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Does Employee Body Weight Affect Employers' Behavior?

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Abstract

This paper offers a study of possible favoritism of normal-weight individuals when firms make decisions on hiring, firing and promoting. Most existing studies use a wage equation to document dispersion in wages between normal- and overweight, however little is known about the reason for dispersion. Furthermore, the wage equations do not capture the sorting of workers into different occupations and industries. Using an equilibrium search model, this paper takes search friction and cross-firm differences in factor productivity into account, when looking at firm behavior. Additionally, a logit model is used to examine the occupation and industry distribution. Most importantly, we find that wage differences between normal-weight and overweight or obese workers are explained by differential firm behavior, both with respect to the job offer arrival rate and to the probability of being promoted. Further, we find that the trade industry hire overweight workers to a lesser extent than other industries.

JEL classification: I10

Keywords: Overweight, Firm behavior, Equilibrium Search Model, Multinomial Logit.

1 Introduction

For a long period differences in firm behavior toward black individuals and women in the labor market has been discussed. Favoritism of male workers is still a "hot" subject. However, it is important that these forms of prejudice do not overshadow other minority groups' differential treatment in the labor market, like people with a handicap; people who look different; or people who weigh more than what is maybe nice to look at. One minority group that has received particular attention in the United States recently is overweight and obese workers. It is, of course, not a coincidence that this group has received attention, since 64.5% of American adults are overweight, 30.5% of these are obese, and 4.7% are extremely obese (see Flegal, Carroll, Ogden & Johnson (2002)).[1] Further, a report published by WHO in 1998 states that the increase in obesity on the global level now is so huge that we may talk about an epidemic. The report shows that in many Western countries a doubling in the number of obese has occurred over the last 20-30 years. One of the countries included in the analysis is Denmark, where 75% more have become overweight since 1987, such that today between 40% and 50% of the grown up population are overweight, with 10% to 13% of these being obese (see Indenrigs-og Sundhedsministeriet m.m. (2005)).

This growing group of overweight individuals generally have hard odds to fight against in the labor market because they are seen as significantly less desirable employees who, compared with others, are less competent, less productive, not hardworking, disorganized, indecisive, inactive, and less successful (Kleges, Klem & Hanson (1990)). All in all, a picture that hardly describes the type of person one would choose as an employee, and one might speculate that this would lead to differential treatment in the labor market. A number of authors have noted that a stigma is attached to being overweight

[1] Overweight is defined as a BMI=weight/height^2 at 25 or more. Obese individuals have a BMI of 30 or more.

in their countries and that this limits an individual's opportunities (see Cahnman (1968), Larkin & Pines (1979), Register & Williams (1990), Gortmaker, Must, Perrin, Sobol & Dietz (1993), Haskins & Ranford (1999), Dejong (1980) and Pingitore, Dugoni, Tindale & Spring (1994)). In this respect Haskins & Ranford (1999) conclude that weight, like race, class, and gender, is a stratification variable of the general society. Although discrimination on the basis of weight, race or sex is illegal if the condition does not interfere with the job duties, some have contended that obesity job discrimination is much less important than sex and race discrimination. The reason is that obesity, for example, might interfere with one's job performance or lead to higher health-related costs. However, around 90% of obesity is in the "mild" range (20-30 percent overweight), and mild obesity is not related to increased risk of morbidity or mortality (see Kleges et al. (1990)).[2]

There are numerous ways in which the existence of discrimination could potentially have an economic impact on individuals. For many people, the major potential source of income is their own or a family member's labor, so that discrimination restricting access to the labor market for certain groups can have serious consequences. Discrimination could potentially operate in the pre-labor market or, having entered the labor market, in becoming employed, in obtaining a particular type of job, or in the wage one is paid for a specific type of work.

A small but growing body of research, almost exclusively from the US, shows that especially overweight women are treated differentially in the labor force, e.g. Cawley & Danziger (2004). They find that overweight women have a lower wage, work fewer hours per week on average, and have a higher probability of becoming unemployed. Gortmaker et al. (1993) found similar results and concluded that the overweight are more affected than people with other chronic illnesses. In the analysis of obesity, a wage equation is generally used to analyze wage dispersion. A wage equation is a great tool to analyze the effect of observed differences on wages. It is useful to show if e.g. education increases wages. We can also include a dummy for overweight, and this will tell us if overweight influences wages. Nevertheless, observed characteristics only explain around 30% of the observed wage dispersion (Mortensen (2003)). Thus, from the wage equation we can deduce whether overweight has an impact on wages, but concluding that it is discrimination if the overweight parameter is significantly negative is risky - 70% of the dispersion is still not explained. Reasons for the low explanation rate in wage equations is that it ignores key factors in the labor market, such as the arrival rate of job offers and the lay-off rate. Revising these explanations is difficult without a model of how each may contribute to the wage densities of individuals. Search models are particularly well suited for this task, since they are easily adapted to include many of the behavioral features of interest here. According to search theory, wage dispersion is largely a consequence of search friction and cross-firm differences in productivity. Thus, it would be a clear improvement of the analysis of the wage gap between normal-weight and overweight individuals to formulate a search model that encompasses both behavioral and productivity differences while still controlling for worker heterogeneity as the wage equation does. This requires a rich longitudinal data set including information about an individuals' labor market history on a weekly or monthly basis.

One shortcoming in the existing search model and in the wage equation is that they do not incorporate differences in the occupational distribution among the normal-weight and overweight individuals. It is well established that occupational segregation exists for race and sex, and a few studies, like Pagan & Davila (1997), have shown that it also exists for weight. Segregation can involve a major source of labor market rigidity and economic inefficiency. In addition, occupational segregation by weight is detrimental to overweight workers because it reduces self-confidence. Thus, it is an important subject when analyzing whether a group is treated in an unfair manner in the labor market. The occupational attainment literature provides two general methodologies for modelling occupational distributions on the basis of productivity or other personal characteristics. The best model, if micro level data are available, is a response model, since the dependent variable is represented by discrete choices, and the

[2] WHO recommended in 1998 that overweight in relation to discrimination should be considered under the same rules as sex and race.

method allows for a broad specification of skill measures.

In this paper, we examine whether firms treat overweight and obese workers differently from normal-weight workers in the Danish labor market. The paper contributes with new detailed data on work history information at the job spell level, making it possible to incorporate behavioral patterns to analyze wage dispersion and look at the occupational distribution. The analysis is the first of its kind, even though we in these years witness a drastic increase in the number of overweight and obese individuals. We use longitudinal register data merged with a survey on Danish individuals aged 40 or 50, which allows us to examine individuals already established in the labor market, unlike many earlier studies which look at young adults. The study provides a baseline for how overweight are treated in the Danish labor market and at the same time gives an indicator for other countries. This will be compared to what is already found using a wage equation.

The paper is outlined as follows. Section 2 looks briefly at the theoretical and empirical search model and an empirical procedure for segregation. In Section 3 individual-level panel data is introduced and estimation results are shown in Section 4. First we examine the effects of being overweight in the labor market using maximum likelihood estimation of the search model. This is followed by cross sectional examination of whether the distribution of jobs is the same for overweight and normal-weight. Conclusions are given in the 5th and final section of the paper.

2 The economic and empirical models

The unfair treatment of particular groups of workers by firms can be divided into two categories as already mentioned, namely discrimination and segregation, where discrimination refers to characteristics of the job itself, whereas segregation refers to the job attained. As Becker (1971) noted, "Many serious errors have been committed because of a failure to recognize that segregation and discrimination are separate concepts. Discrimination refers to the income received by different groups and ignores their distribution in employment; segregation refers to their distribution in employment and ignores their incomes. Hence discrimination and segregation can occur alone or together." Discrimination can involve lower wages, either directly or through higher unemployment rates, shorter employment spells, fewer job offers, and higher lay-off rates. Segregation, on the other hand, exists if overweight workers are employed with each other to a significantly greater extent than would result from their random distribution (Becker (1971)). As follows, segregation can involve different distribution for the normal-weight and the overweight concerning both industries, referred to as horizontal segregation, and occupational position, which is referred to as vertical segregation.

Since firm behavior toward overweight workers to date mostly has been analyzed using wage regressions and the theory behind search is somewhat different, we start out briefly explaining the search model. Over the years a lot of different theoretical models have been used for the analysis of wage dispersion in the labor market, but with different success rates, especially with respect to the fit to the labor market. The interest in finding a model that takes into account imperfect information, such as uncertainty, lead to a growing literature on the job search in the eighties. The job search theory extends the neoclassical theory by incorporating issues of uncertainty and information explicitly to fit the labor market well. The essential feature of the search theory is that workers have only partial information about employment opportunities. Given this fact, employers have monopsony power in the sense that a higher wage relative to those offered by competing employers will attract more workers. Because the extent to which a higher wage attracts workers depends only on its rank in the distribution of all offers, every individual employer has an incentive to differentiate its wage policy. Hence, wage dispersion is the outcome of the wage setting game that employers play with one and another. In the search model, differences in firm behavior is possible because of the presence of search friction, and this can explain the persistence of differences even over time. This is in contrast to the wage equation, which often only explains 30% of the variation in wages. Mortensen (2003) shows that wage dispersion is largely the consequence of search friction and cross-firm productivity. By allowing for imperfect information and cross-firm productivity differences in our model, we should be able to explain a big part of the remaining variation and apply the model to separate weight groups, to see if firms behave differently toward these groups. The search model has already been used to discuss gender and race wage differentials (see Bowlus (1997), Bowlus & Seitz (2000) and Bowlus, Kiefer & Neumann (2001)).

We will use the Burdett-Mortensen (Burdett & Mortensen (1998)) two state equilibrium search model (ESM), with the wage offer distribution endogenously given, in continuous time, and populated by infinitely lived (or finitely lived facing a constant risk of death) employers and employees. In the environment studied, employers post a wage conditional on the search behavior of workers and the wages offered by other firms. Workers meet employers following a Poisson process with an instantaneous rate of arrival, $\lambda_i, i = u, e$ and face a lay-off rate, σ. In particular, both unemployed and employed individuals may choose to sequentially search for a job. Thus, an individual receives an offer with intensity $\lambda_u > 0$ when unemployed, and $\lambda_e > 0$ if employed. It is expected that $\lambda_u > \lambda_e$, corresponding to a situation where the reservation wage exceeds the unemployment benefit, since the unemployed have a higher contact frequency than employed workers. Hence, the labor market is assumed to have three positive exogenous processes driving the movement of workers in the model. Further it is assumed that there are continua of F firms and L workers in the labor market analyzed. We will use the model to compare among other things the arrival rate of offers for employed and unemployed workers and the lay-off rate across the normal-weight (n) and the overweight (o). If all workers are treated the same we have $\lambda_u^o = \lambda_u^n$, $\lambda_e^o = \lambda_e^n$ and $\sigma^o = \sigma^n$,whereas if normal-weight workers are favored by firms, overweight workers will receive an offer with a lower intensity both when unemployed and employed, $\lambda_u^o < \lambda_u^n$, $\lambda_e^o < \lambda_e^n$. Further, an overweight worker will have a higher lay-off rate, $\sigma^o > \sigma^n$. These differences in job arrival by weight, potentially reflecting differences in firm behavior, cannot be handled in traditional human capital wage regressions, and hence our focus on the equilibrium search model.

In the model, the workers' optimal strategy, whether overweight or not, is characterized by their reservation wage. If an employer knows the reservation wages, his optimal wage offer will equal the reservation wage of some group of workers. In this case, the employer takes the whole surplus, and a monopoly outcome arises. In the opposite outcome, where the wage offer equals the marginal cost, the worker takes the whole surplus, and the outcome corresponds to the equilibrium outcome in the absence of search frictions, i.e., the perfectly competitive market, as assumed when using the wage equation. These two are the extreme cases. In all other cases, the degree of search friction will influence the degree of wage dispersion. We believe the labor market in Denmark lies in between these two extreme cases, although exactly where is hard to say.

Employers maximize profit by setting wages for the workers taking the reservation wages and wage offer distributions as given. We assume that the only factor of production is labor, and employers earn no profit, but make no payment if jobs are not accepted. The wages are chosen given the wage posting and search strategies of the other firms and workers, respectively. Profit maximization requires that employers of the same type earn the same profit in equilibrium. Our approach is to incorporate possible discriminatory behavior by estimating structural parameters separately by weight groups, rather than relaxing the profit maximization condition. Hence, firms which are equally productive can offer different wages, as long as profits of firms within the group are equal in equilibrium. Given the wages offered by all others and the distribution of workers' reservation wages, the labor force available to a specific employer evolves in response to the employer's wage. The higher the wage, the larger the steady-state labor force, because higher wage firms attract more workers from and lose fewer workers to other employers. Workers move up the wage offer distribution through on-the-job search, and therefore the steady-state earnings distribution lies to the right of the wage offer distribution, $G(w)$ (see e.g. Bowlus & Seitz (2000)). The resulting labor supply relation determines the profit of each employer conditional on the wages offered by other employers and the reservation wages demanded by workers. This profit function is the payoff in a wage posting game played by employers. Normalizing the price to one, the general profit in a firm of productivity P of employing a worker at wage w is

$$\pi = (P - w). \tag{1}$$

Firms are assumed to have a linear productivity technology with constant returns to scale, and the profit functions are additive in worker types, which makes it possible to look at different groups of workers separately, such as normal-weight, overweight, and obese.

When looking at the supply side, we may either look at all the individuals in the relevant age group or only the ones actively participating in the labor market. Some would argue that people outside the labor force should be part of the model, because a lot of extremely overweight people end up there. At first this may sound reasonable, since extremely overweight people might have ended up outside the labor force for exactly the reason that nobody would hire them. However, when they are outside the labor force, it would not be fair to say that they are actually searching for a job. Secondly, the focus is on firms' behavior toward overweight people in the labor market, and thus only individuals in the labor force are considered here. Still, it should be kept in mind when drawing conclusions that the category out of the labor force is omitted.

Jobs have many characteristics, including wages, hours, benefits, working conditions, and amiability of co-workers and supervisors. To make the model simpler and to fit with the available data it is assumed that wage is the only item on which the worker bases the decision to accept or decline employment. In the same way it is assumed that the unemployed only use the unemployment benefit net of search costs to form the reservation wage, without taking into account leisure or other pros and cons of not having a job. Both in employment and unemployment we assume that the worker's decision is independent of weight.

Based on the above, an individual is assumed to follow an optimal sequential search strategy. Hence, individuals maximize utility by adopting a reservation wage strategy that is state dependent. Thus, each individual has a reservation wage r_i, which for an unemployed person is the amount where he is indifferent between being unemployed and employed. For an employed worker, it is the wage at which they will accept another job offer, i.e. the current wage, w. This reservation wage will be used each time they have to decide whether to accept an offer or not, and the optimal strategy of an employed worker is therefore to accept any outside wage offer, x, which gives a higher utility level than the current. An unemployed person accepts a job offer of wage w if the utility from the offer is higher than the utility from the unemployment benefit, b. From this information the reservation wage can be calculated to be:

$$r_i = b_i + (\lambda_u - \lambda_e) \int_r^h \left(\frac{(1 - G(x_i))}{\lambda_e (1 - G(x_i)) + \sigma} \right) dx_i, \tag{2}$$

showing that the optimal reservation wage depends on market opportunities as summarized, in the wage-offer distribution, $G(w)$, the transition rates and supply-side factors.[3] If firms behave equal toward all workers, the reservation wage will be the same for all workers. Otherwise the reservation wage for overweight workers would depend on their transition rates. Using that $\lambda_u^n = \lambda_u^o + \varepsilon_u$, $\lambda_e^n = \lambda_e^o + \varepsilon_e$ and $\sigma^n = \sigma^o - \varepsilon_\sigma$, where $\varepsilon_s > 0$ for $s = e, u, \sigma$ it can be shown that the reservation wage for overweight workers is

[3]For simplicity of exposition workers and employers are assumed not to discount the future (see Burdett & Mortensen (1998))

$$r_i^o = b_i + (\lambda_u^o - \lambda_e^o) \int_r^h \left(\frac{(1-G(x_i))}{\lambda_e^o (1-G(x_i)) + \sigma^o} \right) dx_i \;\Leftrightarrow \tag{3}$$

$$r_i^o = b_i + (\lambda_u^n - \lambda_e^n) \int_r^h \left(\frac{(1-G(x_i))}{(\lambda_e^n - \varepsilon_e)(1-G(x_i)) + \sigma^n + \varepsilon_\sigma} \right) dx_i - \tag{4}$$

$$(\varepsilon_u - \varepsilon_e) \int_r^h \left(\frac{(1-G(x_i))}{(\lambda_e^n - \varepsilon_e)(1-G(x_i)) + \sigma^n + \varepsilon_\sigma} \right) dx_i. \tag{5}$$

If we for a moment assume that the difference in the rates of laying off overweight and normal-weight workers is equal to the difference in hiring (offer arrival and acceptance) rates between overweight and normal-weight worker $\varepsilon_\sigma - \varepsilon_e (1 - G(x_i)) = 0$, the reservation wage for the overweight can be rewritten in terms of the reservation wage for the normal-weight in the following way:

$$r_i^o = r_i^n - (\varepsilon_u - \varepsilon_e) \int_r^h \left(\frac{(1-G(x_i))}{\lambda_e^n (1-G(x_i)) + \sigma^n} \right) dx_i. \tag{6}$$

Whether the reservation wage for overweight is smaller or larger than for normal-weight depends on the size of ε_u and ε_e. You might expect that overweight workers are treated more dissimilarly to normal-weight workers when unemployed than when already employed $(\varepsilon_e < \varepsilon_u)$, which would result in the last part being positive, and thereby making a gap between the reservation wages for the overweight and normal-weight.

In equilibrium, each employer maximizes profit given the search strategies of the workers and the wages offered by the other employers. At the same time, each worker searches sequentially from the wage offer distribution using an expected wealth maximizing stopping strategy. The market wage offer distribution $G(w)$ is determined endogenously as an equilibrium outcome in this model. For details, see Bunzel, Christensen, Jensen, Kiefer, Korsholm, Muus, Neumann & Rosholm (2001) and Mortensen (1990). The explicit functional form of the c.d.f. is

$$G(w) = \frac{1+z_e}{z_e} \left(1 - \sqrt{\frac{P-w}{P-r}} \right) \text{ for } w \in [r, h], \tag{7}$$

where P is the productivity, $z_e = \frac{\lambda_e}{\sigma}$ the standardized arrival rate for employers, and h the highest wage paid to the workers. The model implies the following restrictions: $G(r) = 0$ and $G(h) = 1$. These can be used to derive the relation between the productivity level, the wage boundaries and the transition rates for the employed,

$$P = \frac{h - \theta^2 r}{1 - \theta^2}, \text{ where } \theta = \frac{\sigma}{\sigma + \lambda_e}. \tag{8}$$

Note that the highest wage will always be lower than the productivity, $h < P$, which confirms that all firms have monopsony power. Further, if the productivity levels are different for the worker groups analyzed, Bowlus (1997) argues that it indicates that the model cannot attribute the entire wage differential between the two groups to differences in the arrival rates.

The homogeneous version of the Burdett-Mortensen model outlined above can account for many empirical labor market regularities, but it produces a convex-shaped earnings distribution, see equation

7. This feature of the model is at odds with empirical evidence on income and wage distributions (see Kiefer & Neumann (1994), and Bowlus, Kiefer & Neumann (1995)) which typically have concave c.d.f.'s. Several papers have shown that the inconsistency between the empirical and theoretical wage distributions can be reconciled if firms are heterogeneous in productivity. We will pursue the discrete heterogeneity approach here, with a discrete distribution of Q firm types that can be ordered as $P_1 < P_2 < P_3 < ... < P_Q$. Then Mortensen (1990) shows that the solution under discrete firm heterogeneity results in a segmentation of the wage offer range among firm types, where low productivity firms offer low wages and high productivity firms pay higher wages. In equilibrium, equal profits within, but not across, firm types are required. The equilibrium wage offer distribution on the wage range for firms of type j is given by

$$G_j(w) = \frac{1+z_e}{z_e} - \left(\frac{1+z_e(1-\alpha_{j-1})}{z_e} \sqrt{\frac{P_j - w}{P_j - r_j}} \right) \text{ for } w \in [r_j, h_j], \ j = 1, 2, ..., Q, \tag{9}$$

where α_j is the fraction of firms with productivity P_j or less, r_j is the lowest wage offered by a firm of type j, and h_j is the highest wage paid by these firms. The following extra restrictions are implied by the model: $r_1 = r$ and $G(r_1) = 0, h_j = r_{j+1}$ and $G(h_j) = \alpha_j$, $j = 1, \ldots, Q-1$ and $G(h_Q) = 1$. The market's wage offer distribution is the mixture:

$$G(w) = \sum_{j=1}^{Q} G_j(w) \left[\alpha_j - \alpha_{j-1}\right]. \tag{10}$$

As the equation for $G(w)$ implies, the wage offer distribution is continuous, upward sloping, and convex between adjacent reservation wage rates for the different homogenous groups of firms, and jumps down at each reservation wage rate.

2.1 The Empirical models

2.1.1 Direct effect of firm behavior on wage dispersion

The assumptions underlying the theoretical ESM allow endogenous derivation not only of the equilibrium c.d.f. of wage offers, but also of the distribution of all relevant variables in realistic data sets. Thus, the model lends itself to a likelihood analysis. The random variables are unemployment duration, job duration, job destination, accepted wages and earned wages. Fortunately the distributions of all of these variables are known from the model. The structural parameters to be estimated in our models are $\psi = (\lambda_u, \lambda_e, \sigma, P, b)$ for the sample. However, it is useful for empirical purposes to reparameterize this set to $\varphi = (\lambda_u, \lambda_e, \sigma, r, h)$. The construction of the likelihood function is left out, but can be seen in Appendix 2. We will just notice that Christensen & Kiefer (1997) prove that the minimal data set that permits identification of all structural parameters consists of a panel where at least some of the individuals are observed with both unemployment duration, reemployment wage, and subsequent jobs. Thus, to identify the parameters of interest here the individual panel data must contain information on a spell of unemployment, the wage received on the job found, and the length of time spent on that job. Since all this information is available in our data all our parameters should be separately identified.

2.1.2 Segregation

There are several reasons to be concerned with horizontal and vertical segregation. First of all, both are sources of labor market rigidity and economic inefficiency. Excluding workers from a majority of occupations is a waste of human resources, increases labor market inflexibility, and reduces the economy's ability to adjust to changes. Secondly, occupational segregation by weight is detrimental to overweight persons. It has an important negative effect on how normal-weight people view overweight people and on how overweight people view themselves. Thus, it negatively affects overweight individuals' social rewards, such as income, material assets, standard of living, class standing, prestige, and deference from others. Finally, the persistence of stereotypes concerning weight also has negative effects on education and training, and thus potentially causes weight-based inequalities to be perpetuated into future generations.

Our primary interest in this section is in comparing the actual occupational distribution of overweight workers with the distribution that would prevail in the absence of differential treatment. More precisely, the question is: to what extent do members of the overweight group share the same occupational distribution as the normal-weight group, having controlled for productivity characteristics such as age, gender, and educational qualification?

The occupational attainment literature provides two general methodologies for modelling occupational distributions on the basis of productivity or other personal characteristics. One approach, the standardization technique, constructs indices of relative employment shares for the relevant worker groups, given the average level of educational attainment (or some other standard) in the occupation. The second approach uses qualitative response models of occupational attainment. These models attempt to measure the impact of productivity related characteristics on relative occupational achievement. Qualitative response models, e.g., multinomial logit, are particularly suited for occupational attainment analysis because the dependent variable, occupation, is represented by discrete qualitative choices. In this section, we adopt this approach, because it allows for a broader specification of skill measures, instead of being restricted to a single reference point such as education. In addition, the analysis employs micro-level data, rather than aggregate percentages such as the average education level of an occupation.

Our empirical test of segregation is based on certain assumptions about the occupational labor market. First, it is assumed that in the absence of segregation, normal-weight and overweight individuals would have identical occupational distributions, accounting for differences in other characteristics. That is, we assume that the overweight would be proportionately represented in each occupation to the degree that they share the skills and educational achievement shown by the normal-weight in that occupation (Bergmann (1971), p. 297). Second, it is assumed that overweight and normal-weight people have the same tastes and preferences with respect to the various occupational classifications. Differential investments in education may reflect different preferences, or they may reflect pre-market discrimination. Ideally, of course, we would like to separate out differences in occupations due to discrimination from differences due to preferences. Unfortunately, this cannot be done without further assumptions. We may interpret the results presented in the empirical section below as evidence of segregation, under an assumption that occupational differences due to preferences are relatively small compared to differences due to segregation. This seems reasonable when considering different weight groups.

The idea is to estimate probabilities for the majority group, namely, normal-weight workers. Then, under the null of no segregation (applying the majority model), we calculate the proportions of the overweight group that we would expect to find in each occupational class, given their productivity characteristics, by applying the model for the normal-weight. If there were truly no job favoritism, these estimated proportions would not vary significantly from the actual proportions. We can use the differences between the estimated proportions and the actual proportions of the minority in each occupational class as a measure of job segregation.

As outlined, the method demands that three steps be employed in the approximation of the extent of segregation against minority workers.[4] First, the parameters from the multinomial logit of normal-weight people are estimated. This establishes how the various productivity characteristics explain the normal-weight occupational distribution. Then, in the second step, the logit estimates are used to generate an "occupational probability density function" for each overweight worker, referred to as the "predicted" or "segregation-free" occupational distribution for each minority cohort. The final step in

[4] The procedure follows Schmidt & Strauss (1975), Brown, Moon & Zoloth (1980a), Brown, Moon & Zoloth (1980b), Polachek (1981), and Miller & Volker (1995).

Table 1: Labour market data by overweight and gender

	ALL	**FEMALES**			**MALES**		
		NW	**OW**	**OB**	**NW**	**OW**	**OB**
Number of individuals	7317	2491	955	372	1483	1585	431
Outside the labor force	15.29	15.78	18.85	26.88	12.68	12.11	15.08
Unemployment Rate	3.92	3.97	5.34	7.8	3.3	3.03	2.55
Annual earnings (1,000 DKK)	238	210	195	171	281	279	253
Hours per week, employed	38.32	35.49	35.49	35.41	41.06	41.82	40.64

Note: NW: Normal Weight, OW: Overweight, OB: Obese.

Source: Random sample of Danish people 40 or 50 in 2000 (see Appendix 1)

the procedure is to project a non-segregated occupational distribution for each group. As we already have it from the data for the normal-weight group, this step is accomplished by summing segregation-free probabilities across all workers in the overweight sample.

3 Data and summary statistics

The data used is a Danish administrative register panel sample for 1985-2002 of individuals 40 or 50 in 1999, explained in details in appendix 1. We use the Body Mass Index (BMI), calculated as bodyweight divided by height squared.[5] A BMI between 25 and 30 indicates overweight, while a BMI of more than or equal to 30 indicates obesity. Obesity is a condition which has serious consequences for one's health. On the other hand, overweight people with a BMI below 30 are generally not affected in terms of their working capacity (see Indenrigs-og Sundhedsministeriet m.m. (2005)).

Throughout, we look separately at males and females. In the sample analyzed, 35% of the individuals are overweight but not obese and 11% are obese.[6] In particular, the average rates of overweight and obesity are 45% and 12%, respectively, for males and 25% and 10% for females.[7] Table 1 shows some key factors in the labor market for normal-weight, overweight, and obese workers, for males and females, respectively.

The table shows that the wage level for males is higher than for females irrespectively of their weight. For both males and females, annual earnings generally decline with the degree of overweight. The number of hours worked per week is about the same for all workers, overweight or not, but differs between women and men. The average unemployment rate in the data (3.92%) is lower than the average of 4.6% for individuals between 15-66 years old in society, this might be because of the age group we are looking at. The males unemployment rate decreases with an increasing BMI, whereas the opposite is the case for females. This may be compared to findings in the US where overweight males are not seen to be hurt from discrimination in terms of employment and wage level, but only when looking at the industrial distribution (Pagan & Davila (1997)). However, in our data, obesity does hurt male workers in terms of wage level, and so does both overweight and obesity for females. As only the obese are work incapacitated, the findings indicate the possibility of dissimilar treatment in the labor market against the middle group (BMI between 25 and 30). Lastly, the number of individuals outside the labor force

[5] Although our sample covers the period 1985-2002 we only have the BMI values for 2000. If a "cure" for obesity is defined as reduction to desired weight and maintenance of that weight for 5 years it is more likely that a person will be cured of most forms of cancer than of obesity (Council on Scientific Affairs (1988), p 2547).

[6] We use the term overweight to refer to overweight but not obese individuals

[7] For comparison, Bendixen, Holst, Sorensen, Raben, Bartels & Astrup (2004) find that the prevalence of obesity more than doubled between 1987 and 2001 in Denmark, for men from 6% to 12% and for women from 6% to 13%. In the same period, the prevalence of overweight increased from 34% to 40% for men and from 17% to 27% for women, which is similar to our findings.

Table 2: Education by weight and gender

EDUCATION	ALL	FEMALES NW	FEMALES OW	FEMALES OB	MALES NW	MALES OW	MALES OB
Primary	28.37	26.46	31.94	36.83	26.3	27.26	35.5
High school	41.33	37.9	39.79	41.4	41.13	46.31	46.87
Middle-range	22.82	29.51	24.92	18.28	19.55	17.85	12.99
University	7.15	5.78	3.14	3.23	12.74	8.14	4.41

Table 3: Occupation and industry by weight and gender

	ALL	FEMALES NW	FEMALES OW	FEMALES OB	MALES NW	MALES OW	MALES OB
POSITION							
Top manager	3.83	2.54	1.82	1.40	6.10	4.90	4.30
High level manager	15.50	16.54	12.35	11.89	19.56	13.15	8.35
Mid-level manager	19.51	26.01	22.52	20.28	14.34	13.79	11.65
Wage earners	37.20	36.43	43.23	46.85	33.90	36.96	39.49
Self-employed	7.56	4.76	4.81	5.24	9.85	10.83	10.13
Other workers	16.40	13.73	15.26	14.34	16.25	20.37	26.08
INDUSTRY							
Manufacturing	25.48	13.50	12.67	9.79	35.15	41.07	39.28
Trade	11.58	10.16	10.70	7.34	14.37	12.18	12.59
Transport	10.25	7.68	7.87	6.64	12.01	13.00	15.86
Consulting	16.76	16.39	17.96	18.53	17.02	16.50	15.11
Public sector	35.94	52.26	50.80	57.69	21.44	17.25	17.13

is relatively low, as expected. For females, the higher the BMI value, the higher is the percentage not represented in the labor force. This is most likely in itself due to dissimilar treatment and should be included when accounting the unfair treatment of the overweight and obese.

Especially for women, using a search model seems important since the overweight are unemployed much longer, a fact which would not be captured in a wage equation. The differences in unemployment rate and earnings can either be due to differences in human capital obtain or in the transition rate between states in the labor market. Since it is important to make sure that the differences found are because of weight and not other personal characteristics we will besides age and gender also control for level of education obtained.

Table 2 shows the relation between education level and overweight. Normal-weight males as well as females study longer than overweight and obese males and females. These differential investments in education may reflect different preferences, or they may reflect the effect of pre-market discrimination. These findings agree with a general tendency across countries showing that overweight and obese individuals are represented in all population-groups, but especially in the group of people with the shortest educations (see e.g. Lissner (1998)).

Lastly, the actual distribution of occupational position and industry are shown in Table 3, to give a background for the segregation analysis. Table 3 indicates that the occupational position and industry of different individuals vary substantially by weight. For the occupational position, there are more normal-weight men as well as women represented in the top positions. For the industry distribution, a pattern arises when looking at the obese compared to the normal-weight females. Here, a higher percentage of the obese work in the public sector and less in manufacturing and trade. For males, the

Table 4: Means for the included variables in the ESM for males and females

	FEMALES			MALES		
	NW	**OW**	**OB**	**NW**	**OW**	**OB**
Sample size	2022	763	286	1229	1305	364
Reservation wage (r)	60.13	63.67	63.37	61.47	61.22	72.52
Highest wage (h)	475.31	391.25	436.88	656.21	614.71	684.95
1th spell employed (%)	88.2	85.7	78	93	92.9	91.5
Unemp. duration (month)	19.8	21.98	24.96	18.2	17	19
Emp. duration (month)	108	108	103	106	104	105
Percentage of spells						
Right censored 1th	55.9	58.58	53.29	50.4	51.2	52.7
Right censored 2nd	51.5	41.8	42.86	47.5	47.9	50.6
Job-to-job trans. 1th	83.2	78.3	74.7	86.9	88.2	86.1
Job-to-job trans. 2nd	66.8	63.8	53.1	79.7	77.8	75.4
ML of λ_u (1/dur unemp)	0.05	0.045	0.040	0.05	0.06	0.05

opposite is the case. The findings in the table will be discussed more deeply when analyzing segregation.

All in all, our sample shows the same general characteristics as other analyses of overweight and normal-weight individuals (see e.g. Harper (2000)). There are fewer overweight and obese among the highly educated and those in top positions. The normal-weight workers have higher annual earnings and for females a much lower unemployment rate. In the wage regression normally used when discussing the issue, the effect of being overweight is measured by including a dummy for overweight. This is done under the assumption of a competitive market, where wage differences across workers reflect variation only in individual worker ability and non-pecuniary attributes of the job held. If this hypothesis is true, workers with the same characteristic should receive the same wage on average. For our sample, if we divide into gender, education, occupation and industry, observed characteristics that would be included in a wage regression, there is still an unexplained wage difference between normal-weight and overweight workers. This difference cannot be explained by the human capital wage regression. A likely explanation of the remaining difference is imperfect information, a departure from the competitive market assumption. This imperfect information in the job market can be analyzed by looking at the employment history of equal workers, which is what we do in the equilibrium search model (ESM).

For the ESM, summary statistics of key variables in relation to the model are provided in Table 4. We report an indicator for whether the first spell was employment. Further, we show two variables for the average duration of the spells, ignoring whether it is the first or the second spell. Finally, we show the fraction of spells that are right censored, and the ratio of workers going from one job to the other when changing state after the first and second spell. The last parameter is a control parameter used later.

From the table, overweight females have on average longer unemployment spells than normal-weight females, but employment spells are similar for normal- and overweight persons, although shorter for obese workers. Further, 88% of normal-weight females were employed in the first spell, which is more than among the overweight (86%) and obese (78%). The censoring indicator for the first spell shows that more of the overweight workers' spells are censored. This agrees with the fact that it may be more difficult for the overweight to shift to another job or get a job in the first place. However, this is not the case for the obese. The destination indicator shows that 83% of the normal-weight employed workers enter a new state because they have found a new job, and only 17% shift because they are laid off. These figures are worse for the overweight and obese workers, with a higher percentage in the group being laid off. The same ranking occurs for the second spell, although with a much higher rate

Table 5: Homogenous ESM for males and females

	FEMALES			MALES		
	NW	**OW**	**OB**	**NW**	**OW**	**OB**
Arrival rate of jobs	0.0425	0.0373	0.03485	0.0628	0.0783	0.0763
when unemp.(λ_u)	(0.0024)	(0.0034)	(0.0053)	(0.0049)	(0.0063)	(0.0112)
Arrival rate of jobs	0.0026	0.0025	0.0020	0.0035	0.0036	0.0030
when emp. (λ_e)	(0.0001)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
lay-off rate	0.003	0.0028	0.0028	0.0033	0.0033	0.0033
when employed (σ)	(0.0001)	(0.0002)	(0.0003)	(0.0001)	(0.0001)	(0.0003)
Productivity (P^o/P^n)	-	0.81	0.99	-	0.93	1.09
Unemp. dur (month)	23.5	26.8	28.7	15.9	12.8	13.11

Note: standard errors are in parentheses

to unemployment. Looking at the right censoring indicator for the second spell, the censoring is higher for the normal-weight, indicating that more of them have longer second spells than the overweight and obese. Thus, all in all we expect the arrival rates and thereby the wage offer distribution to be different across weight groups.

Continuing with the males, the difference across weight groups is similar for the first four variables, but the differences among normal– and overweight are small. Turning to the transition rates, the right censoring indicators show that men more often shift jobs. Contrary to the females the indicators are lowest for normal-weight. Further, the job-to-job transition is higher for males in general, telling us that male more often change from an employment state because of a new job, compared to females. Here overweight has the highest job-to-job transition in the first spell, which indicates that they do not have more difficulties in receiving offers. This can be due to the fact that a lot of males have a BMI of 25 or 26, and it can be discussed whether they should be seen as overweight or not.[8] So the numbers in Table 4 indicate that there might be some explanation of the reason for difference in the wage dispersion in the transition parameters, especially for the females. In what follows, we first estimate the pure homogenous equilibrium search model for normal-weight, overweight and obese workers, separately. We then estimate the ESM with firm heterogeneity. To take into account that workers have different education level we estimate the model for two different levels later. Lastly the results for segregation are reported and discussed.

4 Results

4.1 The homogenous model

The estimation results of the homogenous model are presented in Table 5. Differences in behavior are summarized by different rates of transition between employment and unemployment. First, the transition rates for all the models are significantly different from zero, and the arrival rate for the unemployed (λ_u) is higher than the arrival rate for the employed (λ_e), confirming one of the assumptions of the model. Focusing on the level of the transition rates and comparing across gender, the picture is very clear. Men receive more offers both when employed and unemployed, but they are also more likely to be laid off than women. Overall for females and obese males, jobs tend to end in unemployment rather than leading to new, higher paying jobs along the job ladder ($\lambda_e < \sigma$). For normal-weight and overweight male workers, the reverse is true. Thus, the findings change, compared to Table 4, where we

[8]If measuring the BMI for muscular men the value can without problem be higher than 25, even though they are not overweight at all. Still, as 25 is the convential cut-off we retain this for comparison purposes.

had the same pattern for all groups, namely, that most jobs end in transition to a new job. The analysis shows that a meaningful empirical analysis of fundamental economic parameters is possible within the pure ESM. In particular, the model reveals that it is exactly the non-obese male workers that have a real possibility of climbing up the job ladder.

Calculating the average productivity level for each group is an indication of how well the arrival rates explain the difference in the wage. Importantly, the productivity comparison shows that the model does a good job in ascribing the wage differentials between the groups to differences in arrival rates. For example, for obese females the whole difference (99%) in wages can be attributed to differences in flow parameters in the labor market.

To interpret the parameter estimates, note that for a normal-weight unemployed female the probability of having received and accepted an offer before 10 months of unemployment is 35% ($F(t) = 1 - \exp(-\lambda_u t)$), $F(10) = 0.35$), whereas it is 57% before 20 months of unemployment. These rates are reasonable in the Danish labor market, for the age group of 40 or 50 year old considered. Likewise, the probability of being employed next month given that she is unemployed now is 4%. In the same way, the probability of receiving a new offer before 10 months of employment is 2%.[9] However, for an employed worker it is not certain that the person actually accepts the offer. Finally, the parameters imply that the probability of being laid off is 3% before 10 months of employment in this age group.

Comparison by degree of overweight; females[10]

The comparison of estimates across the three groups for females reveals that overweight and especially obese workers face a significantly lower arrival rate of offers, both when unemployed and when employed. This implies lower competition levels for overweight and obese than for normal-weight workers. As a result of the lower arrival rate when unemployed, the unemployment spells for the overweight and obese are longer. The job destruction rate σ is surprisingly higher for normal-weight workers, meaning that more jobs end in a lay-off for this group than for overweight and obese female workers. Thus, firms behave worse toward overweight and obese workers when hiring, but not when firing, which might be due to the strong unions in Denmark.

Comparison by degree of overweight; males

Contrary to what was found for females, males' transition rate from unemployment to employment is significantly higher for overweight and obese than for normal-weight workers. This is in line with other studies from the US, which find that men who are mildly obese receive a wage premium compared to their standard weight counterparts (see Register & Williams (1990) and Maranto & Stenoien (2002)). Furthermore, the finding is consistent with those in Tables 1 and 4, where the unemployment rate is higher, and the average unemployment spell is longer for normal-weight than overweight.

Looking at the employed male workers, the findings are again different from those for females. The arrival rate is highest for the overweight and lowest for the obese workers. Thus, we have that normal-weight workers get fewer offers than the overweight, but more than obese workers. Comparing to Table 4, where the hourly wage was highest and employment spell longest for normal-weight workers, and Table 1, where the employment rate was lower for overweight compared to normal-weight, the lower employment rate apparently overshadows the two other effects and must be the key to the result. The lay-off rate is about the same for all groups i.e. weight does not affect whether you are laid off. The rest of the parameters for overweight and normal-weight correspond to the assumptions of our model.

Thus, the conclusion is that males are treated similarly by firms in our sample, whereas females are treated differently by weight. These results are in line with the findings in e.g. Cawley (2004) using data from the US and a wage equation. But importantly, by using an ESM we have found for women that the wage difference between normal-weight and overweight and obese can be explained by differential

[9] $F(t) = 1 - \exp(-h_e t)$, $h_e(t) = (\sigma + \lambda_e)\left(\sqrt{\frac{P-w}{P-r}}\right) - \sigma$, $F(t) = 0.0216$, see appendix 2

[10] When comparing, a hypothesis test is used to see whether the differences are statistically significant (see Berry & Lindgren (1996), p. 490)

Table 6: Heterogeneous ESM for males and females

	FEMALES			MALES		
	NW	**OW**	**OB**	**NW**	**OW**	**OB**
Sample size	2022	763	286	1229	1305	364
Arrival rate of jobs,	0.0399	0.0352	0.033	0.0593	0.0747	0.0729
when unemp.(λ_u)	(0.0024)	(0.0033)	(0.0051)	(0.0048)	(0.0062)	(0.011)
Arrival rate of jobs,	0.0053	0.0050	0.004	0.0068	0.0069	0.0065
when emp. (λ_e)	(0.0002)	(0.0003)	(0.0005)	(0.0003)	(0.0003)	(0.0005)
Lay-off rate	0.0025	0.0024	0.0025	0.0027	0.0028	0.0028
when emp.(σ)	(0.0001)	(0.0015)	(0.0003)	(0.0001)	(0.0002)	(0.0002)
Productivity ($\overline{P}^o/\overline{P}^n$)	-	0.88	1.00	-	0.85	1.05
Workers, grp1 (α)	84.97%	85.19%	88.81%	80.71%	75.56%	74.45%
Wage cut	174.05	167.95	173.44	222.57	209.66	191.98
Unemp. dur(month)	25.06	28.39	30.27	16.87	13.39	13.71

Note: standard errors are in parentheses

firm behavior in the hiring process, whereas for men firms behave equally with respect to offering jobs to all weight groups. All in all, the homogenous model gives some interesting results, and some of them not quite as expected. Since a poor fit of the wage offer distribution may be a reason for this, we move on to the extended model allowing for heterogeneous firms.

4.2 The heterogeneous model

The estimated parameters from the ESM with two homogenous groups of firms are presented in Table 6. The table includes the same rows as Table 5 together with the additional wage cut separating the firms into two homogenous groups, and the share of workers in the low productivity group. The wage cut is calculated as in Equation 2 using the wage offer distribution in Equation 6. Overall the estimated parameters for the transition rate of unemployed workers are lower here than in the homogenous case for all samples. The lay-off rate is also lower, but the arrival rate for employed workers is higher. Thus, the inclusion of firm heterogeneity has influence on the estimated parameters. The likelihood values are higher than for the heterogenous model for all groups, so the heterogenous model is a clear improvement. However, the average productivity level for male overweight is decreased to 85% of that of normal-weight. The share of workers in the low productivity group, α, is very interesting, since subsamples with productivity parameters and wage cuts relatively far to the right on the wage axis have relatively more individuals allocated in the low wage range. Hence, the firms offering high wages are not attracting the bulk of the workers. Note that λ_e, the offer arrival rate for the employed, is larger than in the homogenous model, and probably more realistic.

Comparison by degree of overweight

Comparing the estimated parameters for the normal-weight with the overweight and obese workers, the results are similar to those for the homogenous model. For the low productivity group the highest wage is lower for obese than for normal-weight, albeit lowest for the overweight. The table shows that around 85% of the normal-weight and overweight female workers are occupied in the low productivity firms. For the obese this share is slightly higher, around 89%. For males the comparison of the arrival rates gives the same significant results as in the homogenous case. However, the lay-off rates, which were the same for all weights groups before, have changed little. In particular, the lowest lay-off rate is the one for the normal-weight indicating favoritism of normal-weight workers. The surprising thing for males is that a higher share of the normal-weight are employed in the low productivity group. Thus, there is still no evidence of firms treating male overweight and obese workers differently from the normal-weight workers.

A natural next step would be to allow for more firm or worker heterogeneity. The proper number of homogenous firm groups can be decided from the likelihood value of the model. Since the model is estimated separately for homogeneous subsamples, we may allow for a different value of the number of firm types, Q, in each case. We expect large subsamples of workers to contain enough information to separate out a larger number of firm types than small subsamples, where a reasonable fit might be obtained even with a small value of Q. This is not to say that the smaller subsamples of workers necessarily face fewer firm types, but simply that the data may not carry sufficient information to identify all the types. As in Bowlus et al. (2001), the value of the log likelihood function stabilizes as Q increases. In contrast to Bowlus et al. (1995), we find that the parameter estimates are insensitive to the precise choice of Q. This can easiest be seen in the Figures 1 to 4. The first figure shows the evolution of estimated average productivity for males and females separately. If the model explains all the wage dispersion among the groups, the average productivity should be the same. Thus, our analysis seems to do a good job, especially for males. The second figure shows the arrival rate of jobs for unemployed females and males for the three weight groups. Here, there is a clear pattern for females. The more you weigh, the lower is the arrival rate, hence making it more difficult to escape from unemployment. For males the evolution of the arrival rate when unemployed is similar, but here the overweight have the highest rate and the normal-weight the lowest. For the arrival rate of offers when employed, Figure 3, the pattern across weight is the same for females, with a much lower rate for obese. Here, the rate is increasing as firm heterogeneity is controlled for. The arrival rate of offer when employed is also similar for normal and overweight male workers, but lower for obese male workers. Last, for females the lay-off rate, Figure 4, is very similar over weight groups. The lay-off rate for employed males are as for females similar over weight groups. Hence, all in all for females the findings for Q=2 hold up for higher Q's, telling that firms do treat the workers differently even after controlling for firm heterogeneity at different levels. For males the same holds, as found for Q=2 there is no sign of difference in firm behavior toward overweight and obese males. When increasing Q the share of workers in the lowest productivity group stays relatively high, around 50% or higher. Thus, it is the right tail of the model that is improved by allowing for more heterogeneity.

4.2.1 Controlling for education level

Worker heterogeneity is controlled for by dividing workers into homogenous groups. Until now we have controlled for age and gender. Education would be another interesting control variable. However, premarked discrimination might be the reason that overweight and obese have different education level, as seen in Table 2. Nevertheless, it is interesting to know how much education can explain. We have therefore estimated the ESM for two different education levels and included the key parameters in Table 7. Comparing the parameter values for normal-weight workers, those with low education have higher rates, for both males and females, showing that they change position in the labor market more often. We find that for females with at least high school, the conclusions are the same as in Table 6, whereas the low education group is only treated dissimilarly when unemployed. For highly educated males there are no significant differences among the weight groups. When looking at males with less than high school we now get that employed workers are punished for being overweight in the arrival rate of jobs both when they are unemployed and employed.

4.3 Comparison to other findings

To date, no article has used search theory to look at firm behavior across weight. Other studies have instead looked at wage differences isolated, using a wage equation to explain the differences in wage and

Table 7: Heterogenous ESM for 2 level of education

FEMALES	Low level			High level		
Q=2	**NW**	**OW**	**OB**	**NW**	**OW**	**OB**
Sample	686	303	122	1336	460	164
Arrival rate of jobs	0.0463	0.04	0.040	0.0331	0.0288	0.0248
when unemp.(λ_u)	(0.004)	(0.004)	(0.008)	(0.003)	(0.0048)	(0.006)
Arrival rate of jobs	0.0059	0.0068	0.0049	0.005	0.0039	0.0039
when emp. (λ_e)	(0.0004)	(0.0006)	(0.001)	(0.0002)	(0.0003)	(0.0006)
Lay-off rate	0.0042	0.0047	0.004	0.0018	0.0013	0.0015
when employed (σ)	(0.0002)	(0.0004)	(0.0006)	(0.0001)	(0.0002)	(0.0003)

Note: standard errors are in parentheses

Table 8: Heterogenous ESM for 2 level of education

MALES	Low level			High level		
Q=2	**NW**	**OW**	**OB**	**NW**	**OW**	**OB**
Sample	401	450	147	828	855	217
Arrival rate of jobs	0.0623	0.0899	0.0853	0.0571	0.0567	0.055
when unemp.(λ_u)	(0.006)	(0.009)	(0.015)	(0.007)	(0.0075)	(0.014)
Arrival rate of jobs	0.0079	0.0073	0.0062	0.0066	0.0065	0.0065
when emp. (λ_e)	(0.0006)	(0.0005)	(0.0009)	(0.0003)	(0.0003)	(0.0006)
Lay-off rate	0.0043	0.0043	0.0038	0.0021	0.0021	0.0022
when employed (σ)	(0.0003)	(0.0003)	(0.0005)	(0.0001)	(0.0001)	(0.0003)

Note: standard errors are in parentheses

including either BMI or a dummy for overweight or obesity as an explanatory variable in the equation. The main difference between the studies is in terms of the assumption made on the error term and the covariates. The most commonly used procedures are OLS and IV estimation. The large number of studies looking at wage differences among different weight groups can generally be divided into two groups. The first group (Loh (1993), Averett & Korenman (1996), and Gortmaker et al. (1993)) find large wage differentials across workers with the same observable productive characteristics for both males and females, whereas the studies in the second group (Harper (2000), Register & Williams (1990), Harper (2000), Pagan & Davila (1997), Lahteenkorva & Laheima (1999), Maranto & Stenoien (2002), Lahteenkorva, Silventoinen & Laheima (2004), Cawley (2004), Morris (2006) Cawley (2000*b*), Cawley (2000*a*), and Cawley & Danziger (2004)) only find wage differences for females.[11] The only study which did not find evidence of employer discrimination is Behrman & Rosenzweig (2001). They conclude that while BMI by itself may signal to employers about other productivity-related characteristics such as endowed ability, once controlling for earnings endowments, height, schooling and work experience there is no evidence that employers treat overweight or obese individuals differently.

We can from our findings for the Danish labor market conclude the same as the mentioned articles above all together, namely that for females there is a difference in the wage between normal-weight and overweight workers. Furthermore, we find that a large part of the wage differences among the weight groups is due to firms treating workers differently in terms of offering jobs. For males on the other hand, who also face a wage gap as the weight increases, search friction does not seem to explain it for the overweight, but for the obese when they are employed. Since workers often shift jobs to get up the job ladder it might mean that it is more difficult for overweight and obese males to climb the job ladder.

[11] Cawley (2000*a*), Cawley (2000*b*) and Cawley & Danziger (2004) only look at females.

We will look more into promotion shortly when analyzing segregation. However, the results for males fit the findings in other countries quite well.

4.4 Empirical findings for segregation

For simplicity we will only look at a cross section sample from the year 2000, where all individuals are 41 or 51. Following the procedure from section 2.1.2, we first estimate a multinomial logit model from a sample of normal-weight workers, then apply the fitted values to a sample of overweight workers. In this way, we simulate the occupational distribution that overweight workers would have attained had they been treated as if they were normal-weight. In all the models annual earnings, education, parents education, age, year of being hired in a specific firm, number of children, and urban residence are included as explanatory variables. We use the estimated model to test the following two hypotheses about segregation:

1) H_0: The vertical distribution is the same for normal-weight and overweight individuals, taking into account differences in characteristics.

2) H_0: The horizontal distribution is the same for normal-weight and overweight individuals, taking into account differences in characteristics. In 1), industry is included as additional regressors, whereas job position is included in 2).

Vertical segregation

Starting out with the first hypothesis, the distribution is divided up into six groups: top manager, high level manager, mid-level manager, wage earners, self-employed, and other workers. The groups of particular interest are the first three, managers at different levels, since studies in other countries have shown that less overweight workers are promoted (e.g. Pagan & Davila (1997)). In Table 3, the actual probability of being in one of the six job positions for females and males were presented. As expected, the probability of being a top and high level manager is higher for males than for females, whereas the probability for a female to be mid-level manager is higher than for a male. Furthermore, a higher proportion of men than women are self-employed, and for both genders most are employed as wage earners. From the table, it is obvious that the probability of becoming a top or high level manager is much lower if you are either overweight or obese than if you are normal-weight, for both males and females, with the strongest effect for males. The same holds for mid-level managers, although with smaller differences between the weight groups.

The differences in probabilities could be attributed to educational differences or differences in other observables. The alternative is that they are caused by segregation. The predicted probabilities in Table 9 control for the regressors already mentioned, so the difference between the actual probabilities from Table 3 and the predicted probabilities may be interpreted as due to weight, holding other characteristics constant. When comparing actual and predicted probabilities for the overweight females, it seems as if unfair treatment is present, since the predicted probabilities for top, high, and mid-level managers are higher than the actual probabilities. Had the explanatory variable had the same effect on the occupational distribution for overweight as for normal-weight workers, more overweight workers would have been hired in top positions. The same conclusion can be made for the self-employed obese workers, whereas the opposite is true for wage earners and the other workers. Continuing with the males, Table 9 shows that if there were no segregation, there should be more overweight and obese males working as top and high level managers than there are. For the mid-level managers and self-employed overweight workers, the probabilities are similar in the actual and in the predicted distribution.

All in all, this analysis clearly shows that if you want to have a position as a manager, you have to take care of your weigh, both as a woman and as a man.

Horizontal segregation

Horizontal segregation is unfortunately seldom included when analyzing segregation, because it can be difficult to identify the industries where all workers have costumer contact. We face these problems

Table 9: Predicted probabilities for overweight and obese workers

	FEMALES (Prediction)		MALES (Prediction)	
	OW	**OB**	**OW**	**OB**
Top manager	**2.07**	**2.13**	**6.35**	**5.39**
	(1.82)	(1.40)	(4.90)	(4.30)
High level manager	**14.86**	**14.82**	**19.58**	**17.28**
	(12.35)	(11.89)	(13.15)	(8.35)
Mid-level manager	**25.20**	**24.24**	**13.80**	**12.18**
	(22.52)	(20.28)	(13.79)	(11.65)
Wage earners	37.63	36.33	32.77	34.46
	(43.23)	(46.85)	(36.96)	(39.49)
Self-employed	4.71	**6.79**	10.66	**11.58**
	(4.81)	(5.24)	(10.83)	(10.13)
Other workers	15.53	14.82	16.84	19.11
	(15.26)	(14.34)	(20.37)	(26.08)

Note: Actual percentage in parentheses

Bold: The predicted probability is higher than the actual

too, but will still include the results, since theory says that the obese end up in industries where there is less contact to costumers, and because it is the most debated type of unfair treatment of the overweight in society. We only treat the trade industry as one where there might be segregation, not the consulting industry, since many people here do not have costumer contact. In the trade industry, there are also people without costumer contact, and although it is a smaller fraction, this might bias the results downwards, leaving us with a smaller estimated segregation effect due to body weight.

The horizontal distribution is divided into 5 groups, see Table 3. First of all, it is seen that most women are working in the public sector, followed by trade and consulting. Further, the probability of working in the trade industry is less for overweight than for normal-weight workers, and the more obese you get, the lower is the probability of getting a job in that sector. Finally, Table 3 shows that obese females seem to be overrepresented especially in the public sector, but also in consulting. For men, the industrial distribution is somewhat different. First, most male workers are working in manufacturing and consulting, but males are in general more equally distributed across the different industries. Surprisingly, the more a male worker weighs, the less is the probability of him working in the public sector. The same applies to the trade industry, which indicates that segregation might be present for overweight and obese workers. These workers are working in the transportation industry, among others.

Table 10 shows the predicted probabilities. Looking at overweight females, the predicted probabilities are higher than the actual ones for trade. This tells us that more overweight workers should be employed here. In terms of segregation, the result indicates that for an overweight worker, the actual probability of being employed in the trade sector is lower than for a normal-weight worker, but for an overweight worker with the same observed characteristics as a normal-weight worker it should actually be higher. The consulting industry shows an opposite pattern. For the public sector, the probability for overweight female workers is not significantly different between the actual and the simulated distribution, but for the obese, the simulated distribution shows that fewer obese females should be employed in the public sector. We may interpret this as saying that the public sector does not favor normal-weight workers, but instead hires the overweight and obese workers that have difficulties finding a job in the private sector.

All in all, the differences are large enough for the trade industry to conclude that there must be some kind of horizontal discrimination in the labor market for females, assuming that the two groups are homogenous with respect to the factors not controlled for. Turning to the male workers, Table 10

Table 10: Predicted probabilities for overweight and obese workers

	FEMALES		MALES	
	OW	**OB**	**OW**	**OB**
Manufacturing	13.92	13.92	**35.55**	**36.1**
	(12.67)	(9.79)	(41.07)	(39.28)
Trade	**11.02**	**11.20**	**14.78**	**15.36**
	(10.70)	(7.34)	(12.18)	(12.59)
Transport	7.84	**7.68**	12.98	13.87
	(7.87)	(6.64)	(13.00)	(15.86)
Consulting	16.80	16.84	16.34	**15.80**
	(17.96)	(18.53)	(16.50)	(15.11)
Public sector	50.40	50.34	**20.35**	**18.87**
	(50.80)	(57.69)	(17.25)	(17.13)

Note: Actual percentage in parentheses

Bold: The predicted probability is higher than the actual

shows that for both overweight and obese workers, the predicted probabilities are higher for trade and public sector workers. Thus, if the explanatory variables for the overweight had the same effect on the horizontal occupational distributions as for the normal-weight, overweight workers' probability of having a job in the public and trade industry should have been higher. For the obese, the simulated distribution also shows that more people should work in consulting, but for the rest of the industries the pattern is the same as for the overweight. Hence, also men are segregated if they weigh too much.

The empirical results are consistent with the human capital hypothesis that workers choose occupations to maximize the lifetime utility given their individual characteristics. Our results however suggest that personal characteristics and tastes explain only part of the differences in the distribution of occupations between overweight and normal-weight workers, both vertically and horizontally, and instead a substantial portion of the differences in distributions can potentially be attributed to segregation. The large differences between our actual and simulated distributions suggest that appropriate antidiscrimination policies would be worth pursuing in equalizing occupational opportunities between overweight and normal-weight workers.

5 Conclusion

In this paper, we have analyzed whether overweight workers are treated differently in the labor market. First, a search model was used to explain residual wage dispersion and explore whether overweight workers experience different flow rates in the labor market, consistent with firms making them fewer offers or laying them off more easily. Secondly, a discrete choice model was used to analyze whether the position and industry distributions are different for normal- and overweight workers after controlling for observed characteristics.

The unadjusted figures from our sample showed a negative wage gab toward overweight and obese workers, together with quite different distributions especially for job positions. This suggests that overweight and obese workers are treated differently by firms in the labor market. From analyses in other countries we also expected to find that overweight workers, in particular overweight females, would be impaired in the labor market. A main issue pursued in this paper is whether structural estimation of an equilibrium search model (ESM) would reveal that the data on both wage dispersion and flow rates indicate differential treatment of overweight workers. The ESM was estimated by maximum likelihood on a random sample of individuals 40 or 50 years in 1999 over the period 1985-2002. We considered the basic ESM, with purely endogenous wage heterogeneity, together with feasible extensions to allow for heterogeneity in firm productivity. We compared the structural parameters across estimates for normal-weight, overweight, and obese workers. We found that search friction indeed explains some of the remaining wage dispersion, and when comparing the flow parameters across weight groups, overweight and obese females and obese males were treated differently by firms. They got fewer job offers and were more easily laid off.

Finally, we analyzed to what extent overweight and obese workers share the same occupational distribution as the normal-weight, both horizontally and vertically. For this, we used the multinomial logit. In particular, we estimated the parameters of the model for normal-weight workers, then applied it to a sample of overweight and obese workers. In this way, we simulated the occupational distribution that overweight and obese workers would have attained, had they been treated as if they were normal-weight. The simulated distribution was compared with the actual distribution for the overweight and obese, respectively. Using the same data, a cross sectional analysis showed that personal characteristics only explain part of the differences in the distributions, both in the vertical and the horizontal case, for males as well as females. Thus, a substantial portion of the difference in the occupational distribution can potentially be attributed to segregation.

Hence, all in all, we are lead to conclude that overweight and obese individuals are treated differently in the labor market, compared to normal-weight individuals. Especially females are badly harmed, whereas the males seem mostly hurt on the occupational distribution. Since those outside the labor force were excluded, the problem of unfair treatment can be even worse than what we have found. Most importantly, the study shows that the wage difference between normal-weight workers and overweight and obese workers also found in many other studies actually to a large extent can be explained by differential firm behavior with respect to both the job offer arrival rate and the extent to which they promote workers. Finally, the trade industry is more averse to hiring overweight and especially obese workers than other industries.

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FIGURES

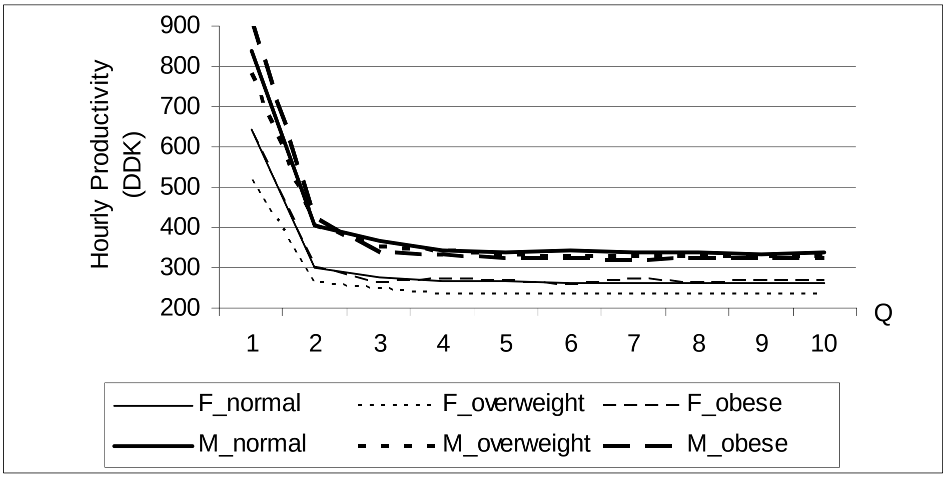

Figure 1: Average Productivity by gender and weight

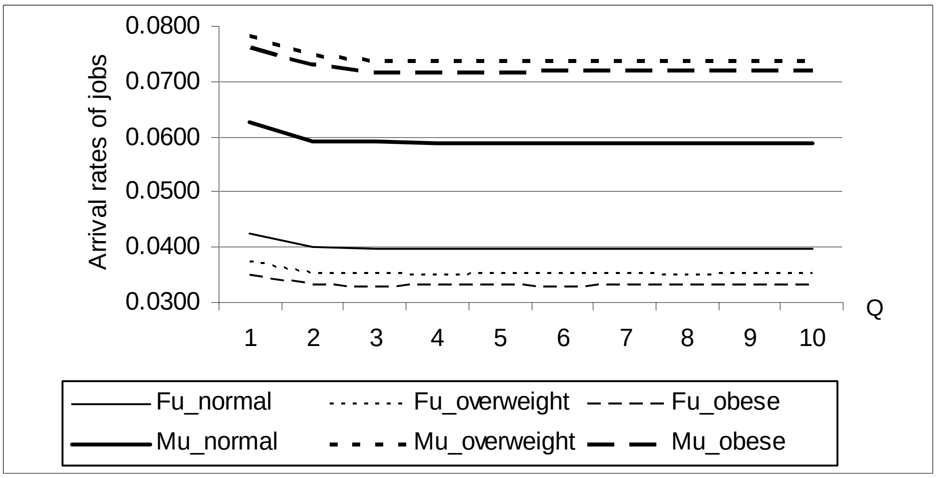

Figure 2: Average arrival rates of jobs when unemployed by gender and weight

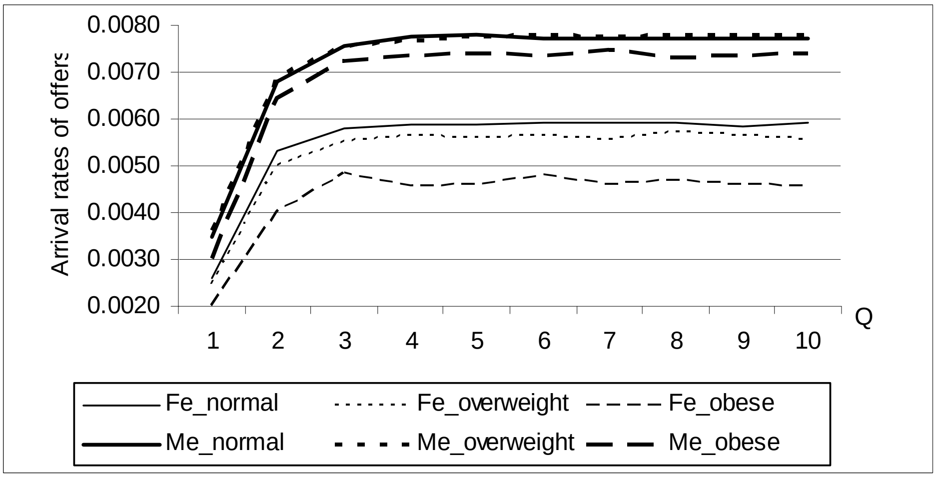

Figure 3: Arrival rates of offers when employed by gender and weight

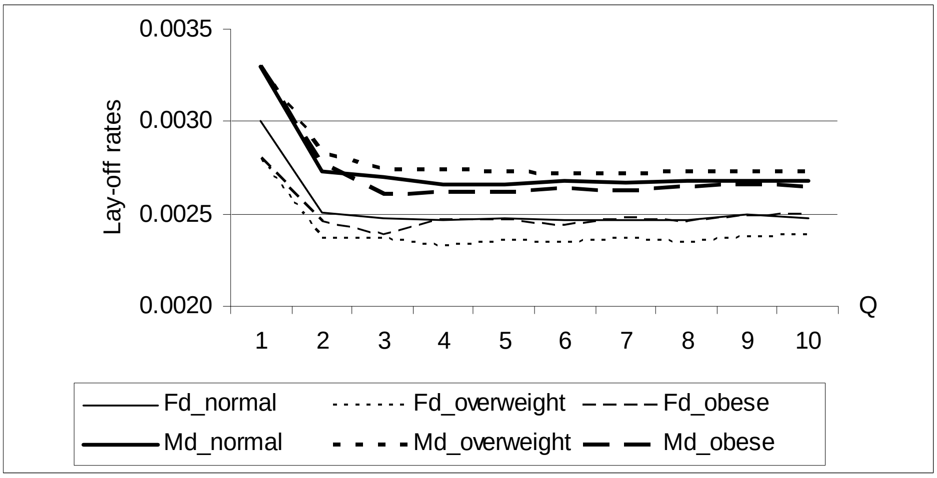

Figure 4: Average lay-off rates by gender and weight

APPENDIX 1: Data description for the ESM

The current study uses a representative sample from the 10%-sample of the Danish population aged 40 or 50 in November 1999 and covers the period 1985-2002. The sample is compiled from various administrative registers by Statistics Denmark for the Danish Institute of Local Government Studies (AKF). The data set includes demographic characteristics, income, labor market history, education, the place of residence and information about an individuals BMI value in 2000. The data is a longitudinal data set that, on a monthly basis, distinguishes spells of absence from the labor force, unemployment and employment, and in the latter case monitors changes in employer. In addition, an average hourly wage is recorded for each individual in each year. As an approximation, we consider this wage figure to be the reemployment wage. From this data set, we extract a sample consisting of all individuals active in the labor market the 1/1 1998 and people becoming active later for the search model and use all observations for 2000 for the segregation.

For the search model, we record the duration of the spell of employment and unemployment, the reemployment wage, and the duration of a subsequent spell, along with the destination, i.e. information on whether the job ended in a lay-off or a quit for employed spells. Lastly we observe whether a spell is censored. The data set furthermore contains observable individual characteristics, and we group the observations to control non-parametrically for variations in sex and education. Age is naturally controlled for in the way the sample has been selected. We also have divided the sample into different educational levels. Finally, since some of the statistical procedures are sensitive to the behavior of order statistics, we trim the highest and lowest 1% of the wage observations in each subsample (Kiefer & Neumann (1994)). A total of 5969 observations meet our selection criteria and remain in the trimmed sample.

The current analysis follows the definition of the labor market states as given by AKF. In particular, open unemployment and participation in active labor market programs (ALMPs) is aggregated into unemployment. Although there are formal job search requirements in order to be officially registered as unemployed, the recorded transitions between unemployment and out-of-labor force may to some extent reflect institutional settings and not the underlying individual behavior. However, the question of how and whether to distinguish unemployment and non-participation has been a problem for economists since Clark, Summers, Holt, Hall & Baily (1979). Recent studies suggest that neither of these states are homogenous but rather different ends of a continuous spectrum of search intensity (Jones & Riddell (1999) and Jones & Riddell (2002). Hence, the distinction between these two states is always an approximation.

APPENDIX 2: Empirical method

Starting with homogenous firms and workers, the distribution to be used for the length of an unemployment spell can be derived from the assumptions underlying the theoretical model. From the assumptions it is clear that any worker can be contacted by each firm. Thus, the total number of offers actually received by a particular worker, call it X, is binomially distributed with "probability of success" equal to the probability of being contacted, $(1/L)$. The last holds because we have a Nash equilibrium, where firms never post wages below the reservation wage r_i, resulting in a probability of an accepted offer of one for unemployed workers. The total number of job applications sent is equal to the number of firms, F. It is convenient to use the fact that the binomial distribution is approximated by the Poisson with mean $\lambda = F/L$ when F is large and $1/L$ small. A Poisson approximation to binomial probabilities works quite well if $F > 100$ and $1/L < 0.05$ or $1/L > 0.95$. Using a Poisson arrival processes, the crucial implications is that offers arrive one at a time and that the probability of receiving an offer does not depend on the duration of a spell.

What we are interested in is the hazard rate as it allows us to approximate the probability of exiting a state, conditional on being in that state at least until time t. Roughly speaking, the hazard rate is the rate at which spells are completed after duration T, given that they last at least until t.[12] It can be shown that the hazard rate for the transition from unemployment to employment is:

$$h_u(t) = \lim_{\varepsilon \to 0} \frac{prob(t \leq t_u \leq t + \varepsilon | t_u \geq t)}{\varepsilon} = \lim_{\varepsilon \to 0} \frac{F_u(t+\varepsilon) - F_u(t)}{\varepsilon S_u(t)} = \frac{f_u(t)}{S_u(t)} = \lambda_u.$$

The interpretation of the estimated arrival rate for unemployed workers can best be illustrated with a small example, as follows: Let $\lambda_u = 0.0236$. Then the monthly chance of being employed, given that you are still unemployed is roughly 2.5 percent, and the implied expected duration of the unemployment spell is $1/0.0236 = 42.37$ or about 42 months. A value of zero for λ_u, meaning no firms are looking for workers, results in a degenerated wage distribution with firms only offering the reservation wage. As λ_u increases to infinity which corresponds to complete information and perfect mobility, the competitive solution where all workers are paid their marginal product emerges. For values of λ_u between zero and infinity, the non-degenerate wage offer distribution $G(w)$ as we have already found results.

If we instead look at the spells of employment, they are assumed to end at layoff or on receipt of a better offer. When information on specific causes of leaving employment is available in addition to information on durations, a Competing Risks (CR) framework is typically used for the analysis (see Mealli & Pudney (1996)).

The CR framework is used when exit can arise from two or more sources. For a single spell, the CR model specifies the joint distribution of two variables: the spell duration, assumed to be a continuous variable, and the destination variable, des, which is an integer variable taking values in the set $\{1 \dots . m\}$, if there are m possible destinations.

In our case, to take the different destinations into account after employment, we specify a competing risks model with 2 distinct destinations, assuming that they are mutually exclusive. As it was the case for unemployment spell duration, job spells will be exponential distributed. As a result the hazard rate for the duration distribution of employment spells ending in a layoff is constant with rate σ:

$$h_\sigma(t) = \sigma.$$

The hazard rate for the distribution of employment durations ending in a quit requires not only the arrival of an offer on the job, λ_e, but in addition that the new offer exceeds the on-the-job reservation wage viz. the current wage w. Consequently, the hazard rate is the product of the offer arrival rate and the probability that an offer is acceptable, hence, the rate is:

$$h_e(t) = \lambda_e(1 - G(w)) = \lambda_e \left[1 - \frac{\sigma + \lambda_e}{\lambda_e} \left(1 - \left(\frac{P-w}{P-r} \right)^{1/2} \right) \right] = (\sigma + \lambda_e) \left(\frac{P-w}{P-r} \right)^{1/2} - \sigma.$$

In this setting the joint distribution may be written as

$$f(t, des1 | w, hc1) = ((1 - des1) h_\sigma + des1 h_e) \, S(t),$$

where $S(t)$ denotes the survivor function for t. In the present case, this depends on the hazards for the employment spells ending in a quit and the employment spells ending in a layoff and is given by

$$S(t) = P(\text{stay in a job at time } t | \text{being working until time } t-1) = exp(-\,(h_\sigma + h_e)\, t).$$

Inserting the survival function in the competing risks framework we have

[12] The hazard function can be used to approximate a conditional probability in much the same way as the height of the density of T can be used to approximate an unconditional probability.

$$f(t, des1|w, hc1) = \left((1-des1)\sigma + des1\left((\sigma+\lambda_e)\sqrt{\frac{P-w}{P-r}} - \sigma\right)\exp\left(-(\sigma+\lambda_e)\sqrt{\frac{P-w}{P-r}}t\right)\right).$$

With this we have found all the functions which are needed to write up the likelihood function. As already mentioned the structural parameters we want to estimate are $\psi = (\lambda_u, \lambda_e, \sigma, p, b)$. However, it is useful for empirical purposes to reparameterize this set to $\varphi = (\lambda_u, \lambda_e, \sigma, r, h)$. This is possible because the wage offer density and the reservation wage allow writing each of r and h as a weighted average of the structural parameters b and p (see Bunzel et al. (2001)). Thus, the function used in the likelihood functions below has to be rewritten using the reservation wage and highest wage instead of the unemployment benefit and the productivity.

For the two types of workers the likelihood functions will consist of one part for the workers employed in the first spell and one for workers unemployed in the first spell. We have the following possible combinations of spells. Either people are unemployed and get employed, employed and get unemployed, employed and get a new job or they do not change status in the observed period. Thus, the following likelihood functions arise,

$$L(\varphi) = \prod_{i=1}^{N} (uL_{ui}(\varphi))^{(1-ST)} ((1-u)L_{ei}(\varphi))^{ST},$$

where $u = \frac{\sigma}{\sigma+\lambda_u}$ is the unemployment rate, the contribution of an unemployed person is $L_{ui}(\varphi)$, and the contribution of an employed person is $L_{ei}(\varphi)$. In this study we further consider the additional information contained in the post-employment destination. We let $des1$ denote the destination after the first spell and $des2$ denote the destination after the second spell, defining $des1 = 0$ for a lay-off and $des1 = 1$ for a quit. In addition, we explicitly deal with the possibility of right-censored job durations and work with the indicators $hc1$ and $hc2$, defining $hc1 = 1$ for censored first spell and $hc1 = 0$ for uncensored first spell. In the same way $hc2$ is defined for censoring after the second spell. The log likelihood contribution for individuals who are unemployed at the time of observation can then be written as:

$$\ln uL_u(\varphi|ST=0) = \sum_{i=1}^{N_u}\left[\begin{array}{c} \ln(u) + (1-hc1)\ln(h_u) - \lambda_u t_1 + \ln(g(w_1)) \\ +(1-hc1)(1-hc2)\ln((1-des1)h_\sigma + des1 h_e) + (1-hc1)(-(h_\sigma+h_e)t_2) \end{array}\right].$$

For an individual employed at the time of observation, the log likelihood contribution is:

$$\ln(1-u)L_e(\varphi|ST=1) = \sum_{i=1}^{N_e}\left[\begin{array}{c} \ln(1-u) + (1-hc1)\ln((1-des1)h_\sigma + des1 h_e) + \ln S_e(t_1) + \ln s(w) \\ +(1-hc1)(1-des1)\ln P(des1=0) + (1-hc1)(1-hc2)(1-des1)\ln(h_u) \\ +(1-hc1)(1-des1)\ln S_u(t_2) + (1-hc1)des1\ln P(des1=1) \\ +(1-hc1)des1 S_e(t_2)(1-hc1)des1(1-hc2)\ln((1-des2)h_\sigma + des2 h_e) \end{array}\right],$$

where $P(des1 = 0) = \frac{\sigma}{\sigma+\lambda_e(1-G(w))}$ is the probability of a person getting unemployed after the first spell of employment and $P(des1 = 1)$ is the probability of a person getting a new job after the first spell.

When using the model with firm heterogeneity, the likelihood function is no longer only a function of the arrival rates and productivity parameters, but of the wage cuts as well. As in the homogenous case the structural parameters are reparameterized, by replacing P_j in the likelihood function with expressions for P_j derived from the restriction $G(h_j^o) = \alpha_j$, for $j = 1, 2, ..., Q-1$. The likelihood function is then a function of both the arrival rates and the wage cutoffs. The parameters to be estimated are now $\varphi = (\lambda_u, \lambda_e, \sigma, r, r_2, ..., r_Q, h, \alpha_1, \alpha_2, ..., \alpha_{Q-1})$, where the number of parameters depends on the number of firm types in the model.

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