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Investigating Exploitation and Productivity in Explaining the Disability Wage Penalty

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INVESTIGATING EXPLOITATION AND PRODUCTIVITY IN EXPLAINING THE DISABILITY WAGE PENALTY*

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Abstract

The paper explains the low wages of the disabled in a monopsonistic framework. In the disabled market firms face different costs of adjustment ("disabled-friendly" firm vs. "disabled-unfriendly" firm), high or low, and offer wages according to these costs. Hence, there will be high- and low-paid disabled. Also, employers can exploit the disabled to increase profits knowing that they face high search costs. This mechanism describes the pre-reform period. In the post-reform period, the adjustment costs are fully covered by programmes designed to help the disabled find and stay in work (e.g. Access to Work, 1996). In addition, legislation (Disability Discrimination Act, 1995) prohibits discrimination hence firms are not allowed to treat the disabled and non-disabled differently. These mechanisms are modelled using an extension of the simple Burdett-Mortensen model (1998). Using data from the BHPS, we find that in the post-reform period wages increase for the disabled and non-disabled but more for the disabled. Also, disabled at the bottom of the wage offer distribution (i.e. mainly disabled in low productivity firms) in the pre-reform period, move more to the right of the distribution in the post-reform period.

Keywords: disability; Burdett-Mortensen; productivity; distribution.
JEL classification: I10, I18, J42, J71.

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1. Introduction

We can think of the pay discrepancies between the disabled and non-disabled as a matter of: i) lower productivity of the disabled and ii) "exploitation" of the minority workers by the employers to increase profits. As we will see, these effects interact when discrimination and employer heterogeneity are prohibited.

In this paper, productivity differences are related to the different accommodation costs the employers face when they decide to hire a disabled worker. These costs are *real* but *environment* specific (e.g. the cost for a firm that might have already installed hearing loops for deaf people and no ramps for wheelchair users will be lower than the cost for another firm who has not made any of these adjustments). The costs can be high or low, i.e. low or high productivity employers respectively, with high productivity employers paying higher wages compared to the low productivity ones. It is important to mention that the wages of the disabled in high productivity firms will still be lower than the wages of the non-disabled as the outside options of the disabled are very low.

The disabled face low outside options as their mobility costs are high or because they have strong preference for part-time jobs to "accommodate" their disability. Employers know about these low outside options and so if disabled and non-disabled face the same job offer arrival rates they receive lower wages, as the search costs for the disabled are very high. Even when the disabled receive less job offers than the non-disabled, they still get lower wages (monopsonistic type of market). This describes the pre-reform period.

But, what if employers do not face a cost for adapting their workplaces or are forced to not discriminate against the disabled workers? Indeed, there are programmes that are designed to help the disabled find and stay in work. These programmes provide full coverage of the accommodation costs in case an employer decides to hire a disabled worker (e.g. Access to Work scheme in 1996).[1] Adding to this, legislation that bans discrimination in employment and related areas has been imposed in the UK (Disability Discrimination Act in 1995). Hence, in the post-reform period employers cannot differ in their productivities and are not allowed to offer different wages to different types of people.

The fact that employers face or not have to face adjustment costs as well as discriminate or not against the disabled makes crucial the distinction between the different types of markets in the pre- and post-reform period. In the pre-reform period, we have the

[1]More information about the Access to Work scheme can be found in *Appendix, Section A.1*.

non-disabled market and in the disabled market we have two types of firms; high or low productivity. On the other hand, in the post-reform period we think of an integrated market of disabled and non-disabled.

We discuss these mechanisms using as a benchmark the simple monopsony model (Burdett-Mortensen, 1998). The simple Burdett-Mortensen (B-M) model assumes that there are frictions in the labour markets, employers have market power that they exercise by setting wages *before* meeting with the workers and there is no wage bargaining. Employers make wage offers to workers and then workers decide to accept or reject them. In equilibrium, all employers earn the same profit. An available extension of the B-M model allows us to account for employer heterogeneity and we use this model to explain what happens in the disabled market in the pre-reform period. In the post-reform period, we *further* extend the B-M to account for the existence of the integrated market of disabled and non-disabled, where employers' heterogeneity is not present and discrimination is prohibited.

The models predict that in the post-reform period the wages increase for the disabled workers but not as much for the non-disabled ones. Also, in the pre-reform period disabled workers who were at the bottom of the wage offer distribution will move more to the right of the distribution in the post-reform period, as now employers are equally productive and they must offer them higher wages than before. The ones at the top of the distribution will not be affected as they were already receiving high wages and very close to the non-disabled ones. Pragmatically, using data from the BHPS (1991-2009) we find that in the post-reform period the wages of both disabled and non-disabled increase but *more* for the disabled. Also, in the post-reform period, the wage offer distribution for the disabled is much higher for lower wages. At the same time, job shopping seems to be more important for the non-disabled.

The structure of the paper is as follows. The next section is an overview of relevant studies that look at the effectiveness of anti-discrimination legislation in the UK. Section 3 outlines the simple B-M (1998) and then presents in detail the models that we use to describe what happens in the pre- and post-reform period, together with some predictions derived from these models. Section 4 describes the data and discusses the results and Section 5 concludes.

2. Disability and Anti-Discrimination Legislation

Anti-discrimination legislation was introduced in the UK, namely the Disability Discrimination Act (DDA) in 1995. The DDA aimed to protect disabled people from direct discrimination in employment and related areas. The DDA was implemented in three phases:

in the first (1996), it is illegal to treat disabled people less favourably because of their disability. In the second (1999), employers should make "*reasonable adjustments*" for their disabled employees and customers such as additional support or equipment (perhaps providing bank statements in large prints for those with sight problems). In the third and final phase (2004), employers may have to make additional adjustments related to physical alterations to their premises so that they remove any access barriers. The latter might include putting bigger signs for customers with sight problems, installing an induction loop for deaf people or ramps for those with wheelchairs.[2] Even companies who employ fewer than 15 people are not exempt from this rule.[3] The Act states that a person is thought of as disabled if he or she has *"a physical or mental impairment which has a substantial and long-term adverse effect on his or her ability to carry out normal day-to-day activities"*.[4] Some of the main critics of the Act point out that additional costs imposed by the legislation such as hiring and firing, possible litigation and adjustment costs as well as higher discount rates through more uncertainty may lower employment rather than raise it.

It is a matter of fact that the DDA has not received much attention, mainly due to the lack of data and suitable definitions for disability pre- and post-Act. Only a few studies have been focused *directly* on the impact of the DDA on employment. Namely, Bell and Heitmueller (2009) in order to account for different disability definitions make use of the BHPS and FRS data. The main advantage of both data sources is that they have a DDA and a work-limiting disability question which allow for comparisons in the pre- and post-legislation period. By applying the difference-in-differences approach, they show that post-DDA employment rates moved into different directions depending on the data source: a 3.5%-4.5% *decrease* using the BHPS data and an up to 1% *increase* using the FRS data. However, the positive effect of the DDA on employment is not indicative of the impact of legislation since unobserved individual heterogeneity across the disabled is not controlled for in this case. For this reason, they conclude that DDA resulted mainly in a decline of employment rates of the disabled in the immediate post-DDA period. They suggest that possible reasons for the absence of a significant impact of the legislation may have been its non-enforcement or the absence of considerable changes in the perceived costs of physical adjustments or in the expected costs of non-compliance.

[2]The law specifically states that they can make alterations in four ways: i) "*remove the barrier or obstacle*, ii) *altering* such as adding a ramp, iii) *find means of avoiding the problem* - for instance, reconfiguring the internal layout of a building and iv) *providing a service by reasonable alternative means* (for example, a GP with an inaccessible surgery may see patients in their homes)".

[3]The *latest* UK anti-discrimination legislation is *Equality Act (2010)*.

[4]More information about the DDA definition can be found in *Appendix, Section A.1*.

Adding to the UK evidence, Jones (2005) using data from the LFS aims at testing whether there is employment discrimination against the disabled after the implementation of the DDA (1995). She finds that the employment gap between the disabled, especially the work-limited, and the non-disabled has narrowed for both genders following the DDA thereby indicating a positive effect of the legislation. In 2008, she reports again a narrowing of the post-DDA employment gap. However, this positive effect is not consistent with a direct effect of the provisions of the DDA as the rise in employment rates is not observed in the small firms who are not anymore excluded from the legislation. She concludes that the DDA probably only created a more favourable environment for the disabled through increasing awareness of the employment potential of the disabled. In a later study, (Jones, 2009) making use of a previously unexploited data source (HSE), she comes into results similar to the US studies. Specifically, by innovatively converting the cross-sectional data to a pseudo panel and avoiding biased estimates of the effect of the legislation on employment, she finds a reduction in employment of the disabled by about 3% in the post-DDA period.

Overall, it can be concluded that the effect of legislation designed to improve the position of the disabled in the labour market has been quite contradictory in the UK.

3. Models of Monopsony

3.1 Why Monopsony?

In this paper we do not think of a standard perfectly competitive labour market to explain wage dispersion and there are certain reasons for this. For example, if the market was competitive then the wages of the workers in low productivity firms should not be determined by the high accommodation costs that employers face for hiring this type of workers. Similarly, if we think of the analysis of the returns to human capital, then workers should receive no return from firm-specific human capital. But, is it really this the case? As Becker (1993) puts it "one might plausibly argue that the wage paid by firms would be independent of training". Hence, a perfectly competitive model does not seem to be the best way forward in our case.

"The main advantage of a monopsonistic approach is that the way someone thinks about labour market is more "natural" and less forced" Alan Manning (2003)

The use of a monopsony model is important in this paper as workers do not perceive markets as frictionless and wage dispersion is a natural result of competitive forces not being strong enough to leave out of the market the low-wage employers. We think of monopsony as the firm not having a perfectly elastic labour supply (because in order to have a larger workforce, a firm must offer a higher wage). A monopsonistic model such as the simple job search general equilibrium model (B-M, 1998) is based on three assumptions: firstly, markets are not without frictions (referring to job rents) so a separation of a worker and an employer will make both parties worse off (the worker has to look for another job and the employer has to look for a new worker). Secondly, allowing for these frictions, employers get enough market power which they then exercise by setting wages *prior* to their meeting with the workers, and finally there is no wage bargaining.

It is important to see that compared to the non-disabled, the disabled face higher frictions in the labour market as: i) there is a limited job mobility of workers with disabilities, ii) the disabled prefer to work more part-time so that they can "accommodate" their disability, iii) there is a large heterogeneity within the disabled population and iv) mobility costs are very high compared to the ones for the non-disabled.

Any productivity differences between employers can be understood as different accommodation costs for hiring a disabled worker. As mentioned above, the costs that the firms face are *real* but *environment* specific. For instance, the cost of buying Braille keyboards for blind people for any firm and the cost of running an inclusive learning plan programme for a university will not be the same as the cost for a completely "disabled-unfriendly" firm. In other words, the cost for a firm without having made any adaptations is greater than the cost for a firm having made a few adjustments. Higher accommodation costs imply lower marginal revenue flow per worker and we refer to a low productivity employer in this case. In equilibrium the wages of the disabled employed by low productivity employers will be lower compared to the wages paid by high productivity employers (the search cost for the disabled is always much higher).

What is unique in this paper is the application of the B-M model to disability together with the extension of this model that we propose. Our extension allows for no discrimination when employers do not differ in productivities, hence it refers to the case of an integrated market of disabled and non-disabled. Then,

- In the pre-reform period, we have i) non-disabled, ii) disabled in high productivity employers and iii) disabled in low productivity employers.

- In the post-reform period, as we examine two reforms (no employer heterogeneity in the disabled market and no discrimination) we can have: i) non-disabled and disabled with identical workers and employers or ii) an integrated market of disabled and non-disabled. In the latter case, employers have to offer the same wages to everybody and at the same time there is no employer heterogeneity.

We continue with an outline of the benchmark model and we then present the different models in the pre- and post-reform period.

3.2 Burdett-Mortensen Model (1998): an overview

We are building our model by firstly presenting the simple B-M (1998) model. Firms are assumed to have identical constant returns to scale production functions with average and marginal product of workers equal to p. Workers are also identical meaning that each has the same value of leisure *b*. Some workers are employed and others are unemployed. The wage offer distribution of the workers and potential workers is $F(w)$ and the job offer arrival rate is λ.[5] An employed worker accepts a wage offer if it is greater than his current wage while an unemployed worker accepts any offer greater than the reservation wage *R*. In equilibrium there is no point in any firm offering a wage less than *b*, therefore an unemployed worker will accept any job offer. Finally, the job destruction rate is δ (movement from employment to unemployment) and is exogenous.

In equilibrium, all firms earn the same profit:

$$\pi(w) = \frac{\delta(p-w)}{\{\delta + \lambda[1-F(w)]\}^2} \tag{1}$$

and when $w = R = b$, (1) becomes:

$$\pi(b) = \frac{\delta(p-b)}{\{\delta + \lambda[1-F(b)]\}^2} \tag{2}$$

with $F(b) = 0$.

[5]For simplicity, we assume that the job offer arrival rates are the same for the employed and unemployed ($\lambda^1 = \lambda^0$, where λ^1 is the job offer arrival rate of the employed [job-to-job moves] and λ^0 is the job offer arrival rate of the unemployed). An analytic representation of the model in case the job offer arrival rates of the employed and unemployed differ can be found in *Appendix, Section A.4*.

After setting (1) equal to (2) and doing some further calculations the equilibrium job offer distribution is given by the following condition:

$$F(w) = \frac{\delta + \lambda}{\lambda}\left[1 - \sqrt{\left(\frac{p-w}{p-b}\right)}\right] \tag{3}$$

The fraction of employed workers receiving wage *w* or less is $G(w)$. $G(w)$ differs from $F(w)$ because workers are more likely to work for high wage firms. There is a monotonic relationship between *F* and *G* which is shown below:

$$G(w) = \frac{\delta F(w)}{\delta + \lambda[1 - F(w)]} \tag{4}$$

with $G(w) < F(w)$ for any $0 < F(w) < 1$.

After substituting (3) to (4) we get the equilibrium wage distribution:

$$G(w) = \frac{\delta}{\lambda}\left[\sqrt{\left(\frac{p-b}{p-w}\right)} - 1\right] \tag{5}$$

3.3 Pre-reform period

In our concept, in the *pre-reform period* the wage offer distribution for the non-disabled workers becomes:

$$F_N(w) = \frac{\delta + \lambda_N}{\lambda_N}\left[1 - \sqrt{\left(\frac{p_N - w}{p_N - b}\right)}\right] \tag{6}$$

and their current wage distribution is:

$$G_N(w) = \frac{\delta}{\lambda_N}\left[\sqrt{\left(\frac{p_N - b}{p_N - w}\right)} - 1\right] \tag{7}$$

where λ_N is the job offer arrival rate of the non-disabled, p_N is the employer's revenue flow per non-disabled worker and the job destruction rate (δ) is assumed to be the same for both disabled and non-disabled.

To account for employer heterogeneity in the disabled market, *p* now varies with the type of employer; p_D is the revenue flow of the low productivity employer and p_N is the revenue flow of the high productivity employer with $p_N > p_D$. Furthermore, the fraction of

high productivity employers is denoted by σ whilst $1-\sigma$ is the fraction of low productivity employers. The rest of the assumptions made in the *benchmark* model are the same here.

In equilibrium, high productivity employers will offer higher wages to (potential) disabled workers. Then, the equilibrium job offer distribution for each of the different types of employers in the disabled market has the following form:

$$F_j^D(w) = \frac{\delta + \lambda_D}{\lambda_D}\left[1 - \sqrt{\left(\frac{p_j - w}{p_j - b}\right)}\right] \tag{8}$$

where $j = D, N$ denotes the low and high productivity employers respectively and λ_D is the job offer arrival rate of the disabled. Their respective current wage distribution will be:

$$G_j^D(w) = \frac{\delta}{\lambda_D}\left[\sqrt{\left(\frac{p_j - b}{p_j - w}\right)} - 1\right] \tag{9}$$

The overall *F* will be a weighted sum (by $1-\sigma$ and σ respectively) of $F_D^D(w)$ and $F_N^D(w)$. Hence,

$$F_{all}(w) = (1-\sigma)F_D^D(w) + \sigma F_N^D(w) \tag{10}$$

In expanded form, using (8) and knowing that:

i) the lowest wage the disabled in low productivity firms can get is *b*,

ii) the lowest wage the disabled in high productivity firms can get is p_D, then (10) becomes:

$$F_{all}(w) = \frac{\delta + \lambda_D}{\lambda_D}\left\{(1-\sigma)\left[1 - \sqrt{\left(\frac{p_D - w}{p_D - b}\right)}\right]I(w < p_D) + \sigma\left[1 - \sqrt{\left(\frac{p_N - w}{p_N - p_D}\right)}\right]I(w > p_D)\right\}$$

3.4 Post-reform period

In the *post-reform period*, we distinguish between two reforms: i) no accommodation costs in the disabled market (employers are identical) and ii) no discrimination. In the first case, the equilibrium offer distribution of the disabled is:

$$F_D^{post}(w) = \frac{\delta + \lambda_D}{\lambda_D}\left[1 - \sqrt{\left(\frac{p_N - w}{p_N - b}\right)}\right] \tag{11}$$

and their current wage distribution is:

$$G_D^{post}(w) = \frac{\delta}{\lambda_D}\left[\sqrt{\left(\frac{p_N - b}{p_N - w}\right)} - 1\right] \tag{12}$$

The respective *F* and *G* distributions in the non-disabled market have the same form as in the pre-reform period, thus

$$F_N^{post}(w) = \frac{\delta + \lambda_N}{\lambda_N}\left[1 - \sqrt{\left(\frac{p_N - w}{p_N - b}\right)}\right] \text{ and } G_N^{post}(w) = \frac{\delta}{\lambda_N}\left[\sqrt{\left(\frac{p_N - b}{p_N - w}\right)} - 1\right] \tag{13}$$

The second case is where we further extend the B-M model. Our extension allows for the existence of an integrated market of disabled and non-disabled. Now, the firms have to offer the same wages to both disabled and non-disabled. Therefore, the wage offer distribution is *common*, $F^{post}(w)$, but the rest of the assumptions made in the *benchmark* model remain the same. We should note that even with a common *F*, the actual wage distribution *G* will still differ for the disabled and non-disabled, $G_i^{post}(w)$, but now assuming that the disabled move more quickly up the wage distribution.

At this stage it is helpful to explain some notation:

- $F^{post}(w)$: job offer distribution in the post-reform period if discrimination and employer heterogeneity are prohibited,
- γ: proportion of the disabled,
- $(1-\gamma)$: proportion of the non-disabled,
- $A_1 = \frac{\gamma\lambda_D}{\gamma\lambda_D + (1-\gamma)\lambda_N}$: proportion of the disabled that a firm offering wage *w* would like to recruit at a given time,
- $A_2 = \frac{(1-\gamma)\lambda_N}{\gamma\lambda_D + (1-\gamma)\lambda_N}$: proportion of the non-disabled that a firm offering wage *w* would like to recruit at a given time.

The relationship between $F^{post}(w)$ and $G_i^{post}(w)$ with $i = N, D$ (*N* if non-disabled and *D* if disabled) is:

$$G_i^{post}(w) = \frac{\delta F^{post}(w)}{\delta + \lambda_i[1 - F^{post}(w)]} \tag{14}$$

Then, the profits that the firms earn are the sum of the matching probabilities of the two types of workers, disabled and non-disabled:

$$\pi^{post}(w) = \frac{(1-\gamma)\lambda_N(p_N - w)}{[\delta + \lambda_N(1-F^{post}(w))]^2[\gamma\lambda_D + (1-\gamma)\lambda_N]} +$$

$$+ \frac{\gamma\lambda_D(p_N - w)}{[\delta + \lambda_D(1-F^{post}(w))]^2[\gamma\lambda_D + (1-\gamma)\lambda_N]}$$

and when $w = R = b$ with $F^{post}(b) = 0$, the above profits condition becomes:

$$\pi^{post}(b) = \frac{(1-\gamma)\lambda_N(p_N - b)}{(\delta + \lambda_N)^2[\gamma\lambda_D + (1-\gamma)\lambda_N]} + \frac{\gamma\lambda_D(p_N - b)}{(\delta + \lambda_D)^2[\gamma\lambda_D + (1-\gamma)\lambda_N]} \quad (15)$$

In order to obtain the equilibrium offer distribution, $F^{post}(w)$, we need to solve the equation below:

$$\frac{(1-\gamma)\lambda_N(p_N - w)}{[\delta + \lambda_N(1-F^{post}(w))]^2} + \frac{\gamma\lambda_D(p_N - w)}{[\delta + \lambda_D(1-F^{post}(w))]^2} = \frac{(1-\gamma)\lambda_N(p_N - b)}{(\delta + \lambda_N)^2} + \frac{\gamma\lambda_D(p_N - b)}{(\delta + \lambda_D)^2}$$

It is important to note that even though there is no analytical explicit solution to the above equation it has a form that can be easily solved numerically. Some qualitative predictions of all models are presented next.

3.5 Predictions for All Models

As for the wage and job offer distributions between the two types of people, knowing that in the pre- and post-reform period the disabled have lower job offer arrival rates than the non-disabled, any reform should improve the job offer distribution of the disabled but worsen it for the non-disabled. Also, in the pre-reform period we have a discrete type of firms (high or low productivity) so the wage offer distribution should be kinked. This should disappear in the post-reform period as there is only one type of firm (integrated market of disabled and non-disabled). Adding to this, disabled at the bottom of the distribution (mainly those in low productivity firms) in the pre-reform period should move to the right of the distribution in the post-reform period. This should not be the case for people at the top of the distribution.[6]

[6]We should note that since both wage and job offer distributions are functions of the job offer arrival rates, the effect of any reform also depends on the size of the job offer arrival rates and job destruction rates. For instance, a really big job offer arrival rate for the non-disabled will not change very much their respective actual wage distribution.

The models' predictions can be summarised as follows:[7]

$$F_N(w) < F_j^D(w) \quad \text{(P.1)}$$

$$G_N(w) < G_j^D(w) \quad \text{(P.2)}$$

$$F_N(w) < F_D^{post}(w) \quad \text{(P.3)}$$

$$G_N^{post}(w) < G_D^{post}(w) \quad \text{(P.4)}$$

$$F_D^{post}(w) < F_j^D(w) \quad \text{(P.5)}$$

$$F_N(w) < F^{post}(w) \quad \text{(P.6)}$$

$$F^{post}(w) < F_j^D(w) \quad \text{(P.7)}$$

$$F_N^{post}(w) < F^{post}(w) < F_D^{post}(w) \quad \text{(P.8)}$$

$$F_N^{post}(w) < F^{post}(w) < F_D^{post}(w) < F_D^D(w) < F_N^D(w) \quad \text{(P.9)}$$

4. Data and Analysis of the Results

The data used in this paper are from the BHPS covering all available waves between 1991 and 2009.[8] In the BHPS individuals were re-interviewed in consecutive waves providing detailed information on personal characteristics such as age, education and gender together with information on employment status, wages, and number of hours worked. Detailed questions on the presence of different types of health problems and any functional limitations caused by these health problems were also included in the survey.[9]

We restrict the sample to working age employed and non-employed men and women who are not likely to be in education, aged 21 to 60 years old. Self-employed and those on government training scenes are excluded.

In order to define the disabled and make comparisons between the pre- and post-reform period, ideally we need a DDA question in the survey. However, the lack of such question in the BHPS made it impossible to define differently the disabled and non-disabled in the two periods. Hence, a person is thought of as disabled in the pre- and post-reform period if he responded "Yes" to the questions "Do you have any of the health problems or disabilities listed on this card?" and "Does your health in any way limit your daily activities compared to most people of your age?". We define the pre-reform period as the period between 1991 and 1995 while the post-reform period covers the years between 2005 and

[7]The proofs of these predictions can be found in *Appendix, Section A.3*.
[8]Each wave starts in September and ends in April or May of the following year.
[9]More information about the BHPS can be found in *Appendix, Section A.2*.

2009. The post-reform period starts in 2005 so that the effect of all phases of the DDA is taken into account (all phases were presented in detail in Paper 1).

In order to make inferences for main labour market transitions (job offer arrival rates and job destruction rates), dummies for any movement from unemployment to employment and vice versa were created. An individual has moved from unemployment to employment (job destruction dummy is equal to one) if he was employed at the end of year $t-1$ and was no longer employed at the end of year t.[10] In any other case, the job destruction dummy is equal to zero. Similarly, an individual has moved from unemployment to employment (job offer arrival dummy is equal to 1) if he was unemployed at the end of year $t-1$ but was employed at the end of year t, otherwise the job offer arrival dummy is equal to zero.[11]

Having made the appropriate changes, the sample consists of 16,616 individuals in the pre- and 13,326 individuals in the post-reform period. Regarding how many of them are disabled and independently of their employment status, only 1,629 individuals, covering 9.8% of the total sample are disabled in the pre-reform period. In the post-reform period, the disabled account for a greater percentage, 13.4% of the total sample (1,784 individuals). Distinguishing by gender disabled women account for slightly more than disabled men in both pre- and post-reform period.[12]

In Table 1 we report descriptive statistics of the flows into and out of employment all of which are expressed as percentages of the total sample. The turnover rates in the last two columns of the table are higher for the disabled. However, the decrease in these rates between the pre- and post-reform period is higher for the disabled. We should mention that our results provide weak evidence of common job destruction rates between the disabled and non-disabled (in the post-reform period).

As for the transitions from unemployment to employment, when comparing the two types of people, as predicted non-disabled have higher job offer arrival rates than those with a disability in both periods. Overall, in the post-reform period the respective percentages for the two groups are lower compared to the pre-reform period, though the decrease is greater

[10]Job destruction could be *endogenous* for example, if the employee is sacked or *exogenous* if the employee decides to quit. Future research should consider the endogeneity or exogeneity of job destruction using the "job history" file available in the BHPS.

[11]It was not possible to check for job-to-job moves in the "individual respondent" file and hence, whether the assumption for the same job offer arrival rates between the employed and unemployed is valid due to the high non-response rates of the relevant variable. We could possibly test this assumption in the future through the "job history" file in the BHPS.

[12]In the pre-reform period, disabled men account for about 9.4% of the total sample of men. The respective percentage for women is 10.11%.
In the post-reform period, disabled men account for about 13.2% of the total sample of men. The respective percentage for women is 13.5%.

for the non-disabled. The latter is consistent with our prediction that the non-disabled miss out if discrimination is not allowed and employers are identical.

Table 1: Labour Market Transitions in the Pre- and Post-Reform Period

	Flows into employment $(U \rightarrow E)$		**Flows out of employment** $(E \rightarrow U)$	
	Non-disabled	Disabled	Non-disabled	Disabled
Pre-reform period	4.76%	3.01%	9.2%	11.79%
Post-reform period	3.43%	2.41%	7.46%	7.51%
Actual change	-1.33	-0.6	-1.74	-4.28
Change (%)	-21%	-19.9%	-18.9%	-36.3%

It is important to see how the wage and job offer distributions of both types of people in the pre- and post-reform period differ. In this way we can test the rest of the models' predictions.[13] The probability density functions are presented first, in Figures 1 and 2 and the cumulative distribution functions, only for those who move from unemployment to employment, are in Figure 3.

[13]We should mention that the wage and job offer distributions do not significantly differ when hourly instead of weekly wages are used.

Figure 1: Wage and Job Offer Probability Densities in the Pre- and Post-Reform Period for the Non-Disabled

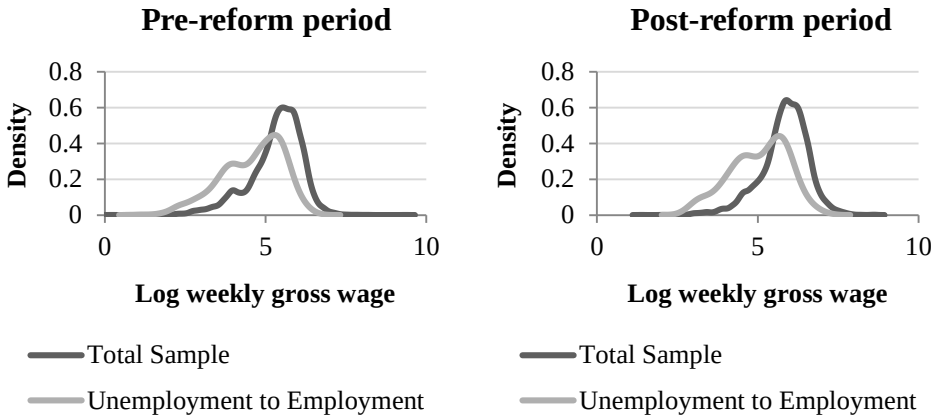


Figure 2: Wage and Job Offer Probability Densities in the Pre- and Post-Reform Period for the Disabled

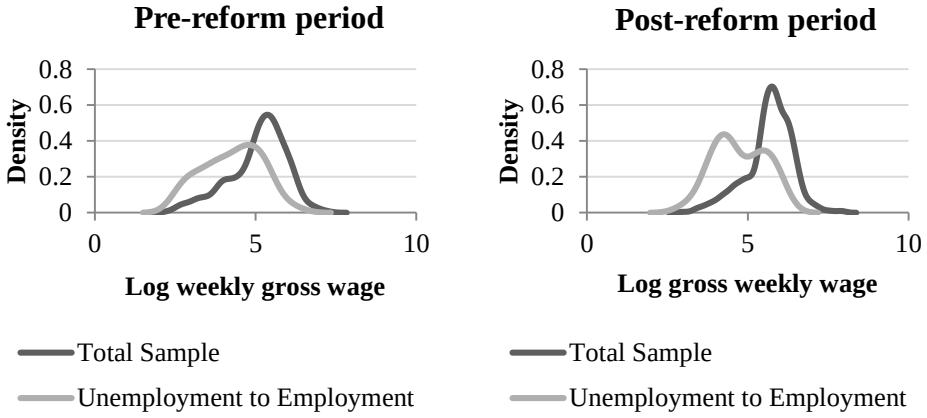
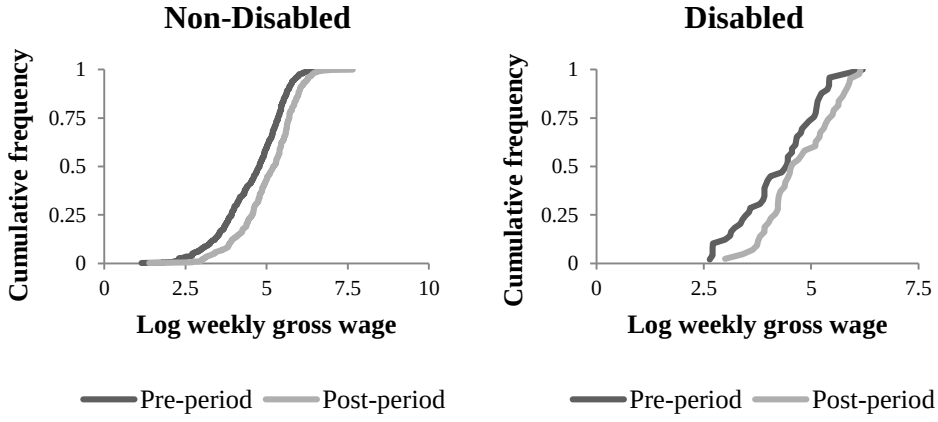


Figure 3: Job Offer Cumulative Densities in the Pre- and Post-Reform Period



The distributions are non-parametrically estimated using the kernel density estimation. In Figure 1, the distribution of wages across the non-disabled workers is represented by the dark grey line whereas the wage offer distribution is shown by the light grey line. We can see that in the post-reform period densities at both distributions are higher, especially for low wages (less than 5 log points). Thus, the offered wages have gone down for the non-disabled making job shopping more important (difference between *F* and *G* has increased) for this group of people.

The respective probability density graphs for the disabled are shown in Figure 2. Now, the shape of the densities is not as nice as for the non-disabled and this is mostly due to the small sample size of the disabled. It is important to note that in the post-reform period the density at the wage offer distribution does not change significantly for wages above 5 log points. This is in accordance with our predictions; disabled mostly in high productivity firms will not face big changes (if no changes at all) to their (offered) wages in the post-reform period (there is not much change at the top of the distribution). Also, in the post-reform period we can see that there are more disabled who receive wages below 5 log points (move-up of the kink for the wage offer distribution).[14]

Finally, looking at the cumulative densities of the disabled and non-disabled in the two periods, only for those who move from unemployment to employment (see *Figure 3* above), we can see that the wages of the disabled in the post-reform period grow faster than the wages of the non-disabled.

5. Conclusion

This paper looks at how wage discrepancies between the disabled and non-disabled can be understood as i) differences in employers' productivity and ii) "exploitation" of the disabled by the employers to increase profits. We allow for different mechanisms depending on whether discrimination or accommodation costs are present and so we distinguish between a pre- and a post-reform period.

In the pre-reform period, disabled workers in low productivity firms are paid lower wages compared to the ones in higher productivity firms but the wages of the latter are still below the non-disabled wage. This is because the disabled always face more difficulties

[14]We should not ignore that the accommodation effects may not be complete. Also, part of this higher wage offer distribution at low wages can be the effect of the minimum wage. In our sample, 10.9% of the disabled and 5.3% of the non-disabled would benefit from the minimum wage.

entering the labour market (e.g. due to large disability heterogeneity). In the post-reform period, employers do not face different accommodation costs (relevant programmes provide full financial support) and they are not allowed to discriminate by law (DDA, 1995). We model these mechanisms using the simple B-M (1998) model as a benchmark. An extension of this model is available allowing for employer heterogeneity and we use this model for the pre-reform period. In the post-reform period, we propose a further extension of the B-M model to account at the same time for non-discrimination and no employer heterogeneity.

From the above models, we predict that in the post-reform period the wages of the disabled should increase but not as much for the non-disabled. Also, disabled (mainly in low productivity firms) at bottom ends of the distribution should receive higher wages in the post-reform period. These predictions are tested using data from the BHPS between 1991 and 2009.

The results are in accordance with our predictions. We find that the wages of the disabled and non-disabled increase in the post-reform period but more for the disabled. In the same period non-disabled are more likely to accept low wages making job shopping more important for this type of people. On the other hand, disabled at lower ends in the pre-reform period, move more to the right of the wage offer distribution in the post-reform period (the distribution is much higher for low wages below 5 log points).

We believe that this is the first attempt to explain the wage gap between the disabled and non-disabled in a simple monopsonistic model. This paper however, is not without its drawbacks. We should not ignore the fact that we could not find a closed form solution for the equilibrium job offer distribution if there is no discrimination and employers do not differ in productivities.

Future avenues for research can perhaps consider finding numerically the form of the equilibrium wage offer distribution and so make clearer inferences about the effect of any type of reform. It will also be interesting to examine how these results vary when allowing for disability heterogeneity; it is often stated that disabled with mental health problems are treated less favourably in the labour market compared to those with other types of health problems but is this apparent in the post-reform period? The latter however can be tested only when we have a sufficient number of disabled workers with mental or mixed health problems so that we can make comparisons (again this potentially requires a dataset other than the BHPS with more detailed information on the types and severity of disability).

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Appendix

A.1 Further Comments on the DDA Definition and "Access to Work"

"A physical or mental impairment that has a substantial and long-term adverse effect on his/her ability to carry out normal day-to-day activities" (DDA, 1995)

- *Physical impairment*: a "weakening" of any part of the body caused through illness, by accident or congenitally, e.g. blindness, paralysis or heart disease,
- *Mental impairment*: a "clinically well-recognised" mental illness e.g. schizophrenia, anxiety or depression, or a learning disability,
- *Substantial*: the impact on normal day-to-day activities must be "more than minor or trivial" but not necessarily severe,
- *Long-term*: "the effect must have lasted, or is expected to last, for at least 12 months",
- *Adverse effect*: manual dexterity, physical coordination, ability to lift or carry everyday objects, continence, speech, hearing or eyesight, memory or ability to concentrate, learn or understand, or perception of risk of physical danger,
- *Normal day-to-day activities*: activities that are carried out on a regular basis such as doing the housework, climbing stairs or walking for at least 10 minutes.

(Pope and Bambra, 2005)

"*Access to Work* can help pay for the support someone may need because of their disability or long term health condition, for example:

- aids and equipment in the workplace,
- adapting equipment to make it easier to use,
- money towards any extra travel costs to and from work if the person cannot use available public transport, or if they need help to adapt a vehicle,
- an interpreter or other communication support at a job interview,
- other practical help at work, such as a job coach or a sign language interpreter."

(Source: Department for Work and Pensions)

A.2 British Household Panel Survey

The survey is conducted by the ESRC UK Longitudinal Studies Centre (ULSC) and the Institute for Social and Economic Research (ISER) at the University of Essex. Its aim is to understand any socio-economic changes in individual and household level in Britain and identify the causes and the consequences of these changes by using a wide range of variables. Each year over 5,000 households consisting of roughly 10,000 individuals have been interviewed.

A.3 Proofs of the Predictions of the Models

Proof of Prediction P.1

$$F_N(w) < F_j^D(w) \tag{A.1}$$

Assume that $\left[1-\sqrt{\left(\frac{p_N-w}{p_N-b}\right)}\right] \geq \left[1-\sqrt{\left(\frac{p_j-w}{p_j-\underline{w_j}}\right)}\right] \Rightarrow \sqrt{\left(\frac{p_N-w}{p_N-b}\right)} \leq \sqrt{\left(\frac{p_j-w}{p_j-\underline{w_j}}\right)} \Rightarrow$

$\Rightarrow (p_N-w)(p_j-\underline{w_j}) \leq (p_N-b)(p_j-w) \Rightarrow$

$\Rightarrow p_N p_j - p_N \underline{w_j} - w p_j + w\underline{w_j} \leq p_N p_j - p_N w - b p_j + wb \Rightarrow$

$$\Rightarrow w\underline{w_j} - p_N \underline{w_j} - w p_j \leq wb - p_N w - b p_j \tag{A.2}$$

Then, we consider two cases:

First, if $\underline{w_j} = \underline{w_D} = R = b$ and $p_j = p_D$, equation (A.2) becomes

$wb - p_N b - w p_D \leq wb - p_N w - b p_D \Rightarrow p_N w - p_N b \leq w p_D - b p_D \Rightarrow$

$\Rightarrow p_N(w-b) \leq p_D(w-b) \Rightarrow p_N \leq p_D$, which contradicts the assumption that $p_N > p_D$.

Second, if $\underline{w_j} = \underline{w_N} = \overline{w_D}$ and $p_j = p_N$, equation (6.2.2) becomes

$w\overline{w_D} - p_N \overline{w_D} - w p_N \leq wb - p_N w - b p_N \Rightarrow (w-p_N)\overline{w_D} \leq (w-p_N)b \Rightarrow \overline{w_D} \leq b$,

which contradicts the assumption that $\overline{w_D} > b$.

Therefore, it should be that $\left[1-\sqrt{\left(\frac{p_N - w}{p_N - b}\right)}\right] < \left[1-\sqrt{\left(\frac{p_j - w}{p_j - \underline{w_j}}\right)}\right]$.

But, we also know that $\frac{\delta + \lambda_N}{\lambda_N} < \frac{\delta + \lambda_D}{\lambda_D}$, as $\lambda_N > \lambda_D$.

Hence, it should hold that $F_N(w) < F_j^D(w)$.

Proof of Prediction P.2

$$G_N(w) < G_j^D(w) \tag{A.3}$$

From (A.1) and since *G* is a monotonic transformation of *F*, it can be easily seen that $G_N(w) < G_j^D(w)$.

Proof of Prediction P.3

$$F_N(w) < F_D^{post}(w) \tag{A.4}$$

Since $\lambda_N > \lambda_D \Rightarrow \frac{\delta + \lambda_N}{\lambda_N} < \frac{\delta + \lambda_D}{\lambda_D}$ it should be that $F_N(w) < F_D^{post}(w)$.

Proof of Prediction P.4

$$G_N^{post}(w) < G_D^{post}(w) \tag{A.5}$$

From (A.4) and since *G* is a monotonic transformation of *F*, it should also be that $G_N^{post}(w) < G_D^{post}(w)$.

Proof of Prediction P.5

$$F_D^{post}(w) < F_j^D(w) \tag{A.6}$$

The intuition is the same as for $F_N(w) < F_j^D(w)$.

Proof of Predictions P.6 and P.7

$$F_N(w) < F^{post}(w) \text{ and } F^{post}(w) < F_j^D(w) \tag{A.7}$$

If $\hat{\gamma}_i = \frac{\gamma_i \lambda_i}{\sum_{i=N,D} \gamma_i \lambda_i}$, $\hat{\gamma}_i > 0 \ \ \forall i$, is the proportion of the workers the firm will recruit at a given wage w in the post-reform period under the second aspect of the legislation ($i = N, D$ for the non-disabled and disabled respectively).

We know from (A.1) that $F_N(w) < F_j^D(w)$

where, $j = 1,2$ (low and high productivity employers respectively),

and in equilibrium it should hold that (profit maximization condition)

$$\frac{(p_N - w)}{\left[\delta + \lambda_i (1 - F_i(w))\right]^2} = \frac{(p_N - b)}{(\delta + \lambda_i)^2}. \tag{A.8}$$

$$\text{Also, } (p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F_i(w))]^2} = (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{(\delta + \lambda_i)^2} \tag{A.9}$$

If $F^{post}(w) \le F_N(w)$ then it should be that $F^{post}(w) < F_j^D(w)$.

Hence,

$$(p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} < (p_N - w) \sum_{i,j=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F_j^D(w))]^2} \Rightarrow$$

$$\overset{(A.8)}{\Rightarrow} (p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} < (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{(\delta + \lambda_i)^2}, \text{ which contradicts (A.9).}$$

Therefore, it must be that $F^{post}(w) > F_N(w)$.

Suppose that $F^{post}(w) \ge F_j^D(w)$. Then, it should be that $F^{post}(w) > F_N(w)$.

$$(p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} > (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F_i(w))]^2} \Rightarrow$$

$$\overset{(A.8)}{\Rightarrow} (p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} > (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{(\delta + \lambda_i)^2}, \text{ which contradicts (A.9).}$$

Thus, it must be that $F^{post}(w) < F_j^D(w)$.

Proof of Prediction P.8

$$F_N^{post}(w) < F^{post}(w) < F_D^{post}(w) \tag{A.10}$$

If $\hat{\gamma}_i = \frac{\gamma_i \lambda_i}{\sum_{i=N,D} \gamma_i \lambda_i}$, $\hat{\gamma}_i > 0 \ \ \forall i$, is the proportion of the workers the firm will recruit at a given wage w in the post-reform period under the second aspect of the legislation ($i = N, D$ for the non-disabled and disabled respectively).

We know that

$$F_N^{post}(w) < F_D^{post}(w) \tag{A.11}$$

and in equilibrium it should hold that (profit maximization condition)

$$\frac{(p_N - w)}{[\delta + \lambda_i (1 - F_i^{post}(w))]^2} = \frac{(p_N - b)}{(\delta + \lambda_i)^2}. \tag{A.12}$$

$$\text{Also, } (p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F_i^{post}(w))]^2} = (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{(\delta + \lambda_i)^2} \tag{A.13}$$

If $F^{post}(w) \leq F_N^{post}(w)$ then it should be that $F^{post}(w) < F_D^{post}(w)$.

Hence,

$$(p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} < (p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F_i^{post}(w))]^2} \Rightarrow$$

$$\overset{(A.12)}{\Rightarrow} (p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} < (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{(\delta + \lambda_i)^2}, \text{ which contradicts (A.13).}$$

Therefore, it must be that $F^{post}(w) > F_N^{post}(w)$ (A.14)

Similarly, suppose that $F^{post}(w) \geq F_D^{post}(w)$. Then, it should be that $F^{post}(w) > F_N^{post}(w)$.

Hence,

$$(p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} > (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F_i^{post}(w))]^2} \Rightarrow$$

$$\overset{(A.12)}{\Rightarrow} (p_N - w) \sum_{i=N,D} \frac{\hat{\gamma}_i}{[\delta + \lambda_i (1 - F^{post}(w))]^2} > (p_N - b) \sum_{i=N,D} \frac{\hat{\gamma}_i}{(\delta + \lambda_i)^2}, \text{ which contradicts (A.13).}$$

Thus, it must be that $F^{post}(w) < F_D^{post}(w)$ (A.15)

From (A.11), (A.14) and (A.15) we can conclude that

$F_N^{post}(w) < F^{post}(w) < F_D^{post}(w)$

Proof of Prediction P.9

$$F_N^{post}(w) < F^{post}(w) < F_D^{post}(w) < F_N(w) < F_D(w) \quad \text{(A.16)}$$

It comes from the fact that $F_N^{post}(w) < F^{post}(w) < F_D^{post}(w)$, $F_D^{post}(w) < F_j^D(w)$, $F_N^D(w) < F_D^D(w)$ and $F^{post}(w) < F_j^D(w)$.

A.4 Non-Discriminating Monopsony with Different Job Offer Arrival Rates for the Employed and Unemployed

λ_N^0 : job offer arrival rate of an unemployed non-disabled person

λ_N^1 : job offer arrival rate of an employed non-disabled person

λ_D^0 : job offer arrival rate of an unemployed disabled person

λ_D^1 : job offer arrival rate of an employed disabled person

γ_1 : fraction of employed disabled

γ_2 : fraction of unemployed disabled

$(1-\gamma_1)$: fraction of employed non-disabled

$(1-\gamma_2)$: fraction of unemployed non-disabled

The proportion of the non-disabled that the firm offering wage w would like to recruit at a given time will be

$$A_N = \frac{(1-\gamma_1)\lambda_N^1}{\gamma_1\lambda_D^1 + (1-\gamma_1)\lambda_N^1} + \frac{(1-\gamma_2)\lambda_N^0}{\gamma_2\lambda_D^0 + (1-\gamma_2)\lambda_N^0},$$

while the proportion of the disabled will be

$$A_D = \frac{\gamma_1\lambda_D^1}{\gamma_1\lambda_D^1 + (1-\gamma_1)\lambda_N^1} + \frac{\gamma_2\lambda_D^0}{\gamma_2\lambda_D^0 + (1-\gamma_2)\lambda_N^0}.$$

The profits that the firms earn will be the sum of the matching probabilities of the four types of workers (employed disabled, employed non-disabled, unemployed disabled and unemployed non-disabled) hence,

$$\pi^{post}(w) = A_N \frac{(p-w)(\delta + \lambda_N^1)\lambda_N^0}{(\delta + \lambda_N^0)[\delta + \lambda_N^1(1-F^{post}(w))]^2} +$$

$$+ A_D \frac{(p-w)(\delta + \lambda_D^1)\lambda_D^0}{(\delta + \lambda_D^0)[\delta + \lambda_D^1(1-F^{post}(w))]^2}$$

Then, we need to find the respective reservation wage (it will not be just equal to the value of leisure) and the profits $\pi^{post}(R)$. To find the equilibrium offer distribution we need to set $\pi^{post}(w) = \pi^{post}(R)$ and solve with respect to $F^{post}(w)$.