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Seeking for Labor Demand Heterogeneity

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ABSTRACT. – The aim of this paper is to examine whether the estimation of labor demand can be affected by individual behavior heterogeneity. We shall consider an error-components model with variable-coefficients, where the coefficients are random and vary accross firms according to the values of time-constant explanatory variables and to a random firm-specific effect.

The specification of labor demand which stems from the variable coefficients hypothesis is estimated by the generalized method of moments on a panel of 810 French manufacturing firms. Heterogeneities appear to be strongly significant. When the share of skilled workers is higher, the ajustment speed is lower and the influence of wages on labor demand decreases (in absolute value) as well as that of sector demand shocks. Moreover, a higher market-share leads to a smaller adjustment speed and to an increased influence of wages and industry demand on employment.

Our estimates reveal strongly significant heterogeneities in labor demand behavior. However, the study of aggregation biases leads to the conclusion that they are very small. In fact our individual coefficients are uncorrelated with the explanatory variables, and this is a sufficient condition for the absence of aggregation biases.

L'hétérogénéité des comportements de demande de travail

RÉSUMÉ. – Cet article a pour objet d'examiner si l'estimation de la demande de travail peut être influencée par la prise en compte des hétérogénéités individuelles de comportements. On considère un modèle à erreurs composées avec des coefficients variables, où les coeffcients sont aléatoires et dépendent de variables explicatives caractéristiques de l'entreprise et d'un aléa individuel spécifique.

La spécification de la demande de travail découlant de cette hypothèse de coefficients variables est estimée par la méthode des moments généralisés sur un panel de 810 entreprises de l'industrie manufacturière française. L'estimation révèle des hétérogénéités très significatives dans les comportements de demande de travail. Quand la part des travailleurs qualifiés dans la main-d'œuvre est plus élevée, la vitesse d'ajustement est plus faible et l'influence du coût du travail sur la demande de travail décroît (en valeur absolue) ainsi que l'influence des chocs sur la demande du secteur auquel appartient l'entreprise. Par ailleurs, une part de marché plus élevée conduit à des ajustements plus lents et à une influence accrue des salaires et des chocs de demande sur l'emploi.

Malgré les fortes hétérogénéités mises en évidence par les estimations, l'étude des biais d'agrégation montre qu'ils sont très faibles. De fait nos coefficients individuels ne sont pas corrélés avec les variables explicatives, ce qui est une condition suffisante pour l'absence de biais d'agrégation.

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1 Introduction

The present paper aims to examine the individual heterogeneities which may affect the labor demand behavior of firms and the aggregation biases which may stem from them.

In the abundant literature devoted to labor demand, three types of problems are addressed: those related to the labor heterogenous components aggregation, problems of spatial aggregation and temporal aggregation.

The estimation of a labor demand model, where the various components of labor are aggregated, leads to biased results so long as specific elasticities to each category exist. This is underlined by a number of studies which divide workers in terms of qualification, age and degrees (Hamermesh [1993 *a*]). This results in an aggregation bias which is illustrated, in the case of French firms, by Bresson, Kramarz and Sevestre [1992]. It is worth noting that in this specific case, the difficulties are due to behavior heterogeneities among the various categories of workers.

Problems of spatial and temporal aggregation have mostly been dealt with through the study of labor demand dynamics. Recently, several works have underlined the employment adjustment costs asymmetry (Pfann and Verspagen [1989], Pfann and Palm [1993], Schiantarelli and Sembenelli [1993], Bresson, Kramarz and Sevestre [1991]). On the basis of such findings, Hamermesh shows in a rather heuristic paper, that the spatial aggregation problems arise when adjustment costs are not both symmetric and quadratic at the firm level. In such a situation, indeed, the model is non linear at the microeconomic level. Even if firms' behavior is homogeneous, a bias appears owing to the linear aggregation of a non linear model. Similarly, if the adjustment costs are not symmetric and quadratic, the temporal aggregation of a model which would be non linear at the unit of time in employers' decision-making, leads to a biased evaluation of the labor demand dynamics. Note that in the examples addressed by Hamermesh, there are no individual behavior heterogeneities: the bias stems from the non linearity of the microeconomic model.

We shall here address the spatial aggregation problem in a different way. We shall consider a simple linear model and assume that individual behavior is heterogeneous. On panel data, the assumed heterogeneity is generally reduced to a firm-specific effect which disappears as soon as first-difference of within estimates are considered. This comes down to accepting the idea of a constant specific to each firm, and assuming that slopes are homogeneous. If it is not justified, the latter assumption may generate biases. Here we shall not adopt such a restrictive hypothesis but rather consider an error-components variable-coefficient model, where coefficients are random and vary accross firms according to the values of time-constant explanatory variables and to a random firm-specific effect.

Zellner [1969] has shown that if the individual coefficients can be viewed as random variables uncorrelated with the explanatory variables that they affect, then the model will not possess any aggregation biases. These hypotheses are the same as those of SWAMY'S [1970] random coefficient model. As stressed by FORTIN [1991] these assumptions are far from being trivial since, when applied to our specific case, they would mean that there is a stochastic independence between the explanatory factors of employment and how employment itself reacts to these factors. Fortin derives the conditions for the existence of an aggregate function in a very general stochastic framework. In a linear framework, there are no aggregation biases if the sum of the covariances between the coefficients and the variables they affect is null.

If the present article does deal with aggregation problems, it mostly addresses heterogeneities which are intrinsically interesting. The labor demand individual coefficients considered here, depend on variables which are specific to the firm's market power and technology. These are averages of the firm's market share and of the share of skilled workers in the firm's total labor, at the considered period of time. Taking into account the latter variable allows the estimation of behavior heterogeneities related to the heterogeneity of the labor itself.

A labor demand equation in accordance with our variable-coefficients specification is estimated by the generalized method of moment on a panel of 810 French manufacturing firms. Heterogeneities appear to be strongly significant. When the share of skilled workers is higher, the adjustment speed is lower and the influence of wages on labor demand decreases (in absolute value) as well as that of sectoral demand shocks. Moreover, a higher market-share leads to a lower adjustment speed and to an increased influence of wages and industry demand on employment. As for the effect of skill composition on labor demand coefficients, it is difficult to distinguish between what is due to higher adjustment costs and what should be attributable to a smaller elasticity of substitution in the production function. On the other hand, the effects of the firm's market power on the wage and industry demand elasticities are quite distinct from the effect of market power on the adjustment speed of employment. The positive effect of market share on the industry demand coefficient is in accordance with the hypothesis of a profit-maximizing firm in a monopolistic competition context. But the effect of the market share on wage elasticity is unexpected.

In the aftermath, our estimates reveal strongly significant heterogeneities in labor demand behavior. However, the study of aggregation biases leads to the conclusion that they are very small. In fact our individual coefficients are uncorrelated with the explanatory variables, which is, as underlined earlier, a sufficient condition for the absence of aggregation biases in a linear framework.

The paper is organized as follows. Section 2 presents our basic model of labor demand and the sources of individual heterogeneity that we shall consider. Section 3 presents the econometric model, the data and empirical specifications. As for the econometric model, we shall specify the individual heterogeneity by assuming that the coefficients are random and vary accross firms according to the value of explanatory variables and to a random firm-specific effect. The resulting specification is a good case of application of the generalized method of moments as presented by ARELLANO and BOND [1991] in the case of panel data. Section 4 reports the results. We shall first comment the estimated heterogeneities of labor demand behavior and then study the aggregation biases.

2 The Economic Model

2.1. A Basic Model of Labor Demand

Suppose that each firm is a part of a monopolistically competitive industry and maximizes its profit for given capital stock and wage levels. The firm faces a demand curve of the form:

$$Q_{it} = QS_{it}\left(\frac{P_{it}}{PS_{it}}\right)^{-E},$$

with $E > 1 \cdot Q_{it}$ and P_{it} are, respectively, the endogeneous output and price levels of the ith firm. QS_{it} and PS_{it} respectively denote the exogeneous output and price levels of the industry to which the ith firm belongs.

In the absence of adjustment costs, the labor demand equation, written in first differences, is of the following form:

$$(1) \quad dn_{it} = \varepsilon_k \, dk_{it} + \varepsilon_w \, d\left(\frac{w_{it}}{ps_{it}}\right) + \varepsilon_q \, dqs_{it} + \text{consts}$$

dn_{it} and dk_{it} are, respectively, the first differences of the log of employment and gross capital. dqs_{it} is the first difference of the log of the aggregate output of the industry to which the ith firm belongs. $d\left(\frac{w_{it}}{ps_{it}}\right)$ is the first difference of the wage log (including social expenses) of firm i, deflated by the output price of the relevant industry. Constants are time dummies included in the equation to take into account a time effect common to all companies.

Equation (1) lies on the assumption that wages are predetermined in the employment decision. Retaining such an hypothesis may mean that the reasoning framework consists in a right-to-manage model, where unions only negotiate over wages. More generally, assuming that wages are predetermined means that wages are adjusted at discrete intervals, while employment is adjusted continuously. Our right-to-manage model is static: we assume that the firm, when choosing the employment level, does not recognize the fact that the present employment level may affect future wages.

In the case of a CES production function of the form:

$$F(N,\ K) = A\left(\delta N^{-\rho} + (1-\delta)\,K^{-\rho}\right)^{-\nu/\rho},$$

the expressions of the labor demand coefficients can be derived:

$$(2) \quad \varepsilon_w = -\frac{\sigma}{1 + \sigma\, e_N \left(\frac{1}{E} - \left(1 + \dfrac{\rho}{\nu}\right)\right)}$$

$$(3) \quad \varepsilon_q = -\frac{1}{E}\,\varepsilon_w$$

$$(4) \quad \varepsilon_k = -e_K \left(\left(1 + \frac{\rho}{\nu}\right) - \frac{1}{E}\right)\varepsilon_w.$$

Where E is the price elasticity of the demand curve that the firm faces. σ denotes the substitution elasticity between labor and capital. e_N and e_K stand for the elasticities of the output with respect to labor and capital in the production function.

In the simpler case of a Cobb-Douglas production function, with $e_N = \alpha$ and $e_K = \beta$, the coefficients are given by:

$$\varepsilon_w = -\frac{\mu}{\mu - \alpha}, \quad \varepsilon_q = -\frac{1}{E}\,\varepsilon_w = \frac{\mu}{E\,(\mu - \alpha)}, \quad \varepsilon_k = \frac{\beta}{\mu - \alpha},$$

where μ, defined as: $\mu = \dfrac{E}{E-1}$, is equal to 1+ the mark-up.

2.2. The Sources of Individual Heterogeneity

In order to study labor demand heterogeneity we shall assume that coefficients ε_w, ε_q and ε_k vary accross firms according to the values of time-constant explanatory variables and to a random firm-specific effect. What are the sources of individual heterogeneity in labor demand behavior? Looking at expressions (2) to (4), we can see that the coefficients crucially depend on σ and E. The first of these two parameters is a characteristic of the firm's technology, while the firm's market power is a decreasing function of the second. We shall restrict the explanatory variables of the labor demand coefficients to proxies of these technology and market characteristics:

– s: the ratio of skilled workers to total employment, which is supposed to be negatively correlated with σ;

– m: the firm's market-share, defined as the ratio of the firm's production to the production of the industry to which the ith firm belongs. m is likely to be negatively correlated with E.

The choice of s stems from the very abundant literature which emphasizes the fact that the heterogeneity of labor input itself should be taken into account when estimating factor demands or production functions. Since the pioneering work of GRILICHES [1969], some studies have given support to the hypothesis that skilled labor is more complementary with capital than unskilled labor (see D. HAMERMESH [1993*a*]). Taking into account labor heterogeneity generally leads to systems of factor demands, each equation referring to each input. In the hypothesis of a Translog production function, the dependent variable is, for each equation, the share of each input in total costs. We shall not choose this approach but rather consider a unique labor demand equation with variable coefficients for two main reasons. The first is that it makes it possible to evaluate directly the heterogeneity bias which could arise from an homogenous coefficients assumption. The second is that it allows to take into account continuous variations of s instead of considering two or three categories of workers. In addition, s, and thus the behavior heterogeneities will be treated as non-exogenous when carrying out the estimates.

The choice of m is quite straightforward as a first approximation, except that the firm's market power could be also affected by industry concentration.

Many other sources of behavior heterogeneity could be examined, such as, for instance, the age of capital or the degree of monitoring in labor organization. But as a first exercise the present analysis is restricted to the technology and market characteristics considered above.

How do the labor demand coefficients vary with respect to σ and E? Looking at expressions (2) to (4), we can see that the answer to this question depends on the values of e_N and e_K, which vary not only with respect to σ and E, but also with respect to the explanatory variables of labor demand. More precisely, we can write:

$$\frac{\partial|\varepsilon_w|}{\partial\sigma} = \frac{\partial|\varepsilon_w|}{\partial\sigma}\bigg|_{e_N} + \frac{\partial|\varepsilon_w|}{\partial e_N}\,\frac{\partial e_N}{\partial\sigma},$$

$$\frac{\partial\varepsilon_q}{\partial\sigma} = \frac{1}{E}\,\frac{\partial|\varepsilon_w|}{\partial\sigma},$$

and: $$\frac{\partial\varepsilon_k}{\partial\sigma} = \frac{\partial\varepsilon_k}{\partial\sigma}\bigg|_{e_K,\,e_N} + \frac{\partial\varepsilon_k}{\partial e_K}\,\frac{\partial e_K}{\partial\sigma} + \frac{\partial\varepsilon_k}{\partial e_N}\,\frac{\partial e_N}{\partial\sigma}.$$

Let us turn now to the variation of the labor demand coefficients with respect to E (the price elasticity of the demand curve that the firm faces); we have:

$$\frac{\partial|\varepsilon_w|}{\partial E} = \frac{\partial|\varepsilon_w|}{\partial E}\bigg|_{e_N} + \frac{\partial|\varepsilon_w|}{\partial e_N}\,\frac{\partial e_N}{\partial E},$$

$$\frac{\partial\varepsilon_q}{\partial E} = \frac{\partial\varepsilon_q}{\partial E}\bigg|_{e_N} + \frac{\partial\varepsilon_q}{\partial e_N}\,\frac{\partial e_N}{\partial E},$$

with:

$$\frac{\partial\varepsilon_q}{\partial E}\bigg|_{e_N} = -\frac{1}{E^2}\,|\varepsilon_w| + \frac{1}{E}\left(\frac{\partial|\varepsilon_w|}{\partial E}\bigg|_{e_N}\right)$$

and:

$$\frac{\partial\varepsilon_k}{\partial E} = \frac{\partial\varepsilon_k}{\partial E}\bigg|_{e_K,\,e_N} + \frac{\partial\varepsilon_k}{\partial e_K}\,\frac{\partial e_K}{\partial E} + \frac{\partial\varepsilon_k}{\partial e_N}\,\frac{\partial e_N}{\partial E}.$$

There is no general result concerning the signs of the partial derivatives of e_N or e_K with respect to σ and E, since, as stated above, e_N and e_K depend on the values of the explanatory variables of labor demand. Therefore it is not possible to predict in general how coefficients ε_w, ε_q and ε_k should vary with respect to σ and E.

If e_N and e_K are held constant, we have:

$$\left.\frac{\partial|\,\varepsilon_w\,|}{\partial\sigma}\right|_{e_N} > 0, \quad \left.\frac{\partial\varepsilon_q}{\partial\sigma}\right|_{e_N} > 0\,,$$

$$\left.\frac{\partial\varepsilon_k}{\partial\sigma}\right|_{e_K,\,e_N} < 0 \quad \text{if } \mu > \nu,$$

$$\left.\frac{\partial|\,\varepsilon_w\,|}{\partial E}\right|_{e_N} > 0,$$

$$\left.\frac{\partial\varepsilon_q}{\partial E}\right|_{e_N} < 0 \quad \text{if } e_N < \frac{1+\rho}{1+\dfrac{\rho}{\nu}}$$

and : $$\left.\frac{\partial\varepsilon_k}{\partial E}\right|_{e_K,\,e_N} > 0.$$

Thus, if we suppose that e_N and e_K present little variations (they are constant parameters in the Cobb-Douglas case), we can expect:

$$(5)\quad \begin{array}{lll} \dfrac{\partial|\,\varepsilon_w\,|}{\partial s} < 0, & \dfrac{\partial\varepsilon_q}{\partial s} < 0, & \dfrac{\partial\varepsilon_k}{\partial s} > 0, \\ \dfrac{\partial|\,\varepsilon_w\,|}{\partial m} < 0, & \dfrac{\partial\varepsilon_q}{\partial m} > 0, & \dfrac{\partial\varepsilon_k}{\partial m} < 0. \end{array}$$

3 Estimation

3.1. The Econometric model

In order to study the individual heterogeneity of labor demand, we consider an error-components model with variable coefficients of the general form :

$$\begin{cases} y_{it} = \underset{(1,\,k)}{X_{it}}\ \underset{(k,\,1)}{b_i} + \alpha_i + \xi_{it}, & (6)\quad \begin{array}{l} i = 1,\,\ldots,\,N \\ t = 1,\,\ldots,\,T+1 \end{array} \\ b_i = b_0 + \beta_i, & (7) \\ \underset{(k,\,1)}{\beta_i} = \underset{(k,\,\ell)}{W_i}\ \underset{(\ell,\,1)}{b_1} + \underset{(k,\,1).}{\eta_i} & (8) \end{cases}$$

In this model, the disturbance contains a firm-specific effect α_i, which may be correlated with the explanatory variables and an error term ξ_{it} such as $E(\xi_{it}) = 0$ and $E(\xi_{it}\,\xi_{it'}) = 0$ if $t \neq t' \cdot \xi_{it}$ may be correlated with the explanatory variables. We assume that the coefficients b_i are random and vary across firms according to the values of explanatory variables W_i and to a random firm specific effect η_i.

η_j is supposed to be uncorrelated with X_{it}, W_i and ξ_{it}, for all i, j, t.

In addition, we assume $E(\eta_i\,\eta_j') = \begin{cases} \Delta & \text{if } i = j, \\ (k,\,k) & \\ 0 & \text{if } i \neq j. \end{cases}$

Combining (6), (7) and (8), we have:

$$y_{it} = X_{it}\,b_0 + X_{it}\,W_i\,b_1 + X_{it}\,\eta_i + \alpha_i + \xi_{it}.$$

To eliminate firm effect α_i, we write the equation in first differences [1], and we obtain:

$$(9) \quad dy_{it} = dX_{it}\,b_0 + dX_{it}\,W_i\,b_1 + \nu_{it},$$

where:

$$(10) \quad \begin{cases} dy_{it} = y_{it} - y_{it-1} \\ \nu_{it} = dX_{it}\,\eta_i + \xi_{it} - \xi_{it-1} \end{cases}.$$

Stacking the T observations for firm i, we have:

$$(11) \quad \begin{cases} dy_i = \underset{(T,\,k)}{dX_i}\;\underset{(k,\,1)}{b_0} + \underset{(T,\,\ell)}{P_i}\;\underset{(\ell,\,1)}{b_1} + \nu_i \\ E\,\nu_i\,\nu_i' = \phi_i = dX_i\,\Delta dX_i' + \sigma_\xi^2\,H, \end{cases}$$

where σ_ξ^2 is the variance of ξ_{it} (supposed to be stationary) and H is a T-square matrix which has twos in the main diagonal, minus ones in the first subdiagonals and zeros otherwise.

Stacking all the NT observations, we obtain:

$$\begin{cases} dy = dX\,b_0 + P\,b_1 + v, \\ E\,vv' = \Omega = \operatorname{diag}\{\phi_1,\,\ldots,\,\phi_i,\,\ldots,\,\phi_N\}. \end{cases}$$

Thus, taking into account individual heterogeneity leads, as usual, to additional explanatory variables and heteroskedasticity.

This model will be estimated by the generalized method of moments (GMM) as presented by ARELLANO and BOND [1991] in the case of Panel Data. The estimates derive from the following orthogonality conditions: $E(\underset{(p,\,T)}{Z_i'}\;\underset{(T,\,1)}{v_i} = 0$ where Z_i is a matrix of p valid instruments (described below).

1. Since we write the model in first differences to eliminate the firm-specific effect, we shall not here deal with the problem of aggregation biases arising from the existence of α_i (if the latter is not purely random with a null expectation). Actually, we study aggregation biases which could affect the estimates of the “slopes”.

In the first stage, the residuals' heteroskedasticity is not taken into account (which is equivalent to assuming that the $b_i\,s$ are deterministic functions of the $W_i\,s$). By assuming that $N \to \infty$ and using the multivariate standard central-limit theorem, one can deduce from the first stage results a consistent estimate of the asymptotic covariance matrix of $\sqrt{N}\,(Z'\,v)$, which permits to obtain the optimal GMM estimator in a second stage.

3.2. **Data**

The dataset used for this analysis consits of a panel of 810 French manufacturing firms observed over the period 1979-1990. This sample is obtained by combining two INSEE panel data sets:

– The "Fichier d'Entreprises", which is a sample of balance sheets of several thousands of firms.

– The surveys about "Structure des Emplois" (employment structure by skill).

While the data set covers the period 1979-1990, the estimation period is reduced to 1986-1990 because of the lags involved in the specification of the model and because of the changes that occured in 1984 in the definition of employment and in the nomenclature of qualifications. However, the observations relative to the period 1979-1984 can be used as instruments for our GMM estimates.

Since 1984, employment (n) has been defined as the number of employees in the middle of the year. Capital stock (k) is taken as the real gross book value of fixed assets at the beginning of the year, adjusted for inflation by using a microeconomic estimate of capital average age. The wage (w) is computed as the labor cost (total wage bill plus social expenses) per employee. Industry output (qs) and price (*ps*) are taken from aggregate output series decomposed into 18 levels for the manufacturing sector. s is defined as the ratio of skilled workers (*i.e.* not fully unskilled workers) to total employment. Another measure of skill, like the ratio of engineers and technicians to total employment, does not change substantially the results. The market share, m, is measured by dividing the firm's production by the production of the relevant industry. Measuring m by using the value-added instead of production does not change the findings. The basic features of the data are presented in table 1.

For obvious reasons, neither s nor m are exogenous. Moreover, the wage, though theoretically predetermined, cannot be treated as exogenous. Indeed, our measure of the wage is actually influenced by the number of hours worked and by the composition of the work force, while the dependent variable (employment) is not influenced by any of these. This should induce a correlation between the disturbance and the wage. Finally, since capital is computed on the basis of balance sheet data, it is likely to be measured with errors; and so is the industry output because firms have multiproduct activities and their breakdown among the various industries entirely depends on their main products. Therefore we shall assume that none of the explanatory variables is strictly exogenous [2]. More precisely, we assume that $E(x_{it}\,\xi_{it+\tau}) = 0$ if $\tau > 0$, where x_{it} is the level of any explanatory variable. This comes down to assuming that the x_{it} are predetermined and that the measurement errors are not autocorrelated.

TABLE 1

Basic features of the data

Variable	Mean	Standard deviation
dn_{it} first difference of Log (Employment)$_{it}$	–0.0065	0.0755
dk_{it} first difference of Log (gross capital)$_{it}$	–0.0039	0.0916
dw_{it} first difference of Log of the wage deflated by the industry output price	0.0090	0.0787
dqs_{it} first difference of Log of industry output	0.0215	0.0540
ds_{it} first diffence of the share of skilled workers in total Employment	0.0060	0.0415
dm_{it} first difference of the firm's market share	-0.0006×10^{-2}	0.0008
$s_{i.}$ individual mean of the share of skilled workers in total Employment	0.7401	0.2018 (Minimum = 0.1236, Maximum = 1)
$m_{i.}$ individual mean of the firm's market share	0.0039	0.0122 (Minimum = 0.00002, Maximum = 0.1595)

810 French manufacturing firms 1986-1990.

3.3. **Empirical Specifications**

The demand equations we intend to estimate are of the following form:

(I) $$dn_{it} = a\,dn_{it-1} + b\,dk_{it} + c\,dw_{it} + e\,dqs_{it} + \text{consts} + v_{it}$$

(II) $$dn_{it} = a\,dn_{it-1} + b\,dk_{it} + c\,dw_{it} + e\,dqs_{it} + f\,ds_{it} + g\,dm_{it} + \text{consts} + v_{it}$$

(III) $$dn_{it} = (a_0 + a_1\,s_{i.})\;dn_{it-1} + (b_0 + b_1\,s_{i.})\;dk_{it} + (c_0 + c_1\,s_{i.})\,dw_{it} + (e_0 + e_1\,s_{i.})\,dqs_{it} + f\,ds_{it} + \text{consts} + v_{it}$$

(IV) $$dn_{it} = (a_0 + a_2\,m_{i.})\;dn_{it-1} + (b_0 + b_2\,m_{i.})\;dk_{it} + (c_0 + c_2\,m_{i.})\,dw_{it} + (e_0 + e_2\,m_{i.})\,dqs_{it} + g\,dm_{it} + \text{consts} + v_{it}$$

(V) $$dn_{it} = (a_0 + a_1\,s_{i.} + a_2\,m_{i.})\;dn_{it-1} + (b_0 + b_1\,s_{i.} + b_2\,m_{i.})\;dk_{it} + (c_0 + c_1\,s_{i.} + c_2\,m_{i.})\,dw_{it} + (e_0 + e_1\,s_{i.} + e_2\,m_{i.})\,dqs_{it} + f\,ds_{it} + g\,dm_{it} + \text{consts} + v_{it},$$

2. However, other regressions, not published here, show that assuming that capital and production are strictly exogenous does not change results significantly.

where constants are time dummies. v_{it} is the heteroskedastic disturbance defined in equation (10).

The estimating forms (I) to (V) allow for dynamics through a quite simple partial adjustment mechanism, which comes down to assuming symmetric and quadratic adjustment costs. However, one should notice that the specification takes into account heterogeneity in adjustment speeds.

As stated above, the lack of continuous definitions for employment and qualifications restrict the estimation period to 1986-1990. The results for labor demand estimates are reported in tables 2 and 3. $s_{i.}$ and $m_{i.}$ are the individual means of s_{it} and m_{it} computed for period 1986-1990. In equations (II) to (V), we introduce the first differences of s_{it} and m_{it}, ds_{it} and dm_{it}, as additional explanatory variables. When we compare the results of equations (I) and (II) we shall see that introducing ds_{it} and dm_{it} does not change anything [3].

Tables 2 and 3 present the GMM estimates. All the variables are instrumented: instruments are the logarithms of all explanatory variables observed on the years 1979-1984 and multiplied or not by s_{it} and m_{it} (observed in 1979-1984). The additional instruments used are the logarithms of the firm's real value-added over the years 1979-1984. In table 3 we allow for more dynamics, including lagged values of explanatory variables and a second lag of the dependent variable.

4 Results

4.1. Seeking for Heterogeneities

Considering the estimations of table 2, one can first observe that all the heterogeneities appear to be strongly significant and that the Sargan tests never lead to rejection of the instruments validity.

The coefficients of fixed coefficients estimates (columns I and II) are significant and have the expected magnitudes and signs. As stressed above, adding ds_{it} and dm_{it} does not change the estimates of the coefficients.

It we take a closer look at the results of column III, we can see that the coefficients vary in accordance with our expectations: when the share of skilled workers is higher, the adjustment speed is lower and the influences of

3. Theoretically, the fact that w_{it} is influenced by the share of skilled workers in employment leads to a downward bias in the wage elasticity, which sould be reduced when taking into account ds_{it} (DORMONT (1993)). However, the estimates show that the effect of introducing ds_{it} on the evaluation of the wage elasticity of labor demand is negligible.

wages and of sectoral demand shocks decrease [4]. As for the wage elasticity, these estimates can be interpreted in the light of expressions (5), and give support to the idea that skilled workers are more complementary with capital than unskilled workers. Such findings, though they stem from a different approach, are in accordance with those of a number of studies compiled by HAMERMESH [1993*a*], who concludes that own-wage demand elasticities decrease with skill. However, one remarks that the adjustment speed is also lower when the share of skilled workers is higher. When calculating the long run coefficients [5], it turns out that these slower adjustments can explain most of the heterogeneity of the short run wage elasticity. Thus we can conclude that in our case most of this heterogeneity due to skill composition lies on adjustment speed.

Finding that the adjustment speed decreases with skill is in accordance with the results of a number of studies which bring to light the fact that the adjustment speed is slower for non production workers than for production workers (see HAMERMESH [1993*a*]). Note however, that since our result is based on the use of a direct indicator of skills, it more firmly supports the conclusion that the demand for human capital responds less rapidely to input cost shocks than the demand for raw labor. It is worth noting also that adjustment costs may be influenced by strains prevailing on the labor market: BURGESS [1988], and SCHIANTARELLI and SEMBENELLI [1993] examine the influence of the unemployment rate or the unemployment vacancy ratio on the adjustment speed in the U.K., respectively with aggregated series and panel data. Thus a slower adjustment speed for qualified workers can be interpreted in our specific case, as an evidence of the difficulties French firms met in recruiting skilled labor during the considered period of time (KRAMARZ and LOLLIVIER [1990]).

Turning now to the effect of m on labor demand behavior, we can see that a higher market-share leads to a lower adjustment speed and to an increased influence of wages and industry demand on employment (column IV). Unlike the case of heterogeneities due to manpower's qualification, the effects of the market-share on wage and industry demand elasticities are here quite distinct from the influence of market-share on the adjustment speed of employment because they work in opposite directions. The positive effect of the firm's market-share on the coefficient of dqs_{it} is in accordance with expressions (5) which were derived within the simple framework of a profit-maximizing-firm labor demand in a monopolistic competition context. On the other hand, the effect of the market-share on the wage elasticity is quite unexpected. The dominant market position of a firm should in principle be profitable to its employees in term of wages (when negotiated) *and* employment. Indeed, NICKELL, VAINIOMAKI and WADHWANI [1994] have shown that increases in a firm's market power lead to a rise in wages. But this effect is taken into account in our estimates, where we evaluate the influence of a given (and instrumented) level of wages. Perhaps our

4. We shall not comment the estimates of the capital coefficients, which are difficult to interprete, because their constant parts are sometimes negative.

5. We find, in the case of regression III, a long run wage elasticity equal to –0.849-0.027 $s_{i.}$. In the case of regression IV, the long run wage elasticity is equal to –0.730-13.521 $m_{i.}$. In the case of regression V, the long run wage elasticity is equal to –0.777+0.022 $s_{i.}$–9.786 $m_{i.}$.

TABLE 2

GMM estimates of fixed or variable coefficients labor demand equations

Explanatory variables	Fixed coefficients		Variable coefficients		
	(I)	(II)	(III)	(IV)	(V)
dn_{it-1}	0.850	0.834	$0.688+0.196s_{i.}$	$0.822+1.377m_{i.}$	$0.728+0.116s_{i.}+1.535m_{i.}$
	(0.001)	(0.001)	(0.004) (0.005)	(0.001) (0.049)	(0.004) (0.005) (0.051)
dk_{it}	0.021	0.022	$-0.087+0.149s_{i.}$	$0.027-1.288m_{i.}$	$-0.076+0.140s_{i.}-1.597m_{i.}$
	(0.001)	(0.001)	(0.003) (0.004)	(0.001) (0.061)	(0.003) (0.004) (0.061)
dw_{it}	–0.128	–0.147	$-0.265+0.158s_{i.}$	$-0.130-1.401m_{i.}$	$-0.216+0.096s_{i.}-1.469m_{i.}$
	(0.001)	(0.001)	(0.006) (0.008)	(0.002) (0.060)	(0.006) (0.008) (0.061)
dqs_{it}	0.108	0.117	$0.166-0.065s_{i.}$	$0.122+0.996m_{i.}$	$0.155-0.039s_{i.}+0.945m_{i.}$
	(0.001)	(0.001)	(0.004) (0.005)	(0.001) (0.050)	(0.004) (0.004) (0.053)
ds_{it}	–	–0.007	–0.006	–	–0.019
		(0.002)	(0.002)		(0.002)
dm_{it}	–	5.296	–	6.379	6.085
		(0.050)		(0.077)	(0.074)
s	130.9	122.8	122.8	122.7	120.4
	(142.1)	(139.9)	(136.6)	(136.6)	(131.0)
ε_w	–0.853	–0.886	–0.886	–0.780	–0.839

All variables are instrumented.
Dependent variable: dn_{it} (first difference of L_n (Employment)$_{it}$).
Asymptotic standard errors robust to cross-section and time series heteroskedasticity are reported in parentheses.
Time dummies are included in all equations.
Estimation period: 1986-1990.
Total number of observations: 4050.
$s_{i.}$, $m_{i.}$: individual means of s_{it} and m_{it} over the period 1986-1990.
All variables are instrumented: instruments are the logarithms of all explanatory variables over the period 1979-1984, the logarithms of all explanatory variables multiplied by s_{it} and m_{it} observed on the years 1979-1984, and the logarithms of firm's real value-added (1979-1984).
S is the value of the statistic for the Sargan test for instrument validity. (The $\chi^2_{5\%}$ for the appropriate degree of freedom is reported in parentheses.)
ε_w: long run wage elasticity of labor demand. For the variable-coefficients estimates, it is calculated by using the average values of $s_{i.}$ and $m_{i.}$.

result should be examined in the light of a dynamic version of the right-to-manage model, as proposed by MACHIN, MANNING and MEGHIR [1993]. In this model, the employer recognizes that the employment chosen today will affect tomorrow's negotiated wages and that this affects future profits. In our case, the employer would react to the fact that, given the market position, the negotiated wages will be higher; therefore he would make technological choices where employment should be more influenced by wages.

Results appear to be quite similar when combining the skill composition and the market-share in the same regression (column V). In fact the correlation between $s_{i.}$ and $m_{i.}$, though significant, is very low (0.039): these two factors work independently.

TABLE 3

GMM estimates of fixed or variable coefficients labor demand equations (more dynamics)

Explanatory variables	Fixed coefficients		Variable coefficients		
	(I)	(II)	(III)	(IV)	(V)
$dn_{it_{-1}}$	1.104 (0.002)	1.073 (0.002)	1.201–0.090$s_{i.}$ (0.010) (0.013)	1.099+1.875$m_{i.}$ (0.002) (0.119)	1.131–0.031$s_{i.}$+1.402$m_{i.}$ (0.010) (0.013) (0.138)
$dn_{it_{-2}}$	–0.263 (0.002)	–0.241 (0.002)	–0.609+0.407$s_{i.}$ (0.010) (0.013)	–0.241–3.968$m_{i.}$ (0.002) (0.136)	–0.527+0.343$s_{i.}$–3.880$m_{i.}$ (0.010) (0.013) (0.156)
dk_{it}	0.058 (0.001)	0.016 (0.002)	–0.297+0.399$s_{i.}$ (0.008) (0.009)	0.017–0.027$m_{i.}$ (0.002) (0.092)	–0.334+0.457$s_{i.}$+0.981$m_{i.}$ (0.008) (0.010) (0.098)
$dk_{it_{-1}}$	–0.045 (0.001)	–0.000 (0.002)	0.342–0.425$s_{i.}$ (0.008) (0.010)	–0.032+4.007$m_{i.}$ (0.002) (0.141)	0.407–0.542$s_{i.}$+2.658$m_{i.}$ (0.009) (0.010) (0.149)
dw_{it}	–0.249 (0.002)	–0.267 (0.002)	–0.609+0.416$s_{i.}$ (0.008) (0.011)	–0.258+5.102$m_{i.}$ (0.002) (0.273)	–0.679+0.455$s_{i.}$+11.361$m_{i.}$ (0.009) (0.011) (0.295)
$dw_{it_{-1}}$	0.161 (0.002)	0.181 (0.002)	0.437–0.349$s_{i.}$ (0.010) (0.012)	+0.258–10.36$m_{i.}$ (0.002) (0.194)	0.579–0.366$s_{i.}$–15.416$m_{i.}$ (0.010) (0.012) (0.213)
dqs_{it}	0.046 (0.002)	0.106 (0.002)	–0.225+0.345$s_{i.}$ (0.013) (0.014)	0.055–3.624$m_{i.}$ (0.003) (0.349)	–0.243+0.372$s_{i.}$–9.153$m_{i.}$ (0.013) (0.015) (0.382)
$dqs_{it_{-1}}$	0.033 (0.002)	–0.011 (0.002)	0.155–0.157$s_{i.}$ (0.011) (0.013)	0.041–0.680$m_{i.}$ (0.002) (0.263)	0.177–0.158$s_{i.}$+1.342$m_{i.}$ (0.012) (0.014) (0.297)
ds_{it}	–	–0.123 (0.002)	–0.089 (0.002)	–	–0.081 (0.002)
dm_{it}	–	3.040 (0.042)	–	–0.774 (0.031)	–0.183 (0.033)
s	94.4 (137.7)	92.2 (135.5)	82.6 (127.7)	82.9 (127.7)	66.6 (117.6)
ε_w	–0.553	–0.512	–0.701	–0.133	–0.286

All variables are instrumented.
Dependent variable: dn_{it} (first difference of L_n (Employment)$_{it}$).
Asymptotic standard errors robust to cross-section and time series heteroskedasticity are reported in parentheses.
Time dummies are included in all equations.
Estimation period: 1986-1990.
Total number of observations: 3240.
$s_{i.}$, $m_{i.}$: individual means of s_{it} and m_{it} over the period 1986-1990.
All variables are instrumented: instruments are the logarithms of all explanatory variables over the period 1979-1984, the logarithms of all explanatory variables multiplied by s_{it} and m_{it} observed on the years 1979-1984, and the logarithms of firm's real value-added (1979-1984).
S is the value of the statistic for the Sargan test for instrument validity. (The $\chi^2_{5\%}$ for the appropriate degree of freedom is reported in parentheses.)
ε_w: long run wage elasticity of labor demand. For the variable-coefficients estimates, it is calculated by using the average values of $s_{i.}$ and $m_{i.}$.

Allowing for more dynamics, as in table 3, leads to the estimates generally obtained with this kind of specification (see, for instance, ARELLANO and BOND [1991] or NICKELL and WADWANI [1991]): we find opposite signs for the coefficients of the lagged values of the explanatory variables. However, some general features of the results previously discussed are found again: a higher labor qualification leads to slower adjustments and decreases the influence of the wage on labor demand (colums III or V). As far as the effect of the market-share on the wage elasticity is concerned, it is worth noting that the negative influence previously observed occurs one year later (on the coefficient of dw_{it-1}, see columns IV or V) whereas the present effect is positive. It should be determined if this finding may give some support to the interpretation in terms of dynamic right-to-manage model.

4.2. Seeking for Aggregation Biases

The estimates discussed above have revealed strongly significant heterogenetities in labor demand behavior. Therefore, the classic paradigm of the "representative agent" is clearly rejected.

In order to study aggregation biases, one has to compare the estimates obtained when behavior is supposed to be homogeneous and the averages of heterogeneous elasticities derived from variable-coefficients estimates. If the difference is small, then the homogeneity hypothesis does not prevent having a good knowledge of the macroeconomic behavior.

The long run wage elasticities for models I to V are reported at the bottom of Tables 2 and 3. In the case of variable-coefficients estimates, ε_w is calculated by using the averages, over the sample, of $s_{i.}$ and $m_{i.}$. Comparing the values obtained for ε_w, one should notice that they are very close to each other in table 2, but that it is less the case in table 3. However, it appears clearly that the short run coefficients are the ones to be compared. Indeed, the aggregation bias assumption is tested on the estimated linear model, whose parameters are the labor demand short run coefficients. Further, the transformation allowing to calculate the long run coefficients is made through a function which may greatly accentuate the differences that may be slight for short run coefficients.

The averages, minima and maxima of the short run coefficients, resulting from variable-coefficients regressions are given in tables 4 and 5, as well as the short run coefficients resulting from fixed-coefficients regressions. Tables 4 and 5 both reveal how heterogeneities are important and how the aggregation bias is small. Indeed, comparing the coefficients resulting from fixed-coefficients regressions with the averages of the coefficients estimated through variable-coefficients regressions shows that the differences, though non zero, are quite little.

As we are in a linear framework, we know that if the individual coefficients (our $b_i\,s$) can be viewed as random variables uncorrelated with the explanatory variables that they affect, then the model will not possess any agregation biases (ZELLNER [1969]). In our case, individual coefficients depend on explanatory variables and on a firm-specific effect $(b_i = b_0 + W_i\,b_1 + \eta_i)$. Since the estimates of b_1 are significant the hypothesis of homogeneity is rejected. However, the correlations between the explanatory variables of labor demand and $s_{i.}$ or $m_{i.}$ are very small (see table 6). Therefore the aggregation bias is also very small.

TABLE 4

Comparison of short run coefficients

(from the estimates of table 2)

	Fixed-coefficients estimates	variable-coefficients estimates					
	(II)	(III) Mean	Min Max	(IV) Mean	Min Max	(V) Mean	Min Max
			0.712		0.822		0.742
$\varepsilon_{n_{-1}}$	0.834	0.833	0.884	0.827	1.042	0.820	1.055
			–0.068		–0.178		–0.259
ε_k	0.022	0.023	0.062	0.022	0.027	0.021	0.064
			–0.245		–0.353		–0.401
ε_w	–0.147	–0.148	–0.107	–0.135	–0.130	–0.151	–0.120
			0.101		0.122		0.116
ε_q	0.117	0.118	0.157	0.126	0.281	0.130	0.286

TABLE 5

Comparison of short run coefficients

(from the estimates of table 3)

	Fixed-coefficients estimates	variable-coefficients estimates					
	(II)	(III) Mean	Min Max	(IV) Mean	Min Max	(V) Mean	Min Max
			1.111		1.099		1.100
$\varepsilon_{n_{-1}}$	1.073	1.134	1.190	1.106	1.398	1.113	1.338
			–0.559		–0.874		–0.972
$\varepsilon_{n_{-2}}$	–0.241	–0.308	–0.202	–0.256	–0.241	–0.288	–0.184
			–0.248		0.013		–0.277
ε_k	–0.016	–0.002	0.102	0.017	0.017	0.008	0.183
			–0.080		–0.032		–0.135
$\varepsilon_{k_{-1}}$	–0.000	0.030	0.292	–0.016	0.607	0.016	0.560
			–0.558		–0.258		–0.621
ε_w	–0.267	–0.301	–0.193	–0.238	–0.556	–0.298	1.457
			0.088		-1.392		–2.140
$\varepsilon_{w_{-1}}$	0.181	0.179	0.394	0.218	0.258	+0.248	0.532
			–0.182		–0.523		–1.510
ε_q	0.106	0.030	0.120	0.041	0.055	–0.003	0.129
			–0.002		–0.067		0.019
$\varepsilon_{q_{-1}}$	–0.011	0.039	0.136	0.038	0.041	0.065	0.311

TABLE 6

Correlation coefficients between the explanatory variables of labor demand and $s_{i.}$ et $m_{i.}$

	$s_{i.}$	$m_{i.}$
$dn_{it_{-1}}$	–0.0002**	–0.0456
dk_{it}	–0.0273*	–0.0183**
dw_{it}	0.0294*	–0.0070**
dqs_{it}	0.0481	0.0214**

** The coefficient is not significant (5%).*
*** The coefficient is not significant (10%).*

One could claim that this result is not surprising, since there is little risk to find a high correlation between individual means and growth rates. Let us underline, on the other hand, that the result related to significant heterogeneities is quite not obvious.

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