Labour demand and job-to-job movement: Macro-consequences as a result from Micro-Economic behaviour

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LABOUR DEMAND AND JOB-TO-JOB MOVEMENT: MACRO-CONSEQUENCES AS A RESULT FROM MICRO-ECONOMIC BEHAVIOUR

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Abstract:

This paper investigates, both theoretically and empirically, the relationship between labour demand and job-to-job movement at the macro-level. A labour demand equation is modelled, which distinguishes the adjustment costs into net and gross adjustment costs. The paper derives and simulates the exact upper bounds of the marginal hiring costs of an employed worker, for which a quit between two firms yields a positive aggregate relationship between quits and employment. The relationship is estimated as a cointegration model for the Netherlands; it appears that the inclusion of quits may provide a substantial improvement of the estimated labour demand equation.

Keywords: labour demand, quits, net and gross adjustment costs, cointegration.

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1. INTRODUCTION

This paper analyzes the impact of labour mobility on employment, by extending the model of Hamermesh (1992). The difference between our model and the approach of Hamermesh is threefold. First, we distinguish inflow and outflow of employed workers, whereas Hamermesh only considers the outflow of employed workers. Second, we explicitly include the possibility that firms may want to fire workers, which is not allowed by Hamermesh. Third, we distinguish the inflow of an employed and the inflow of an unemployed worker, moving from the pool of unemployed to a job. In this paper, we approximate job mobility by voluntary quits; hence, we abstract from quits into unemployment.

We first summarize the role of job mobility in labour demand literature. In the survey of Nickell (1986), the theoretical labour demand equation contains voluntary quits, but they are supposed to be some constant fraction of employment. He also constructs an equation suitable for empirical work, which is obtained via a symmetric quadratic adjustment costs function; voluntary quits, however, are completely left out from this analysis.

Burgess (1988, 1992a,b) and Burgess and Doledo (1989) assume the parameter of the adjustment costs function to be time varying. Consequently, the speed of adjustment of employment is determined by some labour market variables. One of these variables is the number of voluntary quits, since they may facilitate the adjustment of employment to its desired level.

Bentolila and Bertola (1990) model the asymmetry of adjustment costs by distinguishing linear hiring and firing costs. According to their model, there exists a range, in which employment is not adjusted. The barriers of this range are determined by a number of variables, one of them is the quit rate. A calibration of the model showed that the negative impact of quits on the firing barrier is much larger than the positive impact of quits on the hiring barrier.

Hamermesh (1992) disentangles the adjustment costs into quadratic net and gross adjustment costs. Net adjustment costs are the costs due to a change in the level of employment; gross adjustment costs are the costs of the inflow or outflow of employees. Hamermesh also proposes a labour demand equation, where the net and gross adjustment costs are fixed, i.e. independent on the magnitude of the change in employment. His estimates with firm-level data indicate that quadratic net and gross adjustment costs also can be distinguished empirically; but Hamermesh does not succeed in finding empirical evidence for fixed net and gross
Hamermesh and Pfann (1992) also distinguish net and gross adjustment costs, applying a functional form of an asymmetric adjustment costs function proposed by Pfann and Palm (1992). Using manufacturing data of the U.S. for 1960-1981, they show that quits induce asymmetric behavior. Their interpretation of this result is that quits lead to costs, which are the costs of replacing employees.

In this paper, we assume that the decision to move to another job is a worker initiated decision (cf. McLaughin, 1991). Thus, the employer has no influence on the number of quits of his employees. In our model quits may influence the level of employment directly. The line of reasoning is as follows. Inflow of an employed worker may be cheaper for a firm than inflow of an unemployed worker. Hence, in that case inflow of employed implies lower adjustment costs compared to unemployed. Labour mobility between firms may affect the total cost level of firms, which in its turn has impact on the level of employment.

We distinguish the adjustment costs of firms in a firing regime (net decrease of employment) and firms in a hiring regime (net increase of employment). We follow Bentolila and Bertola (1990) by modelling an asymmetric impact of adjustment costs on the level of employment in both regimes. For firms in a firing regime, lower adjustment costs imply that it is easier to destroy jobs, and hence have a negative impact on the level of employment. On the other hand, for firms in a hiring regime, lower adjustment costs facilitate the creation of jobs, and hence have a positive impact on the level of employment. Apparently, the description of the adjustment costs is crucial to understand the relationship between labour mobility and employment.

Although our empirical analysis is at the macro-level, we explicitly construct the theoretical aggregate labour demand equation from the micro behaviour of firms. The reason for doing so is twofold. First, firms have heterogeneous employment fluctuations. See, e.g. Davis and Haltiwanger (1990), who show empirically that even in an economic downturn some firms may be in a hiring regime, whereas at the same time, the aggregate level of employment decreases. Second, job mobility concerns a change of employment of two firms; both firms experience an opposite change of employment. Therefore, we should distinguish between the firm from which an employee leaves, and the firm to which an employee goes. Furthermore, we want to derive the conditions under which job mobility has a positive impact on the level of employment.
The plan of this paper is as follows. Section 2 discusses the theoretical micro-model, whereas section 3 considers the macro-implications. Section 4 reports the estimation results and section 5 concludes.

2. THEORY

2.1. Some intuition about adjustment costs and labour mobility
This sub-section provides some intuitive notions about the impact of quits on the adjustment costs of employment, since we believe that labour mobility should be captured into the labour demand equation via the gross adjustment costs. We suppose labour to be homogeneous inside firms, but heterogeneous between firms. Note that in this case, we abstract from labour movement inside the firm. We concentrate on the role of quits on the adjustment costs for all firms together. We assume that the adjustment costs of employed workers may be lower than the adjustment costs of unemployed workers.

For the sake of reasoning, we consider three cases. First, all firms are in a hiring regime. If the adjustment costs of the inflow of an unemployed worker are the same for all firms, then overall adjustment costs will not decrease by labour mobility between firms: labour mobility leads to another vacant job with the same turnover costs. If the adjustment costs of the inflow of an unemployed worker are different between firms, quits may decrease the adjustment costs of the firms, as a whole. A firm with high adjustment costs of unemployed workers prefers to hire employed workers, who have lower adjustment costs. Suppose this firm hires workers from other firms with low adjustment costs. Firms with low adjustment costs of unemployed workers are less inclined to hire an employed worker, because the difference between the adjustment costs of an employed and unemployed worker is smaller. In other words, these firms, who are also in a hiring regime, are more likely to hire unemployed workers. For all firms taken together, this may reduce adjustment costs, compared to the situation where adjustment costs of unemployed are the same for all firms. Thus, a quit between two firms in a hiring regime lowers the adjustment costs, only if the adjustment costs of the inflow of an unemployed worker between both firms are sufficiently different. The second case is trivial: if all firms are in a firing regime, there are no quits; there is no firm who wants to hire new workers. In the third case, some firms are in a hiring regime and other firms are in a firing regime. An employee moving from a firm in a firing regime to a firm in a hiring regime, lowers the adjustment costs. First, the quit lowers the adjustment costs of the firm in a firing regime (it does not have to fire the worker). Second, the quit lowers the adjustment costs of the firm in the hiring regime, since
the adjustment costs of the inflow an employed worker are lower than the adjustment costs of the inflow of an unemployed worker.

2.2. Net and gross adjustment costs

To formalize the intuition of the previous sub-section, we construct a micro-framework, describing the relationship between employment and quits. To determine the optimal employment path, firm \( i \) maximizes the expected discounted future profits

\[
\max_{\{l_{t+1}\}} \mathbb{E} \sum_{s=0}^{\infty} \phi^s \left[ \Pi(l_{t+s}, z_{1,t+s}, z_{2,t+s}, ..., z_{R+1,t+s}) - w_{t+s} l_{t+s} - 0.5C_{t+s} \right],
\]

where \( \mathbb{E} \) is the expectations operator conditional on the information available at time \( t \), \( \phi \) is a discount factor, \( \Pi \) is a concave production function, \( L \) is the level of employment, \( Z \) are other variables which influence the revenues, \( w \) is the real wage, \( p_r \) is the real price of the \( r \)-th production factor, \( R + 1 \) is the number of production factors, \( N \) the number of firms, and \( C \) is an adjustment costs function.

Following Hamermesh (1992), the functional form of the production function is

\[
\Pi(l_{t}, z_{1,t}, z_{2,t}, ..., z_{R+1,t}) = (c_0 + c_{0,1} l_{t} + c_{0,2} k_{t}) l_{t} + \sum_{r=1}^{R} (c_{r} + c_{r,1} k_{t}) z_{r,t} + 0.5 c_{0,2} k_{t}^2 - 0.5 c_{2,1} k_{t} l_{t} + \sum_{r=1}^{R} c_{r,2} k_{t} z_{r,t}, \]

where \( c_0, c_1, c_2 \) are positive parameters of the production function; \( \xi \) is a serially uncorrelated error process, with zero mean and finite variance.

We assume that the firm faces different adjustment costs under three regimes. In the first regime, the 'hiring regime', the firm only hires. In the second regime, the 'do-nothing regime', the firm neither hires nor fires. In the third regime, the 'firing regime', the firm only fires. Distinction between adjustment costs for different regimes has recently been applied by e.g. Nickell (1986), Bentolila and Bertola (1990) and Bertola (1992). The distinction implies that a firm does not hire and fire simultaneously. The adjustment costs functions of firm \( i \) for the three regimes are, respectively

\[
C_{i,t} = \nu_0 (l_{i,t} - l_{i,t-1})^2 + \nu_1 (p_{i,t} k_{i,t})^2 + \nu_2 (F_{i,t}^{x0})^2,
\]

\[
\text{if } L_{i,t} = L_{i,t-1} + F_{i,t}^{x_0} + F_{i,t}^{x_1} - F_{i,t}^{x_2},
\]

(3a)
\[ C_{i,t} = \nu_0 (L_{i,t} - L_{i,t-1})^2, \quad \text{if } L_{i,t} = L_{i,t-1} - F^{xq}_{i,t}, \quad (3b) \]

\[ C_{i,t} = \nu_0 (L_{i,t} - L_{i,t-1})^2 + \nu_3 (F^{xu}_{i,t})^2, \quad \text{if } L_{i,t} = L_{i,t-1} - F^{xu}_{i,t} - F^{xq}_{i,t}, \quad (3c) \]

\( F \) is the outflow or the inflow of employees; the superscripts iq and lu denote the inflow of employed and unemployed workers, respectively; the superscripts xq and xu denote the outflow to another job and the outflow into unemployment, respectively; \( \nu_0, \nu_{1,i}, \nu_2 \) and \( \nu_3 \) are positive parameters.

The adjustment costs are split up in net and gross adjustment costs. Net adjustment costs are measured by the costs of a change in the level of employment. Gross adjustment costs are the costs of inflow or outflow of employees. For an unemployed worker, the gross adjustment costs are \( \nu_{1,i} \). In our model, these costs differ between firms, since sub-section 2.1 suggested that only if the gross adjustment costs of the inflow of unemployed workers are different between firms, quits may decrease the adjustment costs. We supposed that the gross adjustment costs of an inflow of an unemployed worker are higher than the gross adjustment costs of the inflow of an employed worker, \( \nu_{1,i} > \nu_2 \). Hence, the inflow of employed workers may be beneficial for a firm. Nevertheless, some firms, who are typically at the end of the vacancy chain (Akerlof et al., 1988) hire unemployed workers, either because employed workers are scarce, or because of a small difference of the gross adjustment costs between employed and unemployed workers.

For the inflow of one employed worker, the marginal gross adjustment costs are \( 2\nu_2 \). The marginal firing costs are \( 2\nu_3 \). Note that in a firing regime no gross adjustment costs are connected to a voluntary outflow \( F^{xq} \), since quits contribute to the reduction of employment, that a firm in a firing regime wants to attain. Only in a hiring regime, there is an inflow of employed workers. We realize that in a firing regime the number of quits may be larger than the planned decrease of the level employment, which leads, consequently, to hiring of employees. Since this case does not provide additional knowledge about job mobility, we assume that it does not take place.

To solve aggregation problems, we have to make another simplifying assumption: net adjustment costs are the same for all regimes. Despite this assumption, our model (3) still reflects an asymmetric relationship between outflow of quits and the adjustment costs, since in a hiring regime an outflow of employees may increase the adjustment costs. On the other
hand, in a firing regime an outflow of employees decreases the adjustment costs, as can readily be observed from (3c).

In (3a), there exists a trade-off between the inflow of employed and unemployed workers. To reach the desired employment level, an increase in the inflow of employed, $F_{iq}$, leads to a decrease in the inflow of unemployed, $F_{iu}$. According to (3), firms benefit from the inflow of employed workers, since the gross adjustment costs are lower. Thus, employed workers are preferred to unemployed workers, although there are firms who hire unemployed workers. This is in line with Lindeboom et al. (1992), who show empirically that given a contact between a firm and an applicant, the probability of being accepted is higher for an employed worker than for an unemployed; however, for the latter category, the probability is nonzero.

Appendix A derives the labour demand equations for the three regimes. The constructed form does not contain $F_{iu}$. It is not possible to obtain a labour demand equation with all flows, since in that case, one would obtain the intertemporal identity equation of employment. The labour demand equation for a firm in a hiring regime is

$$ L_{it} = \alpha_t L_{it-1} + \eta_i \nu_{1,ij} F_{iq} - \eta_i \nu_{2,ij} F_{iu} - \eta_i \nu_{3,ij} F_{ix} + \frac{\rho_{iq}}{1 - \rho_{iq}} \gamma_0 (\gamma_0 - 1) / (\gamma_0 + \gamma_1), \quad (4a) $$

where $\alpha$ and $\gamma$ are parameters, and $w = Z_0$. The parameter $\eta_i$ is equal to

$$ \alpha_i (1 - \rho_{iq}/\beta_i)^{-1} (\rho_{iq} - 1) / (\gamma_0 + \gamma_1), $$

where $\rho_{iq}$ is the AR-parameter of the AR(1)-process, that we assume to generate quits; $\alpha_i$ and $\beta_i$ are the smallest and the largest root of the second order difference equation in $L_{it}$ (see appendix A); $(1 - \alpha_i)$ is called the speed of adjustment of employment. In (4a) the inflow of quits, $F_{iq}$, has a twofold effect on employment. First, $\eta_i \nu_{1,ij}$ represents the indirect substitution effect of quits on employment. Recall that there exists a trade-off between $F_{iq}$ and $F_{iu}$. According to this substitution effect, a higher inflow of employed workers implies a lower inflow of unemployed workers. Because the gross adjustment costs of an employed worker are lower than those of an unemployed worker, the firm has lower gross adjustment costs when hiring an employed worker and can hence reach a higher level of employment. Second, $\eta_i \nu_{2,ij}$ represents the adjustment costs of the inflow of an employed worker. Higher adjustment costs have a negative impact on employment. Obviously, the outflow of quits, $F_{ix}$, has a negative effect on employment, since an outflow of workers to other firms leads to a reduction of the level of
employment.

In the same way, it is possible to derive the labour demand equations for a firm in a do-nothing regime and a firing regime. These are, respectively

\[ L_{it} = \alpha_0 L_{it-1} + \sum_{r=0}^{R} \gamma_{r} Z_{r,ij,t} \]

\[ L_{it} = L_{it-1} - F_{it}^{q} \]

and

\[ L_{it} = \alpha_0 L_{it-1} - \eta \nu_3 F_{it}^{q} + \sum_{r=0}^{R} \gamma_{r} Z_{r,ij,t} \]  \hspace{1cm} (4c)

Equation (4c) shows that in a firing regime, higher firing costs, \( \nu_3 \), lead to a more negative impact of quits on employment. Thus, if firing costs are relative low, quits have less impact on employment than if firing costs are relative high. In the extreme case of absence of firing costs (\( \nu_3 = 0 \)), a quit has no impact on employment, since the firm faces two options to destroy employment, voluntary quits or firing, which both have no gross adjustment costs.

3. MACRO-IMPLICATIONS

This section considers the implications of the micro-equations for labour demand at the macro-level. To keep things simple, we first discuss two cases, in which one employee moves from one firm to another. In both cases, the employee moves to a firm in a hiring regime. The firm from which the employee quits, is in the first case also in a hiring regime (sub-section 3.1), but in the second case, it is in a firing regime (sub-section 3.2). Next, we construct the aggregate equation for all firms (sub-section 3.3). We do not explicitly discuss a quit from a firm in a do-nothing regime, since, if we take \( \nu_3 = 0 \), then a quit from a firing firm and a do-nothing firm have the same implications.

3.1. Labour mobility from a hiring firm to another hiring firm

Suppose that both firm i and firm j want to hire one extra employee. We first investigate for which values of \( \nu_{1,i} \), \( \nu_{1,j} \) and \( \nu_2 \), the marginal gross adjustment costs in case of absence of a quit between firm i and j are larger than the marginal gross adjustment costs in case of a quit between firm i and j. Only then, can quits have a positive impact on the level employment.
Next, we compare this outcome with the coefficient of quits in the aggregate employment equation.

If there is no movement of an employee between firm 1 and 2, then both firms hire an unemployed worker. According to equation (3a), the marginal gross adjustment costs without a quit are $2\nu_{1j} + 2\nu_{1j}$. In case of a quit from firm 2 to firm 1, firm 1 hires the employed worker from firm 2, and firm 2 hires two unemployed workers, since both firms want to expand employment with one person each. The marginal gross adjustment costs become $2\nu_2 + 4\nu_{1j}$. Quits have a positive impact on employment only if the marginal gross adjustment costs, in case of absence of a quit between both firms, are larger than the marginal gross adjustment costs in case of a quit between both firms. Hence,

$$2\nu_{1j} + 2\nu_{1j} > 2\nu_2 + 4\nu_{1j},$$

or,

$$\nu_{1j} - \nu_{1j} > \nu_2.$$  \tag{5}

Thus, if the marginal gross adjustment costs of hiring an unemployed worker are much lower (at least $\nu_2$) for firm 2 than for firm 1, then a quit will increase employment at the aggregate level. The inflow of unemployed takes place in those firms, which have relatively low marginal gross adjustment costs of the inflow of an unemployed person. Note that if both firm 1 and firm 2 have the same marginal gross adjustment costs of hiring an unemployed, then the LHS of (5) is zero. This implies that both firms loose from a quit between the firms, because it leads in total to higher marginal gross adjustment costs. This is the case, even if the marginal gross adjustment costs of a quit ($2\nu_2$) are relatively low.

We will compare (5) with the coefficient of quits in an aggregate labour demand equation. Concentrating on the inflow and outflow of workers, the labour demand equations of firm 1 and 2 are, essentially,

$$L_{i,t} = \eta_1 \nu_{1j} F_{i,t} - \eta_2 \nu_{1j} F_{i,t} - \eta_1 \nu_{1j} F_{i,t} + \ldots,$$  \tag{6a}

$$L_{j,t} = \eta_1 \nu_{1j} F_{j,t} - \eta_2 \nu_{1j} F_{j,t} - \eta_1 \nu_{1j} F_{j,t} + \ldots,$$  \tag{6b}

where the dots represent the exogenous variables, which we have omitted for convenience. Suppose there is one quit from firm 2 to firm 1, hence $F_{i,t} = F_{j,t} = 1$ and $F_{i,t} = F_{j,t} = 0$. The aggregate labour demand equation of both firms becomes
\[
L_t = (\eta_i \nu_{1,i} - \eta_i \nu_{2} - \eta_i \nu_{1,j})Q_t + \ldots
\] (7)

where \( Q = F^q_t = \bar{F}^q_t \). Quits have a positive impact on the level of employment if

\[
\nu_{1,i} = \frac{\eta_i}{\eta_j} \nu_{1,j} > \nu_2.
\] (8)

The term \( \eta_i/\eta_j \) can be interpreted as a scaling factor, which arises, because of firm-specific gross adjustment costs of the inflow of unemployed workers. According to appendix A,

\[
\eta_i/\eta_j = \frac{(\nu_0 + \nu_{1,j})/(\nu_0 + \nu_{1,i})}{(\nu_1 - \rho_{10})/(\nu_1 - \rho_{1q})} \frac{(\alpha_i\beta_{ij}/\alpha_j\beta_i)}{(\alpha_j\beta_{ij}/\alpha_i\beta_i)}
\] (9)

Recall that \((1 - \alpha_i)\) is the speed of adjustment of employment of firm \(i\). From equations (A3) and (A4) in appendix A can be derived that \( \nu_{1,j} < \nu_{1,i} \) implies \( \alpha_i > \alpha_j \). This is also intuitive clear, since larger gross adjustment costs of the inflow of unemployed workers leads to a slower speed of adjustment of employment. Hence (8) can be written as

\[
\nu_{1,i} - (1 + \delta)\nu_{1,j} > \nu_2,
\] where \( \delta \) is positive (when \( \nu_{1,j} < \nu_{1,i} \)) and close to zero. Note that \( \eta_i \) is determined by \( \phi, \psi_0, \nu_0 \) and \( \nu_{1,j} \); the exact relationship is very complex. In order to get insight into \( \delta \) we have simulated \( \eta_i/\eta_j \) for different values \( \nu_{1,i} \) and \( \nu_{1,j} \) using several realistic values of \( \phi, \psi_0 \) and \( \nu_0 \) based on estimates of Sargent (1978), Meese (1980), Pfann (1989, page 53) and Hamermesh (1992). \( \delta \) is the upperbound with respect to the differences between \( \nu_{1,i} \) and \( \nu_{1,j} \). These simulations give us information concerning the conditions for a positive impact of quits on labour demand, when the approach via the marginal adjustment costs (5) and the derivation via labour demand (8) are compared. The difference between (8) and (5) appears to be small. Appendix B reports the simulation results. For different values of \( \nu_{1,i} \) and \( \nu_{1,j} \), the upper bounds of \( \nu_2 \) that yield a positive influence of quits on employment are presented. It appears that the ratio \( \eta_i/\eta_j \) is slightly larger than one, and varies only moderately. Moreover, a larger difference between \( \nu_{1,i} \) and \( \nu_{1,j} \) induces a smaller ratio. Thus, according to the simulations of (8), \( \nu_2 \) must be some smaller than the difference between \( \nu_{1,i} \) and \( \nu_{1,j} \); the scaling factor \( \eta_j/\eta_i \) causes (8) to be a somewhat stronger restriction than (5).

Equations (6a,b) also imply that if firm \(i\) and \(j\) hire one worker from each other, the aggregate
labour demand equation of both firms becomes

\[ L_t = -(\eta_1 + \eta_2)\nu_2Q_t + \ldots \]

Hence, quits have a negative impact on aggregate employment, if two firms exchange an employee.

3.2. Labour mobility from a firing firm to a hiring firm

The second case concerns a quit from a firm in a firing regime to a firm in a hiring regime. Again, we first investigate the effect of a quit on the gross adjustment costs for both firms.

Recall that a reduction of gross adjustment costs of employment has a negative impact on employment for the firing firm, but a positive impact on employment for the hiring firm. Therefore, in order to obtain a positive relationship between aggregate employment and aggregate quits, the firm in the hiring regime should have relatively low gross adjustment costs, whereas the firm in the firing regime should have high gross adjustment costs. Hence, in this case, we may not compare the situation without quits with the situation with quits, such as in (5). Instead, we compare the reduction of the marginal gross adjustment costs for the firing firm with the reduction of the marginal gross adjustment costs for the hiring firm. If the former is smaller than the latter, quits have a positive impact on the aggregate level of employment.

Suppose firm i hires an unemployed worker, with marginal gross adjustment costs \(2\nu_1,i\), and firm j fires an employed worker, with marginal gross adjustment costs \(2\nu_3\). Quits have a positive impact on employment for both firms taken together, only if the decrease of the marginal gross adjustment costs of the hiring firm \((2\nu_1,j - 2\nu_2)\) is larger than the decrease of the marginal gross adjustment costs, \((2\nu_3 - 0)\) (since no costs are connected to a quit), of the firing firm. Hence,

\[ \nu_{1,j} \cdot \nu_2 > \nu_3 \]  

(10)

Next, we will compare this result with the coefficient of quits in the aggregate labour demand equation of both firms. The labour demand equation of firm i and j are respectively

\[ L_{it} = \eta_1\nu_1,iF_{it}^q - \eta_2\nu_2F_{it}^{iq} - \eta_3\nu_3F_{it}^{xq} + \ldots \]  

(11a)

\[ L_{jt} = -\eta_3F_{jt}^{xq} + \ldots \]  

(11b)

Since, \(F_{it}^q = F_{jt}^{xq} = 1\) and \(F_{it}^{xq} = 0\), the aggregate equation of both firms becomes
\[ L_t = \left( \eta_1 \nu_{1,t} - \eta_2 \nu_{2,t} - \eta_3 \nu_{3,t} \right) Q_t + \ldots \]  
(12)

Quits have a positive impact on employment at the aggregate level, if

\[ \nu_{1,t} - \nu_{2,t} > \left( \frac{\eta_1}{\eta_2} \right) \nu_{3,t} \]

or,

\[ \nu_{1,t} - \nu_{2,t} > (1 + \delta) \nu_{3,t} \]

(13)

where \( \delta \) is small and positive (negative) if \( \nu_3 \) is smaller (larger) than \( \nu_{1,t} \). Again the ratio \( \eta_1/\eta_2 \) can be interpreted as a scaling factor due to firm-specific gross adjustment costs. Appendix B gives the upper bounds of \( \nu_2 \), which yield a positive relationship in (12), for different values of \( \nu_{1,t} \) and \( \nu_3 \). Thus, also for a quit from a firing firm to a hiring firm, restriction (13), obtained via the aggregate labour demand equation, differs slightly from restriction (10), obtained via a comparison of the marginal gross adjustment costs.

3.3. The aggregate equation

In the two previous sub-sections, we have shown under which restrictions a quit between two firms leads to a positive impact on the level of employment. Job-to-job movement can be considered as an allocation process, which changes the adjustment costs overall. It is, however, possible that a quit between two firms is not an optimal allocation process, for instance, if \( \nu_{11} \) and \( \nu_{12} \) do not differ sufficiently for two firms in a hiring regime, and yet a quit takes place. To test whether quits lead to an optimal allocation process, one should use micro-data, containing at least information concerning the source and the costs of the inflow of the employees. At the macro-level, one cannot validly test the relationship, since, as we have shown, it is not possible to specify the sign of the coefficient of quits \( \text{a priori} \). Therefore, the labour demand equation at the macro-level becomes

\[ L_t = \bar{\lambda}_{t+1} + \sum_{r=0}^{R} \gamma_{r+1} Z_{r,t} + \bar{\gamma}_{R+1} Q_t \]

(14)

where coefficients are weighted sums of the coefficients of the individual labour demand equations. The sign of \( \bar{\gamma}_{R+1} \) is indeterminate.

4. EMPIRICAL RESULTS

In this section we present the estimation results, using quarterly manufacturing data of The
Netherlands from 1973:1 to 1990:IV. Since quits are an essential element in our theoretical model, they also play a substantial role in our empirical model. However, data of quits in The Netherlands are scarce. For the period investigated, two series are available. The first has been collected two yearly from 1975 to 1985. The second has been collected yearly from 1983 to 1990. Using the close resemblance of quits and the vacancy-unemployment ratio (see Burgess (1988) and Burgess and Doledo (1989)), we have constructed quit data for our analysis; see Appendix C.

We use as variables Z the same variables as in Burgess (1992a,b). These are the real wage rate (w), the real capital stock (K), a measure of aggregate demand competitiveness (COMP), world trade shocks (WT), a measure of adjusted fiscal stance (AD) and an index of technical progress (TP). For a description of these variables, we refer to the data appendix C.

First, we conduct a preliminary data analysis by applying the unit root test ofDickey and Fuller (1981), to assess stationarity of the variables involved. The test results, which are very much in line with Burgess (1992b), are presented in table 1. The results indicate that we should take the first difference of the variables involved.

Notice that the aggregate labour demand equation (14) that we derived is based on aggregation across firms with heterogeneous, firm-specific, labour, with different responses. Therefore, we specify a functional form with more lags on employment, the Z variables and the quit rate (Cf. Nickell, 1986 and Bresson et al. 1992). Thus, we start from a general autoregressive distributed lag model where all variables, except the quit rate are in logs. Cf. Hamermesh and Pfann (1992). Rewriting (14) in error-correction form we have

\[
\Delta \log(L_t) = \mu + \lambda_1 \log(L_{t-1}) + \sum_{r=0}^{R} \gamma_r \Delta \log(Z_{r,t-1}) + \gamma_{R+1} Q_{t-1} + \sum_{a=1}^{A} \theta_a \log(Z_{a,t-1}) + \varepsilon_{t} \quad (15)
\]

where \(\mu\) is the deterministic part, usually consisting of a constant and seasonal dummy variables and \(\log(Z_i) = (\log(K_i), \log(w_i), \text{COMP}_i, \text{WT}_i, \text{AD}_i, \text{TP}_i)\)', the latter four variables are already in logs; see appendix C. \(\varepsilon_t\) represents the uncorrelated white noise error process. \(\Delta X = X_t - X_{t-k}\) The lags of the autoregressive variables are set to \(p=5\) and the lags of the other explanatory variables to \(q=4\). All the predetermined variables in (15) are lagged, in order to evade simultaneity bias of the estimates of the parameters.

This model should then sequentially be simplified to a model specification that is still an
adequate representation of the data generating process (DGP) of employment in the Netherlands. In order to assess whether our models are still a valid representation of this DGP, we apply a number of misspecification tests. We use the Lagrange Multiplier test of Godfrey (1978) and the test of Ljung and Box (1978) on absence of residual autocorrelation. Furthermore, we apply the test of Jarque and Bera (1980) on non-normally distributed disturbances and the ARCH test of Engle (1982). As an additional test on heteroskedasticity, we apply the test developed by White (1980). We also apply the familiar RESET test on functional form and omitted variables, and the Chow test on predicted failure.

As a first simplification of the general form (15), we test whether a number of variables with insignificant parameters can be deleted from the dynamic part. The null hypothesis of deleting $\Delta_t \log(L_{ij})$, $i=2,3,5$ combining all lags of $\Delta_t \log(K_{ij})$ to $\Delta_t \log(K_{ij})$ and deleting $\Delta_t \log(w_{ij})$, $\Delta_t \text{COMP}_{ij}$, $\Delta_t \text{WT}_{ij}$, $i=2,3,4$ and deleting all lags of $\Delta_t Q_t$, $\Delta_t AD_t$ and $\Delta_t TP_t$, yields $F(27,27) = 0.738$, which cannot be rejected at a 5 percent significance level.

Second, we test for the presence of a significant cointegration relation. Instead of using the now standard test of Engle and Granger (1987) or the Johansen (1988, 1991) procedure of testing the full system, we use the approach set out in Boswijk (1991) and Boswijk and Franses (1992). It appears that tests on cointegration are sensitive to a correct specification of the dynamic part of the model. Underidentification of the lag structure of this part may lead to spurious cointegration too often, whereas overidentifi cation leads to rejecting cointegration too often (cf. Boswijk and Franses, 1992).

We therefore started with a general model specification and first simplified the dynamic part so that this simplified model is still consistent with the general model we started with. Application of the cointegration test yields $\xi_1 = 30.51$, which is significant at a 5% significance level; the 5% critical value with seven explanatory variables is 27.27 (cf. Boswijk, 1991). Thus, the presence of a cointegration relation as included in (15) cannot be rejected. This result is confirmed by the standard cointegration tests of Engle and Granger (1987), $\text{CRDW} = 0.404$ and $\text{ADF}(4) = -3.673$, indicating a stationary error process of the static error correction equation of (15).

Finally, we simplify the error-correction part of the model. Testing the validity of constant returns to scale and deleting all variables, except $\log(w)$ and $Q$, yields $F(5,54) = 2.034$. This cannot be rejected at 5% significance. The finally selected model is presented in table 2. Notice that the model slightly suffers from heteroskedastic disturbances, as indicated by the test of White
(1980). This implies that the estimates might not be efficient. This problem can be avoided by using the heteroskedasticity-consistent covariance matrix estimator of White (1980), which still yields efficient estimates asymptotically. Application implies that only the coefficient of the real wage rate in the error-correction part becomes slightly insignificant at a 5 percent significance level; it is however, still significant at 10 percent.

This model has the following implications. First, the long-run wage elasticity has a value of about -0.4 (cf. Hamermesh, 1986, 1991), whereas the 'short-run' wage elasticity, derived from the dynamic part of the model, is about -0.15. The coefficients of $\Delta_t\text{COMP}$ and $\Delta_t\text{WT}$ have the expected sign. The negative sign of the capital stock variable implies substitution between labour and capital. Finally, we turn to the effect of the quit rate. The coefficient of the quit rate is positive, implying that an increase in the quit rate contributes to expanding employment. The long-run elasticity of quits with respect to $\log(L/K)$ is about 0.23. Hence, with respect to the labour-capital ratio, this means an elasticity of about 1.26. In order to get an impression of the actual number of workers this amounts to, we estimated the same model as in table 2, but instead of $\log(L/K)$, we only took $\log(L)$ in the error-correction part. It implies that a one percentage point increase in the quit rate yields an increase in employment of around one thousand persons. At first sight this appears to be only of minor importance. However, considering the relative large fluctuations in the quit rate in the Netherlands, ranging from 15% in 1975 to 6% in 1983, to again 15% in 1990 (see table 1), its effect can in fact be quite substantial.

In the theory of section 2, we have introduced the possibility of a different effect of quits on employment, depending on the assumption of whether the firm is in a hiring regime or in a firing regime. However, the estimates of table 2 imply a constant impact. We will next try to relax this assumption by introducing a tentative index of the number of firms in a hiring and firing regime. We take the number of fires $F_t$ to be equal to the total number of persons for whom an application of dismissal was granted by the Public Employment Agencies in the Netherlands. The hires are constructed as $H_t = \Delta L_t + F_t$. Under the simplifying assumption that the number of quits is independent of the regime of employment, the total mobility from firms in a firing regime to firms in a hiring regime is approximated by

$$Q_{t+1} = Q_t + F_t/(F_t + H_t).$$

\[1\] Since fires are connected to all employees, we now take $L_t$ to be total employment in the business sector.
and mobility from firms in a hiring regime to other firms in a hiring regime is approximated by

\[ Q_h = Q_t \cdot H_t / (F_t + H_t) . \]

Reliable data on hires and fires are available from 1978:II onwards. So before 1978:II, we take the aggregate quit rate as in our previous model, whereas from 1978:II to 1990:IV we distinguish quits in both regimes, i.e., \( Q_h \) and \( Q_f \). This approach yields the model presented in table 3. This model does not appear to be severely misspecified. Apart from the RESET(3) test, none of the other misspecification tests points towards an invalid specification. Hence, for the time being, we assert that this model is reasonably adequate.

The estimation results of this extended model imply that the coefficients of the explanatory variables are of a similar magnitude as those of the model in the table 2. However, the distinction we make between quits in a hiring and in a firing regime, seems to suggest that only quits in a hiring regime have a significant impact on employment, whereas the influence of quits in a firing regime appears to be insignificant. A Wald test on the equality of the coefficients of \( Q_h \) and \( Q_f \) yields \( \chi^2(1) = 7.52 \), which indicates that this hypothesis cannot be accepted. The long-run elasticity of \( Q_h \) with respect to log\((L/K)\) equals 0.32 and that of \( Q_f \) is 0.03. This means that a percentage point increase in the quit rate, when the majority of firms is a hiring regime implies an increase in employment of more than 2000 persons, whereas in the other regime this effect is negligible.

Turning back to the theory of sections 2 and 3, we can draw the following tentative and cautious conclusions from our empirical results. First, quits appear to have a significant impact on employment. Second, in distinguishing hiring and firing regimes, it appears that the impact of quits on employment is significantly different between those regimes. This suggests that there is considerable heterogeneity between firms, which is also implied by our theory. As to the coefficients of \( Q_h \) and \( Q_f \), which are linked to the coefficients of equation (7) and (12), respectively, we can merely state that the fact that the coefficient of \( Q_f \) is about zero implies that there might be relatively high costs involved in firing a person, i.e., \( \nu_3 \) might be rather high in (12).

5. CONCLUSIONS

In this paper we have shown under which conditions job mobility between two firms has a
positive impact on the aggregate level of employment. We have derived and simulated the upper bound of the marginal hiring costs of an employed worker, for which a quit has a positive impact on aggregate employment.

It appears that a quit from a firm in a hiring regime to another firm in a hiring regime has a positive effect on aggregate employment if the difference of the marginal adjustment costs of hiring an unemployed worker between both firms is somewhat larger than the marginal hiring costs of an employed worker. On the other hand, a quit from a firm in a firing regime to a firm in a hiring regime has a positive impact on employment if the quit leads to a somewhat larger reduction of the marginal gross adjustment costs for the firm in the hiring regime, than for the firm in the firing regime.

It can be concluded that we cannot establish the sign of quits in the aggregate employment equation a priori. This is because mobility between two hiring firms is not necessarily beneficial for both firms as a whole. Therefore, the relationship should ideally be tested with micro-data, containing at least information on the source and the costs of the inflow of employees. Since we do not have access to these micro-data, we have estimated the relationship with macro-data for the Netherlands. It appears that quits have a substantial positive impact on employment. Moreover, if we make an effort to distinguish quits in a hiring regime and quits in a firing regime in our empirical model, we find that indeed the impact of quits differs between those regimes. This implies substantial heterogeneity between firms concerning the relationship between quits and employment.
Table 1 - Unit root test results of the augmented Dickey-Fuller test.

<table>
<thead>
<tr>
<th>Name</th>
<th>ADF(k)$^a$</th>
<th>k</th>
<th>Suggested l(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>log(L)</td>
<td>-0.311</td>
<td>10</td>
<td>l(1)</td>
</tr>
<tr>
<td>log(K)</td>
<td>-2.482</td>
<td>5</td>
<td>l(1)</td>
</tr>
<tr>
<td>log(L/K)</td>
<td>-1.092</td>
<td>5</td>
<td>l(1)</td>
</tr>
<tr>
<td>log(w)</td>
<td>-3.869</td>
<td>3</td>
<td>l(1)$^b$</td>
</tr>
<tr>
<td>COMP</td>
<td>-1.861</td>
<td>10</td>
<td>l(1)</td>
</tr>
<tr>
<td>WT</td>
<td>-3.713</td>
<td>2</td>
<td>l(1)$^b$</td>
</tr>
<tr>
<td>AD</td>
<td>-0.037</td>
<td>10</td>
<td>l(1)</td>
</tr>
<tr>
<td>TP</td>
<td>-1.233</td>
<td>10</td>
<td>l(1)</td>
</tr>
<tr>
<td>Q</td>
<td>-1.594</td>
<td>4</td>
<td>l(1)</td>
</tr>
</tbody>
</table>

$^a$ Based on $\Delta Z = a + bt + cZ_{t-1} + \sum_{i=1}^{k} \Delta Z_{t-i} + \epsilon_t$, where $t(\delta)$ is the t-value of $\delta$.

$^b$ Strictly speaking the hypothesis of a unit root in w and WT is rejected at 5%, but not at 1%. However, in our error-correction-form (16) we do take $\Delta \log(w)$ and $\Delta WT$ in the short-run dynamic part.
Table 2 - Estimation results.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable: $\Delta \log L_t$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{CONST}$</td>
<td>0.0027</td>
<td>(3.310)</td>
<td>*</td>
</tr>
<tr>
<td>$\log(L/K)_{t-1}$</td>
<td>-0.0046</td>
<td>(3.799)</td>
<td>*</td>
</tr>
<tr>
<td>$\log(w_{t-1})$</td>
<td>-0.0017</td>
<td>(2.027)</td>
<td>*</td>
</tr>
<tr>
<td>$Q_t$</td>
<td>0.0011</td>
<td>(3.884)</td>
<td>*</td>
</tr>
<tr>
<td>$\Delta \log L_{t-1}$</td>
<td>1.1467</td>
<td>(36.26)</td>
<td>*</td>
</tr>
<tr>
<td>$\Delta \log L_{t-4}$</td>
<td>-0.2775</td>
<td>(7.238)</td>
<td>*</td>
</tr>
<tr>
<td>$\Delta \log(K_{t-1})$</td>
<td>-0.0187</td>
<td>(4.730)</td>
<td>*</td>
</tr>
<tr>
<td>$\Delta \log(w_{t-1})$</td>
<td>-0.0196</td>
<td>(2.827)</td>
<td></td>
</tr>
<tr>
<td>$\Delta \log(C_{t-1})$</td>
<td>0.0039</td>
<td>(2.141)</td>
<td>*</td>
</tr>
<tr>
<td>$\Delta \log(T_{t-1})$</td>
<td>0.0193</td>
<td>(4.757)</td>
<td>*</td>
</tr>
</tbody>
</table>

S.E. 0.000676
$R^2$ 0.985
T 72
$\chi^2_{\text{norm}}(2)$ 2.577
$F_{\text{AR}}(1,58)$ 0
$F_{\text{AR}}(5,54)$ 0.019
LB(12) 13.67
$F_{\text{ARCH}}(5,67)$ 1.066
$F_{\text{RESET}}(1,58)$ 0.848
$F_{\text{RESET}}(3,56)$ 1.575
$F_{\text{Chow}}(16,43)$ 1.351
$F_{\text{Chow}}(8,51)$ 0.864
$F_{\chi^2}(19,53)$ 1.825

* Statistically significant from zero at the 5% level.

Seasonal dummies are not presented. The t-values are in brackets by the estimated parameter values. SE is the residual standard error of the equation, $R^2$ is the correlation coefficient and T is the number of observations used to estimate and test the model. $\chi^2_{\text{norm}}$ is the normality test of Jarque and Bera (1980). $F_{\text{AR}}$ is Godfrey's test on residual autocorrelation (Godfrey, 1978). LB is the Ljung-Box test on residual autocorrelation. $F_{\text{ARCH}}$ is Engle's ARCH test on heteroscedasticity (Engle, 1982). $F_{\text{RESET}}$ is the RESET-test. $F_{\text{Chow}}$ is the Chow test on predictive failure and $F_{\chi^2}$ is White's (1980) test on heteroskedasticity, based on actual and squared regressors.
Table 3 - Estimation results.

Dependent variable: $\Delta \log L_t$  
Sample period: 1973:I-1990:IV

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>T</th>
<th>R$^2$</th>
<th>$\chi^2_{norm}(2)$</th>
<th>$F_{AR}(1.56)$</th>
<th>$F_{AR}(5.52)$</th>
<th>$F_{ARCH}(5.67)$</th>
<th>$F_{RESET}(1.56)$</th>
<th>$F_{RESET}(3.54)$</th>
<th>$F_{Chow}(18.41)$</th>
<th>$F_{Chow}(8.49)$</th>
<th>$F_{X_2}(23.49)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONST</td>
<td>0.0030</td>
<td>0.000733</td>
<td></td>
<td>0.987</td>
<td>5.502</td>
<td>0.031</td>
<td>0.420</td>
<td>0.512</td>
<td>1.697</td>
<td>4.390*</td>
<td>1.154</td>
<td>1.114</td>
<td>1.422</td>
</tr>
<tr>
<td>$\log(L/K)_{t-1}$</td>
<td>-0.0057</td>
<td>0.00658</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>$\log(w_{t-1})$</td>
<td>-0.0023</td>
<td>0.00643</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>$Q(73.1-1978.1)_{t-1}$</td>
<td>0.0009</td>
<td>0.00637</td>
<td></td>
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<tr>
<td>$Qh_{t}$</td>
<td>0.0016</td>
<td>0.00637</td>
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<tr>
<td>$Qf_{t}$</td>
<td>0.0002</td>
<td>0.00637</td>
<td></td>
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<tr>
<td>$\Delta \log L_{t-1}$</td>
<td>1.0689</td>
<td>0.00733</td>
<td></td>
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<tr>
<td>$\Delta \log(K_{t-1})$</td>
<td>-0.3043</td>
<td>0.00733</td>
<td></td>
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<tr>
<td>$\Delta \log(w_{t-1})$</td>
<td>-0.0218</td>
<td>0.00733</td>
<td></td>
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</tr>
<tr>
<td>$\Delta \log(\text{COMP}_{t-1})$</td>
<td>0.0031</td>
<td>0.00733</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>$\Delta \log(\text{WT}_{t-1})$</td>
<td>0.0153</td>
<td>0.00733</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

* Statistically significant from zero at the 5% level.

a) The variable is equal to Q for the period 1973:I-1978:I, and equal to zero elsewhere.
b) The variables are equal to Qh and Qf for the period 1978:II-1990:IV, and equal to zero elsewhere.
Appendix A - Micro labour demand equations

For its employment decision, the maximization problem of firm \( I \) in a hiring regime is

\[
\max_{\{J_{i,t+s}\}} E_t \sum_{s=0}^{\infty} \phi^s \left( \Pi (L_{i,t+s}, Z_{i_1,t_1+s_1}, Z_{i_2,t_2+s_2}, \ldots, Z_{R_{i,R_i+t+s_1}}) \cdot W_{i,t+s} L_{i,t+s} \right.
- \sum_{t=1}^{R} P_{i,t} Z_{i,t+s} \cdot 0.5 \left[ \nu_0 (L_{i,t+s} - L_{i,t+s-1})^2 + \nu_1 (F_{i,t+s}^q)^2 \right] +
\left. + \nu_2 (F_{i,t+s}^q)^2 \right) \}.
\]

(A1)

Using the definition of \( \Pi \) in (2), this is equal to

\[
\max_{\{J_{i,t+s}\}} E_t \sum_{s=0}^{\infty} \phi^s \left( \left( \xi_0 + \xi_0 L_{i,t+s} \right) L_{i,t+s} + \sum_{t=1}^{R} \left( \xi_0 + \xi_0 L_{i,t+s} \right) Z_{i,t+s} \right.
- 0.5 \nu_0 L_{i,t+s}^2 - 0.5 \sum_{t=1}^{R} \nu_0 Z_{i,t+s}^2 + \sum_{t=1}^{R} \left( \xi_0 + \xi_0 L_{i,t+s} \right) Z_{i,t+s} \cdot W_{i,t+s} L_{i,t+s} \right.
- \sum_{t=1}^{R} P_{i,t} Z_{i,t+s} \cdot 0.5 \left[ \nu_0 (L_{i,t+s} - L_{i,t+s-1})^2 + \nu_1 (L_{i,t+s} - L_{i,t+s-1})^2 \right]
- F_{i,t+s}^q + F_{i,t+s}^{q2} + \nu_2 (F_{i,t+s}^q)^2 \right) \}.
\]

(A2)

The Euler-equations of (A2) are

\[
\phi E_{t+s} L_{i,t+s+1} - \left[ \psi_0 / (\nu_0 + \nu_1) + 1 + \phi \right] L_{i,t+s} + L_{i,t+s+1} =
\]

\[
(\nu_0 + \nu_1)^{-1} \left[ \left( \xi_0 + \xi_0 L_{i,t+s} \right) W_{i,t+s} \right. - \sum_{t=1}^{R} \xi_0 Z_{i,t+s} +
\left. + (\nu_1 - \nu_2) \left( \phi E_{t+s} F_{i,t+s+1} - F_{i,t+s}^q \right) - \nu_1 (\phi E_{t+s} F_{i,t+s+1}^q - F_{i,t+s+1}^q) \right],
\]

\( s = 0, 1, 2, \ldots \)  \hspace{1cm} (A3)

where the transversality condition is

\[
\lim_{s \to \infty} \phi^s E_t L_{i,t+s} = 0.
\]

We follow Sargent (1978) and Hamermesh (1992) by modelling forward looking expectations.
The solutions of the Euler equations, after factorisation, are

\[ L_{it} = \alpha L_{i,t-1} - \alpha / (\nu_0 + \nu_1) \xi_{i0}^{\alpha} \beta_1^{-1} - \xi_{i0}^{\alpha} \beta_1^{-1} + w_{i,t+s} - \sum_{r=1}^{R} \xi_{r,i,t+s} \]

\[ + (\nu_{1,1} \cdot \nu_2) (\phi E_{t+s}^{q} F_{i,t+s+1}^{q} - F_{i,t+s+1}^{q}) - \nu_{1,1} (\phi E_{t+s}^{q} F_{i,t+s+1}^{q} - F_{i,t+s+1}^{q})], \]

(A4)

where \( 0 < \alpha < 1 < \phi^{-1} < \beta \). Note that the roots of the second order difference equation (A3), \( \xi_{0,1}, p_{0,1}, p_{1,0} \), \( \nu_0 \) and \( \nu_1 \), are nonlinear functions of \( \phi, \nu_0, \nu_1, \xi_{0,1}, F_{i,t}, w_{i,t} \) and \( Z_{r,i,t}, r=1,\ldots,R \), to follow an AR(1)-process, with AR parameters \( \rho_{i,0}, \rho_{x,q}, \rho_{q,0}, \rho_{w} \) and \( \rho_{Z,r}, r=1,\ldots,R \) respectively. The labour demand equation becomes

\[ L_{it} = \alpha L_{i,t-1} - \alpha / (\nu_0 + \nu_1) (1 - 1/\beta)^{-1} - \xi_{0,i} (1 - \rho_{x,q}/\beta) - \rho_{w}/(\beta \nu_0) + w_{i,t}(1 - \rho_{x,q}/\beta) \]

\[- \sum_{r=1}^{R} \xi_{r,i,t}(1 - \rho_{Z,r}/\beta) + (\nu_{1,1} - \nu_2) (1 - \rho_{q,0}/\beta)^{-1} (\phi \rho_{q,0} - 1) F_{i,t}^{q} \]

\[- \nu_{1,1} (1 - \rho_{x,q}/\beta)^{-1} (\phi \rho_{x,q} - 1) F_{i,t}^{x,q}], \]

(A5)

We define \( w = Z_{0} \), and suppose \( \rho_{q,0} = \rho_{x,q} \). (A5) becomes in obvious notation

\[ L_{it} = \alpha L_{i,t-1} + \eta_{i} \nu_{1,1} F_{i,t}^{q} - \eta_{i} \nu_{1,1} F_{i,t}^{x,q} + \sum_{r=1}^{R} \eta_{i} \nu_{1,1} F_{i,t}^{x,q} + \sum_{r=1}^{R} \xi_{r,i,t} Z_{r,i,t} \]

(A6)

\[ F_{i,t}^{q} + F_{i,t}^{x,q} > 0, \]

where \( \eta_{i} = \alpha (1 - \rho_{q,0}/\beta)^{-1} (\phi \rho_{q,0} - 1)/(\nu_0 + \nu_1) \).

In the same way, the labour demand in the do-nothing regime and the firing regime can be derived.
Appendix B - Simulations

This appendix provides the simulation results of the upper bound of \( \nu_2 \), for which

\[
\nu_2 < \nu_{1,j} - (1 + \delta)\nu_{1,j}.
\]  

(B1)

For these values, there exists a positive coefficient of quits in the aggregate employment equation, of two firms in a hiring regime. The ratio \( \eta_j/\eta_i \) in (B1) is very complex. It is equal to

\[
\left[ (\nu_0 + \nu_{1,i})/(\nu_0 + \nu_{1,j}) \right] \left[ (\beta_i - \rho_{ij})/(\beta_j - \rho_{ij}) \right] \left[ (\alpha_i\beta_j/\alpha_j\beta_i) \right],
\]

where \( \alpha_i \) and \( \beta_i \) are nonlinear functions of \( \phi, \psi_0, \nu_0 \) and \( \nu_{1,i} \).

Table B1 up to B5 show the upper bounds of \( \nu_2 \) for different values of \( \nu_{1,j} \) and \( \nu_{1,i} \), given \( \phi, \psi_0, \rho \) and \( \nu_0 \). We can conclude from these tables that \( \eta_j/\eta_i \) is slightly larger than one, because \( \nu_2 \) is somewhat smaller than the difference between \( \nu_{1,j} \) and \( \nu_{1,i} \). Moreover, if the difference between \( \nu_{1,j} \) and \( \nu_{1,i} \) becomes larger, then \( \eta_j/\eta_i \) becomes closer to one.

For a quit from a firing firm to a hiring firm, we have to find the upper bound of \( \nu_2 \), for which

\[
\nu_2 < \nu_{1,j} - (1 + \delta)\nu_{3}.
\]  

(B2)

After substituting \( \nu_3 \) for \( \nu_{1,j} \) in (B2), one can use the simulations of (B1) to obtain the upper bound of \( \nu_2 \) in (B2).
Table B1 - Values of $\nu_2$ for different $\nu_{1,i}$ and $\nu_{1,j}$.
Other parameters: $\phi = 0.95$, $\psi_0 = 1.0$, $\rho = 0.25$, $\nu_0 = 50$.

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Table B2 - Values of $\nu_2$ for different $\nu_{1,i}$ and $\nu_{1,j}$.
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Table B3 - Values of $\nu_2$ for different $\nu_{1,j}$ and $\nu_{1,j}$. Other parameters: $\phi = 0.90$, $\psi_0 = 1.0$, $\rho = 0.25$, $\nu_0 = 50$.

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Table B4 - Values of $\nu_2$ for different $\nu_{1,j}$ and $\nu_{1,j}$. Other parameters: $\phi = 0.95$, $\psi_0 = 2.0$, $\rho = 0.25$, $\nu_0 = 50$.

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Table B5 - Values of $v_2$ for different $v_{1,1}$ and $v_{1,\nu}$.
Other parameters: $\phi = 0.95$, $\psi_0 = 1.0$, $\rho = 0.90$, $\nu_0 = 50$.

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Appendix C - Data sources, definitions and abbreviations

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CBS</td>
<td>Netherlands Central Bureau of Statistics</td>
</tr>
<tr>
<td>CPB</td>
<td>Netherlands Central Planning Bureau</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization of Economic Cooperation and Development</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>MEI</td>
<td>Main Economic Indicators</td>
</tr>
<tr>
<td>MBS</td>
<td>Monthly Bulletin of Statistics</td>
</tr>
<tr>
<td>NA</td>
<td>National Accounts</td>
</tr>
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</table>

All variables are based on those used by Layard and Nickell (1986) and Burgess (1992). Interpolation is done by means of a third order polynomial function, unless mentioned otherwise.

L: Paid employment in the industrial sector in thousand man years, interpolated. Burgess (1992) and Hamermesh (1992) take the actual number of employed as a measure of labour demand. Unfortunately, for the Netherlands this series is only available since 1978. Because we study data of the industrial sector, and part-time jobs are rare in industries, our measure of employment in labour years seems to be a good proxy for the actual number of employed (CBS, Statistisch Jaarboek 1990).

K: Real value of the capital stock of the industrial sector, interpolated. The nominal capital stock CS is calculated as

\[ CS_{t} = CS_{t-1} - D_{t-1} + I_{t-1}. \]  

(A1)

where \( D \) is the depreciation and \( I \) is the investment of the industrial sector. To yield \( K \), CS is deflated by the real price of capital, defined by deflating the price index of investment goods \( (P_{\text{inv}}) \) by the producers price index of finished products \( (P_{y}) \).

D, CBS, NA 1969-1984 and various issues, table D10;
w: the real wage costs, interpolated. It is defined as
\[ W = W_l [(1 - WT/44.2) * 1.3 + WT/44.2], \]
deflated by \( P_y \), where \( W_l \) is the wage rate in the industrial sector, \( WT \) is average working time. \( W \) takes account of the reduction in working time and allows for an overtime premium of 30%.
Source: \( W_l \), CBS, Statistisch Jaarboek, various issues;
\( WT \), CBS, Statistisch Jaarboek, various issues.

COMP: measure of domestic competiveness. COMP is calculated as
\[ COMP = \log(e^*P^*/P_y), \]
where \( e^*P^* \) is the unit value index of world manufacturing exports converted from US dollars to Dutch guilders relative to the output price index \( P_y \); \( e \) is the spot exchange rate from US dollars to Dutch guilders.
Source: \( P^* \), UN, MBS, various issues, special table C or E;
\( e \), OECD, MEI.

WT: world trade measure. WT is defined as the residuals of the following regression
\[
\log(QW)_t = 3.934 + 0.0234t - 0.0003t^2 + 2.4E-06t^3 + \text{seasonals.}
\]
\[
(224.1) \quad (14.17) \quad (-6.631) \quad (6.561)
\]
\( QW \) is the quantity index of exports of all commodities from world economies.
Source: \( QW \), UN, MBS, various issues, special tables C or E.

AD: adjusted fiscal deficit, interpolated. AD is defined as in Nickell (1986)
\[
AD = \frac{GOVDEF}{POTGDP} - 0.39*\left[\left(\frac{COST \ GOVDBT}{POTGDP}\right) - 0.02*\left(\frac{GOVDEBT}{POTGDP}\right)\right].
\]
where GOVDEF is the government deficit, (ICOST)GOVDBT is the (interest payment of) government debts and POTGDP is the potential GDP, which we define as

\[ \text{POTGDP} = \frac{\text{GDP}}{\text{CAPUT}} , \]

where GDP is the actual GDP and CAPUT is the capacity utilization rate.

Source: GOVDEF, CBS, NA, table R5; GOVDEBT, CBS, Statistisch Jaarboek, various issues; (ICOST)GOVDEBT, CBS, Statistisch Jaarboek, various issues; GDP, CBS, NA 1969-1984 and various issues, table M3; CAPUT, OECD, MEI, various issues.

TP: measure of labour augmenting technical progress, interpolated. TP is computed via

\[ \Delta \log A_t = \frac{\Delta \log Y_t - \nu_L \Delta \log L_t - (1 - \nu_L) \Delta \log K_t}{\nu_L} , \]

where \( Y_t \) is the GDP of the industrial sector and \( \nu_L \) is the labour income share. The initial value of \( \log A \) is set equal to zero. TP = logA, smoothed by double exponential smoothing.

Source: Y, CBS, NA, table M3; \( \nu_L \), CPB, Lange Reeksen.

Q: quit rate, defined as the number of job-movers per 100 workers. This series is composed of the labour mobility measure, as collected by the CBS, Arbeidsskrachten- telling, for 1975, 1977, 1979, 1981, 1983 and 1985, where the intermediate values were obtained by interpolation, the number of job-movers per 100 workers, as collected by the Dutch Ministry of Social Affairs and Employment in Kwartaalbericht Arbeidsmarkt for 1992, for the years 1983 to 1990. This series serves as the basis for the quit rate that we apply. The years 1972, 1973 and 1974 of Q are determined by means of the vacancy-unemployment (V-U) ratio, which is assumed to resemble the quit rate quite well. In table 3, we present the building blocks that we used to create Q. Quarterly figures of Q are obtained by dividing by 4 and replicating the observations for each quarter in each consecutive year. See table 4.

F: number of persons for which an application of dismissal was granted by the Public Employment Affairs in the Netherlands, interpolated.

V-U: vacancy unemployment ratio, where V is the number of job vacancies in thousand units, and U is the seasonally adjusted unemployment in 1000 persons.

Source: V, OECD, MEI;
U, OECD, MEI.

Table 4 - Job-to-job mobility (%) in the Netherlands, 1972 - 1990.

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<th>Year</th>
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<th>V-U</th>
<th>Q</th>
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a) Source: Arbeidskrachtentelling, CBS.
b) Source: Ministry of Social Affairs & Employment, Kwartaalbericht Arbeidsmarkt, 1992/3.
c) The mean of the V-U ratio over the four quarters is presented.
d) Quit rate based on Q2, where the values of 1972 to 1974 are constructed with help of V-U.
References


