if the economic geography forces are relevant to explain the observed distribution of economic activities and to empirically investigate the link between transaction costs and regional inequalities.

The three-region following example illustrates some of the difficulties in deriving from economic geography 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 EAs) 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., as on the links with other European regions. 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 precise measure of road transport costs.

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

Last, agglomeration and dispersion forces that shape the spatial distribution of economic activities are really intricate and often indirectly affect firms' location choices. In order to capture such effects and beyond data constraints impediments, empirical studies should therefore mirror the specifications that directly 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 regional inequalities.

Numerous previous works focus on the productivity gains that could arise from public spending in transport infrastructures. However, disparate results have flowed 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 to consider the network dimension of infrastructures in multi-regional contexts of trade and factors mobility.

First, some calibration attempts of these models have been performed (Smith and Venables [1988], Haaland and Norman [1992], Gasiorek *et al.* [1992], Gasiorek and Venables [1997], Forslid *et al.* [2003]). A first idea of the relocation effects of economic integration is obtained. However, the values of all parameters are arbitrarily fixed and not estimated, which narrows the exercise scope. For instance, the authors assume that transport costs account for 10 (or 20% depending on the study) of the value of trade instead of using data specific to each region and estimating the corresponding elasticity.

At the other extreme of the spectrum, real estimations are provided by some recent studies on gravity models (McCallum [1995], Helliwell [1996, 1997], Wei [1996]). This literature shows that trade flows sharply increase with trading partners' proximity, as measured by geodesic distance, language or adjacency. First, the measure of transaction costs and the consideration of the real geography remain crude. By contrast, recent papers focus on the measure of oceans or air freight rates (Hummels [1999a, 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]). Second, in any cases, all of these studies lack of theoretical foundations and neglect some of the effects stemming from underlying models.

For these reasons, a recent literature is designed to take economic geography models seriously for guiding empirical studies. These authors estimate equations directly derived from theoretical models, which allow them to provide much more precise statements, for instance on the impact of borders on trade flows (Head and Mayer [2000], Anderson and van Wincoop [2003]) or of transport costs on spatial concentration and regional inequalities (Hanson [1998], Redding and Venables [2000]). Our study clearly turns towards these lines.

To sump-up, the exercise here is different from the most achieved simulation exercise on economic geography models (Forslid *et al.* [2003]), because it is based on econometric estimations and not on postulated values of parameters. It is also different from the recent estimations of the Krugman [1991] model by Hanson [1998] and of the Krugman and Venables [1995] model by Redding and Venables [2000]. First, because the underlying theoretical model is different and, more importantly, because we go one step further in the use of theory and consider regional incomes as really endogenous, whereas these papers are mainly based on a labor (inverse) demand equation. Last, we use very precise data on transport costs between the 341 French regions, instead of physical distance, and we simultaneously estimate the model for 64 different industries.

The methodology we use is as follows. We first set up a multi-regional trade model in which plants 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 the good markets gives plants 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 the sectoral local employment per plant, on the one hand, and transport costs, regional incomes and number of plants, on the other hand. We use this specification to perform a structural estimation of the model at the geographical level of the 341 French EAs. Parameters are estimated for 64 sectors simultaneously. The new dataset on road generalized transport costs we use is computed using the real road network. Both a unit distance cost (gas, tolls, ...) and a unit time opportunity cost (truck depreciation, drivers' wages, ...) are considered. The theoretical model is not rejected for most sectors, for various specifications, including different sectoral and geographical aggregation levels. Endogeneity tests are performed. Moreover, the corresponding estimated coefficients are consistent with plausible values for the structural parameters of the model.

We next use the estimated model to present its predictions regarding the local economic conditions. For instance, the mark-up per unit is higher either at the France centre (low transport and unit costs even if high competition) or at the extreme periphery (low competition even if high costs), and low in between. Due to large inequalities in production per plant, our model predicts, however, a decrease in total profit from the center towards the periphery: Large concentration incentives exist and regional inequalities would further increase in the future.

Finally, we simulate the impact of a step by step decline in transport costs. In the short-run, that is, the number and location of plants being hold constant, the spatial concentration decreases at the country level. A 30% transport costs decline induces a 21% decrease in the concentration of production and a 32% decrease in the concentration of employment. However, agglomeration mechanisms simultaneously strengthens specialization within a large number of the 22 French "administrative regions", yielding there the development of competitive and dense EAs at the expense of others. The emergence of a duo-centric structure of profits confirms such a feature. Hence, spatial concentration would increase at the regional level.

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 costs 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 plants' 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' technology 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 technology is Cobb-Douglas. Production functions are the same across regions but they differ across sectors. The production of a representative plant operating in sector s and located in region j, y_j^s, is given by:

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

where l_j^s is the number of workers and $k_j^{s's}$ the quantity of good s' used by this plant. λ^s and $\beta^{s's}$ are constant parameters such as, for any s, $\sum_{s'} \beta^{s's} + \lambda^s = 1$. 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 plant's cost minimization program is:

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

This implies that the cost function in sector s and region j is 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:

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

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

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

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

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 $\sum\limits_s \gamma^s = 1$. 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 plants 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 plants owners' average income[2] and $\bar{l}_j$ is the number of plants owners in region j.

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

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

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

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:

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

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 plant 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 plant of sector s located in region j can be written as:

$$\pi_j^s = \sum_i \left(p_i^s - c_j^s - t_{ji}^s\right) y_{ji}^s - f_j^s. \tag{14}$$

We assume that plants behave as Cournot-Nash oligopolists. Each plant 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 plants as given. As usual in economic geography models, plants do not internalize the effect of their strategy on regional expenditures, R_j^s. These assumptions lead to the following first-order conditions for each plant in region j and sector s:

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

Short-run equilibrium

In the short-run, the number of plants 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 region j and sector s interior equilibrium price and quantities can be derived:

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

$$y_{ji}^s = \frac{p_i^s - c_j^s - t_{ji}^s}{\left(p_i^s\right)^2} R_i^s, \quad \forall i. \tag{17}$$

Note that, when transaction costs are high and/or asymmetries in the number of plants located in each region important, plants do not necessarily produce for all markets. Indeed, plants 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 $y_{ji}^s = 0$.

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 plants.

In the long-run, the number of plants in each region and sector is endogenous. It adjusts such as profits are zero:

$$\pi_j^s = 0. \tag{19}$$

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, these models prevent 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 plants across space. If regional demands and marginal costs were the same across regions, the more numerous the plants in a region (thus called the "highly competitive" region), the lower their size and average mark-up, and thus the lower their profits. This gives plants 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 plants 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. Moreover, this effect self-reinforces: The total production is even greater there and thus the demand. These demand effects increase the individual production of local plants relatively to the plants located in the less competitive regions. Thus, they give plants 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 plants are located. Plants' creation is stronger in this region, as long as the asymmetry between regions in the number of plants is not too large. Without any exogenous cost or demand advantages, an asymmetric equilibrium can be achieved in the long-run, one region benefiting from the location of more plants. This is all the more true, the lower the transaction costs and the higher the scale economies.

By comparison to Combes [1997], considering intermediary inputs first magnifies the endogenous demand effects that now transit through both final and intermediate markets. However, an agglomeration force of another nature is worth noting. Indeed, inputs prices are lower in the region where more plants are located. This acts as a new agglomeration incentive by creating an endogenous competitive advantage. The production costs of the plants located in the region where the competition between input producers is stronger are lower. Their short-run profit is higher, since Cournot competition prevails.

Clearly, when the number of regions is greater than two, as regards the impact of transaction costs on the location equilibrium, the story is more intricate. For instance, when transaction costs decrease, medium competitive regions would loose plants in favor of highly competitive regions, although attracting plants 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 scale economies parameters. Hence, hierarchical structures leading to the coexistence in the long-run of high, medium and low production areas may emerge.

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 plants 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 were sufficiently mobile, since they would also benefit from lower price index. Thus, this acts simultaneously as an agglomeration force, as in Krugman [1991]. These forces could be worth considering. However, important labor market disequilibrium makes European wages more rigid than the US ones and the labor mobility is fairly low in Europe,[3] the reason why we believe that these dispersion and agglomeration effects should not play a major role in France. Last, no reliable data on local wages exist in France. Thus, we choose to concentrate on the good market effects.

3 Data and econometric issues

This section first presents the data we use to perform the structural econometric estimation of the model presented in section 2, and next, the econometric methodology is developed. The geographical

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

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, incomes

The EA 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 all 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 $\left(\beta^{s's}\right)_{s',s}$ 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 plants are obtained by dividing the national wage bill (which includes the plants' 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 plant owners' income are obtained 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 French real road network, embodied in 9 912 and 10 430 arcs for 1978 and 1993, respectively, and the corresponding nodes. Next, the EA zoning is associated with the digitized network. Each EA is defined on the basis of its geographical centre.

We consider a six-arc classification, r $(r = 1, ..., 6)$, for which we first create a cost typology for a typical truck. The truck speed being different for each arc class,[6], let define the cost per km, c_r, as the average charge paid per kilometer for the arc class r. 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, which does not depend on the arc class. This cost includes the truck driver's wages, haulers' charges (insurance, taxes and security contributions), as well as the interim

[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.

[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). They have been reduced by 30% in the Ile-de-France EAs, due to congestion effects.

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.

Next, 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. Let $DistC_{ij}^I$ ($TimeC_{ij}^I$, respectively) denote the distance (the time, respectively) cost of joining areas i and j using itinerary I. They are defined by:

$$DistC_{ij}^I = \sum_{a_r \in I} c_r d_{a_r} \text{ and } TimeC_{ij}^I = f\left(\sum_{a_r \in I} t_{a_r} + t_l\right), \tag{20}$$

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 Θ_{ij} denotes the set of existing itineraries between EAs i and j, the transport cost between i and j is:

$$t_{ij} = \underset{I \in \Theta_{ij}}{Min} \left(DistC_{ij}^I + TimeC_{ij}^I\right). \tag{21}$$

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 gas price, 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 ($Dist_{ij} = \underset{I \in \Theta_{ij}}{Min}\left(\sum_{a_r \in I} d_{a_r}\right)$) or time ($Time_{ij} = \underset{I \in \Theta_{ij}}{Min}\left(\sum_{a_r \in I} t_{a_r} + t_l\right)$).

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 Table 1 (Cost per km Components) and Table 2 (Time Opportunity Cost Components) -

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 gas consumption. Gas costs, which correspond to the most sensitive haulers' budget heading, have been

[7] t_l is fixed to twice one hour.

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.

The inter-EA transport cost declines between 1978 and 1993 by 38% on average. If c_r and f had remained identical, this decline, due to infrastructure improvement alone, would have been 2.5% only.

Figure 1 maps the average generalized transport cost from any EA to the other EAs. This cost monotonically decreases from the center to the periphery. Note also that the center does not correspond to the geographical center of France, but is located norther, towards Paris surrounding EAs (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 Figure 1 (Map of Average Generalized Transport Cost) -

The reader can find further methodological details as well as some complementary descriptive statistics on the generalized transport cost in Combes and Lafourcade [2002].

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 specifications derived from the theoretical model. We 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 technology 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 to be estimated ν^s such that:

$$t^s_{ij} = \nu^s t_{ij}. \tag{22}$$

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

Two interpretations can be given to the parameter ν^s. First, ν^s may embody the differences between sectors in the size of the batches which are exported using the truck. Indeed, it corresponds to the inverse of the number of good s units that can be loaded in the truck, since in the model t_{ij}^s 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, ν^s more generally reflects the "correlation" between the true transaction cost incurred in sector s and the road transport cost. This is the second interpretation we give to the parameter ν^s.

Parameter $(\nu^s)_s$ are those we estimate. If the ν^s are not significantly negative, the theoretical model is not rejected for the particular transaction cost which corresponds to our generalized road transport cost. In particular, the observed employment per plant observed is consistent with our Cournot competition assumption as with the fact that markets are segmented. Negative estimates mean either that the transport costs we use do not reflect the true transaction costs incurred, or that the Cournot competition economic geography model is not relevant to explain the French spatial distribution of economic activities. Data are available for all other parameters of the model.

Econometric methodology

The dependent variable used to perform estimations is the local sectoral employment per plant, l_j^s. However, in the theoretical model, this variable is not linear in $(\nu^s)_s$. It is thus first necessary to linearize equations (5), (16), and (17), to be able to perform a structural estimation using simple econometric methods. Note, however, that we check afterwards that the linearization assumption is indeed verified. This linearization is presented in the Appendix and leads to:

$$l_j^s = \nu^s Z_j^s + \sum_{s' \neq s} \nu^{s'} Z_j^{s's} + \alpha^s, \tag{23}$$

where the Z_j^s and $Z_j^{s's}$ explanatory variables are defined in the Appendix, as the sectoral constant α^s. These variables are computed using the data reported in section 3, that is to say, preferences and technology parameters, sectoral wages, transport costs, local sectoral employment and plant number.

The estimation we perform is structural in the sense that equation (23) is directly derived from the relations that characterize the equilibrium of the economic geography model. The Z_j^s and $Z_j^{s's}$ variables cannot be directly interpreted, but they embody all the agglomeration and dispersion forces of this framework. In this model, recall that the local sectoral employment is endogenous, whereas transaction costs and wages are exogenous. The local sectoral plant number is exogenous in the short-run and endogenous in the long-run. We make the econometric assumption that errors terms are due to measurement errors on the local sectoral employment per plant. This assumption makes it possible to consider the explanatory variables as exogenous from an econometric point of view. This is all the more plausible since these variables depend on aggregate values, whereas the dependent one is employment per plant.[9] However, since Z_j^s and the $Z_j^{s's}$ depend on variables that are endogenous in the model and since, more generally, employment per plant measurement is probably not the only source of error, some endogeneity tests are performed below. Note finally that the local sectoral plant number is observed. Hence, we have no assumption to make regarding the fact that we observe a short- or a long-run equilibrium, and thus regarding the local level of fixed costs for instance: Equation (23) is thus compatible with both the short-run and the long-run equilibrium.

Because of the linear specification derived from the model and considering the exogeneity assumption, we can use the Ordinary Least Squares to fit equation (23) on our panel of 341 EAs and 70 sectors, for any given year. For computational feasibility at the 70-sector level, we restrict the input-output matrix to the intermediates which represent more than 10% of the cost expenditures. This implies that 6 sectors have neither intermediate nor final demands, and must be excluded from the study.

The availability of panel data gives us some flexibility in the econometric specification: Both EA and sectoral fixed effects may be included. The sectoral fixed effects are necessary, since the theoretical model implies a sector-dependent constant. They also control for the characteristics that are common to all EAs, but specific to sectors, as for instance sectoral differences in the business cycle or variations in the representativity of the employment survey, which depends upon the sector. The EA fixed effects capture those characteristics of the local sectoral employment per plant that are unobservable, but do not vary across sectors. They may arise, for instance, from differences in the EA area or from the presence of mountains, seas, oceans or borders with foreign countries, that is to say, purely geographical effects. Importantly, they partly correct for the autarkic nature of the model in which international trade is not considered.

4 Structural estimations

In this section, we first move on to the 1993 estimation of equation (23). 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 and to the transport cost matrix (distance or time instead of generalized cost) are studied to test for the robustness of the 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

[9] This is the reason why we choose to not multiply both left- and right-hand-sides by the observed number of plants, even this would have greatly increased the R^2.

specifications are estimated: Including no geographical effects, including eight geographical dummies (corresponding to the presence of seas, oceans or borders), or including fixed effects for all geographical units. We include sectoral fixed-effects in all regressions, as implied by the model.

70-sector aggregation

When the 70-sector aggregation is considered, we carry out estimations over 64 sectors as explained above. The estimation results are reported in Table 3.

- Insert Table 3 (70-sector, 341-EA Full Model Estimations) -

Recall that our data and theoretical model are not invalidated when the estimates are not significantly negative.[10] The solution which produces the best fit includes EA fixed effects (Table 3, column (3)). Even if the R^2 is not high, 47 estimates are significantly positive, 33 (over 46) in industry, 14 (over 18) in services. Only one estimate is significantly negative, for the sector Gas and oil production. This is, however, a rather specific activity in France, as regards both the location of production and the retail organization. Only two other estimates are negative, non-significantly.

Compared to the regression without any geographic effects, including geographical dummies improves the fit and this improvement is even stronger when EA fixed effects are used. Less and less estimates are negative and the significance of the positive estimates is higher. The absolute value of the significantly negative estimate is divided by two when considering EA fixed effects and its significance 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 are well captured by the generalized transport cost measure we use. The interaction between the resulting agglomeration forces (high final 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 EA fixed effects, that is to say, by constant local characteristics, exogenous to the model. One could for instance think about real geographical components, access to oceans, proximity to other European countries, mountains, climate amenities... Hence, even if geography is partly captured by the transport cost matrix and the strategic interactions on segmented markets model, other geographical effects also matter in the shaping of economic activities. One requires both types of explanations, the endogenous ones underlined in the economic geography models and the exogenous ones purely geographical, to understand the agglomeration process in France.

10-*sector 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] "significant" means here significant at least at the 10% level, even if the 5% or 1% levels are often reached.

10 sectors. Corresponding estimations are reported in Table 4.

- Insert Table 4 (10-sector, 341-EA Full Model Estimations) -

Without geographical effects, the estimates of four sectors only are significantly positive. They are significantly negative for the sector of Energy (sector 3), and non-significantly, though positive, in other sectors. The precision of the estimation increases when considering geographical dummies. With EA fixed effects, all estimates are positive, significantly for 9 sectors over 10. These are the results that are used for the predictions and simulations reported in section 5.

4.2 Sensitivity Tests

Tables 5 to 9 set out regressions designed to deal, first, with some potential econometric problems (endogeneity and heteroscedasticity), and, next, with the role of intermediate inputs (in comparison with a model where labor is the only input), with the role of the generalized transport cost matrix (in comparison with the distance or time matrices) and with the role of the geographical aggregation level (in comparison with the département level).

Endogeneity and heteroscedasticity

Some econometric problems may arise first from the fact that the right-hand-side variables of equation (23) may be correlated with the disturbance term, ϵ_j^s. There are two possible sources of such an endogeneity. The first one occurs when the EA specific effect is correlated with the error term, which can be addressed by using first-difference regressions. The second one occurs when the explanatory variables 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 (23) 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 (70-sector, 341-EA Full Model Estimations for 1978) -

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 quality 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 ν^s are the same in 1978 and 1993. This could be false for two reasons at least. 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 the INSEE modified its 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 explanatory variables with the error term, even if the dependent variable, the employment per plant, does not directly enter their definition (which are functions of total employment, wage and plant number). 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 heteroscedasticity. For instance, Figure 2 presents such a plot for the sector of Equipment goods (sector 4).

- Insert Figure 2 (Map of Residual) -

More precisely, we check out for possible spatial auto-correlation by computing the correlation between the absolute difference of the EA residual estimates, $\left(\left|\widehat{\epsilon}_j^s - \widehat{\epsilon}_i^s\right|\right)_{i,j=1,\ldots 341}$ and the corresponding distance, $Dist_{ij}$. These correlations, reported in Table 6, are close to zero for all sectors, which is the second sign of no spatial auto-correlation.

- Insert Table 6 (Correlation between Distance and Residual difference) -

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 simplified version of the model developed in section 2, in which all intermediate consumptions are set to zero ($\left(\beta^{s's}\right)_{s',s} = 0$). Whereas all the $(\nu^s)_s$ are simultaneously estimated in the previous estimations, in this simplified model, for any given sector, equation (23) is independent from other sectors ones. Therefore, the $(\nu^s)_s$ 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 fixed effects 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 final consumption is zero, which lead us to exclude 7 more sectors. Table 7 reports the 1993 results for the remaining 57 sectors.

- Insert Table 7 (70-sector, 341-EA, without Intermediate Model Estimations) -

Estimates are non-significant for 37 sectors, among which 23 are positive. The estimate is still significantly negative for the Gas and oil production sector. Estimates are significantly 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 and at the 10-sector aggregation level (see Combes and Lafourcade [2001]).

Hence, the assumption of labor as the only production input, and of final consumption as the unique use for output, is relevant in some sectors, more in services, which makes sense. However, the increase in the level of estimates shows that the agglomeration and dispersion forces are magnified when taking into account the intermediate demand and cost effects. Considering intermediate inputs is even absolutely necessary to obtain consistent estimations in many sectors.

Employment Areas vs "Départements"

Another interesting question arises from the influence 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 EA definitions rely on the density of the local economic activity. For instance, their borders are assumed to be consistent with daily migrations or upstream-downstream plants' relationships. However, the decrease of the explanatory power of the model for the département geographical level is modest. When département fixed effects are introduced, a fairly satisfactory fit is obtained in 1993, as can be seen in Table 8.

- Insert Table 8 (10-sector, 94-département Full Model Estimations) -

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 aggregation level. Note, however, that the distance and time considered are the real ones, that is corresponding to the real road network, being thus more sophisticated measures than the geodesic distance. Table 9 presents the results for the distance and time matrices.

- Insert Table 9 (10-sector, 341-EA Full Model Estimations using Distance or Time) -

Actually, the quality of the fit in both cases is comparable to the one obtained with the generalized transport cost. The role of geographical dummies or fixed effects 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 present the predictions of on local economic variables (sectoral employment, production, trade, but also prices, marginal costs, demands, and profits) for all the French EAs, according to our model. We first provide and interpret some descriptive statistics and maps relative to these variables.

Note that these predictions may correspond as well to the short-run as to the long-run equilibrium, depending on how the observed number of plants is interpreted. If it is interpreted as a long-run equilibrium number, the only difference with the short-run interpretation relies on the fact that the variable profit predictions give also an estimation of the local fixed costs.

As a second step, we also investigate the impact of a progressive decline in transport costs. In this case, we simulate the short-run model for different values of the transport cost, assuming that the number of plants remains fixed to its observed value. The plants' entry process is discussed at the end of the section. Note that, in order to be consistent with the estimation procedure, we present the predictions of and simulate the linearized model. Moreover, when the simulated marginal profits are negative, which is the case for a few EAs and markets, we set the exports to zero, as the theoretical model predicts, and simulate again the model under this constraint.

5.1 Predictions of the local economic conditions

We present the predictions of the model for the 10-sector and 341-EA aggregation levels, for the model including EA fixed effects (Table 4, column (3)). Actually, 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 ν^s have to be positive. However, they are not necessarily consistent with the real market segmentation in France, as measured for instance by the share of transport charges in the total marginal cost or by 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:

$$Tshare^s = \sum_i \left[\frac{n_i^s y_i^s}{\sum_k n_k^s y_k^s} \sum_j \left(\frac{y_{ij}^s}{\sum_k y_{ik}^s} \left(\frac{\nu^s t_{ij}}{\nu^s t_{ij} + c_i^s} \right) \right) \right]. \tag{24}$$

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

$$Dist^s = \sum_i \left[\frac{n_i^s y_i^s}{\sum_k n_k^s y_k^s} \sum_j \left(\frac{y_{ij}^s}{\sum_k y_{ik}^s} (Dist_{ij}) \right) \right]. \tag{25}$$

These figures are given in Table 10.

- Insert Table 10 (Average Share of Transport Cost and Average Distance) -

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 range is thus obtained. Note that the estimation at the 70-sector level gives for some sectors much higher ν^s estimates, for which we would have obtained figures 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. Comparable figures given in Combes and Lafourcade [2001] are obtained for 1978.

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 comparable, unless mentioned. We first illustrate in Figures 3 and 4 the real employment per plant and the employment per plant, as predicted by the model, respectively.

- Insert Figure 3 (Map of Employment per Plant, Real) and Figure 4 (id. Predicted) -

The spatial variation of the predicted employment per plant is lower than the real one. This rough fit stems from the low R^2 that is typical of panel regressions. However, first, the correlation between both variables is not so bad as it seems, since it is significantly positive and equal to 0.42. Next, the spatial fit would be better with the 70-sector estimations that are more precise. Last, we could have artificially 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 plants, that is observed. This would have increased, however, the possibility of endogeneity. As regards the real and predicted total employments, both maps (Figures 5 and 6) look very similar, and the local sectoral employment is well predicted by our model. This is confirmed by the high positive correlation between both variables which is 0.9.

- Insert Figure 5 (Map of Employment, Real), Figure 6 (id. Predicted) -

Note also that the sectoral employment is positively correlated with the number of plants (Figure 7) and the production (Figure 8) of the sector.

- Insert Figure 7 (Map of Plant Number), and Figure 8 (Map of Total Production) -

Hence, we observe that the sector of equipment goods is more concentrated in North than in South and in East than in West. Large cities represent important isolated production areas in more peripheral regions, as, for instance, Bordeaux or Toulouse in South-West, and Marseille in South-East.

Exports and imports

Our model also provides predictions of the good flows traded between any EAs, for any sector. Since no such data exist in France, this is another application of our methodology. We map the exports to any EA of two regions, Ile-de-France and Rhône-Alpes, corresponding to the two largest French cities, Paris and Lyon, respectively (Figures 9 and 10).

- Insert Figure 9 (Map of Ile-de-France Exports) and Figure 10 (id. Rhône-Alpes) -

Ile-de-France exports more to the northern EAs and to the largest 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 Figure 13) that all EAs export a lot towards them, even if faraway located. Last, Rhône-Alpes exports more to the Rhône-Alpes EAs and to the southern EAs which are closer. Thus, negative distance effects and positive demand effects, which are reminiscent of the standard gravity and accessibility effects, are observed. They stem here, however, from a fully-specified economic geography model. Note that, even if our estimated parameters may look a bit low compared to real values, markets are a bit too much segmented. For instance, Rhône-Alpes EAs do not export at all to some other EAs faraway located, which is not what one would have expected. This is due to the strong competition effects that the model deals with. Similar conclusions can be drawn for other regions or for imports (see Combes and Lafourcade [2001]).

Local market conditions

In order to go more closely into these predicted location patterns, it is worth mapping the upstream variables they depend upon, as prices, costs, and demands.

- Insert Figure 11 (Map of Marginal Cost) and Figure 12 (Map of Unit Price) -

As can be seen in Figures 11 and 12, 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 decrease from this center to the periphery. Note however that variations are low, the differences between extremes values being around 3%. Note also that this justifies our linearization assumption.

The size of local demand, including final and intermediate demands, that is presented in Figure 13 (in value), 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 multi-centric.

- Insert Figure 13 (Map of Demand in Value) -

Local profitability

We now move on to the variable on which really depend location choices, the variable profit earned by a plant that locates in a given EA. This profit is the sum of the profits realized on each market to which the plant exports and of the local profit. It is highly dependent on two other variables we depict in Figures 14 and 15, the average mark-up weighted by the exports and the production per plant.

- Insert Figure 14 (Map of Average Mark-up), Figure 15 (Map of Production per Plant) -

As can be seen in Figure 14, the average mark-up presents a very interesting spatial pattern. It is simultaneously high around the Ile-de-France EAs and in the peripheral EAs, whereas low in between. Recall the trade-off that works on this variable in our inter-regional Cournot competition trade model. First, the marginal cost and unit price, which are both increasing from the center towards the periphery (Figures 11 and 12), act as opposite forces on the mark-up: High prices increase the mark-up, whereas high costs decrease it. The mark-up also decreases with the transport cost, which itself increases with the distance to the center (Figure 1). Finally, the mark-up decreases with the number of plants, which is polarized, but in a multi-centric sense (Figure 7). Figures 14 shows that the marginal and transport cost effects dominate the price and competition ones regarding the EAs around Ile-de-France. These EAs benefit from low marginal and transport costs, without suffering from the proximity of an important number of plants and from low prices. Conversely, marginal and transport costs are high in peripheral regions, but competition is simultaneously low, which directly increases the mark-up but also implies high prices. These last effects are dominant in this case and the average mark-up is also high there. On the contrary, EAs located in between are not extremely penalized by competition and prices, but benefit neither from low marginal costs nor from low transport costs. All of these reduce in lower average mark-up there.

Regarding production per plant, recall that exports are proportional to marginal profits. However, they also depend on prices (which are low, leading to a high demand in central EAs), and on local demand, which, as seen before (Figure 13), is not monotonously distributed, but is higher in more developed EAs. As can be seen in Figure 15, the forces benefiting to the central areas dominate and the production per plant presents a monotonic core-periphery pattern.

Therefore, the total effect on the local variable profit per plant, that depends on both the average mark-up and the production per plant, is ambiguous for peripheral EAs (high mark-up but low production), whereas both effects converge for the EAs around Ile-de-France (high mark-up and production) and for intermediate EAs (medium mark-up and production). As can be seen in Figure 16, the variable profit per plant presents a marked core periphery pattern decreasing from the center to the periphery. Note, moreover, that the spatial gradient of the profit is much more important than the marginal cost and price ones. It is less steep in direction of the South-West.

- Insert Figure 16 (Map of Variable Profit per Plant) -

Thus, according to the model, the coexistence of transport costs and imperfect competition playing on endogenous local demands, strongly affect the location of economic activities in France. Moreover, this result prevails although the predicted share of transport cost in marginal cost is a bit lower than the usually admitted values. As regards the location incentives, which also strongly vary across space, the demand and cost benefits, higher in central EAs, clearly dominate the competition dispersive effects.

This last conclusion observed on maps also reflects in the fact that the variable profit is, more generally, higher in the most competitive and dense places, as shown by the correlation matrix reported in Table 11.

- Insert Table 11 (Correlation Matrix Between Local Variables) -

Correlations are strongly positive between the variable profit and the number of plants, the total production, and the total employment. Once more, this confirms that strong agglomeration incentives prevail in France, the advantages of locating in dense and competitive EAs being large, assuming that fixed costs are not much higher there. The level of transport costs remaining fixed, it can be expected that, in the long-run, new plants 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 plants' creation. Only low fixed costs in low dense EAs could reverse this trend. However, this advantage should prevail over the variable profit benefits in the more developed EAs, which seems to be unrealistic.[11]

5.2 Impact of a transport cost 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 gas, tires, or toll costs (reducing c_r) or in wages, insurance or truck renewal costs (reducing f), or due to road infrastructure improvements (reducing both distance and time costs). Whereas the predictions presented in the previous sections are consistent with both the short-run and the long-run equilibrium, we now focus on the short-run model: The number of plants producing in each area remains fixed to its real value. Thus, we capture the production and pricing variations of existing plants without considering the plant relocation or creation process, which is discussed at the end of the section.

Total employment and production concentration variation

As a measure of the degree to which more sectoral employment or production concentration stem from a generalized transport cost decline, we study the variations of two different concentration indexes: A Herfindhal gross index, HI^s, and the Ellison and Glaeser [1997] index, EGI^s, given by:

$$HI^s = \sum_i \left(\frac{n_i^s l_i^s}{\sum_j n_j^s l_l^s} \right)^2 \quad \text{and} \quad EGI^s = \frac{G - \left(1 - \sum_i x_i^2\right) H}{\left(1 - \sum_i x_i^2\right)(1 - H)}, \tag{26}$$

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

The smaller the value of the indexes, the less concentrated the employment, or the production if y_i^s replaces l_i^s in equation (26). However, the Ellison and Glaeser index has the advantage of allowing comparisons across sectors in which the number of plants differ at the national level. Figure 17 plots the total production EG index against the transport cost variations. Other concentration plots can be found in Combes and Lafourcade [2001], as well as the average indexes decrease for each sector.

- Insert Figure 17 (Total Production EG Concentration Index Variations) -

Production in Insurance (sector 9) is more concentrated than in other sectors, followed by Market Services (sector 8) and Finance (sector 10). Intermediate Products (sector 3) are also more concen-

[11] Unfortunately, no data on fixed costs exist in France.

trated in the Ellison and Glaeser point of view, but less for the gross index. This means that the production concentration is low in this sector.[12] Whatever the sector, both concentration indices, in employment or production, decline when the generalized transport cost declines. This means that, conditionally to the current location of plants and without considering the creation of new plants, declining transport costs make total production and employment less concentrated between EAs.

A strong result of our previous predictions is the positive correlation between local profits and the plant number or the total production. Hence, it is worth studying how these correlations vary when transport costs decrease. Combes and Lafourcade [2001] plot the correlation between profits and the number of plants, on the one hand, and between profits and total production, on the other hand. In both cases, it is observed that the correlation decreases, which is consistent with the noticed decline in employment and production concentration indices.

Employment, production and profits spatial patterns

Figures 18 and 19 map the production and profit patterns induced by a 30% transport costs decline.

- Insert Figure 18 (Map of Production after the Transport Cost Decrease) and Figure 19 (id. Profit) -

As regards total production, no clear evolution emerges, apart from a limited spatial dispersion, which confirms the results on concentration indexes variations. However, interesting features emerge regarding profits. Profits are initially monotonically decreasing from the Ile-de-France EAs towards the periphery. When transport costs decrease, the highest profit central area narrows, profits being even more concentrated there. However, a second profit concentration point emerges around and north to the Lyon EA. This means that, due to this decline, new location incentives are created in this area, while the profit gradient around the Ile-de-France EAs simultaneously increases. Thus, from a mono-centric spatial configuration of variable profits, we move to a duo-centric configuration, the local gradient around each peak being steeper after the transport costs decline. Thus, profits and, hence, concentration incentives 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 12, in many French regions and for many sectors, concentration increases due to the transport cost decline.

- Insert Table 12 (Number of Regions in which Concentration Increases) -

This is all the more true as regards sectoral employment, whose concentration increases in more than 2/3 of the regions. Total employment or production concentrations increase in roughly 1/3 of the regions.

[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.

We may thus infer from these results that the transport cost decline strengthens dispersive forces at the country level, but reinforces agglomeration mechanisms within a large number of French regions. Note that not only the employment and production concentrations increase in the short-run equilibrium, but also that the concentration incentives that affect the future plant location choices reinforce at the regional level. This means that, in many regions, the development of highly competitive central EAs yields at the expense of less competitive peripheral EAs.

Discussion about the long-run equilibrium

It could be worth carrying out a last simulation. What would one expect in the long-run equilibrium from a transport costs decline? However, critical questions make this exercise difficult. The main one relates to whether we currently observe a short-run or a long-run equilibrium, a question we cannot answer since no data on local fixed costs are available. If we assume that the current equilibrium is a short-run one, do the plants enter the market more or less rapidly that transport costs decrease? That is to say, do we have to first decrease the transport cost by 30%, and next simulate the plant entry / exit process, or do we have to simulate the transport cost decline step by step and simulate the entry / exit process between each simulation, or, even, simulate the plant entry, until profits are zero everywhere and next reduce transport costs? Since economic geography models lead to multiple equilibria, which are more numerous the larger the number of regions considered, each simulation strategy would not lead to the same long-run equilibrium. The last strategy would lead for instance, for given transport costs, to the emergence of a much stronger concentration than the current one, if fixed costs are assumed to be the same in all locations, since variable profits are mono-centrically concentrated. Next, we would simulate the impact of a transport cost decline. However, concentration would be so strong once the entry would have been simulated that the transport costs decline could only benefit to the central EAs: Almost no more production would take place in the peripheral EAs and demand would be close to zero there. A second issue would be to determine if fixed costs are indeed uniformly distributed, or not. Alternatively, if we consider that the current equilibrium is a long-run one, variable profits give an estimation of fixed costs. First, the implied spatial variability of fixed costs and their much higher levels in central EAs does not seem to be realistic. Second, the reduction in transport cost next implies the same rather complex plant entry and exit process, whose issue would again strongly depend on the simulation strategy. Hence, we prefer to not make any assumption, which would be anyway arguable, regarding the nature of the current equilibrium and the local fixed cost levels. We prefer to present predictions of the local production conditions for the current level of transport costs, compatible with both the short- and long-run equilibrium, and next the impact of a transport cost decline for given plant numbers. Doing that, we quantify a transport improvement impact in the short-run, not only on the production location, but also on the concentration incentives that determine the long-run plant location choices.

6 Conclusions and extensions

This paper first develops a tractable inter-regional trade model in the economic geography spirit, which we use to investigate the impact of transport cost on regional inequalities. The model includes real strategic interactions and competition effects through the use of Cournot competition. High final and intermediate demands and low input costs give plants 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. We find strong evidence that our model correctly explains the sectoral employment spatial distribution. This result is robust across many specifications. Including EA fixed-effects greatly improves the fit. Thus, even if geography is partly captured by transport costs and imperfect competition on segmented markets, other real geography effects (proximity to oceans, to foreign countries, climate amenities,...) play a critical role on the spatial shaping of economic activities. The role of intermediate inputs is also important.

Next, we present the estimated model predictions regarding the spatial distribution of local sectoral economic variables, such as employment, production, but also costs, prices, and profits. The mark-up per unit presents an interesting pattern. It is higher either at the France centre (low transport and unit costs even if high competition) or at the extreme periphery (low competition even if high costs), and low in between. Due to large inequalities in production per plant, our model predicts, however, a mono-centric structure of variable profits. Their high level in the most competitive and dense areas shows that plants have strong incentives to concentrate over space in France.

As a final step, the impact of a transport cost decline on the short-run equilibrium is simulated. Total employment and production concentration decrease at the national level, but increase in many regions. The result that inequalities in France depend both on geographical units and transport cost variations is particularly consistent with Esteban [1999] conclusions that regional inequalities have decreased between European countries, while increasing within them for twenty years. As regards variable profits, a duo-centric structure emerges, which is a second illustration of this feature, lower inter-regional concentration incentives and higher intra-regional concentration incentives.

We hope that public authorities would find an interest in this step towards a better prediction of the real employment and production redistribution effects of regional policies relying on transport networks or regulation. Indeed, it is surprising how neglectful calculations of infrastructure rates of return are, as regards these spatial and location effects. Using our methodology, some direct and indirect impacts of a local improvement of the French road network could be simulated. For instance, the impact of the creation of new highways based on what is planned in France for the next 20 years, or 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, simulating the impact of a transport cost decline on the long-run distribution of plants and employment could be worth considering. However, the problem is to determine, first, whether fixed costs are the same everywhere and, next, whether plants react to regional profit differentials faster than the transport costs decrease, or not. Since no answer can be given to these questions, the simulation strategy we adopt in this paper has two advantages: (*i*) It is consistent with both the short-run and long-run equilibrium for given transport costs; (*ii*) It is policy oriented, providing economic recommendations on the short-run impacts of transport costs as regards both the location of production and the agglomeration incentives.

This choice is also consistent with the assumptions on local labor markets, since, for instance, the wage rigidity we assume may also correspond to a short-run situation. Indeed, the labor market plays no role in our setting that emphasizes demand and competition effects on the intermediate and final good segmented markets. The assumptions of nationally fixed wages and unemployment in each sector and region, while relevant for France, cancel possible agglomeration and dispersion effects working through the local labor markets and wages. In the future, and for application to other countries, it could be worth providing extensions of our methodology including these features, even if the framework would lose part of its tractability and become much more non linear.

Finally, Cournot competition models represent only one type of economic geography theoretical framework. A monopolistic competition model with differentiated inputs would be also worth estimating. It would allow to study the robustness of the links between transaction costs decline and regional inequalities, as embodied in an alternative, and very standard, imperfect competition framework.

References

Anderson J. and E. van Wincoop, 2003. "Gravity with Gravitas: A Solution to the Border Puzzle", *American Economic Review*, forthcoming.

Brander, J., 1981. "Intra-industry Trade in Identical Commodities", *Journal of International Economics*, 11, 1-14.

Combes, P-P., 1997. "Industrial Agglomeration under Cournot Competition", *Annales d'Economie et de Statistique*, 45, 161-182.

Combes, P-P., and M. Lafourcade, 2001. "Transport Costs Decline and Regional Inequalities: Evidence from France", *CEPR Discussion Paper*, 2894.

Combes, P-P., and M. Lafourcade, 2002. "Transport Costs Effects on Core-Periphery Patterns of Market Potential: France, 1978-1993", *Mimeo CERAS*, Paris.

Dixit, A., and J. Stiglitz, 1977. "Monopolistic Competition, and Optimum Product Diversity", *American Economic Review*, 67, 297-308.

Eichengreen, B., 1993. "Labor Market and European Monetary Unification", in P. Masson and M. Taylor (eds.), *Policy Issues in the Operation of Currency Unions*, Cambridge University Press, 130-162.

Ellison, G. and E. Glaeser, 1997. "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach", *Journal of Political Economy*, 105, 889-927.

Esteban, J.M., 1999. "L'Euro y la Desigualdat Territorial: Implications for Catalunya", in J.M. Esteban and J. Gual (eds.), *Catalunya dins l'Euro*, Antoni Bosch, Barcelona, 165-210.

Forslid, R., J. Haaland, and K.-H Midelfart Knarvik, 2003. "A U-Shaped Europe? A Simulation Study of Industrial Location", *Journal of International Economics*, forthcoming.

Gasiorek, M., A. Smith, and A.Venables, 1992. " '1992': Trade and Welfare - A General Equilibrim Model", in L. Winters (ed.), *Trade Flows and Trade Policies*, Cambridge University Press, 35-63.

Gasiorek, M., and A., Venables, 1997. "Evaluating Regional Infrastructure: A Computable Equilibrium Approach", *Modelling Report*, the European Institute and the London School of Economics.

Gramlich, E., 1994. "Infrastructure Investment, a Review Essay", *Journal of Economic Literature*, 32, 1176-1196.

Haaland, J., and V. Norman, 1992. "Global Production Effects of European Integration", in *Trade Flows and Trade Policies*, L. Winters (ed.), CEPR, Cambridge University Press, 67-88.

Hanson, G., 1998. "Market Potential, Increasing Returns, and Geographic Concentration", *NBER Working Paper*, 6429.

Head, H., and T. Mayer, 2000. "Non-Europe: The Magnitude and Causes of Market Fragmentation in the EU", *Weltwirtschaftliches Archiv*, 136, 285-314.

Helliwell, J., 1996. "Do National Borders Matter for Quebec's Trade?", *Canadian Journal of Economics*, 29, 507-522.

Helliwell, J., 1997. "National Borders, Trade and Migration", *Pacific Economic Review*, 3, 165-185.

Hummels, D., 1999a. "Towards a Geography of Trade Costs", *Mimeo Krannert School of Management* (http://www.mgmt.purdue.edu/faculty/hummelsd/).

Hummels, D., 1999b. "Have International transport Costs Declined?", *Mimeo Krannert School of Management* (http://www.mgmt.purdue.edu/faculty/hummelsd/).

Krugman, P., 1991. "Increasing Returns and Economic Geography", *Journal of Political Economy*, 99, 483-499.

Krugman, P., 1993. "On the Number and Location of Cities", *European Economic Review*, 37, 293-298.

Krugman, P., and A. Venables, 1995. "Globalization and The Inequality of Nations", *Quarterly Journal of Economics*, 110, 857-880.

Limão, N., and A. Venables, 2000. "Infrastructure, Geographical Disadvantage, Transport Costs and Trade", *Mimeo LSE* (http://econ.lse.ac.uk/staff/ajv/).

McCallum, J., 1995. "National Borders Matters: Canada-U.S. Regional Trade Patterns", *American Economic Review*, 85, 615-623.

Puga, D., 1999. "The Rise and Fall of Regional Inequalities", *European Economic Review*, 43, 303-334.

Redding, S., and A. Venables, 2000. "Economic Geography and International Inequality", *CEPR Discussion Paper,* 2568 (http://econ.lse.ac.uk/staff/ajv/).

Smith, A., and A. Venables, 1988. "Completing the Internal Market in the European Community, Some Industry Simulations", *European Economic Review*, 32, 1501-1525.

Tatom, J.,1993. "Is an Infrastructure Crisis Lowering the Nations Productivity?", *Federal Reserve Bank of St Louis Review*, 75, 3-21.

Wei, S.-J., 1996. " Intra-National versus International Trade: How Stubborn are Nations in Global Integration?", *NBER Working Paper*, 5531.

Appendix: Linearization of the short-run equilibrium

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

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

$$p^s = \frac{N^s \left(w^s\right)^{\lambda^s}}{\left(N^s - 1\right) B^s} P^s, \tag{27}$$

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

¿From equation (27), the explicit expressions of $(p^s)_{s=1,\ldots,S}$ are derived by solving the following system:

$$
\begin{pmatrix} \log(p^1) \\ . \\ . \\ \log(p^s) \\ . \\ . \\ \log(p^S) \end{pmatrix} = \begin{pmatrix} \beta^{11} & .. & \beta^{s1} & .. & \beta^{S1} \\ . & .. & . & .. & . \\ . & .. & . & .. & . \\ \beta^{1s} & .. & \beta^{ss} & .. & \beta^{Ss} \\ . & .. & . & .. & . \\ . & .. & . & .. & . \\ \beta^{1S} & .. & \beta^{sS} & .. & \beta^{SS} \end{pmatrix} \times \begin{pmatrix} \log(p^1) \\ . \\ . \\ \log(p^s) \\ . \\ . \\ \log(p^S) \end{pmatrix} + \begin{pmatrix} \log(\frac{N^1\left(w^1\right)^{\lambda^1}}{(N^1-1)B^1}) \\ . \\ . \\ \log(\frac{N^s(w^s)^{\lambda^s}}{(N^s-1)B^s}) \\ . \\ . \\ \log(\frac{N^S\left(w^S\right)^{\lambda^S}}{(N^S-1)B^S}) \end{pmatrix}. \tag{28}
$$

Next, the equilibrium regional price may be written as:

$$
p_j^s = p^s \left(1 + \delta_j^s\right), \tag{29}
$$

where the parameter δ_j^s represents the relative gap between the price if markets were perfectly integrated and regional prices in the segmented case. 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 assumption to be true and it is indeed, see Figure 12).

¿From equations (4), (16) and (29),we can derive the following $J \times S$ system for the $(\delta_j^s)_{j,s}$:

$$
\delta_j^s = \frac{1}{N^s} \sum_i n_i^s \sum_{s'} \beta^{s's} \delta_i^{s'} + \frac{\nu^s}{p^s\left(N^s - 1\right)} \sum_i n_i^s t_{ij}. \tag{30}
$$

These expressions can be written in the following matrix form:

(31)

$$
\begin{pmatrix} \delta_1^1 \\ \cdot \\ \delta_J^1 \\ \cdot \\ \cdot \\ \delta_1^s \\ \cdot \\ \delta_J^s \\ \cdot \\ \cdot \\ \delta_1^S \\ \cdot \\ \delta_J^S \end{pmatrix}
=
\underbrace{\begin{pmatrix}
\frac{\beta^{11}n_1^1}{N^1} & \cdot & \frac{\beta^{11}n_J^1}{N^1} & \cdot\cdot & \frac{\beta^{s1}n_1^1}{N^1} & \cdot & \frac{\beta^{s1}n_J^1}{N^1} & \cdot\cdot & \frac{\beta^{S1}n_1^1}{N^1} & \cdot & \frac{\beta^{S1}n_J^1}{N^1} \\
\cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot \\
\frac{\beta^{11}n_1^1}{N^1} & \cdot & \frac{\beta^{11}n_J^1}{N^1} & \cdot\cdot & \frac{\beta^{s1}n_1^1}{N^1} & \cdot & \frac{\beta^{s1}n_J^1}{N^1} & \cdot\cdot & \frac{\beta^{S1}n_1^1}{N^1} & \cdot & \frac{\beta^{S1}n_J^1}{N^1} \\
\cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot \\
\frac{\beta^{1s}n_1^s}{N^s} & \cdot & \frac{\beta^{1s}n_J^s}{N^s} & \cdot\cdot & \frac{\beta^{ss}n_1^s}{N^s} & \cdot & \frac{\beta^{ss}n_J^s}{N^s} & \cdot\cdot & \frac{\beta^{Ss}n_1^s}{N^s} & \cdot & \frac{\beta^{Ss}n_J^s}{N^s} \\
\cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot \\
\frac{\beta^{1s}n_1^s}{N^s} & \cdot & \frac{\beta^{1s}n_J^s}{N^s} & \cdot\cdot & \frac{\beta^{ss}n_1^s}{N^s} & \cdot & \frac{\beta^{ss}n_J^s}{N^s} & \cdot\cdot & \frac{\beta^{Ss}n_1^s}{N^s} & \cdot & \frac{\beta^{Ss}n_J^s}{N^s} \\
\cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot \\
\frac{\beta^{1S}n_1^S}{N^S} & \cdot & \frac{\beta^{1S}n_J^S}{N^S} & \cdot\cdot & \frac{\beta^{sS}n_1^S}{N^S} & \cdot & \frac{\beta^{sS}n_J^S}{N^S} & \cdot\cdot & \frac{\beta^{SS}n_1^S}{N^S} & \cdot & \frac{\beta^{SS}n_J^S}{N^S} \\
\cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot & \cdot\cdot & \cdot & \cdot & \cdot \\
\frac{\beta^{1S}n_1^S}{N^S} & \cdot & \frac{\beta^{1S}n_J^S}{N^S} & \cdot\cdot & \frac{\beta^{sS}n_1^S}{N^S} & \cdot & \frac{\beta^{sS}n_J^S}{N^S} & \cdot\cdot & \frac{\beta^{SS}n_1^S}{N^S} & \cdot & \frac{\beta^{SS}n_J^S}{N^S}
\end{pmatrix}}_{M}
\times
\begin{pmatrix} \delta_1^1 \\ \cdot \\ \delta_J^1 \\ \cdot \\ \cdot \\ \delta_1^s \\ \cdot \\ \delta_J^s \\ \cdot \\ \cdot \\ \delta_1^S \\ \cdot \\ \delta_J^S \end{pmatrix}
+
\begin{pmatrix} T_1^1 \\ \cdot \\ T_J^1 \\ \cdot \\ \cdot \\ T_1^s \\ \cdot \\ T_J^s \\ \cdot \\ \cdot \\ T_1^S \\ \cdot \\ T_J^S \end{pmatrix},
$$

where

(32)
$$T_j^s = \frac{\nu^s}{p^s\left(N^s-1\right)} \sum_i n_i^s t_{ij}.$$

Thus, the solution of this linear system can be written as:

(33)
$$\delta_j^s = \sum_{s'} \nu^{s'} X_j^{s's},$$

where

(34)
$$X_j^{s's} = \frac{1}{p^{s'}\left(N^{s'}-1\right)} \sum_i b_{ij}^{ss'} \sum_k n_k^{s'} t_{ik},$$

where the $b_{ij}^{ss'}$ 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 $J \times S$. Hence, 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 23 870×23 870, 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 restrict the input-output matrix to the intermediates which represent more than 10% of the cost expenditures. As a consequence, matrix M can be written in a block diagonal form and then be inverted by blocks. This assumption implies that 6 sectors have neither intermediate nor final demands, and must be excluded from the study. All inputs are considered at the 10-sector level. Note also that, if labor is the only input, $(I_{J\times S} - M)$ is not invertible.

We directly obtain in this case: $X_j^{s's} = 0$ for $s' \neq s$, and $X_j^{ss} = \frac{1}{p^s(N^s-1)} \sum_i n_j^s t_{ij}$.

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

$$(35) \qquad \begin{cases} p_j^s = p^s \left(1 + \sum_{s'} \nu^{s'} X_j^{s's}\right) \\ c_j^s = \frac{(w^s)^{\lambda^s} P^s}{B^s} \left(1 + \sum_{s''} \nu^{s''} \sum_{s'} \beta^{s's} X_j^{s''s'}\right) \end{cases}.$$

Finally, equations (17) and (35) allow us to compute the ν^s-linear expressions for the quantities sold in each market, from which we deduce the total production of a representative plant in each region and sector:[13]

$$(36) \qquad y_j^s = \frac{\left(p^s B^s - P^s \left(w^s\right)^{\lambda^s}\right)}{\left(p^s\right)^2 B^s} \sum_i R_i^s \left[1 + \nu^s \left(W_{ij}^{ss} - 2X_i^{ss}\right) + \sum_{s' \neq s} \nu^{s'} \left(W_{ij}^{s's} - 2X_i^{s's}\right)\right],$$

with:

$$(37) \qquad \begin{cases} W_{ij}^{s's} = \frac{B^s}{\left(p^s B^s - P^s (w^s)^{\lambda^s}\right)} \left[p^s X_i^{s's} - \frac{P^s (w^s)^{\lambda^s}}{B^s} \sum_{s''} \beta^{s''s} X_j^{s's''}\right], \text{ for } s' \neq s \\ W_{ij}^{ss} = \frac{B^s}{\left(p^s B^s - P^s (w^s)^{\lambda^s}\right)} \left[p^s X_i^{ss} - \frac{P^s (w^s)^{\lambda^s}}{B^s} \sum_{s'} \beta^{s's} X_j^{ss'} - t_{ij}\right] \end{cases}.$$

¿From equation (36) and from the linearization of equation (5), the final ν^s-linear expression for the employment per plant is given by:

$$(38) \qquad l_j^s = \nu^s Z_j^s + \sum_{s' \neq s} \nu^{s'} Z_j^{s's} + \alpha^s,$$

with:

$$(39) \qquad \begin{cases} Z_j^s = \sum_i \left[E_i^s \left(X_i^{ss} - \sum_{s''} \beta^{s''s} X_j^{ss''}\right) - F_i^s t_{ij}\right], \\ Z_j^{s's} = \sum_i E_i^s \left(X_i^{s's} - \sum_{s''} \beta^{s''s} X_j^{s's''}\right), \\ \alpha^s = \sum_i G_i^s, \end{cases}$$

where $E_i^s = \frac{R_i^s \;\; 2P^s(w^s)^{\lambda^s} - p^s B^s \;\; \lambda^s P^s}{(p^s B^s)^2 (w^s)^{1-\lambda^s}}$, $F_i^s = \frac{R_i^s \lambda^s P^s}{(p^s)^2 B^s (w^s)^{1-\lambda^s}}$, $G_i^s = \frac{R_i^s \;\; p^s B^s - P^s(w^s)^{\lambda^s} \;\; \lambda^s P^s}{(p^s B^s)^2 (w^s)^{1-\lambda^s}}$.

[13] For the sake for simplicity, we assume that an EA exports to all EAs, which is indeed satisfied in most cases.

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	3.09	-20	3.87	3.09	-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 between the distance ($Dist_{ij}$) and the absolute difference between estimated residual ($|e_i - e_i|$)

Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10
0.009	0.064	0.036	0.016	0.030	0.053	-0.005	0.068	-0.021	0.038
(0.0033)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.1051)	(0.0001)	(0.0024)	(0.0001)

Standard errors in brackets.

Sector 1: Agriculture Industry, Sector 2: Energy, Sector 3: Intermediate Products, Sector 4: Equipments Goods, Sector 5: Consumption Goods Sector 6: Construction, Sector 7: Transport Services, Sector 8: Market Services, Sector 9: Insurance, Sector 10: Finance.

Table 7: Model with labor as the only input
Sectoral aggregation: 70 sectors - Geographical aggregation: 341 employment areas
Matrix used: generalized transport costs - Year: 1993

	Estimate	Std. Error	Nb. of Obs.	R^2
Coking, Mineral combustible	-47.39	(278.7865)	13	0.01
Gas, Oil production	-0.3276****	(0.109)	48	0.16
Electricity	-0.6897	(0.5472)	28	0.06
Gas retail	-27.5339	(118.2809)	13	0.01
Water, Urban heating	-0.0162	(0.043)	180	0.01
Primary processing of steel	3.9445***	(1.758)	118	0.04
Metallurgy of non-ferrous metals	-32.241	(25.6202)	99	0.02
Miscellaneous ores	-5.2601	(11.6621)	57	0.01
Construction, Ceramic materials	0.7593****	(0.276)	288	0.03
Glass	1.1411	(1.474)	126	0.01
Basic chemics	-5.8258	(19.4053)	164	0.01
Parachemics	0.0944	(0.0715)	184	0.01
Pharmaceutics	-0.0006	(0.0419)	117	0.01
Metalworking	0.069	(0.0495)	316	0.01
Agricultural machinery	0.5581	(1.1546)	118	0.01
Office machinery, Computers	30.5416	(37.9865)	66	0.01
Electrical equipment	0.3286	(0.232)	237	0.01
Electronic equipment	-0.0099	(0.0965)	214	0.01
Household equipment	0.0208	(0.1813)	78	0.01
Automobile	0.0809****	(0.0311)	239	0.03
Precision equipment	-0.045	(0.1585)	153	0.01
Meat products	0.0058	(0.0052)	250	0.01
Milk products	0.0707****	(0.0229)	215	0.04
Canned foods	0.0539	(0.0436)	143	0.01
Bakery	0.0167**	(0.0089)	147	0.02
Grain products	0.1019	(0.0859)	214	0.01
Miscellaneous food products	0.0404	(0.0368)	160	0.01
Beverages, Alcohol	0.0527	(0.1126)	121	0.01
Tobacco	0.136	(0.2873)	20	0.01
Textile	0.0143	(0.0127)	202	0.01
Leather	0.2982	(0.2155)	110	0.02
Shoes	0.0565***	(0.0263)	83	0.05
Wearing apparel, Dressing	-0.0011	(0.005)	244	0.01
Wood	0.1373	(0.1225)	274	0.01
Furniture	0.0131	(0.0111)	223	0.01
Paper, Pulp	-0.0947	(0.085)	224	0.01
Printing, Press, Publishing	0.0343****	(0.0132)	247	0.03
Rubber	1.4928**	(0.8123)	138	0.02
Plastic	0.0702	(0.0535)	270	0.01
Miscellaneous industries	0.018**	(0.0107)	195	0.01
Construction	0.0168****	(0.0054)	340	0.03
Repair, Trade of motor vehicles	0.0025	(0.0022)	317	0.01
Miscellaneous repair	0.0453***	(0.0199)	47	0.10
Hotel, Restaurant	0.0028**	(0.0016)	244	0.01
Rail transport	3.8066**	(2.1415)	251	0.01
Road transport	0.0395****	(0.0091)	326	0.06

Table 7 (continued)				
Sea, Shipping transport	-2.7142	(8.4726)	20	0.01
Air transport	2.6166***	(1.3111)	35	0.11
Warehouse	-0.1175*	(0.0784)	199	0.01
Telecommunications, Mail	0.0505**	(0.028)	33	0.10
Holdings	0.0292	(0.0228)	286	0.01
Personal goods renting	0.2232***	(0.1024)	104	0.04
Education (market)	0.1161****	(0.0309)	129	0.1
Health (market)	0.0007	(0.0035)	305	0.01
Social work (market)	0.0012*	(0.0008)	326	0.01
Insurance	0.0517**	(0.0266)	148	0.03
Finance	0.1134	(0.1033)	252	0.01

****, ***, **, *: estimates significant at the 1%, 5%, 10% and 15% level, respectively.
Separate regressions for each sector, no fixed effects.

Table 8: 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)

Table 8 (continued)

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)
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 9: Model with intermediate inputs
Sectoral aggregation: 10 sectors - Geographical aggregation: 341 employment areas
Matrix used: distance or time - Year: 1993

	Distance			*Time*		
	(1)	(2)	(3)	(1)	(2)	(3)
Agriculture Industry	5.6636**	6.7152***	43.3773***	6.4006**	7.7966***	50.3016****
	(3.0555)	(3.1173)	(17.2617)	(3.3466)	(3.4084)	(17.697)
Energy	-49.677****	-47.5781****	43.3477	-47.2673****	-44.3669****	61.063
	(9.882)	(9.9961)	(43.8168)	(10.901)	(10.9985)	(44.8708)
Intermediate Products	2.3839**	2.5713**	14.3819***	2.3838*	2.6386**	16.2535****
	(1.436)	(1.4458)	(5.5843)	(1.562)	(1.5721)	(5.6891)
Equipment Goods	5.3673***	5.8752***	31.9632****	5.4654***	6.1822***	36.3928****
	(2.2531)	(2.2864)	(12.2401)	(2.458)	(2.4911)	(12.5081)
Consumption Goods	2.1076	2.5874	21.7369***	2.2187	2.8599	25.0826****
	(1.7872)	(1.8086)	(8.9099)	(1.9544)	(1.9751)	(9.1473)
Construction	10.9522	17.9152	357.3797***	16.5477	26.7101	421.227***
	(24.4766)	(25.136)	(159.7388)	(26.79)	(27.4652)	(163.681)
Transport Services	1.4194***	1.5615***	8.4128****	1.8058***	2.0057****	9.936****
	(0.6672)	(0.6744)	(3.2637)	(0.7326)	(0.7399)	(3.3434)
Market Services	-0.1208	-0.099	0.8799**	-0.1323	-0.0982	1.0377***
	(0.2223)	(0.2219)	(0.5036)	(0.2435)	(0.2431)	(0.5231)
Insurance	7.0257	8.1242*	57.6757***	8.2874*	9.8091**	67.9068****
	(5.2153)	(5.2932)	(24.3942)	(5.7003)	(5.7664)	(25.0503)
Finance	2.6918	4.092	60.5692***	4.7991	6.8625	73.0385***
	(5.1853)	(5.2798)	(27.5665)	(5.6862)	(5.7789)	(28.362)
Number of Observations	2952	2952	2952	2952	2952	2952
R^2	0.07	0.08	0.18	0.07	0.08	0.18

****, ***, **, *: 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 10: Average share of transport 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

Sector 1: Agriculture Industry, Sector 2: Energy, Sector 3: Intermediate Products, Sector 4: Equipments Goods, Sector 5: Consumption Goods Sector 6: Construction, Sector 7: Transport Services, Sector 8: Market Services, Sector 9: Insurance, Sector 10: Finance.

Table 11: 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

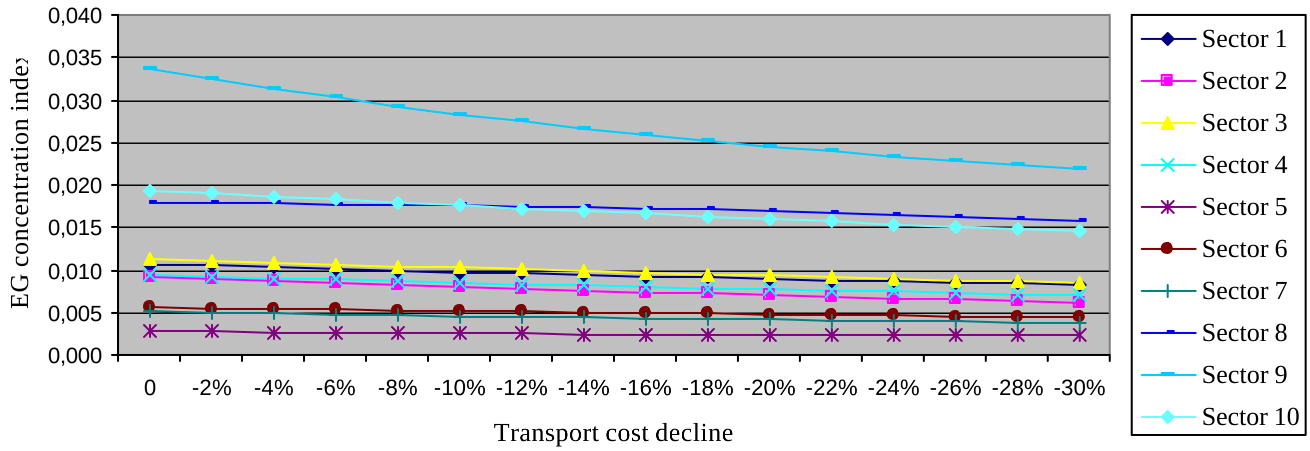
Table 12: Number of regions in which the EG index increases (over 21) due to a 30% transportation cost decline

Sector	1	2	3	4	5	6	7	8	9	10	Total*
Employment	15	17	15	18	15	18	14	17	15	17	7
Production	10	13	7	10	9	11	10	11	10	9	5

*: Gross concentration index

Sector 1: Agriculture Industry, Sector 2: Energy, Sector 3: Intermediate Products, Sector 4: Equipments Goods, Sector 5: Consumption Goods Sector 6: Construction, Sector 7: Transport Services, Sector 8: Market Services, Sector 9: Insurance, Sector 10: Finance.

Figure 17: Total production EG concentration index variations



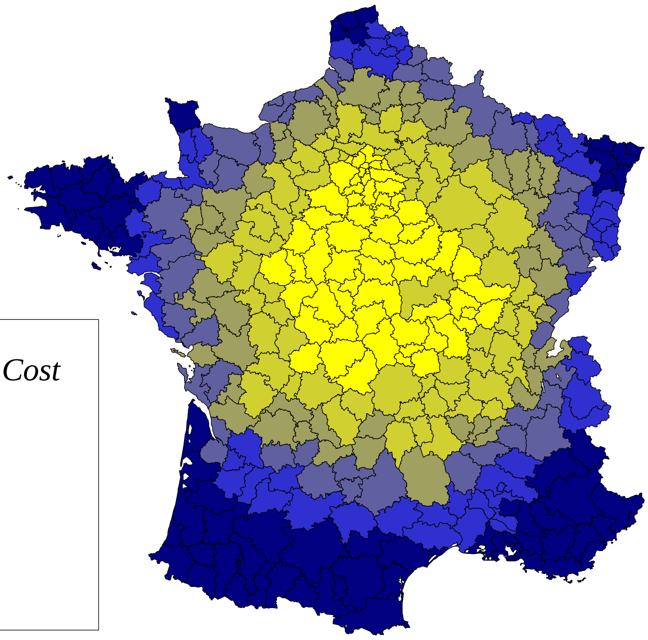


Figure 1: Average Generalized Transport Cost

Average = 100

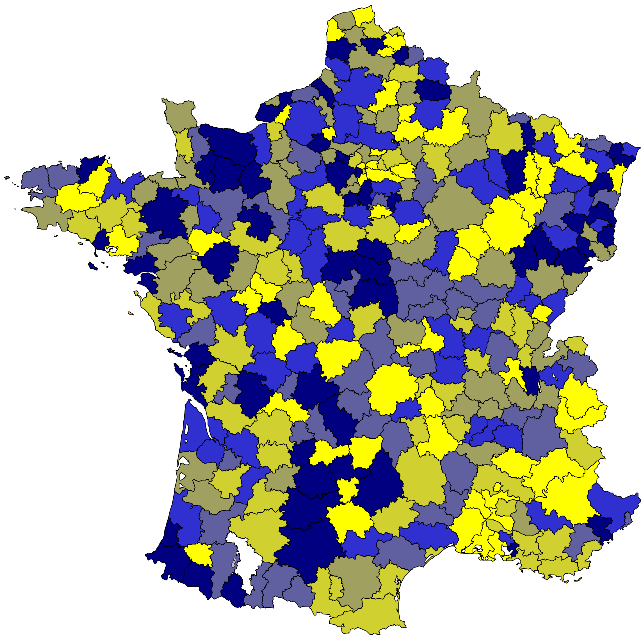


Figure 2: Residual - Sector 4

Average = 100

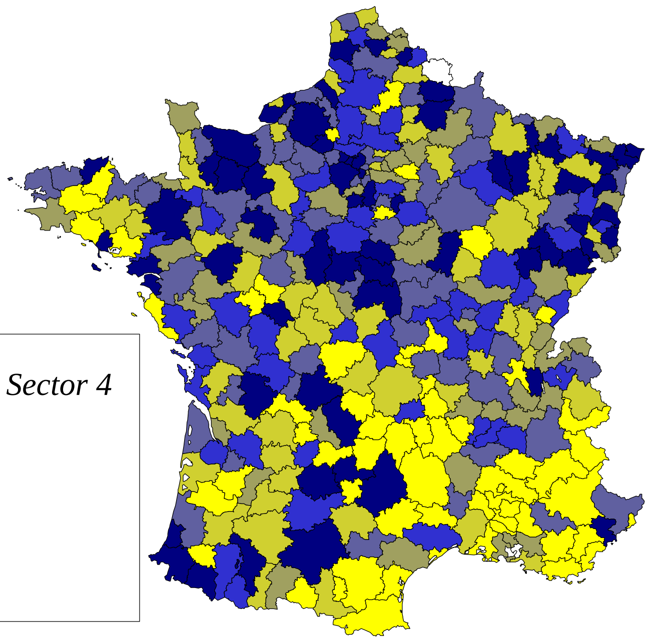


Figure 3: Employment Per Firm (Real) - Sector 4

Average = 100

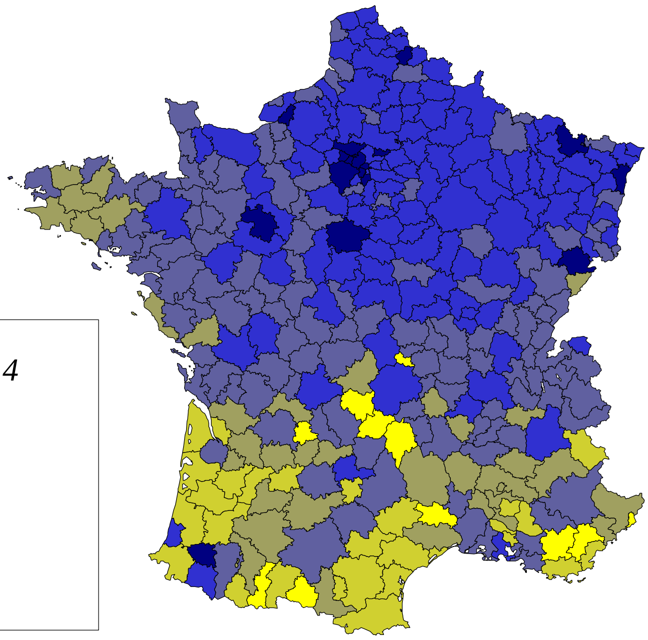


Figure 4: Employment Per Firm - Sector 4

Average = 100

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

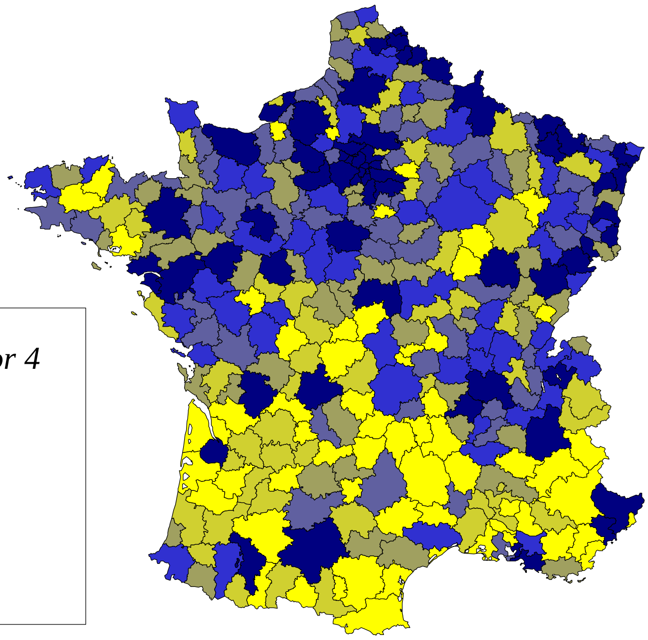


Figure 5: Total Employment (Real) - Sector 4

Average = 100

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

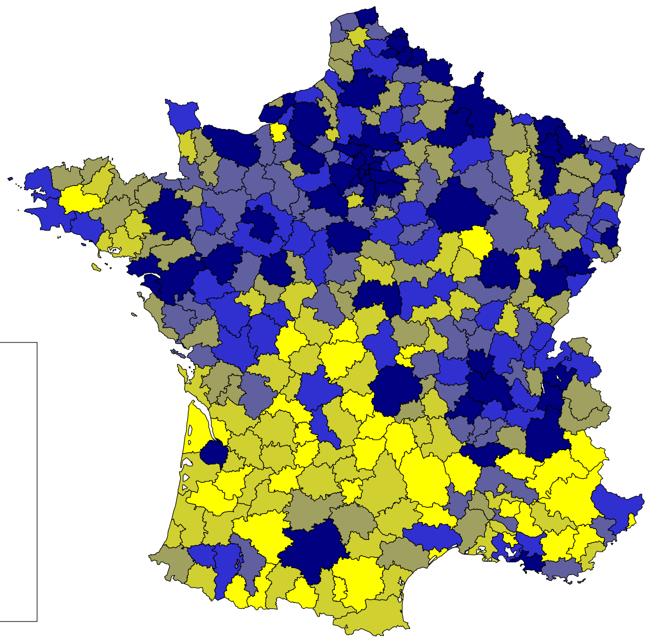


Figure 6: Total Employment - Sector 4

Average = 100

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

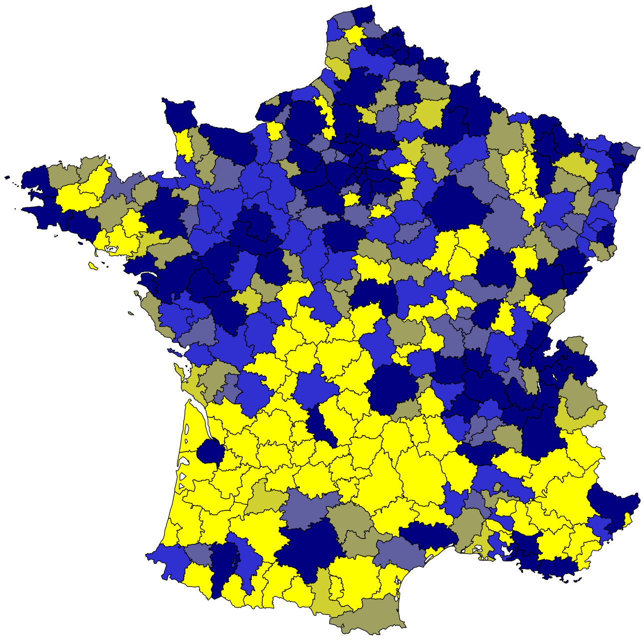


Figure 7: Number of Firms - Sector 4

Average = 100

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

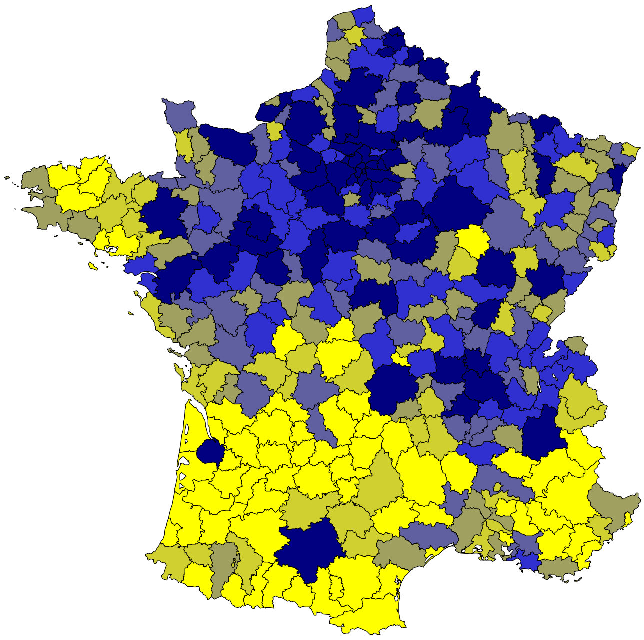


Figure 8: Total Production - Sector 4

Average = 100

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

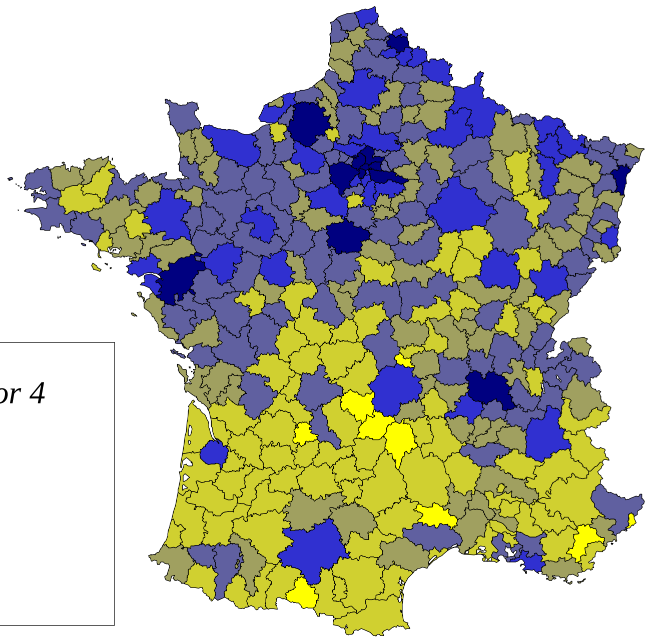


Figure 9: "Ile-de-France" Exports - Sector 4

Average = 100

250 - 10 933	(13)
45 - 250	(39)
6 - 45	(99)
1 - 6	(91)
0 - 1	(90)
0 - 0	(9)

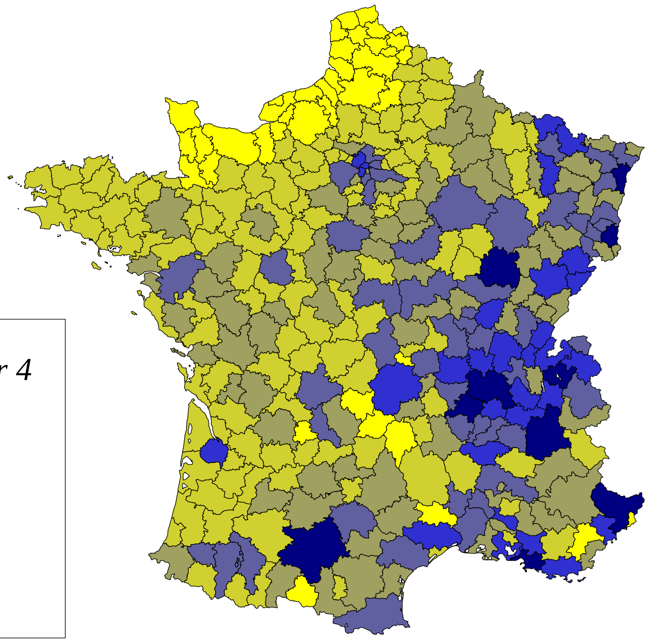


Figure 10: "Rhône-Alpes" Exports - Sector 4

Average = 100

250 - 20 995		(10)
50 -	250	(31)
10 -	50	(52)
1 -	10	(82)
0 -	1	(126)
0 -	0	(40)

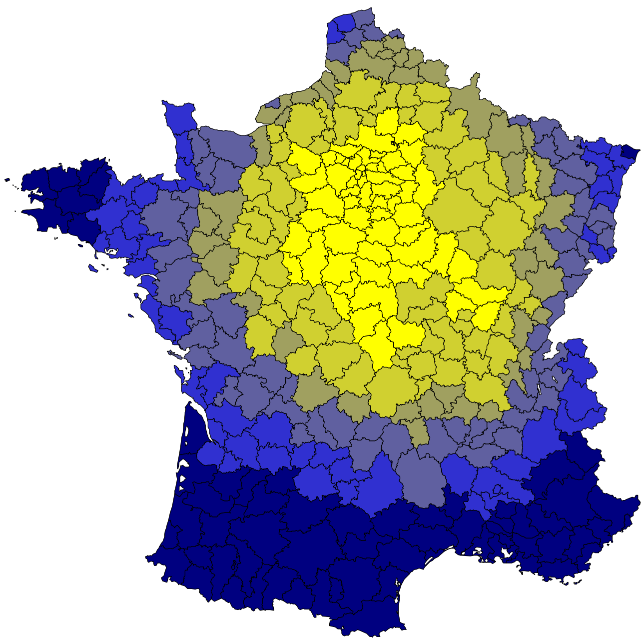


Figure 11: Marginal Cost - Sector 4

Average = 100

100,0046 - 100,016	(65)
100,0015 - 100,0046	(50)
99,9989 - 100,0015	(61)
99,9971 - 99,9989	(43)
99,9948 - 99,9971	(63)
99,9917 - 99,9948	(59)

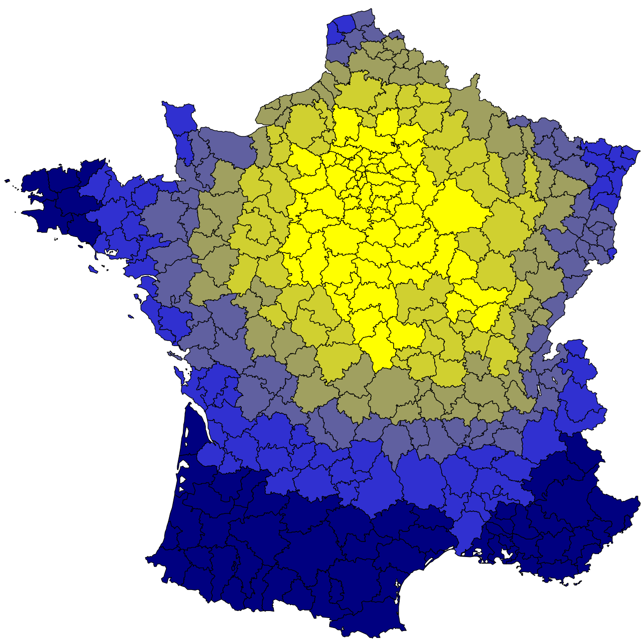


Figure 12: Unit Price - Sector 4

Average = 100

100,0124 - 100,0352	(60)
100,003 - 100,0124	(57)
99,998 - 100,003	(56)
99,9931 - 99,998	(55)
99,9885 - 99,9931	(51)
99,9815 - 99,9885	(62)

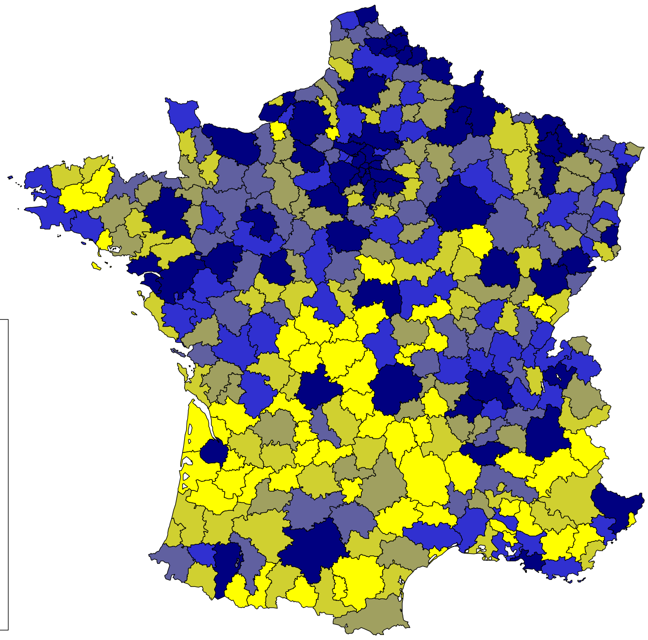


Figure 13: Demand (Value) - Sector 4

Average = 100

125 - 2 492 (60)
65 - 125 (55)
44 - 65 (53)
27 - 44 (58)
15 - 27 (56)
1 - 15 (59)

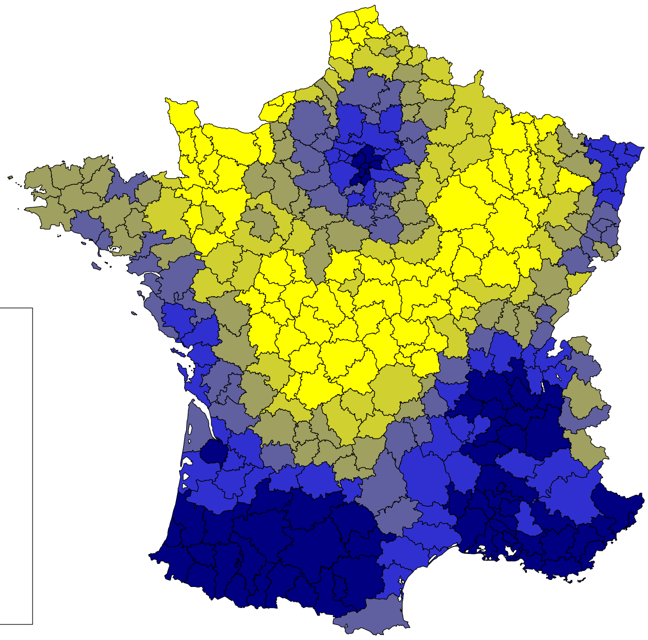


Figure 14: Average Mark-Up - Sector 4

Average = 100

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

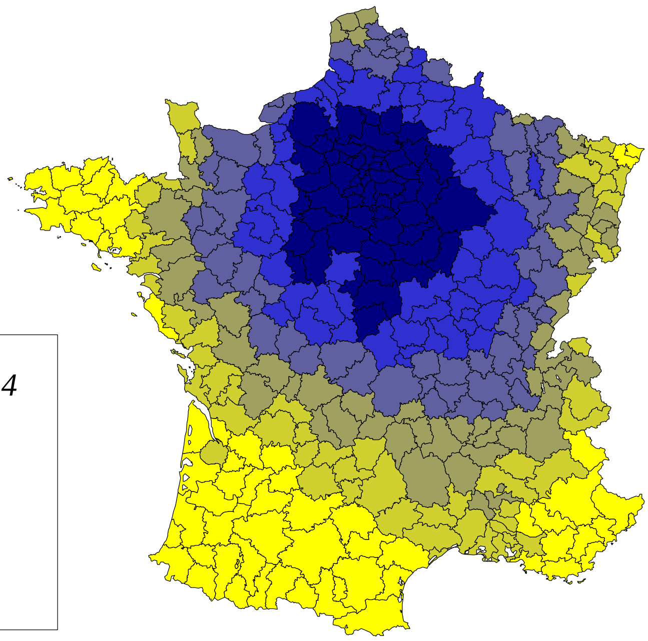


Figure 15: Production Per Firm - Sector 4

Average = 100

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

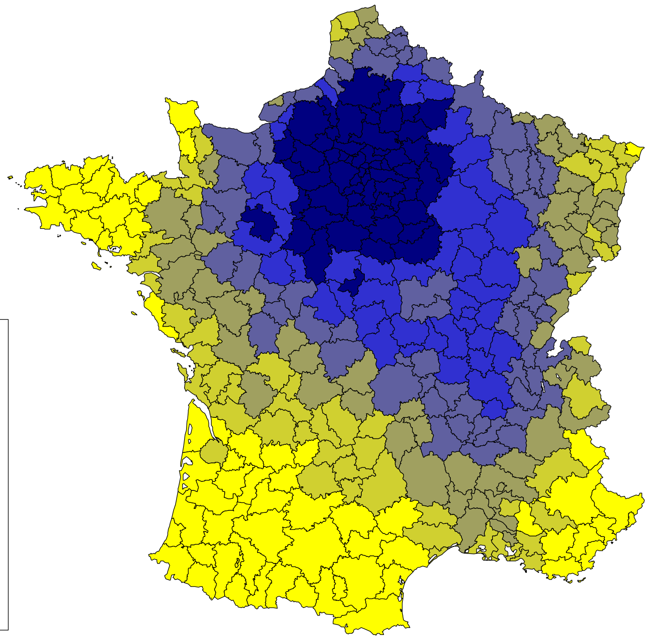


Figure 16: Profit Per Firm - Sector 4
Average = 100

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

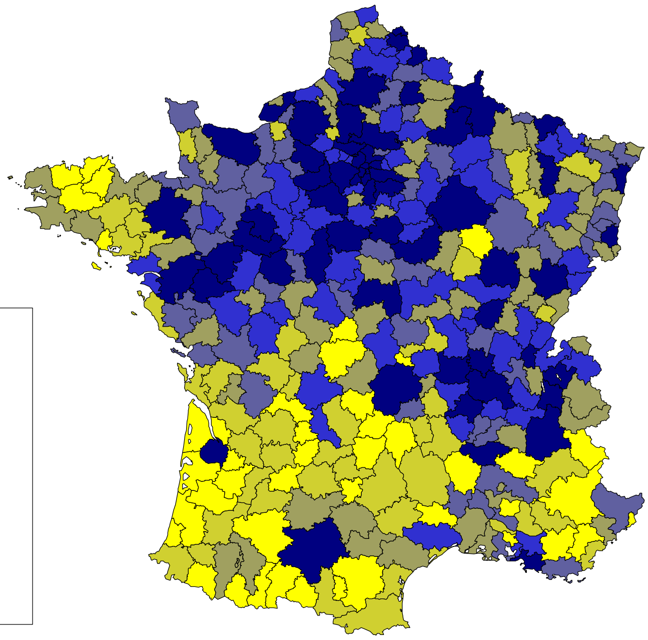


Figure 18: Total Production - Sector 4
30% transp. cost reduction (Average = 100)

128 - 2 595 (61)
71 - 128 (66)
39 - 71 (53)
19 - 39 (68)
8 - 19 (49)
0 - 8 (44)

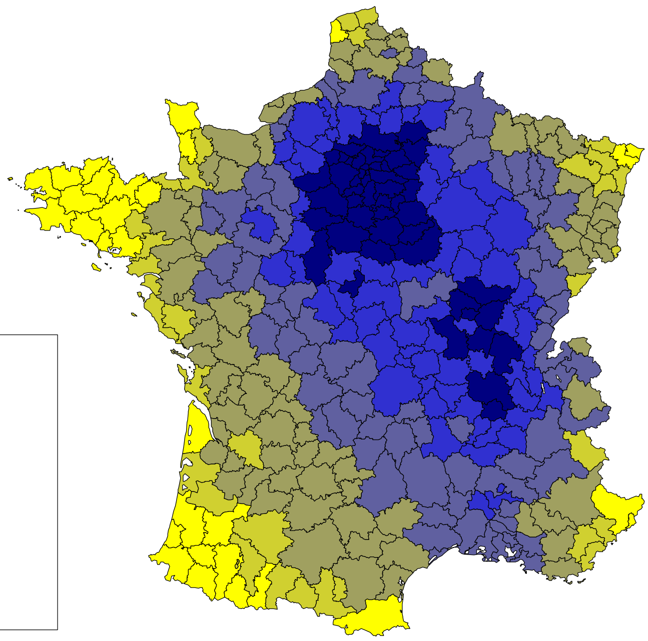


Figure 19: Profit Per Firm - Sector 4
30% transp. cost reduction (Average = 100)

147 - 289 (50)
115 - 147 (67)
85 - 115 (79)
63 - 85 (83)
48 - 63 (32)
18 - 48 (30)