

## THE STRUCTURE OF ADJUSTMENT COSTS FOR LABOUR IN THE DUTCH MANUFACTURING SECTOR

Gerard A. PFANN and Bart VERSPAGEN \*

*University of Limburg, 6200 MD Maastricht, The Netherlands*

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This paper investigates the appropriateness of the hypothesis of symmetric adjustment costs for labour (ACL) in dynamic labour demand models.

### 1. Introduction

It is a widely accepted view that the demand for labour is basically dynamic because of the hiring and firing costs imposed on top of a firm's regular wage costs when the firm alters its productive workforce. Nickell (1986) presented an overview of the size of hiring and firing costs, generally known as the adjustment costs for labour (ACL), and surveyed dynamic models of labour demand. These models universally adopt the hypothesis that ACL can be approximated by a quadratic function of the size of the firm's adjustments in labour input.<sup>1</sup>

The hypothesis of a symmetric quadratic ACL function implies that the costs a firm faces when a number of new workers is hired (such as expenditures on advertising, screening and training) vary in the same way as when the same number of workers is fired. The quadratic assumption is made mainly for analytical convenience and computational ease, and is most probably at variance with the real structural form of ACL, since 'there is no reason for hiring cost functions to be symmetric' [Nickell (1986, p. 478)]. Recently, some evidence is given for ACL functions not being stable through time. Smith (1984) has found the speed of adjustment in short run employment functions to be positively related to the rate of unemployment. Burgess (1988) has found evidence for a significance effect of labour market legislations, labour market tightness, and union power on ACL. Hamermesh (1988) shows that non-convexities of the ACL function (fixed costs) give rise to lumpy adjustments of the firms workforce to its target level. These authors, however, model the variable costs that depend on the extent of labour adjustments through a quadratic ACL function.

This paper examines the appropriateness of symmetric quadratic specifications of adjustment costs for labour on the firm level. The outline of the paper is as follows. First, we interviewed personnel managers of Dutch manufacturing firms. The interviews focussed on decisions of firms to change their productive workforces and the costs that arise from these changes. The joint firms represent the Dutch manufacturing sector as a whole. The general outcomes of the interviews are

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<sup>1</sup> See, e.g., Holt et al. (1960), Tinsley (1971), and the references in Nickell (1986) related to this topic.

discussed in section 2. In section 3 we propose an alternative ACL function which satisfies the properties of the dynamic theory of labour demand and encompasses the symmetric quadratic form as a special case. The merit of the novel specification is the possibility to measure the difference between hiring and firing costs. Econometric analysis of the alternative ACL function using data obtained from annual reports of Dutch manufacturing firms for the period 1978–1986 show that hiring costs exceed firing costs. This finding has an important implication. The speed of adjustment of the firm's workforce to the target level is slower in economic booms than in recessions. Conclusions are drawn in section 4.

## 2. ACL in practice

In order to get a better insight into the structure of ACL in practice we interviewed personnel managers of DSM (chemicals), Fokker (aircrafts), Hoogovens (steel), Vendex International (retail), and Volvo (cars). The interviews focussed on decisions of the firms to change their productive workforces and the costs that arise from these changes. The choice of firms has been such that together they represent the Dutch manufacturing sector as a whole. The firms are relatively large with outlets that reach beyond domestic markets. The various firms reflect differences in production technologies, that is, differences in production processes, required technological knowledge, and the input of labour as a production factor. In this section we present the general outcomes of the interviews. Fokker and Hoogovens stated that the rate of labour turnover amounts to five percent of the total workforce. Although start-up costs of new entries are inversely related to the capacity and quality of a firm's training department, the ACL a firm faces to keep its workforce at a constant level do not increase at the margin. However, a growth up to five percent yield marginally increasing ACL, whereas an increase over five percent is practically impossible, since this will lead to large inefficiencies in the production process. If these statements hold true in general, the ACL function should be adjusted for the size of the firm.

The personnel managers of all the firms agreed that ACL depend on union power, the expectation formation of labour input requirements in the near future and production technology. Labour unions have a considerable effect on the costs of labour adjustments through their influence on the rate of dismissal payments and the duration of application terms for dismissals. Tight dismissal regulations and high dismissal payments boost ACL. Given the power of labour unions, a firm that accurately forecasts its future sales and, accordingly, its future labour input minimizes ACL when the firm changes its workforce. The longer it takes firms to fire their workers, the higher are ACL when employment expectations do not match future realizations.

A dismissal application lasts between six and twelve months. Consequently, a firm that wants to reduce the workforce below the level of its labour turnover rate must start the dismissal procedure this period in advance. Figs. 1a and 1b<sup>2</sup> illustrate how a firm's expectation formation process of labour input requirements in the near future reduces ACL. We assume that a firm is confronted with an unforeseen structural change in its economic environment at  $t = 1$ , such that a decrease in employment becomes necessary. Given that the dismissal application term lasts one period, and assuming that the firm gradually reduces the workforce over one period, the costs of inefficient employment policy equals the labour surplus (shaded areas) times the average wage costs of these workers. In fig. 1a the firm's expectation formation process is rational, that is, it takes account of the tight dismissal regulations and applies for the firing of  $L_1^e - L_3^e$  workers at time  $t = 1$ . Fig. 1b shows the ACL of a firm with myopic foresight, which takes employment decisions structurally one period

<sup>2</sup> These figures were initially drawn by Ir. J. Zaaier of Fokker.

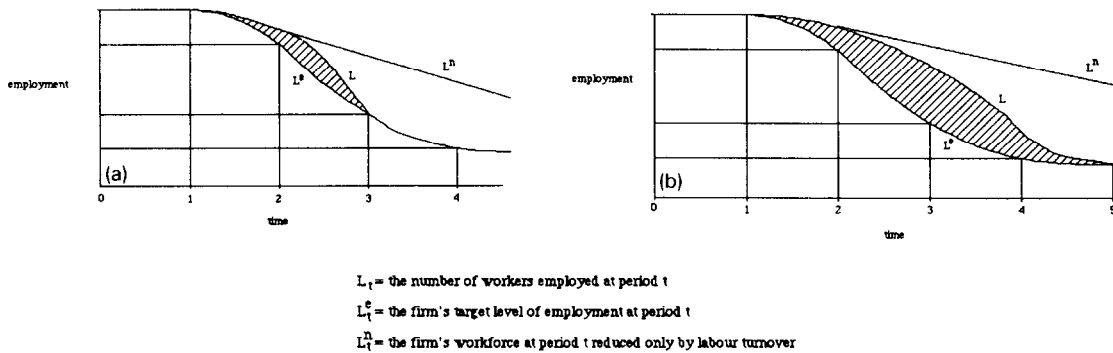


Fig. 1. (a) ACL caused by once-only expectational error in a case of tight dismissal regulations. (b) ACL caused by a structural expectation error of one period in the case of tight dismissal regulations.

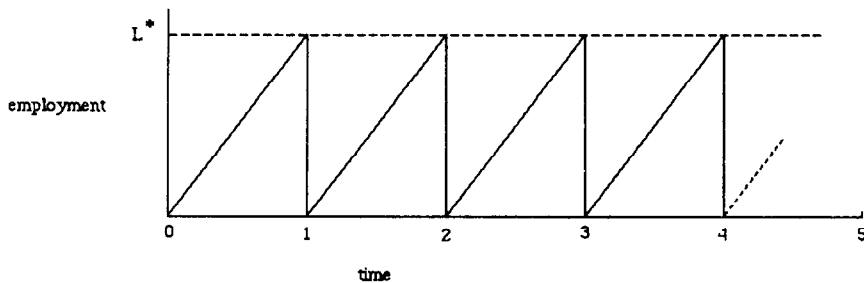


Fig. 2. Indentation employment policy.

too late. At  $t = 1$  it applies for the dismissal of  $L_2 - L_1$ , at  $t = 2$  it applies for the dismissal of  $L_3^e - L_3^e$ , and so on. During the time that the firm's target level of employment ( $L^e$ ) does not remain constant the firm has a structural labour surplus.

Consequently, we may conclude that the expectations formation process of the firm is of crucial importance as to minimize the adjustment costs of labour. In a changing economic environment forces that limit the firms to adjust optimally to these changes, such as long application terms for dismissals, boost ACL.

The extent to which ACL effect the firm's reaction to a changing economic environment depends also on the labour-intensity of the production process. Firms with a high-tech labour-intensive production process, such as aircraft industries (Fokker), face high costs of labour adjustments. These firms employ relatively many highly qualified workers, with large hiring and training costs. ACL differ significantly between skilled and unskilled workers. This fact, surveyed in Nickel (1986), has also been underlined by the personnel managers of the Dutch firms. ACL of unskilled workers are low in comparison with their variable wage costs. Firms using low-level knowhow labour-intensive production technologies employ mainly unskilled recruits. For these firms variation in workforce is an important instrument to change output and production costs. Fig. 2 illustrates employment reductions when production costs rise above a permissible level.<sup>3</sup> Given that the firm's departments are inclined to grow in size, with low ACL and in the absence of dismissal regulations, the least

<sup>3</sup> Fig. 2 was initially drawn by B. van Dijk of Volvo Cars. He called it 'indentation employment policy'.

productive and relatively most expensive workers are fired at  $t = 1$ ,  $t = 2$ , etc. In spite of the fact that ACL are low, this model leads to a cyclical pattern in the dynamic demand of labour.

Decisions to change the production capacity of a capital-intensive firm, such as steel (Hoogovens) and chemical industries (DSM), are not based on considerations of personnel costs. Such firms develop a marketing plan, which is followed by an investment plan, from which the employment plan is derived. Investment decisions are based on the product market, that is, the expectations of future product demand. The time lag between the investment decision and the resulting demand for labour equals two years on average. Costs of recruiting, screening and training are less than one percent of the total investment. The ACL are part of the investment and are written down as such together with the new capital.

### 3. The shape of the ACL function

In this section we discuss the shape of the function that relates costs to the rate of workforce adjustments. Nickell (1986) discusses several likely forms of ACL functions and their implications for dynamic labour demand theory. The linear adjustment cost model, for instance, is found to be consistent with the instantaneous hiring and firing of groups of workers. In this model there is no partial adjustment to the long-run equilibrium, and consequently labour demand is not dynamic.

As has been pointed out by Oi (1962), however, when labour is a quasi-fixed production factor, labour demand follows an autoregressive process. In the dynamic theory of the firm it is assumed that ACL is represented by a strictly convex function with the following properties ( $n$  = number of workers employed,  $\Delta n$  = number of workers hired or fired in one period).

*Property 1.*  $ACL(\Delta n) |_{\Delta n=0} = 0$ ;

*Property 2.*  $\partial ACL(\Delta n) / \partial n \geq 0$ , if  $\Delta n \geq 0$ ;

*Property 3.*  $\partial^2 ACL(\Delta n) / \partial n^2 > 0$ .

The symmetric quadratic function which satisfies these properties is as follows:

$$ACL(\Delta n) = \gamma(\Delta n)^2, \quad \gamma > 0. \quad (1)$$

In this section we propose an alternative ACL function which measures the asymmetry between hiring and firing costs. The novel specification encompasses the quadratic form as a special case. The function is as follows:

$$ACL(\Delta n) = \alpha - \beta\Delta n + \gamma(\Delta n)^2 + \exp(\delta\Delta n) - 1, \quad (2)$$

where  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$  are constant parameters. Properties 1 to 3 are satisfied in the following restricted version of eq. (2).

$$ACL(\Delta n) = -\beta\Delta n + \gamma(\Delta n)^2 + \exp(\beta\Delta n) - 1, \quad (3)$$

where  $\alpha = 0$ , and  $\beta = \delta$ . ACL represented by eq. (3) is not symmetric in case of  $\beta \neq 0$ . If  $\beta > 0$  hiring costs are marginally higher than firing costs. If  $\beta < 0$  firing costs exceed hiring costs (see fig. 3).

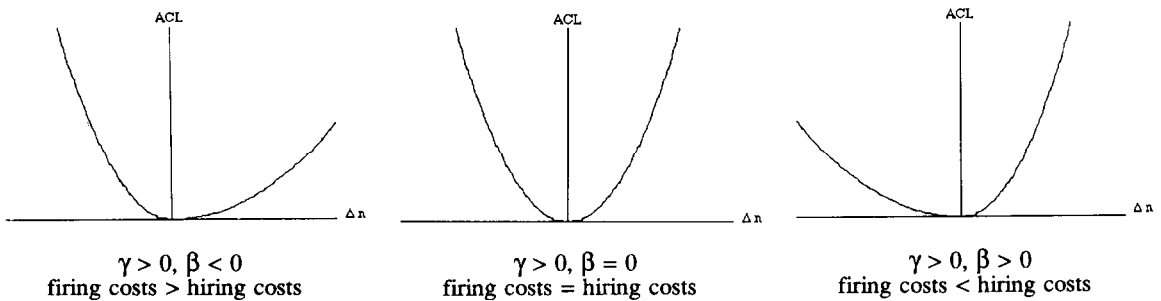


Fig. 3. The structure of ACL represented by eq. (3).

In order to estimate the ACL function we collected data on net changes in workforce per year and the corresponding ACL from annual reports of Dutch manufacturing firms for the period 1978–1986. Annual reports do not precise ACL but some of them contain the entry ‘total costs of reorganisation’, which we assumed to be a good proxy for ACL. ACL are measured in thousands of guilders and have been deflated by the 1980 = 100 producers price index of domestic sales. Net changes in workforce ( $\Delta n$ ) are expressed in hundreds of workers. For 119 cases firings exceeded hirings ( $\Delta n < 0$ ). This corresponds to the overall employment trends in The Netherlands over the spell. We regressed the data on several forms of the ACL function. This allows us to test the importance of fixed costs ( $\alpha \neq 0$ ). We note that ACL is measured as total costs instead of variable costs. An example of fixed ACL are training departments that are expensive even if no newly hired workers are trained. The estimation of the flexible form eq. (2) also allow us to test the validity of the restrictions layed upon the parameters by the dynamic theory eq. (3) or the restrictions implied by the symmetric quadratic shape of ACL eq. (1). Results are given in table 1.

Chow’s test on parameter stability ( $F_1$ ) between the periods 1978–1982 and 1983–1986 does not point at any structural change in the parameters through time. This justifies regarding the data as a panel, and assuming the parameters of relation eq. (2) to be time-independent. The  $F_2$ -statistic tests

Table 1

Estimation results and hypothesis tests of the ACL function (standard errors are given within parentheses).

(1) Unrestricted [eq. (2)]	$\alpha = 4.45$ (1.50)	$\beta = 1.02$ (0.17)	$\gamma = -0.11 \text{ E-2}$ (0.13 E-2)	$\delta = 0.22$ (0.03)	$\bar{R}^2 = 0.59$	
(2) $\beta = \delta$	$\alpha = 6.64$ (1.54)	$\beta = 0.20$ (0.05)	$\gamma = 0.51 \text{ E-2}$ (0.06 E-2)	$\delta = 0.20$ (0.05)	$\bar{R}^2 = 0.52$	$\chi^2(1) = 25.62$
(3) $\beta = \delta = 0$	$\alpha = 7.43$ (1.52)	–	$\gamma = 0.66 \text{ E-2}$ (0.05 E-2)	–	$\bar{R}^2 = 0.50$	$\chi^2(2) = 25.82$
(4) $\alpha = 0; \beta = \delta$ [eq. (3)]	–	$\beta = 0.23$ (0.03)	$\gamma = 0.54 \text{ E-2}$ (0.06 E-2)	$\delta = 0.23$ (0.03)	$\bar{R}^2 = 0.47$	$\chi^2(2) = 47.73$
(5) $\alpha = \beta = \delta = 0$ [eq. (1)]	–	–	$\gamma = 0.71 \text{ E-2}$ (0.05 E-2)	–	$\bar{R}^2 = 0.43$	$\chi^2(3) = 102.32$
Tests: Normality	: $KS = 3.38$					
Parameter constancy through time	: $F_1(4,160) = 1.92$					
Parameter constancy over firm size	: $F_2(4,160) = 1.33$					
Number of observations	: 168					

the hypothesis that the parameters in eq. (2) do not depend by the size of the firm. The sample has been divided into 91 firms with less than 5000 employees on the one hand and 77 firms that have 5000 or more employees on the other hand. The statistic  $F_2$  does not reject the hypothesis, which implies that the ACL function should not be adjusted by the size of the firm, as suggested in section 2. The Kolmogorov–Smirnov test (KS) point at some deviation from normality of the residuals, which implies that the tests may be biased.

Wald's tests ( $\chi^2$ ) on parameter restrictions and the adjusted  $\bar{R}^2$  given in table 1 show that the flexible ACL function eq. (2) is superior to all the alternatives, including the symmetric quadratic form with a constant term measuring fixed ACL (specification 3, table 1) and eq. (1) (specification 5, table 1). Besides, the parameter restrictions implied by Properties 1 to 3 are not in accordance with the data. Moreover, the parameter estimates indicate that ACL are basically not symmetric. The estimates of  $\beta$  and  $\delta$  being both significantly greater than zero indicate that hiring costs exceed firing costs in the period 1978–1986. This finding has an important implication. The speed of employment adjustment to a (higher) target level of expanding firms is slower than the speed of employment adjustment to a (lower) target level of shrinking firms. Or, stated differently, during economic booms (hirings exceeding firings) employment will be lagged more behind the target level than during recessions (firings exceeding hirings).

#### 4. Conclusions

From interviews we have had with personnel managers of a selection of Dutch manufacturing firms we found that the costs of labour adjustments to a new target level depend on the expectations formation process of a firm, and the labour-intensity of a firm's production process. Labour unions have a substantial effect on ACL through the bargained rate of dismissal payments and the duration of dismissal application terms. This finding is in accordance with recent research in the U.K. [Burgess (1988), Burgess and Dolado (1988)].

Next, we have presented an alternative ACL function that measures the asymmetry between hiring and firing costs, and encompasses the symmetric quadratic form commonly used in models of dynamic labour demand as a special case. Under certain restrictions the novel specification of ACL, satisfies the properties of the dynamic theory of the firm. Estimation of the ACL function showed that in the period 1978–1986 hiring costs exceed firing costs in the Dutch manufacturing sector. Accordingly, during economic booms, a firm's employment will be more lagged behind its target level than during periods of recession. We also found that ACL consist of both variable costs, as well as fixed costs that do not vary with the size of the adjustment. Results in support of this conclusion are given by recent research on the structure of adjustment costs for labour faced by US manufacturing firms [Hamermesh (1988)].

Implementation of the ACL function into dynamic factor demand models and empirical examination of the differences in hiring and firing costs between production and non-production workers in manufacturing firms will be part of our future research.

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