Employment Changes, the Structure of Adjustment Costs, and Firms' Size[†]

Øivind A. Nilsen

(University of Bergen)

Kjell G. Salvanes

(Norwegian School of Economics and Business Administration)

Fabio Schiantarelli

(Boston College)

March 2001

Preliminary Version: Please do not quote without the authors' permission

Abstract

In this paper we analyze the pattern of employment adjustment at the plant level using a rich data set for Norway. We first document the stylized facts about employment changes in small and large plants. The data reveals important differences across size classes. In particular, episodes of zero net employment changes are more frequent for smaller plants. A simple "q" model of labor demand is then developed, allowing for the presence of fixed, linear and convex components in adjustment costs. Econometric estimation supports the importance of departing from traditional models of labor demand based solely on symmetric convex adjustment costs. Fixed (or linear) components of adjustment costs are important. There is, moreover, evidence that fixed costs contain a component that are unrelated to size, in addition to a components proportional to size. As a result, the range of inaction is wider for smaller plants. Finally, the quadratic components of costs are asymmetric and they indicate that it is more costly at the margin to contract employment than to expand it.

JEL classification: D21, C24, E24

Key words: Adjustment costs, employment demand, size.

[†] We would like to thank Kevin Lang for useful suggestions.

1. Introduction

In the last few years there has been an heightened awareness of the shortcomings of traditional models of factor demand based on convex and symmetric adjustment costs and of the need to consider more general adjustment cost functions (see Hamermesh and Pfann (1996) for a critical review). The increased availability of firm and plant level panel data has made it easier to provide empirical evidence on these issues and has lead to a blossoming of empirical studies, particularly on investment.[1] Recent contributions on labor demand are scarcer, although by no mean absent.[2]

In this paper we intend to advance our understanding of net employment changes, using a rich data set on Norwegian plants that can also be matched with administrative records. We will initially limit ourselves to plants in the metal product and machinery sector (excluding large-construction and ship-building industry) over the period 1986-1995. This sector contains a large number of plants of different size and with different employment histories. Concentrating on a single industry keeps the problem of matching plant and individual level observations manageable and reduces heterogeneity problems in estimation.

We start by presenting some descriptive evidence on employment adjustment patterns and gross hiring. The data reveals interesting differences across plants of different size. We then provide more formal econometric evidence on the nature of adjustment costs. The econometric results are based on a simple model of labor demand that allows for a fairly general structure of adjustment costs. In the basic specification, such costs are function of net employment changes and include fixed, linear and quadratic components. The model, like others in this area, generates a region in which labor demand does not respond to changes in fundamentals, because the gains from increasing or decreasing employment by one unit is not large enough to compensate the incurring of adjustment costs. Moreover, the response to fundamentals may differ for net employment increases versus decreases, reflecting asymmetries in the quadratic component of adjustment costs. Finally, adjustment costs are allowed to contain a truly fixed component that makes the range of inaction wider for smaller firms. For instance, larger firms are more likely to have personal and planning departments

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[1] Among the most recent papers that analyze the importance of non convexities and irreversibility in generating non smooth investment patterns see Doms and Dunne (1998), Goolsbee and Gross (1997), Barnett and Sakellaris (1998), Abel and Eberly (1999), Cooper, Haltiwanger and Power (1999), Nilsen and Schiantarelli (2000), Letterie and Pfann (2000)

[2] See, for instance, Rota (1995), Abowd and Kramarz (1997), Broersma and Hassink (1997).

that are used with dealing with employment changes and they may experience less disruption to production when changes in employment levels leads to workers' assignment being rearranged. As a result, the range of the value of fundamentals for which there are no employment changes is wider for smaller firms.

The empirical results suggest that fixed or linear components of adjustment costs are important Moreover, the fixed component appears to be larger for smaller firms. Finally the quadratic components of costs appear to be asymmetric, with higher marginal adjustment costs for employment contractions, compared to expansions.

Since the plant level data can be linked to individual records, we have been able to reconstruct gross hiring. Unfortunately gross separation cannot be distinguished according to their cause. In future work, we will investigate models for gross hiring, based on the assumption that adjustment costs depend upon gross and not net flows. Moreover, we plan to use more extensively the possibility of matching individual and plant level data in order to break down employment according to workers' characteristics, such as education and length of tenure, that are likely to affect adjustment patterns.

2. Data and Descriptive Evidence

2.1. The Data

Our empirical work is based on yearly plant level information for the period 1986-1995 contained in Manufacturing Statistics including production, sales, employment, production costs, the age of the plant, whether the plant belongs to a multi-plant or single plant firm. Investment and capital stock information is also is available (see Halvorsen, Jensen and Foyn (1991)). Total sales are calculated by adding sales of produced goods and traded goods, income from repairs and contracted works, income from leasing and deliveries to other plants in same firm. We restrict our attention to plants with an average size of at least five employees, since plant or firm specific information is not available for plants below five employees. We have excluded all auxiliary units which do not take part of the production directly (separate storage and office units). Plants in which the central or local governments own more than 50 percent of the equity have been excluded from the sample, as well as observations that are reported as "copied from previous year". This actually means missing data. In this paper we focus on plants in the metal products and machinery industries (ISIC 38), excluding large-construction and ship-building industry.

The remaining data set was trimmed to remove outliers. To avoid measurement errors in the employment changes, observations where the total employment level was 3 times larger than, or less than 1/3 of the employment level for the previous year were dropped. Finally, we included only series with at least four consecutive observations implying also that exits and new entries of plants were excluded. The final unbalanced panel contains 1414 production plants with a total of 10681 observations (an unbalanced panel).

The plant level data can be matched with administrative individual information. In the administrative registers, individuals are identified by their social security number. In the second quarter each year every worker is matched to the individual's main employer. The starting and terminal dates of each matched employer-employee contract are given. Up to now we have used such information to reconstruct gross job flows. However in the future we plan to use also individual information on education, age, tenure etc. to analyze how adjustment patterns differ across heterogeneous workers.

2.2 Descriptive Statistics

What are the basic patterns of employment changes for our sample of Norwegian plants? We summarize the basic characteristics of the distribution of net employment changes in Table 1 and in Figure 1. Over the period 1986-1995, there is a large degree of heterogeneity in the patterns of employment changes. Employment increases and decreases occur equally frequently: approximately 40% of the observations represent positive employment changes while 40% correspond to employment decreases. Interestingly in 20% of cases we observe no employment changes. This may be suggestive of the fact that changing the number of jobs even by a small amount may imply sizeable adjustment costs that deter firms from adjusting. This would be the case for instance, in the presence of fixed or linear components of adjustment costs. If the firm increases the work force the more frequent changes occur in the interval (0, +20%). This occurs 55% of the times (conditionally on the firm expanding) and represents a 49% share of total employment increases. Similarly, if the firm contracts, decreases in the interval (-20%, 0) occur most frequently (65% of the times) and they represent a share of 51% of total employment changes. However plants experience frequently also changes in excess of 20%, particularly for employment increases.

The pattern of adjustment differs in at least one important way across plants of different sizes: the frequency of episodes characterized by no employment changes decreases with size. The frequency of zero episodes is approximately 27% for plants of 25 workers or less, 10% for plants of 25-50 workers, 5% for plants of 51-100 workers and 3% for plants larger than 100 workers. Several reasons can be listed why there is a connection between plant size and adjustment costs. One possible explanation may be that the fixed component of adjustment costs is relatively more important for smaller plants. For instance, smaller plants are less likely to belong to a firm with a personal department used to handle expansions or contraction of the workforce. In general, reorganizations and definition of work assignments may involve fixed components of cost that are more difficult to absorb for a small plant. For the very smallest of plants there may also be an element of indivisibility, that generates consequences that are observationally equivalent to those of fixed costs. Indivisibility becomes, however, a less plausible explanation for plants of more than 25 workers, some of which continue to display significant occurrences of zero employment changes episodes.

In Table 2 we report the salient characteristics of gross hirings. Slightly more than half of the observations is accounted for hiring rates in the range (10%, 30%). Also in these cases zero hiring episodes are important and represent 22% of the observations. This frequency decreases with firm size, just as in the case of net hiring. It is interesting to note that in the majority of observations in which net employment does not change, some gross hiring take place, presumably to replace workers that have left the firm. This occurs in 56% of the cases and it suggest that there are costs specific with changing the size of the workforce that are independent from the search and training costs, and the like, that are related to the identity of the worker filling a job.

3. Institutional setting

The costs of changing both the plant size and especially the workers filling the jobs, is of course affected by the institutional setting and legislation introduced to protect workers against unfair dismissal. The institutional setting varies over countries and potentially over time and therefore particular results in some countries may be explained with differences in employment regulations.

Both the degree of employment protection, the flexibility of plants with respect to temporary hiring, and the use of subcontractors, are important in explaining the costs of adjustment for plants. The different types of constraints regulating the hiring and firing of workers are not completely transparent, since, in addition to national laws, collective agreements between employer and workers organization also are very important in regulating the adjustment of the labor factor. These agreements may differ over industries and over worker categories regarding age, tenure positions etc.

One of the most important pieces of national regulation is contained in a law from 1982, “Arbeidsmiljøloven”, which includes standards for the general working conditions, overtime regulations and legal regulation for employment protection. In general it is possible but very difficult to replace an individual worker in a given job with another worker. The general rule for firing a worker is that the job is redundant. This regulation covers all workers independent of how long he/she has been hired. Thus, there is a very strong employment protection in Norway, i.e. protecting individual workers against unfair dismissals. According to the legal regulation, employment is terminable by one month’s notice in Norway, and this one-month notice is at the lower end as compared to many countries. However, most workers have three months’ notice on either side in their contracts.

In Norway, there are also constraints regulating decreases in employment due to economic reasons. Large scale reduction of jobs in Norway now basically follows the minimum rules for EU-countries. Many EU-countries actually have stronger rules than the minimum including also general compensation, a social plan for re-training or transfer to another plant within a firm for instance. Although not mandatory, some of these other requirements have been used also in Norway. For instance, in Norway no general rule for severance payment exists, but the compensation is negotiable. As an example, in the contract between LO (the largest blue collar workers organization) and NHO (the employers’ association), the worker must be 50 and been hired for 10 consecutive years or 20 years in the firms in order to be eligible for one to two months pay. Comparable agreements exist for the other unions. Thus, the severance payment is low in Norway compared to other countries. However severance pay are just one dimension of employment protection.

Very few comparative studies of the overall degree of employment protection exist. A much-sited study by Emerson (1987), ranks Italy as having the strongest employment protection rules while the UK and partly Denmark are at the other end of the spectrum. Norway is ranked together with Sweden, France and partly Germany, when all regulations taken together as an intermediate country with a fairly high degree of protection. Obviously inter-country comparisons are difficult, however also Rogstad (1990) finds that employment protection is stronger in for instance Norway and France as compared to for instance the UK and Denmark.

4. A simple “*q*” model for employment.

In this section we develop a model for employment demand that allows for a general structure of adjustment costs. The model is similar in spirit to q models of investment in the presence of fixed adjustment costs and irreversibilities (see Abel and Eberly (1994) and (1999)). It is also related to the model in Hamermesh (1992) that also contains fixed and quadratic components of adjustment costs.[3] We will show that when firms expand or contract, the growth rate of employment is related to the shadow value of the marginal worker, q, defined as the present discounted value of the marginal product of labor, net of wage costs. Our strategy is to use simple approximations to q and to estimate various versions of the model that differ in the precise specification of adjustment costs and of the stochastic elements of the model.

More precisely, we assume that firm i maximizes the present discounted value of cash flow, defined as:

$$V_t = E_t \sum_{j=0}^{\infty} \beta^j \left[F(L_{t+j}) - C(\Delta L_{t+j}, L_{t+j-1}) - w_{t+j} L_{t+1} \right] \tag{1}$$

where L_t denotes employment, $F(L_t)$ the gross production function, $C(\Delta L_t, L_{t-1})$ adjustment costs, assumed to be a function of net employment changes, and w_t the wage rate. We omit the index i for each firm for notational simplicity. Similarly, although capital is not introduced explicitly in the problem for ease of notation, firms should be thought as using both capital and labor. However, capital is not costly to adjust, or, if it is, its adjustment costs are additively separable from those for labor. Adjustment costs contain fixed, linear and quadratic components. Fixed costs, in turn, contain two elements: a_0, that is truly fixed, and $a_1 L_{t-1}$ that depends upon firm size. More specifically:

$$\begin{aligned} C(\Delta L_t, L_{t-1}) = D_t^+ &\left[a_0^+ + a_1^+ L_{t-1} + b^+ \Delta L_t + \frac{c^+}{2} \left(\frac{\Delta L_t}{L_{t-1}}\right)^2 L_{t-1} \right] \\ + D_t^- &\left[a_0^- + a_1^- L_{t-1} - b^- \Delta L_t + \frac{c^-}{2} \left(\frac{\Delta L_t}{L_{t-1}}\right)^2 L_{t-1} \right] \end{aligned} \tag{2}$$

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[3] See also the other seminal contributions by Hamermesh (1989a), (1989b).

D_t^+ (D_t^-) is a dummy that equals one when the firm expands (contracts) and it is zero otherwise. When firms increase employment, the proportional increase in employment satisfies:

$$\frac{\Delta L_t}{L_{t-1}} = \psi^+ \left[q_t - b^+ \right] \qquad (3)$$

For employment to expand, it must be true that the marginal profits generated by the expansion are positive. This requires q_t to satisfy:

$$q_t \geq \sqrt{2c^+ \cdot \left(\frac{a_0^+}{L_{t-1}} + a_1^+ \right)} + b^+ \qquad (4)$$

Similarly contractions in employment obey:

$$\frac{\Delta L_t}{L_{t-1}} = \psi^- \left[q_t + b^- \right] \qquad (3')$$

Contractions occur when:

$$q_t \leq -\sqrt{2c^- \cdot \left(\frac{a_0^-}{L_{t-1}} + a_1^- \right)} - b^- \qquad (4')$$

In all cases, the shadow value of employment, q_t, is:

$$q_t = E_t \sum_{j=0}^{\infty} \beta^j \left[F'(L_{t+\tau}) - w_{t+j} - \beta \cdot C_L(\Delta L_{t+j}, L_{t+j-1}) \right] \qquad (5)$$

q_t represents therefore the present discounted value of the marginal product of capital, net of adjustment costs, minus the flow of wage costs associated to the marginal worker. In order to make the model estimable, we need to approximate the shadow value of a worker. We will assume that the production function is Cobb Douglas, in which case the gross marginal product of capital is proportional to the sales to capital ratio. Moreover we assume that firms use simple AR(2) processes to forecast the sales to capital ratio and the wage rate. Finally, if we assume that the partial derivative of the cost function with respect to L_t, given net hiring, ΔL_t, denoted by C_L is dominated by the other two terms on the right hand side of (5), we can write:

$$q_t = \gamma_0 + \gamma_1 ' Z_t - \varepsilon_t \tag{6}$$

where $Z_t = \left[(S/L)_{t-s}, (S/L)_{t-s-1}, w_{t-s}, w_{t-s-1}\right]$ and s equals zero or one depending on whether contemporaneous information on the wage and sales to labor ratio is available or not. Note we have added an error term ε_t to the definition of the shadow value of a worker to capture all those idiosyncratic factors at the firm level that are not observable by the econometrician. We will assume that ε_t (actually, ε_{it}) is normally independently distributed with mean zero and variance σ_{11}^2.

One last simplification is useful in taking the model to the data when a_0 is non-zero, in order to keep the non-linearity of the problem manageable in estimation. We will take a first order linear expansion of the first term on the right hand side of (4) and (4') to rewrite the thresholds as:

$$q_t \geq g_0^+ + g_1^+ \frac{1}{L_{t-1}} + \varepsilon_t \tag{4''}$$

$$q_t \leq -g_0^- - g_1^- \frac{1}{L_{t-1}} + \varepsilon_t \tag{4'''}$$

The log likelihood function for the problem summarized by (3), (3'), (4''), (4''') and (5) can be written as:

$$
\begin{aligned}
LogL &= \sum_{+} \log \frac{1}{\psi^{+}\sigma_{11}\sqrt{2\Pi}} - \sum_{+} \frac{1}{2\cdot(\psi^{+})^{2}\cdot\sigma_{11}^{2}} \left(\frac{\Delta L_{it}}{L_{it-1}} - h^{+} - \psi^{+}\gamma_{1}' Z_{it} \right)^{2} \\
&+ \sum_{-} \log \frac{1}{\psi^{-}\sigma_{11}\sqrt{2\Pi}} - \sum_{-} \frac{1}{2\cdot(\psi^{-})^{2}\cdot\sigma_{11}^{2}} \left(\frac{\Delta L_{it}}{L_{it-1}} - h^{-} - \psi^{-}\gamma_{1}' Z_{it} \right)^{2} \qquad (7) \\
&+ \sum_{0} \log \left\{ \Phi\left[(\gamma_{1}' Z_{it} + c_{0}^{-} + g_{1}^{-} \frac{1}{L_{it-1}}) \frac{1}{\sigma_{11}} \right] - \Phi\left[(\gamma_{1}' Z_{it} - c_{0}^{+} - g_{1}^{+} \frac{1}{L_{it-1}}) \frac{1}{\sigma_{11}} \right] \right\}
\end{aligned}
$$

where $h^{+} = \psi^{+}[\gamma_0 - b^{+}]$, $h^{-} = \psi^{-}[\gamma_0 + b^{+}]$, $c_0^{+} = (g_0^{+} - \gamma_0)$, and $c_0^{-} = (g_0^{-} + \gamma_0)$, in addition to that $\sum_{+}, \sum_{-}, \sum_{0}$ denotes summation over the observations with respectively positive, negative or zero employment changes. This is a sort of two-sided generalized Tobit model. Note that the coefficients can be identified only up to the scale parameter σ_{11}. However we can identify the ratio of the quadratic adjustment costs parameters in the employment increase and decrease regimes. Moreover the components of fixed costs g_0^{+} and g_0^{-} cannot be identified separately from the constant in the definition of q_t. However their sum can be identified, which allows us to identify the fixed component as well, if we assume that it is the same for employment increases and decreases.

Parameters estimates can be obtained by maximizing the likelihood function in equation (7). Alternatively a Heckman type two step estimator can be used. First one estimates the ordered probit models to obtain the determinants of the shadow value of employment. The ordered probit model can be written:

$$
\begin{aligned}
LogL &= \sum_{+} \log \Phi\left[(\gamma_{1}' Z_{it} + c_{0}^{-} + g_{1}^{-} \frac{1}{L_{ti-1}}) \frac{1}{\sigma_{11}} \right] \\
&+ \sum_{-} \log \left\{ 1 - \Phi\left[(\gamma_{1}' Z_{it} - c_{0}^{+} - g_{1}^{+} \frac{1}{L_{it-1}}) \frac{1}{\sigma_{11}} \right] \right\} \qquad (8) \\
&+ \sum_{0} \log \left\{ \Phi\left[(\gamma_{1}' Z_{it} + c_{0}^{-} + g_{1}^{-} \frac{1}{L_{it-1}}) \frac{1}{\sigma_{11}} \right] - \Phi\left[(\gamma_{1}' Z_{it} - c_{0}^{+} - g_{1}^{+} \frac{1}{L_{it-1}}) \frac{1}{\sigma_{11}} \right] \right\}
\end{aligned}
$$

This allows us to recover estimates of the coefficients in (8) (relative to σ_{11}). These estimates can be used to construct a proxy for q_{it} and of the expected value of the error terms in the employment change equations, conditional on the probability of being in an employment increase or employment decrease regime. One can then estimate the following two equations:

$$\frac{\Delta L_{it}}{L_{it-1}} = h^{+} + \psi^{+}\sigma_{11}\left(\frac{\left(\gamma_1^{'}{}'Z_{it}\right)}{\sigma_{11}} + w_{it}^{+}\right) + \eta_{it}^{+} \tag{9}$$

for employment increases and:

$$\frac{\Delta L_{it}}{L_{it-1}} = h^{-} + \psi^{-}\sigma_{11}\left(\frac{\left(\gamma_1^{'}Z_{it}\right)}{\sigma_{11}} - w_{it}^{-}\right) + \eta_{it}^{-} \tag{9'}$$

η_{it}^{+} and η_{it}^{-} denote zero means error terms, while w_{it}^{+} and w_{it}^{-} denote the appropriate inverse Mills ratios and are defined as:

$$w_{it}^{+} = \frac{\phi\left[(\gamma_1{}'Z_{it} - c_0^{+} - g_1^{+}\frac{1}{L_{it-1}})\frac{1}{\sigma_{11}}\right]}{\Phi\left[(\gamma_1{}'Z_{it} - c_0^{+} - g_1^{+}\frac{1}{L_{it-1}})\frac{1}{\sigma_{11}}\right]} \tag{10}$$

$$w_{it}^{-} = \frac{\phi\left[(\gamma_1{}'Z_{it} + c_0^{-} + g_1^{-}\frac{1}{L_{it-1}})\frac{1}{\sigma_{11}}\right]}{1-\Phi\left[(\gamma_1{}'Z_{it} + c_0^{-} + g_1^{-}\frac{1}{L_{it-1}})\frac{1}{\sigma_{11}}\right]} \tag{10'}$$

Equations (9) and (9') can be estimated by OLS after replacing $\gamma_1^{'}/\sigma_{11}$, w_{it}^{+} and w_{it}^{-} with the values constructed using the estimates obtained using the in the ordered probit model. The values obtained in the two step estimator can be used as starting values in the Maximum Likelihood iterations. Note that one iterations of Newton-Raphson type of algorithm, yields an estimator that is asymptotically equivalent to the ML estimator (together with the appropriate standard errors, contrary to the two step estimator described above)

A more general stochastic specification of the model would allow for an additional optimization error in the employment expansion equation, ν_{it}^{+}, and in the employment contraction equation, ν_{it}^{-}. The composite error term in such equations would then become $u_{1it} = \nu_{it}^{+} - \psi^{+}\varepsilon_{it}$, and $u_{1it} = \nu_{it}^{-} - \psi^{-}\varepsilon_{it}$. We will assume that $u_{1it}, u_{2it}, \varepsilon_{it}$ are jointly normally distributed with mean zero and covariance matrix Σ equal to:

$$\Sigma = \begin{bmatrix} \sigma_{11}^{2} & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{21} & \sigma_{22}^{2} & \sigma_{2\varepsilon} \\ \sigma_{\varepsilon 1} & \sigma_{\varepsilon 2} & 1 \end{bmatrix} \tag{11}$$

The likelihood function, using the information about sample separation, can be written as:

$$\begin{aligned} LogL = {} & \sum_{+} \log \frac{1}{\sigma_{11}\sqrt{2\Pi}} - \sum_{+} \frac{1}{2 \cdot \sigma_{11}^{2}} \left(\frac{\Delta L_{it}}{L_{it-1}} - h^{+} - \psi^{+} \gamma_{1}' Z_{it} \right)^{2} \\ & + \sum_{+} \log \Phi \left\{ \left[\gamma_{1}' Z_{it} - c_{0}^{+} - g_{1}^{+} \frac{1}{L_{it-1}} - \frac{\rho_{1}}{\sigma_{11}} \left(\frac{\Delta L_{it}}{L_{it-1}} - h^{+} - \psi^{+} \gamma_{1}' Z_{it} \right) \right] \left[1 - \rho_{1}^{2} \right]^{\frac{1}{2}} \right\} \\ & + \sum_{-} \log \frac{1}{\sigma_{22}\sqrt{2\Pi}} - \sum_{-} \frac{1}{2 \cdot \sigma_{22}^{2}} \left(\frac{\Delta L_{it}}{L_{it-1}} - h^{-} - \psi^{-} \gamma_{1}' Z_{it} \right)^{2} \\ & + \sum_{-} \log \left[1 - \Phi \left\{ \left[\gamma_{1}' Z_{it} + c_{0}^{-} + g_{1}^{-} \frac{1}{L_{t-1}} - \frac{\rho_{2}}{\sigma_{22}} \left(\frac{\Delta L_{it}}{L_{it-1}} - h^{-} - \psi^{-} \gamma_{1}' Z_{it} \right) \right] \left[1 - \rho_{2}^{2} \right]^{\frac{1}{2}} \right\} \right] \\ & + \sum_{0} \log \left\{ \Phi(\gamma_{1}' Z_{it} + c_{0}^{-} + g_{1}^{-} \frac{1}{L_{it-1}}) - \Phi(\gamma_{1}' Z_{it} - c_{0}^{+} - g_{1}^{+} \frac{1}{L_{it-1}}) \right\} \end{aligned} \qquad (12$$

For this model as well one could easily write down the appropriate two step estimator.

5. Results

In this section we will report some preliminary results obtained for two versions of the model summarized by (3), (3'), (4''), (4''') and (5), i.e. the model whose only stochastic element ε_{it} is the error term associated to the shadow value of labor q_{it}. We have used the two step procedure outlined in the previous section to get initial and asymptotical consistent parameter estimates. Then we have run one iteration of the maximum likelihood procedure to get an estimator asymptotically equivalent to the full maximum likelihood estimates. The results are summarized in Table 3. Initially we have assumed that a_0 equals zero, so that the probability of increasing, decreasing or keeping employment the same does not depend upon firm size, measured by past employment ($g_1^+ = g_1^- = 0$). Results are reported in the first two columns of Table 3. Note that a ~ above a parameter denotes the ratio between the original parameter and σ_{11} (for instance, $\tilde{c}_0^+ = c_0^+ / \sigma_{11}$, etc.). Moreover, $\delta^+ = \varphi^+ \sigma_{11}$ and $\delta^- = \varphi^- \sigma_{11}$. The results suggest that there are significant fixed components of adjustment costs or important linear components (in the change of employment). Their sum equals 1.720 (0.976+0.744) and it is significantly different from zero. If the fixed component was symmetric, its value would equal 0.860). The sign of the coefficients of the sales to labor ratio and of the wage rate are sensible. The coefficient of $(S/L)_{it}$ is positive significant and larger (in absolute value) than the negative coefficient of $(S/L)_{it-1}$. The coefficient of the contemporaneous wage is very small and not significant, while the lagged wage has a negative coefficient. This means that, looking at the sum of the coefficients on the contemporaneous and lagged determinants of q_{it}, the sales to labor ratio has a positive effect and the wage a negative effect on the shadow value of labor q_{it}, as one would expect. As a result, a higher sales to labor ratio is associated with an increase in the probability of observing an increase in employment, while a higher wage is associated with a decrease in such probability. The opposite holds true for the probability of employment decreases.

The results in Table 3 (first column) also suggest that there are significant quadratic components of adjustment costs both in the case of employment expansion and employment contraction. The coefficient in the employment expansion equation is δ+ = 0.198 and the one in the employment contraction regime is δ- = 0.102, which seems to suggest that the coefficient of the quadratic component is approximately twice as large for employment contractions compared to employment expansions (contracting is more expensive at the margin). One can easily reject the hypothesis that the coefficient of the quadratic component is equal in the two regimes.

When we allow for the inverse of firm size to enter as a determinant of the threshold values of the shadow value of employment, the results suggest that g_1^+ and g_1^- are significantly different from zero (see the last two columns of Table 3). This suggests that firm size matters in determining the threshold values of q_{it} beyond which the firm decides to increase or decrease employment. The range over which smaller firms keep employment constant is wider for firms with smaller initial employment, because both the lower threshold decreases and the upper threshold increases. The effect of size seems to be larger on the lower threshold. These overall econometric results seem to be very much consistent with the descriptive evidence discussed in Section 2, and in particular, with the larger frequency of zero employment changes episodes for smaller firms. Note that now the sum of the estimated values of c_1^+ and c_1^- is much smaller than before (0.139), indicating that the fixed component of cost proportional to size and the component linear in employment changes are not as important as in the results reported in the first column of Table 3.

Finally**, a**lso in this specification the quadratic components of costs remain important. The estimated value of $\delta^+ = \psi^+\sigma_{11}$ and of $\delta^- = \psi^-\sigma_{11}$ are very similar to the ones obtained before. Both of them are significantly different from zero and from each other, confirming that the marginal costs of employment contractions exceeds the cost of employment expansions.

6. Conclusions

It would be premature, a this stage, to reach definitive conclusions. However, the initial results we have presented suggest that the framework proposed in this paper is potentially a fruitful one. In particular, the *q* model of employment with a general specification of adjustment costs, seems to be a useful way to organize the analysis of employment changes at the firm level. The initial results imply that it is important to depart from the standard specification of convex and symmetric adjustment costs. Fixed (or linear) costs are important factors that the firm must consider when changing its employment levels. The evidence suggests that he fixed components are relatively larger for smaller firms (with size measured by past employment).

Quadratic components of costs are also important, and the evidence suggests that they are higher during employment contractions compared to expansions.

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Table 1. Net Employment Changes, $\frac{\Delta L_t}{L_{t-1}}$

$\frac{\Delta L_t}{L_{t-1}}$	# obs.	Freq. (overall)	Freq. (<0,>0)	Share; ΔL/sum(ΔL)	Percent, by plant size 4-25	26-50	51-100	101-
< -0.5	51	0.006	0.014	0.048	0.46	0.64	1.14	0.40
-0.5, -0.4	89	0.010	0.024	0.099	0.83	1.13	1.14	1.47
-0.4, -0.3	211	0.023	0.058	0.104	2.67	1.35	1.55	1.74
-0.3, -0.2	563	0.061	0.154	0.232	6.56	4.96	5.57	4.81
-0.2, -0.1	1332	0.144	0.364	0.314	14.95	13.76	11.76	14.15
-0.1, 0.0	1413	0.152	0.386	0.204	8.39	24.26	31.68	33.24
= 0	1886	0.204	-	-	27.45	9.72	4.54	2.67
0.0, 0.1	1192	0.129	0.320	0.214	7.09	22.41	24.87	26.70
0.1, 0.2	1222	0.132	0.328	0.283	14.06	12.84	10.42	10.28
0.2, 0.3	601	0.065	0.161	0.158	7.97	3.90	3.92	2.54
0.3, 0.4	251	0.027	0.067	0.099	3.16	2.34	1.65	1.07
0.4, 0.5	220	0.024	0.059	0.074	3.21	0.99	0.62	0.40
0.5, 1.0	210	0.023	0.056	0.132	2.92	1.49	0.62	0.53
>1.0	26	0.003	0.007	0.041	0.29	0.21	0.52	0.00
Total	9267	1.000	3.000	3.000	#obs = 6139	#obs = 1410	#obs = 969	#obs = 749

Table 2. Hirings $\frac{H_t}{L_{t-1}}$

$\frac{H_t}{L_{t-1}}$	# obs.	Freq.	Share H/sum(H)	Percent 4-25	by plant 26-50	size 51-100	101-
= 0	2047	0.221	0.000	30.18	10.21	4.13	1.34
0.0, 0.1	1955	0.211	0.163	10.96	31.77	45.10	53.00
0.1, 0.2	2410	0.260	0.288	24.30	30.00	28.38	29.37
0.2, 0.3	1328	0.143	0.229	15.10	14.04	12.38	11.08
0.3, 0.4	593	0.064	0.113	6.65	8.16	4.95	2.94
0.4, 0.5	458	0.049	0.068	6.39	2.41	2.58	0.93
0.5, 0.6	117	0.013	0.037	1.47	0.92	0.93	0.67
0.6, 0.7	135	0.015	0.026	1.92	0.71	0.41	0.40
0.7, 0.8	56	0.006	0.012	0.80	0.43	0.00	0.13
0.8, 0.9	64	0.007	0.018	0.94	0.28	0.10	0.13
0.9, 1.0	44	0.005	0.015	0.57	0.50	0.21	0.00
>1.0	60	0.006	0.032	0.72	0.57	0.83	0.00
Total	9267	1.000	1.000	#obs = 6139	#obs = 1410	#obs = 969	#obs = 749

	NJCR < 0	NJCR == 0	NJCR > 0
HR==0	1214	833	0
HR > 0	2445	1053	3722

Figure 1. Distribution of Net Employment Changes, $\frac{\Delta L_t}{L_{t-1}}$

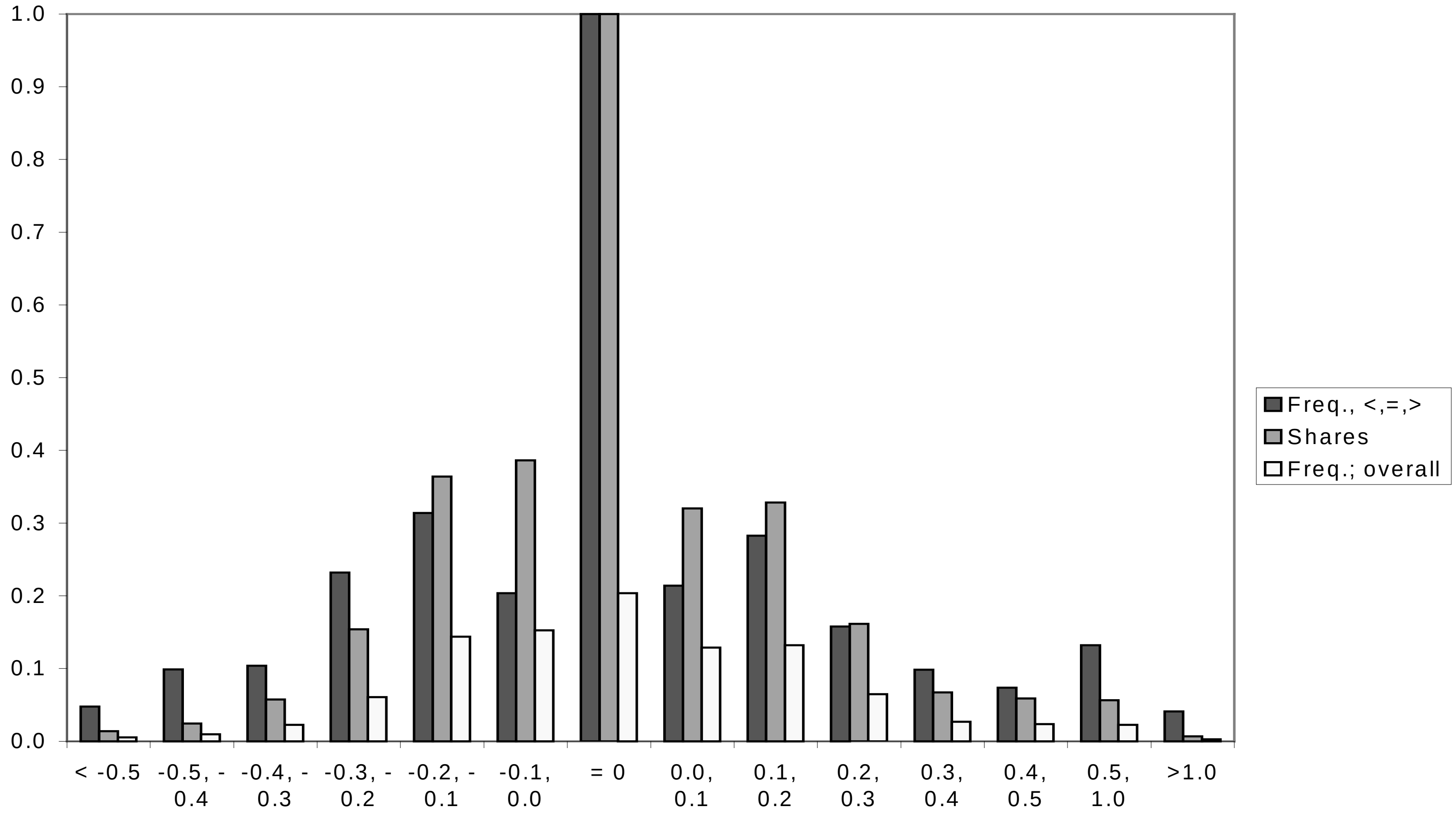

Table 3. Estimation Results for the Net Job Change Model

	Coeff.	z-values	Coeff.	z-values
$(S/K)_{it}$	0.189	25.145	0.187	25.151
$(S/K)_{it-1}$	-0.080	-10.888	-0.080	-11.030
w_{it}	0.071	1.376	0.081	1.346
w_{it-1}	-0.160	-2.940	-0.161	-2.392
c_0-	0.744	13.335	-0.534	-4.803
c_0+	0.976	17.817	0.673	6.002
h-	-0.173	-34.970	-0.164	-15.751
h+	0.090	8.813	0.009	0.296
g_1-			8.567	14.567
g_1+			3.000	5.384
δ-	0.102	85.346	0.110	71.846
δ+	0.198	73.059	0.223	26.774
Nbr. of obs.	7853		7853	