

(Working title:)
**My Pay is Too Bad (I Quit). Your Pay is Too Good
(You're Out)¹**
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Abstract:

This paper considers the relationship between wage and employer-employee separation patterns. It is argued that the probability of the two agents separating is negatively related to the rents which are associated with their contract. The observation that different groups of employees have different elasticities of separation probability w.r.t. wage variation does suggest that employees differ by the extent of which their wages are close to what employers may consider as being 'too high' relative to some productivity measure or what the employees may consider as 'too low' relative to some measure of alternative wage.

I follow this idea, and estimate a binary choice model of the separation behaviour of 55,000 employees in the Danish private sector economy. The model has two latent variables which can be interpreted as being measures of the employee's unobserved alternative wage and productivity, respectively. Wage variation and parametric restrictions allow to identify the distributions of these variables.

Relating the individual alternative wage and productivity estimates to observed wages allows to relate findings to different rent-sharing hypotheses originating from theories of firm-specific human capital, gender discrimination, and monopsony on the labour market.

Keywords: employer-employee data, rent sharing, employer-employee separations

JEL codes: J3,J6

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You are paid more than you are required to do your job, but less than you are worth to your employer (McLaughlin (1994)).

1 Introduction

A simple argument for the presence of imperfections on the labour market is that decreasing an employee's wage by some very minor amount, say, a penny, will typically not lead the employee to leave her job. Another related observation is that some employees succeed in getting wage increases even though there is no sign of any productivity increase taking place simultaneously.

But even though an employee whose wage is set down by a penny may not leave straight away, her propensity to leave the employer may reasonably be assumed to increase. By symmetry, a person who is getting a wage increase without any associated productivity increase will have increasing probability of being replaced by some alternative employee or arrangement (say, some machine) by her firm. In short, there is a stochastic relationship between wage and any of the two contractual partners terminating the contract.

The wage-separation relationships are obviously not symmetric across employees with different characteristics. Different groups of employees may be distinguished by their elasticities of separation rates w.r.t. wage variation. For example, some employees are characterized by having high quit rates when being low paid relative to otherwise comparable employees, others are not. Some employees pay heavily with higher lay-off risk when their wage is higher than the wage of their peers, others do not. Making this point and empirically investigating its relevance is the contribution of the present paper.

Those groups of employees who leave immediately when subject to a small scale wage drop do so because they have an alternative wage (i.e., the value associated with their outside option) close to current wage. Those employees for whom there is a strong positive wage-separation probability relationship are suggested to generating profit only slightly above the firm's alternative arrangement. To wit, conditional on assumptions regarding unobservables, wage rigidity and functional form, information of wages and separations (and a set of controls) does allow to track down the locations of the alternative wage and productivity distributions.

Estimates of these location's distributions are individual specific and can be related to the wages which are actually paid. The present analysis exploits this idea and thereby extends our knowledge of how rents, i.e., the sum of valuations of the employer and the employee, respectively, are shared between the contractual partners.

Both the size of rents and rent sharing rules/coefficients may be presumed to be different for different groups of employees. Indeed, there are large literatures making predictions on the size of the rents as a result of monopoly power on either side or both sides of the market, which may for example be a result of relationship-specific investments (e.g., specific human capital (Becker (1962), Hashimoto(1981)), mobility costs (which are implying, monopsony on the labour

market (Manning (2003)) or adjustment costs (e.g., Hamermesh (1993)). Regarding the sharing of rents there have evolved hypotheses claiming that some employees are paid higher or lower than others simply by being more or less successful in getting their share of the pie, say, by discrimination, or hypotheses regarding bargaining power differences due to union membership or severeness of threats (Arai (2003)).

Testing these hypotheses requires measurement of alternative wages, wages, employee-specific profits and profits generated by the firm's best alternative. This is not straightforward, but the present paper argues that employer-employee separations reveal information of the valuations that employers and employees associate with their contracts, and thereby allow to partly overcome the tremendous problems of measuring these variables.

The paper is thus placed in the literature on the relationship between productivity³ and wages, prominent examples of which are Hellerstein and Newmark's (1995) and Hægeland and Klette's (1999) studies on age-earnings profiles, and Hellerstein, Newmark and Troske's (1997) study on gender discrimination. As the value of the outside option is made explicit in the current study, findings can be related to Barth and Dale-Olsen's (1999) study on whether or not women are facing more monopsonistic labour markets as men.

The wage-separation probability relationship has been analysed extensively from the point of view of the employee in the matching (Jovanovic (1979)) and on-the-job-search-literature (e.g., Burdett and Mortensen (1998)), however, there is shortness of studies making explicit employee heterogeneity and/or the firm's decision making (with Rosholm and Skyt-Nielsen (1997) being an exception). Including labour demand in the analysis is thus another contribution of the present paper.

In this paper, separations may occur if (a) the employer considers an employee not being worth her wage, if (b) an employee considers the alternative wage being higher than actual wage, or (c) if both conditions are fulfilled at the same time. The basic idea of the paper is that the probabilities of these events depend on the location of the wage relative to the locations of the alternative wage and the employee's value product, respectively. This is why variation in separation probabilities in relation to variation in wages allows to distinguish employees not only by the total rents of their contracts, but also by how these rents are shared.

To illustrate, consider two persons with the same observed characteristics which imply the same expected alternative wage and the same expected value product. If wages are different, and the person who is better (less) paid separates, this is less likely to be a quit⁴ (lay-off) and more likely to be lay-off

³Note that the productivity measure used in this analysis is derived from the likelihood of being separated, i.e., related to the subjective evaluation of the firm's management rather than any objective productivity measure.

⁴In the following, separations in case of the employee associating the contract a positive value are denoted lay-off (firings), separations in the case of the firm associating a positive value to the contract are denoted quits, and separations with total value being negative are denoted efficient separations. 'Value associated the outside option' and 'alternative wage'

(quit) than if it was the lower paid person who separated. This implicitly defines quits as separations the probability of which decreases with wage, and lay-offs as separations the probability of which increases with wage. The more successful a group of persons is in extracting rents, the less likely it is that these employees will experience changes in the alternative wage (say, receive alternative job offers) which are large enough to trigger a quit. On the other hand, it becomes more likely that the firm decides to replace these employees with some alternative arrangement.

Estimation uses two latent variables which can be given the interpretation of being measures of the alternative wage, and marginal product, respectively, and fits a bivariate normal distribution to the observed patterns of wage, background information, and separations. The data employed is a large employer-employee data set that combines information of a cross section of 55,000 individuals with ca. 1,100 employers. As there is virtually no legislation in Denmark which restricts firms from laying off⁵, separation patterns are relatively undistorted by market intervention, and makes Danish data suitable for this approach.

Results will be illustrated by describing estimated quit- and lay-off probabilities for different groups of employees, where focus is on comparisons between employees distinguished by age, region of residence, and gender. The choice of considering age was motivated by human capital vs. deferred pay hypotheses. Regional information is taken as a correlate of the thickness of the labour market, and chosen to address the monopsony hypothesis, and gender is chosen to address the question of whether women are paid less than men because of low bargaining power (i.e., low rent sharing coefficients) or because of low alternative wages.

The paper is organized as follows: the next section establishes a link between the current study and related studies on the relationship between wage, alternative wage, and productivity. The third section organizes the main ideas behind the study to make them amenable for estimation, and the fourth explains the specification of the estimation. The fifth section explains the data, the sixth presents results, and the last section summarizes and concludes.

2 Background

Different employees are paid different. It has for example been documented that in most labour markets young workers are paid less than senior ones, women are paid less than men, and workers in the countryside are paid less than those

will be used as synonyms. The 'value the firm associates with her employee' will be denoted 'marginal product'.

Consequently, an employee's mobility costs decrease her alternative wage and a firm's adjustment costs increase the employee's marginal product.

⁵Lay-offs are subject to severance payments ('Fratrædelsesgodtgørelse'), which are 1 month for job tenure less than or equal to 12 years, and up to 3 months' salary for job tenure above 18 years. There is a need for the firm to give a reason for the lay-off taking place, which, however, is typically in general terms and thus of purely technical nature

in the cities. Further, there are large literatures on whether or not different employees are paid different *relative* to their productivities and the values associated with their alternative options ('alternative wages' in the following), thus suggesting deviations from a competitive equilibrium to take different forms for different employees. Examples of prominent hypotheses related to this issue are human capital theory (Becker (1962), Hashimoto (1981)) which states that senior employees are paid less relative to productivity than young ones, theories of deferred pay (Lazear (1979), Lazear and Rosen (1981)) which states that young employees are paid less relative to productivity than senior ones, and gender wage discrimination (e.g., Blau and Kahn (1992)) which states that women are paid less relative to productivity compared to men.

These hypotheses address the question not only of the size of the total (quasi) rents - defined as the difference between marginal product and alternative wage (e.g., Cahuc and Zylberberg (2005)) - but also how these rents are shared between the contractual partners.

Empirical studies on rent sharing do typically address the question of whether or not product market rents are reflected in higher wages (Arai and Heyman (2004), Martins (2004), Margolis and Salvanes (2001), Oswald (1995)). First recently there have occurred studies addressing the determinants of the rent sharing coefficients, e.g., Nekby (2003) who distinguishes rent sharing by gender, or Arai (2003) who considers rent sharing in firms with high vs. low capital intensities. In these studies, the profit measure is on the firm and not on the individual level, say, value added.

The rent sharing literature is part of a wider literature on how personal characteristics relate to pay and productivity. Examples of much discussed hypotheses on this relationship and which will be considered in this paper are age-productivity relations, the relationship between pay and the thickness of labour markets (e.g., Manning (2002), and the gender wage gap (see Blau and Kahn (1992) for a survey on this issue).

Although there is a large body of research on wages, linking wages to productivity has proven difficult because of the difficulties to measure individual workers' productivities. One approach is to relate the results of regressions of firms' wage costs on variables describing the composition of the employees (say, share of women, share of employees within some age interval, etc.) with the results of regressions of firms' product on the same set of variables, and compare the coefficients (e.g., Hægeland and Klette(1999), Hellerstein and Neumark (1995)). This 'two regressions' approach treats employees with different characteristics as substitutes, and ignores pure composition effects, say, the shape of the employee age distribution being related to productivity. Interpretation of results is complicated by employees selecting into occupations and firms by unobserved firm and - predominantly (Abowd et al. (1999)) - person characteristics.

Another way to proceed is to assume that these unobserved characteristics are time constant, and estimate fixed effects regressions on panel data. This comes at the cost of absolute differences between productivity and wage being no longer observed, as it is in the two regressions studies referred to above.

Estimations using firm and person fixed effects (such as Abowd et al. (1999)) measure changes in product and wages between states in which some persons are in the firm compared to states in which other persons are. The movements of persons between firms that identify the firm and person effects are, however, endogenously determined by some mismatch, and may thus limit the validity of results for employees who stay with the firm.

Yet another way to improve upon the precision of the estimates is of course to use individualized measures of productivity, such as Medoff and Abraham (1980), who use superiors' evaluations as a productivity measure, or Oliviera et al.(1989), who approximate individual productivities by the productivity of observationally equivalent individuals who are self-employed. Another example is Suen (2000), who measures the value products of domestic helpers by their employers' labour income.

The current analysis attempts to find alternative wage and productivity measures from information on individual wage and separation behaviour, and conditional on a set of identifying assumptions. The alternative wage measure will be derived from the expected probability of taking a better offer from the point of view of the employee. This is by the argument that the closer a person's wage is to her reservation wage, the more likely it is that there is an increase in the reservation wage (or a decrease in the wage which is offered by the employer) which is large enough to trigger a quit. In analogy, the productivity measure will be derived from the expected probability of the firm finding a more preferable arrangement. Put different, the larger the rents which are appropriated by one of the agents, the lower the likelihood that she initiates a separation. This study can thus be interpreted as a very simple search model in which the probability of finding a better match is lower the higher the rents. Employees search for better jobs, firms search for possibilities to reduce costs.

An individual's relative quit and lay-off probabilities contain information on where the individual's wage is located relative to the alternative wage and productivity, respectively. This allows addressing hypotheses related to rent sharing on the labour market. Focus in the following will be on rent sharing hypotheses related to gender, age, and the thickness of labour markets.

E.g., with regard to theories of gender discrimination, it makes of course a difference whether firms pay their female employees less because they value their female employees less relative to some alternative arrangement, or whether they succeed in paying women just above their respective low alternative wages (Blackaby et al. (2005)). If the former was the case, women's separation probabilities should be more positively associated with wage than men's - as asking for more pay more strongly increases the risk of being fired. This could for example be the case when there are low adjustment costs as a consequence of low specific investments. If the latter was the case women's separation probabilities should increase less for increasing wages as firms still value the contract higher than any alternative arrangement.

Regarding age, young employees should have relatively higher quit probabilities (i.e., higher alternative wages relative to actual wages) compared to senior employees if they are getting a small share of the returns of the specific

investments relative to senior employees, as suggested by theories of deferred pay (Lazear (1979) and Lazear and Rosen (1981)). Note that this model does not make any predictions with regard to lay-off probabilities. This is because it is an equilibrium model. The firm does not lay off senior employees, because this would be a breach of an implicit contract (Bull (1987), Carmichael (1984)), which again would destroy younger employees loyalty and motivation. This is simply an adjustment cost associated laying off senior employees, and this cost will positively enter the firm's valuation of the senior employee relative to the alternative arrangement; so even though senior employees are overpaid relative to their own labor productivity this money is well-spent. While deferred pay implies the value of an employee from the point of view of the firm to be constant, increasing wage implies the employee's valuation to increase and a quit becoming less likely over age (and/or tenure).

In contrast to the deferred pay hypothesis, human capital theories suggest that costs and benefits of specific investment are shared over the tenure of the contract. This flattens an individual's wage-tenure profile, and thus decreases the expected differences in quit rates across employees of different age. Instead, lay-off probabilities should decrease as the difference between marginal product and actual wage is suggested to decrease with age.

In addition to the two theories outlined above, there are of course hypotheses related to age and productivity e.g., Warr (1994).

Employees in rural areas should have lower quit probabilities (i.e., lower alternative wages relative to actual wages) than those in densely populated areas if they are successful in exploiting their bargaining power which follows from firms having greater difficulties to recruit alternative employees Lay-off probabilities should be low in rural areas if firms are successful at exploiting their bargaining power implied by high mobility costs of employees who may find it difficult to find alternative jobs when fired.

An additional hypothesis which can be formulated within this framework is that the wage elasticity of separation probability should be negatively related to the contract's total rent, which is a positive function of asset specificity, e.g., as a result of specific investments, and the firm's adjustment and the employee's mobility costs. For instance, large fixed adjustment and/or mobility costs decrease the likelihood of separation even when wages are very high or low.

3 Set-up

An employee's value product is an upper threshold of her wage. The alternative wage is a lower threshold. Wage variation can thus be due to variation in productivity, variation in the alternative wage, or variation in how the wage is set between the thresholds. Having some idea of how wages are located relative to measures of the alternative wage and productivity allows to address the relative relevance of these three alternative explanations of wage variation. It can give us an idea of where different employees' wages are located at the firm's trade-off between wage and quit probability and the employee's trade-off

between wage and lay-off probability.

The underlying idea of the paper is as follows: employees compare the utility from their current job with the utility associated with the alternative option, and quit if the latter exceeds the former. Firms compare the value they associate with a person with her wage w , and lay off if the latter exceeds the former. Separations are allowed to be inefficient in the sense that wages do not fully adjust to external shocks in productivity or alternative wage.

In the following, 'the utility associated with the alternative option' will be denoted alternative (or 'reservation') wage, shorthand aw ; the value which the employee generates in the firm will be denoted 'marginal product' and abbreviated by mp , but it should be kept in mind that this value may be highly subjective, as e.g. hypothesized by the discrimination hypothesis.

The utility a person associates with her job is the utility of the difference between wage and alternative wage. In the following, the utility and the firm's profit function function will be specified as linear, which implies that estimates will be measured by the same units as wage (which is Danish Kroners).

A person who is in a firm has lower alternative wage and higher productivity than actual wage. A separation occurs if one or both conditions become violated. What is observed in the data is only that a person is employed in some period t , and still employed or separated in period $t + 1$. Consequently, it holds in t that $aw_t < w_t < mp_t$, and in $t + 1$, $aw_{t+1} < w_{t+1} < mp_{t+1}$ in case of no separation and either $aw_{t+1} > w_{t+1}$ or $w_{t+1} > mp_{t+1}$ in case of a separation taking place.

The aw is estimated by some linear reduced form, such that $aw = \widehat{aw} + \varepsilon_1$, where \widehat{aw} is the estimate of the alternative wage, and ε_1 is unobserved heterogeneity. In period $t + 1$, $aw_{t+1} = \widehat{aw}_t + \varepsilon_{2,t+1}$, where ε_2 is an estimation error in $t + 1$, which is the sum of ε_1 and some unobserved increment (or 'shock') ε_3 . In analogy, $mp_t = \widehat{mp}_t + \eta_{1t}$, and $mp_{t+1} = \widehat{mp}_t + \eta_{2,t+2}$, with $\eta_{2,t+1} = \eta_{1t} + \eta_{3,t+1}$, with $\eta_{3,t+1}$ being an increment to mp in $t + 1$.

There is no separation if

$$\widehat{aw}_t + \varepsilon_1 + \varepsilon_3 < w_t + \mu < \widehat{mp}_t + \eta_1 + \eta_3$$

or, equivalently,

$$\widehat{aw}_t + \varepsilon_1 + \varepsilon_3 - \mu < w_t < \widehat{mp}_t + \eta_1 + \eta_3 - \mu,$$

where μ is an increment to wage in period $t + 1$ (which is unobserved in case of a separation taking place), and there is a separation if either (or both) of the two inequalities is violated. Estimation of \widehat{aw}_t and \widehat{mp}_t is by a binary choice model which has two latent variables and which imposes the restrictions that wage enters the quit probability with a negative sign, and the lay-off probability with a positive sign. Conditional on the assumption that quits are negatively, and lay-offs are positively related to wage, and assuming $w - aw$ to enter job utility symmetrically for all employees, it is possible to give the latent variables of the model the interpretation of being estimates (or measures) of aw_t and mp_t , respectively.

To simplify, $\varepsilon_2 - \mu$ and $\eta_2 - \mu$ are specified as (jointly) normal, thus not making any attempt to split up heterogeneity into last period's realizations and shocks by some random effects framework. As in any random utility model, the scale of the coefficients and the error variances are not jointly specified, and there is a need for a normalisation. Here this normalisation will be that w enters the regression with its coefficients restricted to one in absolute size - which allows to estimate the variances of $\varepsilon_2 - \mu$ and $\eta_2 - \mu$, respectively, and which scales results by Danish Kroners. The normalisation implies that there is no particular treatment of job characteristics in the model, but job utility and unobserved job characteristics will obviously be captured by the aw measure.

Heterogeneity in separation decisions in association with wage variation may thus both be due to unobserved differences in ε_2 and/or η_2 and unobserved differences in wage flexibility. This is because different employees may draw the ε_1 , ε_3 , η_1 , η_3 , and μ , respectively, from potentially different distributions. For example, there may be persons whose aw is just below wage, but low variation (either across time or across employees) in the aw implies low separation probability for this group of employees. In other words, small changes in the explanatory variables or wage have large effect on separation probability, which suggests low variance of the unobserved heterogeneity distribution; separations can be predicted better for these individuals than for individuals for which this distribution has a large variance.

By this argument, estimation can be specified such as to partly accommodate heteroscedasticity in errors. In particular, variances of $\varepsilon_2 - \mu$ and $\eta_2 - \mu$ will be made dependent on age, region, and gender, i.e., those employee characteristics which are in focus of the analysis.

Regarding wage flexibility, the easiest way to handle this issue would of course be to assume it away. In any case, the effects of wage variation will have to be considered in the latter results, so it is worth to outline potential biases.

The variances of $\varepsilon_2 - \mu$ and $\eta_2 - \mu$, respectively, partly depend on the correlation between ε_3 and μ and the correlation between η_3 and μ . Counteroffers and wage reductions due to shocks to value product imply the correlations between ε_3 and μ and η_3 and μ to be positive which decreases the estimated variances of $\varepsilon_2 - \mu$ and $\eta_2 - \mu$, respectively, thus implying that the share of separations which can be explained by observables relative to unobservables increases. In the interpretation of the results one will further have to be aware of positive correlations dragging the aw estimate down (as at given aw one observes fewer separations) and the mp estimate up.

For the employee, the willingness of the firm to counteroffer positive changes in the aw can thus be given the same interpretation as job amenities, which is that it decreases the utility of the outside option compared to the utility of the current job. For the firm, downward wage flexibility increases the value which is associated with the employee's contract. Wage changes between t and $t + 1$ which are uncorrelated to ε_3 and η_3 are orthogonal to the aw and mp estimates and only have effect on the variances of $\varepsilon_2 - \mu$ and $\eta_2 - \mu$ which it is possible to identify from the strength of the wage-separation relationships.

A high variance of either of the two distributions of $\varepsilon_2 - \mu$ and $\eta_2 - \mu$ may

thus both be due to high variance in either aw and/or mp , or low wage flexibility in response to either or both ε_3 and η_3 .

In case one is interested to give the variances of $\varepsilon_2 - \mu$ and $\eta_2 - \mu$, respectively, the interpretation of being measures of the variances of the aw and mp , respectively, one needs to make assumptions regarding wage flexibility, the most simple ones being (again) that wages are fixed or that wage variation is equal across employees with equal correlation with ε_3 and η_3 .

4 Estimation

The separation decision is a simple binary choice problem which can be estimated within a latent variable framework. The alternative wage and marginal product are estimated by reduced form.

Let the separation decision take place in time $t + 1$, and let $y_{ie}^* = w_i - \exp(x_i \bar{\beta}_e) - \varepsilon_e$ be the value the employee associates the contract at time $t + 1$, with w_i = wage of individual as of time t , x_i her observables as of time t , β_e a vector of coefficients, and $\varepsilon_e = \varepsilon_2 - \mu$ being unobserved heterogeneity in the valuation of the contract; with $\mu = 0$ this is equal to unobserved heterogeneity in the alternative wage. The choice of exponential forms of the latent variable indices allows to introduce restrictions which proved to increase stability of the estimations below. These are the latent variables are positive, and that the latent variable which is supposed to measure marginal product is larger than the latent variable which is supposed to be a measure of the alternative wage.

Let the firm's valuation of the contract at $t+1$ be $y_{if}^* = (\exp(x_i \bar{\beta}_f) - \varepsilon_f) - w_i$ with $\bar{\beta}_f$ being a vector of coefficients, and $\varepsilon_f = \eta_2 - \mu$ being unobserved heterogeneity in the firm's valuation of the contract (the minus sign being chosen for convenience, which is innocuous as ε_f is normal and thus distributed symmetric around zero); if $\mu = 0$, it is unobserved heterogeneity in the employee's marginal product at time $t + 1$.

A quit occurs if $y_{ie}^* < 0$, a lay-off occurs if $y_{if}^* < 0$, and an efficient separation occurs if both $y_{ie}^* < 0$ and $y_{if}^* < 0$. This defines a quit by its probability being negatively related to wage, and a lay-off by its probability being positively related to the wage - which implies the need to include controls in the x_i to making sure that these condition are indeed realistic.

An employee indexed i stays in the firm as long as both individual y_{ie}^* and y_{if}^* are positive. Estimation is by a binary choice model, the scale of the coefficients and the variance of the error term of which is in general not jointly identified. However, given the parameter restriction on the wage (which is 1), wage variation allows to freely estimate the variance of the errors. Further, the variance estimate of the ε_e and ε_f may be made individual specific by making them contingent on a subset of regressors of X (Harvey (1976))

Under the simplifying assumption of ε_e and ε_f being jointly normally dis-

tributed the probability of a separation is

$$\begin{aligned}
& \Pr(\textit{separate}) \\
&= 1 - \Pr(\textit{stay with firm}) \\
&= 1 - \Pr\left(\frac{w_i - \exp(x_i\bar{\beta}_e)}{1/\exp(\tilde{x}_i\tilde{\beta}_e)} - \varepsilon_e > 0, \frac{\exp(x_i\bar{\beta}_f) - w_i}{1/\exp(\tilde{x}_i\tilde{\beta}_f)} - \varepsilon_f > 0\right) \\
&= 1 - F\left(\frac{w_i - \exp(x_i\bar{\beta}_e)}{1/\exp(\tilde{x}_i\tilde{\beta}_e)}, \frac{\exp(x_i\bar{\beta}_f) - w_i}{1/\exp(\tilde{x}_i\tilde{\beta}_f)}\right),
\end{aligned}$$

where $F()$ is specified as the c.d.f. of the normal distribution with correlation coefficient ρ in the following, and $\exp(\tilde{x}_i\tilde{\beta}_e)$ and $\exp(\tilde{x}_i\tilde{\beta}_f)$ are the inverses⁶ of the estimated standard deviations of the unobserved heterogeneities in ε_e and ε_f with \tilde{X} including a constant term.

As the motivation of the paper was to relate alternative wage and marginal productivity estimates to observed wages, their coefficients will be presented as deviations from a corresponding wage regression, which will be jointly estimated with the binary choice problem. To wit, $\bar{\beta}_e = \beta_w + \beta_e$ and $\bar{\beta}_f = \beta_w + \beta_f$. The corresponding log-likelihood function is

$$\begin{aligned}
L(d \mid w, x, \beta_e, \beta_f) = \sum_{i=1}^N \{ & d_i \times \log \left[1 - F \left(\frac{w_i - \exp(x_i(\beta_w + \beta_e))}{1/\exp(\tilde{x}_i\tilde{\beta}_e)}, \frac{\exp(x_i(\beta_w + \beta_f)) - w_i}{1/\exp(\tilde{x}_i\tilde{\beta}_f)} \right) \right] \\
& + (1 - d_i) \times \log \left[F \left(\frac{w_i - \exp(x_i(\beta_w + \beta_e))}{1/\exp(\tilde{x}_i\tilde{\beta}_e)}, \frac{\exp(x_i(\beta_w + \beta_f)) - w_i}{1/\exp(\tilde{x}_i\tilde{\beta}_f)} \right) \right] \} \\
& + \sum_{i=1}^N \log [f(w_i - \exp(x_i\beta_w))],
\end{aligned}$$

where d_i takes the value 1 if a separation takes place, and 0 otherwise, i is a person index, and N is the number of observations in the sample. Note that the person specific variance estimate is identified by the assumption that those variables in X but not in \tilde{X} have same effect on the expectation of the alternative wage and the marginal product, respectively. The last term in the likelihood function is the wage regression, where $f(\cdot)$ is the normal density function. Coefficients are specified such that β_e and β_f , respectively, measure deviations from the wage regression coefficients.

Conditional on these assumptions, $\exp(x_i\bar{\beta}_f) - w$ is a measure of the value the firm associates the contract, while $w - \exp(x_i\bar{\beta}_e)$ is a measure of the distance between the wage and the value the employee associates her alternative option. Rents appropriated by the employee and firm, respectively, are positive functions of these distances, which makes it possible to use the β_e and β_f coefficients of

⁶Taking the inverse was due to the need to avoid division by values close to zero in the estimations.

different groups of employees to consider rent-sharing hypotheses. Given the job utility being defined as a linear function of wage only, differences in job utility, say by amenities and compensating wage differentials across jobs will show up as shifting the alternative wage estimate. This will have to be kept in mind in the interpretation of the results.

Wage is obviously the result of a bargaining process, in which firms trade off wage cost against quit probability, and employees (or their unions) trade off income against lay-off risk. With respect to bargaining, it should thus be noted that the maximum likelihood procedure estimates the most likely locations of the variables which are exogenous in the wage bargaining process (the latent variables) as relative to the wage, which is endogenously determined.

Estimation proved to be complicated by the finding that lay-off probabilities are hard to predict, and the risk of being laid off is only slightly increasing with wage. Results proved to become instable and standard errors exploded when too many regressors were included. Obviously, if one for example includes a dummy variable for a subgroup of employees in which there are only two employees and the higher paid employee does not separate, the model would estimate the marginal product of this group of employees to be infinite. Given this problem, only 15 explanatory variables were included in the regressions, which implies that results are to be interpreted as being descriptive due the the potential presence of omitted variables. Being a woman, for instance, reduces the alternative wage estimate - which is a result by itself, but it stays unclear why this is the case (e.g., occupation, education, etc.).

In \tilde{X} are included a constant, a gender dummy, an dummy for whether or not the person lives in the Copenhagen area, and a dummy for employees above age 45 years. This implies a total of 39 parameters to be estimated. Estimation is on the cross section of 55,000 employees which is described in the next section.

5 Data

The empirical analysis is based on the 'ever-private-sector' database, administered by the Center for Corporate Performance at the Aarhus School of Business. This data is a subsample of the 'Integrated Database for Labour Market Research (IDA)', which is matched employer-employee data generated by Statistics Denmark from various registers and covering all employees in the entire Danish private sector economy. The original IDA data contain a large number of demographic information regarding the employees, such as age, family status, occupation, place of residence, labor market experience, etc., i.e., information which may be considered important for the modelling of the values associated the employees' outside options. On the firm side, there is information regarding size, industry, location, and of course all the information which can be deduced from the employee characteristics. The original data does, however, not contain any information regarding the financial situation of the firm, which may be considered important for modelling the marginal products of the employees. For this reason, data has been merged with Statistics Denmark's 'Business Sta-

tistics Database' which contains financial information. The information in this database is used to construct the employer's lagged total factor productivity as an explanatory variable - which is the residual of a regression of the firm's net profit on net assets, hours worked in the firm in the given year, and use of raw materials without additional controls.

For parsimony, estimation is on a cross section, i.e. on a single year. Over the time period for which there is data, wage bargaining in Denmark has become increasingly individualized. To add realism to the assumption that the variances of the alternative wage and marginal productivity estimates are not affected by individual specific differences in wage flexibility (thus allowing for a nice feature in the interpretation of the results), the most early year in the sample, which is 1993, is chosen for estimation.

The sample of the Business Statistics Database is selected as large firms and firms in manufacturing are over-represented. However, given that the final data consists of 55,000 employee observations in about 1,100 firms, some generality of the results may be assumed.

When sampling, some filters were employed to create a reasonably homogeneous sample, and to avoid heteroscedasticity problems. Only full time employees working in the private sector in firms with at least 50 employees are sampled. Employees with age below age 25 and above age 55 years are not sampled to reduce unobserved heterogeneity w.r.t. the separation decision. Only firms in the industries manufacturing, trade and construction industries are sampled. This merely accommodates the fact that the data is overrepresenting these industries in the first place. Firm outliers (e.g., w.r.t. accounting profit per employee, net revenue per employee, and depreciation of fixed assets) and employees earning more than 500Kr/hour⁷ or less than minimum wage (80 Kr/hour) are deleted from the sample.

It should be noted that imposing the conditions reduced separation rates from ca. 25 percent in the raw data down to ca. 12 percent. The data used for estimation is described in Table 1.

⁷All wages before tax. In 1993, $100DKK \approx 15USD$.

Table 1: Descriptive Statistics

Variable	mean	std.dev	min	max
Separation dummy	0.12	0.33	0	1
Hourly wage (in Danish Kronors)	147.30	49.82	80	416
<i>Employee Information:</i>				
Employee age	39.45	8.54	25	55
Gender: women	0.28	0.45	0	1
Living in Copenhagen area	0.23	0.42	0	1
Firm tenure	8.67	6.54	1	30
<i>Education group specific average</i>				
unemployment rate (in percent)	8.29	1.52	5.36	9.60
Education: vocational training	0.52	0.50	0	1
<i>Occupational group classifications</i>				
White collar	0.48	0.50	0	1
Blue collar	0.25	0.43	0	1
<i>Labour union affiliation:</i>				
Manual workers (SID)	0.16	0.36	0	1
Metal workers	0.11	0.31	0	1
<i>Employer information:</i>				
Number of employees	260.68	327.15	50	2386
Total factor productivity	-0.01	0.19	-0.58	0.58

Number of observations: 55,734 employees in 1,131 firms

The variables included in the regression are two age dummies, one for employee age equal to or below 35 years, and one for employee age above age 45. There is a gender dummy taking the value one if the employee is a woman, and a dummy for whether or not the person is living in the Copenhagen area, which is the only larger metropolitan area in the country, and which is assumed to have a thicker labour market than the rest of the country.

As other control variables which are not in focus of the analysis I arbitrarily chose to include tenure dummies, two dummies for two different labour unions, and a dummy for whether or not the person's education includes vocational training, and the (log) size of her firm. These variables, just as the employee's education group's (using seven different categories based on Statistics Denmark's '*hffsp*' variable) average unemployment in the given year, and the total factor productivity measure are supposed to capture part of the heterogeneity in alternative wages and marginal productivities, respectively.

Note that the (log) size of her firm, the unemployment and total factor productivity measure are included as standardized (i.e. mean-subtracted and divided by their standard deviation) in the regressions.

6 Results

Results are displayed in Table 2. The numbers generate the best predictions of actual separation behaviour given the parametric assumptions. Findings translate into the predicted wage being located at 147 DKK, the mean alternative wage being located around 29 DKK with expected mean standard deviation 43 DKK, and the mean marginal product being located at 2,262 DKK with expected mean standard deviation 1,629DKK.

The clear message of these numbers is that separation rates increase stronger at the lower end of the wage spectrum than at the upper end. Their absolute

values should of course be taken with caution as subject to the distributional assumptions and lying beyond the support of the data, i.e., identified from the tails of the respective distributions. Relative comparisons of different employees, on the other hand, are based on the relative strengths of the wage-separation relationships and thus only rely on the assumption of the normal distribution being an equally good (or bad) approximation for all employees.

Table 2. Maximum likelihood regression estimates¹

	Alternative wage		Wage estimates		Marginal product	
	β_e	ste.s	β_w	ste.s	β_f	ste.s
Constant	-1.027 ***	0.110	0.472 ***	0.012	3.008 ***	0.504
Age<=35 yrs	0.076	0.051	-0.096 ***	0.007	-0.055 ***	0.017
Age>45 yrs	-0.130 **	0.055	0.014 **	0.007	0.050	0.220
Person lives in Copenhagen area	0.299 ***	0.060	0.073 ***	0.006	-0.911 *	0.515
Gender: female	-0.623 ***	0.194	-0.310 ***	0.008	-0.113	0.286
Tenure<=5 yrs	-0.084	0.080	-0.030 ***	0.007	-0.185 ***	0.018
Tenure> 10 yrs	0.075	0.058	0.019 **	0.007	0.100 ***	0.018
White collar worker	-0.511 ***	0.089	0.100 ***	0.008	-0.193 ***	0.021
Blue collar worker	0.014	0.070	-0.130 ***	0.011	0.082 ***	0.026
log(Firm size)	0.318 ***	0.034	0.015 ***	0.003	-0.037 ***	0.008
Education group specific average						
unemployment rate	0.335 ***	0.058	-0.081 ***	0.006	0.081 ***	0.015
Total factor productivity	-0.104 ***	0.026	0.041 ***	0.003	0.000	0.007
Education: vocational training	-0.389 ***	0.082	0.057 ***	0.013	-0.049	0.031
Labor Union: blue collar workers ('SID')	-1.595	1.305	-0.172 ***	0.011	0.181 ***	0.028
Labor Union: Metal workers ('METAL')	-0.365 ***	0.097	-0.123 ***	0.011	0.139 ***	0.026

Coefficients of (inverse) standard error estimates.

	$\tilde{\beta}_e$	ste.s	$\tilde{\beta}_f$	ste.s
Constant	1.042 ***	0.081	-3.070 ***	0.535
Age>45 yrs	-0.105 **	0.044	0.011	0.240
Person lives in Copenhagen area	-0.110 *	0.060	0.873	0.561
Gender: female	-0.405 ***	0.081	0.612 *	0.330

Likelihood-fct: -75821.598

Number of observations: 55,734

Estimated correlation of bivariate normal distribution:

$\rho = 2(1 + \exp(x))^{-1} = -0.32$, with x estimated as 0.66 with standard error 0.61.

Notes: All wages in 100 DKK. *, **, *** denote significance at 10, 5, and 1 percent significance level, respectively.

The general result of a weak relationship between wages and lay-off probability is in line with a related study on Danish data by Brendstrup et al. (2006). This also suggests that lay-offs are much harder to predict from the data than quits, as unobserved heterogeneity with regard to productivity is high. Marginal product is obviously unbounded, while the alternative wage may be bounded from below, e.g., at the minimum wage. The large noise in the marginal productivity estimate explains almost 90 percent of all separations as lay-offs rather than quits, but note that this share is highly sensitive to the coefficient estimates of the constants of the conditional heteroscedasticity regressions which are - especially for the marginal product - estimated with large standard error.

The coefficients in the lower part of the table are negatively associated the estimated person specific heteroscedasticities. They suggest that relationships between wages and those variables included in X , but not in \tilde{X} , on the one

hand and expected quit probability on the other are weaker for senior employees, persons in the Copenhagen region, and women, as implied by the negative coefficients in the lower left panel of the table. For these groups, unobserved heterogeneity w.r.t. the alternative wage estimates is larger than for the remainder of the sample. Part of an explanation for the finding for women may be separations related to childbirth, and, for senior employees, health reasons. For Copenhagen, large heteroscedasticity may reflect that the metropolitan labour market offers a wider spectrum of alternative opportunities uncontrolled for by the other regressors as compared to the country side.

For women, the SE panel of the table provides weak evidence that lay-offs are more easily predicted from the observables in the model. One explanation could be that unobserved heterogeneity with regard to productivity is smaller, or that there is a 'glass ceiling' which implies that there are fewer individuals who are characterized by high wages and low lay-off probability in the group of women compared to men.

The correlation of the unobserved heterogeneity of the two latent variables is slightly positive but not significantly different from zero. Recall ε_e was defined as positively related to the alternative wage, and ε_f was defined as negatively related to marginal product which implies that - if anything - this finding suggests employees with higher alternative wage to have slightly higher marginal product as well.

Findings related to the wage, alternative wage, and marginal product estimates of employee age, region, and gender, respectively, can be summarized as follows⁸.

Regarding age, the gap between the alternative wage and the marginal productivity estimate is increasing. In other words, the rents of labor contracts are suggested to be increasing with age. The finding that more senior employees' separation rates are not sensitive to wage variation (and variation in the other variables in X , but not in \tilde{X}) at the low end of the wage distribution does suggest that these employees are characterized by lower alternative wages and larger noise in the alternative wage measure compared to younger employees.

Findings suggest that young employees are 'overpaid' by being located close to the marginal product estimate, which may be taken as support of human capital theory which suggests that the costs of investing in specific human capital are shared. Senior employees are 'overpaid' relative to their alternative wage; however, the rise in their share of the rents is mostly due to deteriorating outside options rather than wage increases, so this finding cannot be taken as support of notions of deferred pay.

While there is a significant decline in lay-off risk from age equal to or below 35 years to age 36 - 45 years (just as suggested by human capital theory, which makes senior employees more valuable from the point of view of the firm), senior employees are suggested to not having higher marginal product relative to wage compared to medium age ones. On the other hand, the fact that there is no

⁸Note that the choice of exponential forms implies that coefficients have the interpretation of percentual changes of the respective estimates.

negative relationship either does not make any case for firms losing money on senior employees as would be suggested by the deferred pay hypothesis.

The coefficients of the Copenhagen dummy suggests that rents are much less in the capital compared to the province. This is mostly due to the difference between marginal product and actual wage being suggested to be a tenth of the difference outside Copenhagen, which places the marginal product estimate close to the actual wage. Given the large standard error on the marginal product coefficient estimate, results are tentative, and suggest the actual wage to be closer the marginal product estimate than the alternative wage estimate, in short, suggesting employees to gain a larger share of their rents. This would agree with the hypothesis that firms benefit from thin labour markets.

Regarding gender, results indicate that women are less mobile in response to being low paid. Their quit probability elasticity to wage variation is suggested to be lower than men's. As a consequence, the distance between the alternative wage and the actual wage is estimated to be 62% larger for women than for men. The small number of controls makes this result mostly descriptive as potentially influenced by other, omitted variables (of which the large negative wage regression estimates may taken as an additional indication), but the message is clearly that women consider their alternative options as less favourable compared to their present job compared to men. This finding suggests that women's jobs have high amenities which compensate for low wages, or that wages are dragged down by low alternative wages (cf. Blackaby et al. (2002) and Barth and Dale-Olsen (1999)) - or low *expected* alternative wages, see Clark (1997). There is no indication of women getting low wages because they are getting a smaller share of the rents; part of an explanation for this may be the observation that women could have higher risk aversion (Jianakoplos and Bernasek (1998)) which would drive down the values which are associated with the alternative options that in many cases have some degree of uncertainty (regarding working environment, career prospects, etc.).

Some short notes on the other control variables. For these, coefficients are identified only by the assumption of homoscedasticity, as no corrections were made for potentially different error variances as was done for age, location, and gender. Conditional on this assumption, results are as follows.

There is a positive association between tenure and the part of the rents which is appropriated by the firm, giving support to the specific human capital hypothesis. White collar worker have smaller rents compared to blue collar workers, as alternative wages are estimated to be higher, and marginal productivity is estimated to be lower. They gain a larger share of their rents.

Employees in large firms are better paid (which is a common observation (e.g., Brown and Medoff (1989))), and, additionally, are suggested to be of lower value for their firms, i.e., more likely to be laid-off when well-paid. Employees in large firms have higher quit elasticity w.r.t. to low wage, a finding for which there may be set of different potential explanations, say, employment in large firms signalling quality because of large firms spending more effort on screening or working in large firms having positive effect on general skills.

Education-group specific unemployment rates are positively related to the

alternative wage and the marginal product estimate, respectively, and suggest this characteristic to be negatively associated with the share of the rents which are appropriated by the employee. The positive relationship with the alternative wage coefficient may be explained by high unemployment rates being partly due to large employee mobility on these markets, i.e., a large number of unemployment spells being transitory.

Total factor productivity is suggested to be fully appropriated by the employees, as the marginal product estimate does not change relative to the wage estimate when there is variation in the (one-year-lagged) factor productivity measure. Instead, employees are less willing to leave firms with high factor productivities, potentially because of career prospects, signalling values, or the like. This implies the estimated share of rents which are appropriated by the employees to be positively related to a firm's total factor productivity measure.

Vocational training increases this share of the rents, as alternative wages in comparison to actual wages are bad. Employees in the labor unions for which there were dummies included in the regressions are 'underpaid' in the sense of those individuals who for some reason are having high wages being suggested to only having slightly higher separation probability.

To sum up, results replicate the empirical regularity of separation rates being related to demographic background variables (such as age, region, or gender). They suggest that a person's location in her age, region, or gender specific wage distribution has importance for her quit and lay-probability by placing her wage somewhere between what firms may consider as being 'too high' relative to marginal product or what the employee may consider as being 'too low' relative to the alternative wage. This suggests the existence of deviations from a competitive equilibrium, in other words: existence of 'good' and 'bad' contracts from the point of view of the employee or the firm.

7 Conclusion and Outlook

The goal of this paper was to show that under a set of identifying assumptions, differences in individual separation probabilities can be interpreted as determined by the relative locations of productivity, wage, and alternative wage. An empirical implementation on the basis of rich Danish register data is possible because absence of significant layoff restrictions ensure some generality of results, and richness of both demographic and firm background information allows to reduce omitted variable bias down to a minimum.

The model fits a bivariate probit of separation probability to variation in wage and observed characteristics, and thereby identifies the locations of the latent variables. Under the assumption that quits are negatively, and lay-offs positively related to wages, the latent variables can be given the interpretation of being measures the employee-specific alternative wage and marginal product, respectively. This is by the argument that employees having high separation probability when being at the low end of the peer group specific wage distribution are having high alternative wage relative to actual wage, while those

with high separation risk when being at the high end of wage distribution being associated low value by their employers.

The locations of the estimated individual specific latent variables can be compared to the actual wages, thus allowing to address different rent sharing hypotheses. Results indicate that there are strong negative relationships between quit probability and wage at low wages, and otherwise weak relationships between wage and separation probability; this again suggests that lay-offs occur more randomly than quits from the point of view of the modeller, and that lay-off risk only increases slightly with wage.

In particular, age is positively associated with total rents. Findings are most consistent with theories that suggest employees and employers to share the costs and benefits of specific human capital investments. Regarding gender, women are suggested to be more likely to stay in poorly paid jobs, which suggests their alternative wage to be low. Regarding location, rents in the Copenhagen area, which is taken as a proxy for a thick labor market, are lower. Here, employees are suggested to gain a higher share of the rents on thick labour markets compared to thin ones that work at the benefit of firms.

Further work on the issue may of course include a discussion of other variables which may be of interest for the relation of wage and separation probability, say, tenure or experience. Obviously, one could allow for more flexibility with regard to parametric assumptions and make an attempt to exploit panel data to split up heterogeneity into a permanent part and shocks.

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