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ABSTRACT

An Alternative Approach to Testing Dual Labour Market Theory*

In this paper we suggest an alternative approach to testing for the dual structure of the labour market. The novelty of the suggested approach is that rather than considering wage determination we concentrate on the turnover. To perform the test we suggest using a latent class count data framework, which allows modelling the turnover in the unobserved primary and secondary markets in the appropriate way. To illustrate the suggested approach we apply our methodology to the German labour market data. Our testing procedure finds no support for the predictions of the dual labour market theory. We also consider the problem of inconclusiveness of the test for involuntary confinement to the secondary market.

JEL Classification: J42

Keywords: segmented market, dual labour market, count data, latent class model

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1 Introduction

In the present paper we readdress the issue of testing for the dual structure of the labour market.

According to the dual labour market theory the market consists of the two segments. The workers that belong to the first segment receive relatively high wages and have stable jobs. The workers that belong to the second segment get relatively low wages, work at unstable jobs and change jobs more frequently.

Empirical analysis of the dual labour market theory has a long history (see Leontaridi, 1998 for the review). At the same time, among all the suggested methods only two were capable of providing the answers that take on account the selectivity bias that arises due to fact that the affiliation of the worker to either primary or secondary market is not directly observed. The first such method is due to Dickens and Lang (1985) who test the predictions of the dual labour market theory in the framework of the switching regime model of wage determination. The second method is proposed by Heckman and Hotz (1986) who perform their analysis using the earnings equations corrected for selectivity. They develop the test for the duality using both earnings and participation equations.

At the same time Heckman and Hotz (1986) point out that the results of both these methods may be affected by the ad-hoc assumptions about the functional form of the estimated wage equation. Our suggested approach allows avoiding this problem, because instead of concentrating on wage determination we rather consider the turnover aspect of the dual market. In other words we address the question of duality by looking at the number job change instances in both segments. It turns out that using this approach one can similarly outline the role of human capital in the both segments of the market. Namely, in Section 2 we demonstrate that if the market has a dual structure, the number of job change instances in the primary market should be increasing in the amount of accumulated human capital. At the same time in the secondary market job change is independent of the variation in human capital. We use this property to test for the validity of the predictions of the dual labour market theory. This is done, essentially, in the way similar to that of Dickens and Lang (1985). In our framework we also consider the test for another particularity of the dual labour market, which is the involuntary confinement of the worker to the secondary sector.

To analyze the turnover on the primary and secondary segments of the market we use a latent class count data approach. This framework is advantageous, firstly, because it properly models the distribution of the job change instances and, secondly, because it allows consistent estimation of the determinants of the number of job changes by employee when the affiliation of the employee to either primary or secondary market is unobserved from the data. Finally, this approach enables us to make the probability of choosing any of the sectors dependent on the observed characteristics of the worker. We use this fact later on to formulate a version of the test for noneconomic barriers for moving from the secondary to the primary sector.

Even though application of various count data models has a certain record in the contemporary research in empirical labour economics (see Winkelmann and Zimmermann, 1998, and Barmby et al. 2001, among others), use of the latent class count data analysis is rather uncommon in this area. At the same time application of latent class models proliferates in various health economics issues with Deb and Tirevedi (1997), (2002) and Jiménes-Martín et al. (2002) being resent typical examples. The present paper also aims at filling in this gap.

The paper is organized as follows. In Section 2 we review the concept of the dual labour market and discuss the link between human capital and turnover in the primary and secondary segments of this market. In Section 3 we discuss the specification of the latent class count data model and its' correspondence to the dual structure of the market. Here we also provide information about the estimation strategy and testing. In Section 4 we present an implementation of our proposed method. We discuss the data, perform the test for the duality and also address the still unresolved problem of testing for involuntary confinement to the secondary labour market. Section 5 concludes.

2 Theoretical Considerations

The conceptual characteristic of the dual labour market, following Cain (1976), Doeringer and Poire (1980), Saint-Paul (1996) and many others, is that this market can be described by the presence of the two distinct segments. The representatives of the first segment (primary labour market) enjoy stable employment, good working conditions and high promotion possibilities. The representatives of the second segment (secondary labour market) have relatively unstable and worse-paid jobs, worse working conditions and relatively poor promotion possibilities. According to Doeringer and Poire (1980) rationing of workers into each market happens on the basis of not only inadequate skills but also residence, poor working history and other forms of discrimination. Thus the next particularity of the dualism is that the wage setting in the secondary market does not depend on the level of accumulated human capital whereas in the primary market the role of human capital is crucial. Dickens and Lang (1985) use this particular feature to develop a formal test of the duality. As long as from the sample of employed individuals it is impossible to judge upon the affiliation to any of the two markets Dickens and Lang (1985) suggest studying wage determination in a switching regression model with unknown regimes. In this framework they estimate the effect of human capital in both regimes and argue that whenever in the first regime log-wages are increasing in human capital whereas in the second regime contribution of the human capital is insignificant, the market under consideration is dual. Furthermore Dickens and Lang (1985) develop a test for the involuntary confinement to the secondary segment.

In the present paper we try to address the same issue from the other side. Again, we study the effect of human capital in both segments. However, rather than looking at wage determination, we focus on the turnover. As argued by the above supporters of dualism (also see Leontaridi, 1998, for the extensive literature review), the workers in the primary sector have much more secure and stable jobs and therefore turnover in this sector is lower that in the secondary one. Job stability also implies that the majority of job changes in the primary market should make the worker better off in either pecuniary or nonpecuniary (or both) aspects. So, as long as in the primary market job payoff increases in the level of attained human capital we conclude that in this market there should exist a positive relationship between human capital and job change instances. At the same time we notice that the higher is the wage paid at the current job the higher should be the opportunity cost of leisure. This implies that with an increasing wage the incentive to search for a better job reduces so the number of job change instances should go down. However, this dependence is not necessarily linear. If the monetary value of the arriving offer exceeds the current wage by the substantial amount the worker may also decide to change the job. So we would rather expect a convex shape of the dependence of job change on wages. Finally, in the primary market high nonpecuniary value of the job should also reduce the incentive to change it. Thus we conclude that the number of job change instances in the primary market should positively depend on the amount of accumulated human capital, negatively depend on the earnings but, possibly, positively depend on the squared earnings and, finally, negatively depend on the nonpecuniary job characteristics.

Consider now the secondary market. The level of turnover on this market is quite high and this fact is connected to a job instability rather than to the accumulated human capital. So, according to the standard views of the dual labour market theory, there should be no dependence between job change instances and the attained level of education/skills. At the same time, as long as all jobs are bad-paid and possibilities of getting high offers are limited, the dependence between wages and turnover is expected to be negative and, most likely, simply linear. Finally, following Dickens and Lang (1985), nonpecuniary characteristics should play no role in the secondary market.

In the present paper we propose to analyze the determinants of job change frequency in each segment. Provided that the market is indeed segmented, we suggest investigating the properties of each segment and see whether they correspond to those of the primary and secondary sectors of the dual labour market. As in all studies before, the most important component of the analysis is the role of the human capital since the behavior of wage and non-wage job characteristics is not incompatible with the human capital theory. So we concentrate on the significance pattern of the human capital in both sectors. Similarly to Dickens and Lang (1985) we reject the hypothesis of the dual structure when human capital plays significant role in both segments of the market.

The advantage of our "turnover approach" is that we can make the conclusion about the presence or absence of duality on the market controlling for all important worker characteristics, such as human capital, current earnings and nonpecuniary value of the job at once. We also avoid imposing arbitrary functional forms on the wage equation, as criticized by Heckman and Hotz (1986), since wage determination is not the corner stone of our method. The suggested approach, however, is by no means designed to replace that of Dickens and Lang (1985). To the contrary, it is rather a complement to the existing framework. Our analysis considers another aspect of the dual market and thereby provides an additional information, which could possibly shed more light on the empirical applicability of the dual labour market theory. We need to notice, however, that even though our approach has certain advantages over that of Dickens and Lang (1985) with respect to functional and distributional assumptions it is still unable to resolve the critique of Heckman and Hotz (1986) about the ambiguity of the test for rationing into primary and secondary markets. We return to this issue in Section 4.2.

To conclude let us briefly talk about the practical implementation of the proposed approach. Our dependent variable is the number of job changes, so the appropriate econometric specification is a count data regression. Since the affiliation of any particular worker to either primary or secondary market is unobserved we perform our study using a latent class count data model, which is ideologically equivalent to the switching regime regression of Dickens and Lang (1985). Our analysis has two steps. On the first step we try to investigate whether the latent class model fits the data better than the basic count data model, i.e. whether the two distinct segments really exist. Provided that they do we proceed the second step and study the determinants of job change frequency in the two segments and their correspondence to the predictions of the dual labour market theory.

In the next section we describe in detail the appropriate model and its' applicability to the concept of duality.

3 Specification and Testing

In this section we give a brief theoretical description of the econometric methods used in the subsequent analysis and explain their meaning in application to the dual labour market. In our study we apply basic and latent class count data models. The discussion of the econometric specification mostly follows Cameron and Trivedi (1998).

3.1 Latent Class Analysis and Its Application

As long as the basic count data regression does not require any specific introduction[1] we start directly with the Latent Class (LC) model. The statistical model suggests that the population consists of a finite number of classes (groups) and for each and every group the data generation process is assumed to be different. Since the number of distinct classes in the whole population is finite, any random draw from the population density will with certain probability belong to one of the existing classes. This probability will exactly correspond to the share of a specific group in the whole population. Assume that there are J

[1] Otherwise see Cameron and Trivedi (1998), Chapter 3.

such groups. Then the population density can be represented as a finite mixture of the densities $g_j(\theta_j)$ of J distinct subpopulations with mixing proportions $\pi_1,...\pi_J$ such that $\sum_{j=1}^{J}\pi_j = 1$ and $\pi_j \geq 0\ \forall j$, i.e.

$$f(y_i|\theta_j) = \sum\nolimits_{j=1}^{J} \pi_j g_j(y_i|\theta_j), \qquad i = 1,...,n \tag{1}$$

In other words the latent class model has a common finite mixture representation. The special feature of this mixture model, however, is that as long as all $g_j(y|\theta_j)$ are defined on one and the same set of possible realizations for any random draw from the population density it will not be possible to tell with certainty which of J subpopulation densities $g_j(\theta_j)$ generates it.

To illustrate the correspondence of the model to our particular application consider a dual labour market. As outlined before, this market consists of a primary segment with stable, well-paid and long-lasting jobs and secondary segment with unstable, worse-paid jobs of relatively short duration. Such description of the segments implies that during any long enough period of time individuals who come from the primary segment should have relatively fewer instances of job changes than the individuals who belong to the secondary segment. At the same time, however, from the sampled number of job changes it is impossible to to judge whether any given individual comes from the primary or from the secondary sector. The reason is that it is quite possible that for one or another reason a certain representative of the secondary market did not change job at all, while at the same time a certain representative of the primary market has undergone a series of fast job changes. This tells us that the two classes are unobserved. So the the population density of the sampled job changes must be a mixture of these two classes, i.e. nothing else but (1) with $J = 2$.

To establish empirically the existence of the duality on the labour market we firstly have to show that the model with the two classes is superior to the single-class model. Obviously, the latter is just a basic count data model with the density of dependent count being $g(y|\theta)$. Two demonstrate the superiority of the latent class specification we use conventional goodness of fit analysis (see page 8 for details). Provided that the model with two classes fits the data better we need to check whether the estimates of this model are consistent with predictions of the dual labour market theory. In other words, we need to show that the human capital variables significantly contribute to the increase in the job change instances in the primary sector and at the same time have no influence in the secondary sector (see Section 2).

3.2 Estimation Strategy

From the discussion above it is clear that the probabilities $\{\pi_j\}_{j=1}^{J}$ are never observed from the data. So we need to estimate them along with the parameter vectors $\{\theta_j\}_{j=1}^{J}$. The most straightforward estimation method is a constrained maximum likelihood suggested by Deb and Trivedi (1997), (2002). It is a full information approach, which is based on the maximization of the log-likelihood function

$$\ln(\mathcal{L}) = \sum_{i=1}^{n} \ln\left[\sum\nolimits_{j=1}^{J} \pi_j g_j\left(y_i|\theta_j\right)\right] \tag{2}$$

subject to $\pi_j \subset (0,1)$ and $\sum_{j=1}^{J} \pi_j = 1$.

Alternatively, one can represent (1) as a missing data problem and estimate the parameters using EM algorithm. This approach is suggested, for instance, by Cameron and Trivedi (1998). The log-likelihood function appropriate for EM estimation is

$$\ln(\tilde{\mathcal{L}}) = \sum_{i=1}^{n}\sum_{j=1}^{J} \delta_{ij}\left[\ln g_j\left(y_i|\theta_j\right) + \ln \pi_j\right] \tag{3}$$

where δ_i is a $J \times 1$ vector of 'missing' data with j-th element being unity if i-th individual comes from j-th class and zeros otherwise. Substituting on E-step δ_i with its expected value we go to M-step and maximize expectation of (3) with respect to $\{\theta_j, \pi\}_{j=1}^{J}$ (for more details see Lancaster, 1990, p.288-289, and Cameron and Trivedi, 1998, p.130-132). The two steps are repeated until convergence.

In principle it does not make much difference which estimation strategy to choose. However, in the present application we have found that using constrained maximum likelihood to is more convenient than using EM estimation.[2]

3.3 Further Comments on Specification and Testing

Making parametric assumptions about $g\left(y|\theta\right)$ we experiment with both Poisson and Negative Binomial (NB2) densities. The appropriate log-densities are

$$\ln g(y_i|\beta) = y_i \mathbf{x}_i\beta - \exp(\mathbf{x}_i\beta) - \ln(y_i!) \tag{4}$$

for Poisson and

$$\begin{aligned}\ln g(y_i|a,\beta) = {} & \ln(\Gamma(y_i+\alpha^{-1})) - \ln(\Gamma(y_i+1)) - \ln(\Gamma(\alpha^{-1})) - \\ & -(y_i+\alpha^{-1})\ln(1+\alpha\exp(\mathbf{x}_i\beta)) + y_i\ln\alpha^{-1} + y_i\mathbf{x}_i\beta\end{aligned} \tag{5}$$

for NB2. The conditional mean is $\mu_i = \exp(\mathbf{x}_i\beta)$ for both.

Even though we assume that underlying processes are either Poisson or Negative Binomial this in fact may not necessarily be the truth. To ensure consistent inference in the presence of the misspecified density we apply Quasi Maximum Likelihood Estimator (QMLE) suggested by White (1982). White (1982) shows that whenever the true density is different from the assumed one, MLE $\hat{\theta}_n$ of

[2]We further notice that as long as in the present application we have only two classes, even the constrained maximization in the full information approach can be avoided using parameterization $\pi = (1+e^{-\alpha})^{-1}$ or alike. Later on we use this fact to construct the test for noneconomic barriers (see Section 4.2)

the parameter vector θ converges to a the pseudo-true value θ_* that minimizes relative entropy of the true distribution with respect to the assumed one[3] and

$$\sqrt{n}(\hat{\theta}-\theta_*) \overset{A}{\sim} N(\mathbf{0}, \mathbf{A}_n^{-1}(\hat{\theta})\mathbf{B}_n(\hat{\theta})\mathbf{A}_n^{-1}(\hat{\theta}))$$

where

$$\mathbf{A}_n(\hat{\theta}) = n^{-1}\sum_{i=1}^{n}\frac{\partial^2 \ln l_i}{\partial\hat{\theta}\partial\hat{\theta}'}\ , \quad \mathbf{B}_n(\hat{\theta}) = n^{-1}\sum_{i=1}^{n}\frac{\partial \ln l_i}{\partial\hat{\theta}}\frac{\partial \ln l_i}{\partial\hat{\theta}'}$$

with l_i being an individual contribution to the likelihood. So, even when the true density is misspecified, provided that the conditional mean is specified correctly QML covariance estimator will ensure proper inference about the true parameter vector θ. In case underlying process is indeed Poisson (NB2) relative entropy is zero so QMLE $\hat{\theta}_n$ converges to the true parameter vector θ and has all standard MLE properties.

Concerning the model selection we notice that basic model is non-nested in the latent class specification. We decide which model fits the data better on the basis of a χ^2 goodness of fit test developed by Andrews (1988a) and advised by Cameron and Trivedi (1998) and Deb and Trivedi (1997), (2002). The goodness of fit test statistic has a form

$$T = \left[\sum_{i=1}^{n}\left(\mathbf{d}_i(y_i) - \mathbf{p}_i(y_i|\hat{\theta})\right)\right]' \hat{\mathbf{\Omega}}^{-} \left[\sum_{i=1}^{n}\left(\mathbf{d}_i(y_i) - \mathbf{p}_i(y_i|\hat{\theta})\right)\right] \overset{A}{\sim} \chi^2(K-1) \quad (6)$$

where $\mathbf{d}_i(y_i)$ is a vector of actual cell frequencies and $\mathbf{p}_i(y_i|\hat{\theta})$ is a vector of predicted cell frequencies for each observation; $\hat{\mathbf{\Omega}}$ is an estimate of the covariance matrix of the sum of the differences between actual and fitted cell frequencies and K is the number of cells. Estimation of $\mathbf{\Omega}$ is generally cumbersome. However, Andrews (1988a,b) demonstrates that whenever $\hat{\theta}$ has all MLE properties (6) is equivalent to nR^2, where R^2 is a coefficient of determination from the auxiliary regression of the matrix of the differences between actual and fitted frequencies $\mathbf{A} = \left[\mathbf{d}_i(y_i) - \mathbf{p}_i(y_i|\hat{\theta})\right]$ and the matrix of scores $\mathbf{B} = \left[\frac{\partial \ln l_i}{\partial\hat{\theta}}\right]$ on a constant. Define $\mathbf{H} = [\mathbf{A}\ \mathbf{B}]$ and let $\mathbf{1}$ be a vector of ones. Then the above test statistic can be represented as

$$T = \mathbf{1}'\mathbf{H}(\mathbf{H}'\mathbf{H})^{-}\mathbf{H}'\mathbf{1} \overset{A}{\sim} \chi^2(K-1) \quad (7)$$

where $(\mathbf{H}'\mathbf{H})^{-}$ is a generalized inverse, since $rank(\mathbf{\Omega}) = K-1$ as a consequence of frequencies' summing up to unity.

To further judge upon the validity of the latent class model we also test the estimated probability mass values against the degenerate distribution with all its' mass concentrated at one point. In this case standard z-test applies.

This completes the description of the econometric tools used in the present work. In the next section we present a numerical example that illustrates the suggested empirical analysis of the duality.

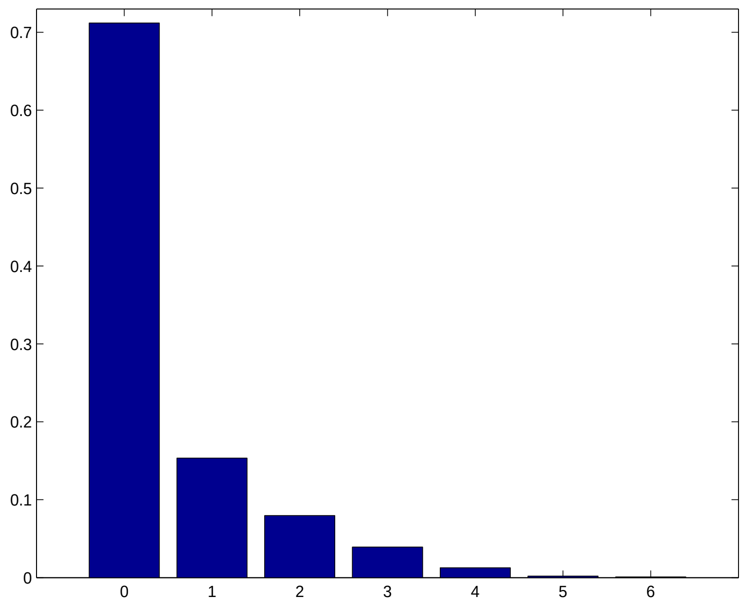
[3] The measure of relative entropy is a Kullback-Leibler distance defined as: $I(g : g, f) = E\left[\log(g(x)/f(x)\right]$, where $g(x)$ is the true and $f(x)$ is the misspecified distribution; expectation is taken over $g(x)$.

4 Numerical Illustration

4.1 The Data

The data we use are a part of the German Socio-Economic Panel (GSOEP). This is a longitudinal survey of German households that has started at 1984 and was conducted on the annual basis ever since. We use the information starting from the wave of 1994. The reason is that from this wave on there appears an additional variable that classifies the job change instances during the previous year. We qualify as a job change all instances of the job start with a new employer, the new job as self-employed and the job change within the same firm. Recording the number of job changes that took place from 1994 to 2000 (end of information available) we get the dependent count. Histogram of the number of job changes is given in Figure 1.

Figure 1: "Histogram of the Dependent Count"



Our sample contains observations on 2059 employed individuals. Mean job change in the sample is 0.497, standard deviation: 0.930.

At the first glance we see that the distribution of the number of job changes has a tail which rapidly goes down for the small counts but then quite slowly declines for the bigger ones. This kind of tail behavior is rather uncommon for a standard Poisson variate. Two possible explanations for such a shape of the dependent count distribution could be suggested. The first one is that there are indeed two types of workers in our data. Representatives of the first type have a relatively low arrival rate of job changes and are big in numbers. Representatives of the second type, to the contrary, are subject to a more frequent job change, but their proportion in the sample is rather low. Too small share of the second-type workers does not allow for the second mode in the observed distribution. However, it is at the same time sufficient to ensure a heavy right tail. This hypothesis goes in line with the existence of a segmented labour market suggesting that our data illustrate the example of rather big primary and relatively small secondary markets. The second possible explanation for the tail behavior observed in Figure 1 is that the dependent count is just a generalized Poisson (e.g. NB2) rather than a simple Poisson variate. So the shape of the observed distribution is simply an evidence of overdispersion and not of the fact that the data generation process is a mixture of the two Poisson variates with small and large means. Obviously, the second hypothesis is in odds with the concept of dual labour market implying that indeed there is no segmentation whatsoever. So in the analysis to follow in case we find that the market is indeed segmented will also need to demonstrate that this result is robust to the overdispersion hypothesis.

Next we present the explanatory variables used in the analysis. The first three of them are dummy variables for the marital status (= 1 if an individual is married), gender (= 1 for male individuals) and country of origin (= 1 for foreigners). To represent the level of human capital attained by an individual we use the years of formal education. We also calculate the average net monthly wage of an employed person (D-Marks in prices of 1999; when estimating the model we use the net wages measured in thousands of D-Marks to facilitate more stable convergence). Finally, to measure the amount of nonpecuniary value of a job we use the index of job satisfaction offered by GSOEP. The index ranges from 0 to 10 with 0 being the lowest and 10 – the highest levels of satisfaction. For every individual we use the average value of this index over the observation period.[4]

Table 1: "Summary Statistics of Explanatory Variables"

			$Y \leq 1$		$Y > 1$	
Variable	Mean	(Std.Dev)	Mean	(Std.Dev)	Mean	(Std.Dev)
Married	0.642	(0.480)	0.665	(0.472)	0.498	(0.501)
Gender	0.640	(0.480)	0.637	(0.481)	0.663	(0.474)
Foreigner	0.210	(0.407)	0.212	(0.409)	0.201	(0.401)
Education	11.92	(2.539)	11.84	(2.506)	12.38	(2.691)
Satisfaction with the Job	7.122	(1.364)	7.134	(1.358)	7.041	(1.406)
Income	3129.9	(1952.)	3155.1	(2012.)	2974.2	(1529.)

[4]By construction this index captures the non-monetary value of the job only. In the GSOEP questionnaire it is always accompanied with the question about the satisfaction with the level of household income.

In the above table we also present the statistics for the two subsamples: individuals with zero or one job change and individuals with two or more job changes. We do so to create at least a rough idea about the characteristics of the representatives of the two latent classes, since we can expect that the majority of the participants of the secondary market will indeed have more than one job change instance during the observed seven years. Looking into these two subsamples we notice that except of the marital status the individuals are almost identical (those who change job more often have 12% less married people then the others). Provided that the duality in the market exists, comparison of the first five variables would really go in line with this concept: their summary statistics would support the fact that the same people with the same abilities are rationed into two different segments. At the same time comparing the mean wage levels we see that for those with high occurrence of the job change the average wage is not really much below the average wage of the people with less frequent job change. This is in odds with the predictions of the dual labour market theory which would suggest that incomes of the $[Y > 1]$-group should be significantly lower. Thus, rough division of the data provides an ambiguous evidence of the dual structure. This means that in order to tell with certainty whether the market under consideration is indeed dual one should obtain the unbiased characteristics of the two latent segments and study the role of the human capital in both of them.

4.2 Estimation Results and Interpretation

This section provides the analysis of the estimation results and deals with their implications for the existence of the duality on the German labour market.

4.2.1 Model Selection

We start with model selection, which is the first step in testing for the dual structure of the market. As outlined in Section 3.1 to establish the existence of the dual market we first need to demonstrate that the latent class model fits the data better than the basic one. To deal with this issue we firstly estimate both models with underlying Poisson density. Afterwards we extend our specification to Negative Binomial.

In Table A.1 we present the results of the goodness of fit test for all estimated models. To visualize the fit to the data in Figure A.1 we additionally plot the predicted by each model frequencies of job change. In Figure A.2 we show the deviation of the predicted frequencies from the actual ones.

Consider first the Poisson case. From Table A.1 it's easy to see the simple Poisson specification is rejected while the latent class Poisson is not. This implies that the labour market should indeed consist of the two segments. Though, remembering our discussion of overdispersion vs. distinct latent classes (see Section 4.1) before stating this result we need to be sure that the LC Poisson specification fits the data better than the NB2. Evidence of this is readily available in the same Table. Goodness of fit test rejects NB2 specification.

Furthermore from Figures A.1-2 we see that the dependent count frequencies predicted by NB2 are less accurate than those predicted by LC Poisson. So we conclude that there exist two distinct segments in the labour market.

Consider now the same models with Negative Binomial rather than Poisson densities. The result we get here is exactly the same as above. While simple NB2 specification is rejected, the latent class NB2 is not (see Table A.1). So again we find that the model with the two distinct classes fits the data better. We notice also that while fitting LC NB2 to the data we have found that overdispersion parameter in the second class converges to zero. This simply means that there is no much dispersion in the second segment and NB2 just reduces to Poisson. So the resulting latent class model here is a mixture of NB2 density for the first subpopulation and Poisson density for the second one. We call the resulting model a "latent class NB2-Poisson".

Our analysis of both Poisson and Negative binomial cases demonstrates that the market indeed turns out to contain two segments. Furthermore, from Table 2 below we see that for the representatives of the second segment the expected number of job changes over the analyzed period is higher than for those who belong to the first segment. This fact already goes in line with the predictions of the dual labour market theory.

Table 2: "Expected Number of Job Changes"

	Expected number of job changes per year:	
The Model	First segment	Second segment
LC Poisson	0.0792	1.2984
LC NB2-Poisson	0.1006	1.3119

To further continue the analysis and assess the importance of human capital in both sectors we need to choose the best of the two above specifications. As long as χ^2 test does not reject either of them our further choice will be based on information criteria: AIC, Consistent AIC and Schwarz criterion (see Cameron and Trivedi, p.183). From Table A.1 we see that according to the last two of them LC Poisson is a more parsimonious specification. Therefore all our subsequent inference will be based on the estimates from this model. These estimates are presented in Table A.2.[5]

4.2.2 Consistence with the Dual Labour Market Theory

Now we need to investigate whether the properties of the segments discovered above are equivalent to those of primary and secondary components of the dual labour market. As discussed in Section 2 the dual labour market theory

[5]For the sake of brevity no other estimation results are presented in this paper. However these are available from the author upon request.

would predict that the role human capital is significant in the primary market and insignificant in the secondary one. From Table A.2 we see that for the German labour market data this is not the case. In both sectors human capital significantly contributes to the increase in the job change instances. Thus the obtained results demonstrate that there is no evidence of the dual structure of the market. Additionally we test for the equality of education coefficients in both sectors and find that in the sector with higher expected number of job changes the effect of education is significantly lower.

It is also interesting to notice that nonpecuniary value of the job plays no role for the job change decision – all that is important in the job value aspect is only the net wage. We find that in the first segment the relationship between job change and the net wage is quadratic. This can be seen from the negative significant coefficient at the income variable and positive significant coefficient at the squared income variable. As argued in Section 2, such form of the dependence should imply that the representatives of the first sector receive quite high wages and therefore only considerable increase in the offered wage can make them changing the job. To the contrary in the second sector the linear income term is negative significant, while the quadratic income term is not. This means that the representatives of this sector are more eager to change the job even when the increase in offered wage is relatively small. As long as the duality hypothesis is rejected, such pattern of jobchange-income dependence would imply that those who belong to the second sector are simply less educated workers. This implication will also be consistent with the previously discovered fact of the smaller importance of human capital in the second sector. Taken together, these results convey that the human capital theory rather than the dual labour market theory is the appropriate one for explaining the turnover on the German labour market.

Eventually, we notice that the effect of the rest of explanatory variables is quite expected. Married people tend to have less job changes in both sectors. Males, whenever coming from the second sector, have a higher chance of changing job. And finally, foreign origin has no explanatory power whatsoever.

Even though we already do not find support for the dual labour market theory in our data, we still need to discuss the applicability of our approach for further testing of the duality. Within their switching regime regression framework Dickens and Lang (1985) develop a test for the involuntary confinement to the secondary market. Firstly Dickens and Lang (1985) estimate the coefficients at workers' observable characteristics in the first and second wage equations. Then they show that under the null hypothesis of no rationing the probability of workers' choosing either primary or secondary sector will be proportional to the difference of these estimated coefficients (see equations [4]-[5] in Dickens and Lang, 1985). Rejection of the proportionality establishes the existence of noneconomic barriers in choosing sectors. Heckman and Hotz (1986), however, criticize the validity of this testing procedure arguing that: a) there could be more than two sectors in the market; b) the distributional assumptions on the error term in sectoral allocation equation may be false; c) assumption about no mobility costs between sectors is unrealistic, and d) agents may be utility maximizers rather than earnings' net present value maximizers, which implies unmeasured heterogeneity bias. Even though Heckman and Hotz (1986) suggest an alternative test, they point out that neither the original nor the alternative specification is conclusive because both of them rely on the estimation of wage equations true functional form of which under the hypothesis of no duality is unknown.

With our approach to the analysis of duality it is possible to avoid the critiques about the sector multiplicity and arbitrary distributional assumptions. With the model selection technique we use it is easy to demonstrate that there are not more than two sectors in the market. Even if χ^2-test would not reject the three-sector specification, in view of the acceptance of the two-sector model this would be already an unnecessary overparameterization. Furthermore, the goodness of fit analysis helps choosing the appropriate distribution for the dependent count. However, the last two points of Heckman and Hotz (1986) cannot be satisfactorily handled. First of all we still need to assume that there are no mobility costs between sectors. Second, and most important, we do not consider wage determination and therefore we cannot compare the net present values of the lifetime incomes when analyzing the sectoral choice probabilities. We can sure parameterize π in (2) making it dependent on the set of individual characteristics of the worker and estimate the extended version of (2) with, say,

$$\pi = (1 + e^{-\mathbf{x}\omega})^{-1}$$

Though, unlike in Dickens and Lang (1985), in our case the probability of choosing either sector will be equal to the difference of the expected log-number of job changes and not the difference in the expected net present values of the lifetime income. Specifically, we get

$$P = \Pr\{\ln(Y_p) - \ln(Y_s) > C\} = \Pr\{\mathbf{X}(\beta_p - \beta_s) + C' > 0\}$$

where subscripts p and s denote primary and secondary markets and C and C' are constants. The interpretation of this equation is that given the individual observable characteristics and assuming that monetary and nonpecuniary values of the job that enter $\mathbf{X}$ are the correct measures of the discounted lifetime values, the worker will voluntary choose the sector with lower or higher turnover only when the estimated ω are equal to the estimated $(\beta_p - \beta_s)$. Rejection of this hypothesis will imply barriers for sectoral choice. However, the turnover is rather a consequence of the segmentation and not the variable of choice for the worker. So in our formulation the originally proposed test looses its intuitive meaning and thereby becomes unconvincing. Thus, unfortunately, we cannot state that our suggested approach to study the duality is able to resolve the risen by Heckman and Hotz problem of the inconclusiveness of the existing tests for involuntary confinement to the secondary market.

4.2.3 Correspondence to the Existing Procedure

To compare our method with the already existing procedure we fit the switching regime regression of Dickens and Lang (1985) to the same data set.

The estimation results from the wage equations with unknown regimes are presented in Table A.3 of the Appendix. Analyzing these results we come to the same rejection of the duality as we have obtained before, since the coefficients at the years of education in both regressions are statistically significant. The switching regime regression also matches the fact that importance of human capital in the primary sector is higher than in the secondary sector. This again corresponds to our results obtained from the estimation of the latent class model. So, in its' general points, our proposed approach appears to be coherent with the existing one. Keeping in mind that both techniques address the problem of the dual structure of the market from different sides we may argue that application of the both may provide more information about this phenomenon.

At the same time the switching regression estimates of the coefficient at the dummy variable that indicates foreign origin raise some concern. It turns out that in the primary sector, which we would expect to be better paid, foreigners get higher wages than the others and in the secondary sector this relationship is reversed. Additionally we would not expect that nonpecuniary value should have a significant effect on the monetary net present value of the job. We might suggest that these misalignments with the expectations may appear because of the possible unmeasured heterogeneity bias as pointed out by Heckman and Hotz (1986). If this is true, the simultaneous application of the two approaches (ours and that of Dickens and Lang, 1985) can be more attractive since it will allow to double check the obtained results.

5 Summary and Conclusions

In this paper we suggest an alternative approach to testing the implications of the dual labour market theory. Unlike the traditional approach that concentrates on the wage determination in the primary and secondary markets, we focus our attention on the turnover. Dual labour market theory implies that in the primary market the turnover is lower and job stability is higher than in the secondary market. Furthermore, in the secondary market human capital should not have significant influence on the turnover, whereas in the primary market the relationship between turnover and human capital must be positive. We take these two passages and verify them empirically estimating the latent class count data model. The dependent variable in our analysis is the number of job change instances by the worker. The suggested statistical model is capable of resolving the problem of unobservable affiliation of the worker to either primary or secondary market which makes our approach providing consistent estimates of the determinants of the turnover in both sectors.

The proposed analysis is performed in two steps. On the first step we suggest a model selection procedure that is designed to detect segmentation. Provided that the model with two distinct classes is accepted, on the second step of the analysis we test the effect of the human capital variable and see whether its' significance pattern corresponds to the predictions of the dual labour market theory. We reject the duality whenever human capital plays significant role in both sectors.

In our framework we also try to consider the problem of the inconclusiveness of the test for the involuntary confinement to the secondary market pointed out by Heckman and Hotz (1986). However, despite certain advantages due to less strict distributional assumptions, our approach cannot to the desired extent contribute to the solution of this problem.

To illustrate the suggested method we set up a small numerical example in which we consider the number of job changes by employed workers in the Germany in the 1994-2000 period. We find that there exist two distinct classes of workers in the market. However we reject the duality hypothesis, since the role of human capital in both of them is inconsistent with the predictions of the dual labour market theory. We also find a high degree of coherence between the results from our procedure and the results obtained using the approach of Dickens and Lang (1985). Since both methods consider one and the same issue from the two different sides, we could advise using them as complements.

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6 Appendix

Table A.1: "Model Selection"

The Model	Andrews χ^2 Test: Test Statistic	Andrews χ^2 Test: p-Value	Information Criteria: AIC	Information Criteria: CAIC	Information Criteria: SBC
Poison	397.3285	0.0000	–	–	–
Negative Binomial	337.1494	0.0000	–	–	–
LC Poisson	9.2506	0.1599	3779.7	3909.4	3892.4
LC NB2-Poisson	10.7702	0.0957	3778.8	3916.2	3898.2

Table A.2: "Estimation Results – Latent Class Poisson Model"

Variables	Coefficient	Standard Errors: MLH	Standard Errors: QML	p-Values: MLH / QML
Primary Sector:				
Constant	−1.6628	1.4339	1.9316	0.246 / 0.389
Married*	−2.2725	0.8338	0.8951	0.006 / 0.011
Gender	0.1394	0.3515	0.3878	0.692 / 0.719
Education*	0.1953	0.0596	0.0639	0.001 / 0.002
Income*	−0.9669	0.3135	0.3421	0.002 / 0.005
Income Squared*	0.0417	0.0219	0.0126	0.057 / 0.001
Foreigner	0.7817	0.4443	0.5864	0.078 / 0.183
Job Satisfaction	−0.0756	0.1280	0.1616	0.555 / 0.640
Secondary Sector:				
Constant	0.3504	0.3149	0.2772	0.266 / 0.206
Married*	−0.3429	0.0833	0.0826	0.000 / 0.000
Gender*	0.2540	0.1074	0.1112	0.018 / 0.022
Education*	0.0433	0.0180	0.0167	0.016 / 0.009
Income*	−0.1839	0.0887	0.0796	0.038 / 0.021
Income Squared	0.0118	0.0084	0.0071	0.161 / 0.096
Foreigner	0.0478	0.1040	0.1056	0.646 / 0.651
Job Satisfatction	−0.0220	0.0297	0.0276	0.459 / 0.427
π_1 *(primary sector)*	0.6582	0.0299	0.0319	0.000 / 0.000
Log(Likelihood):			−1881.3632	

* For convenience we mark with asterisk all the variables significant at 5% level (z-Test is performed using QML standard errors)

Figure A.1: "Predicted Frequencies of Job Change: All Estimated Models"

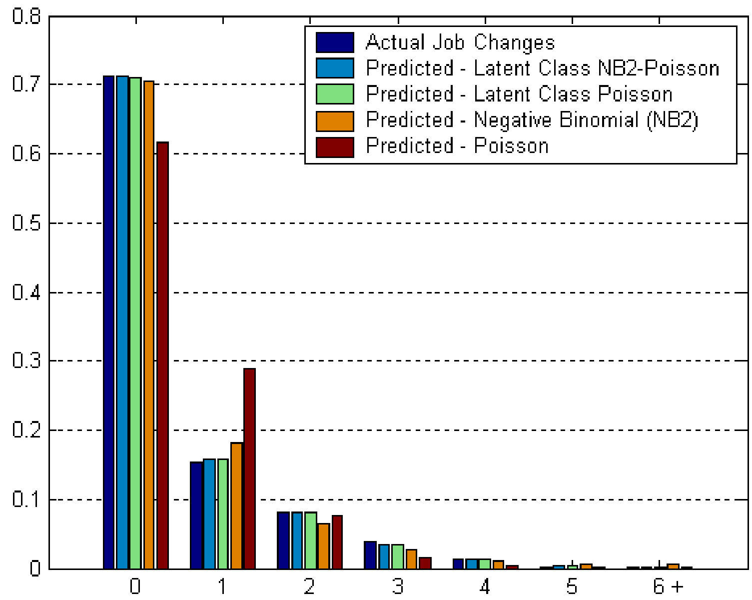

Figure A.2: "Deviation of Predicted from Actual Frequencies: All Estimated Models"

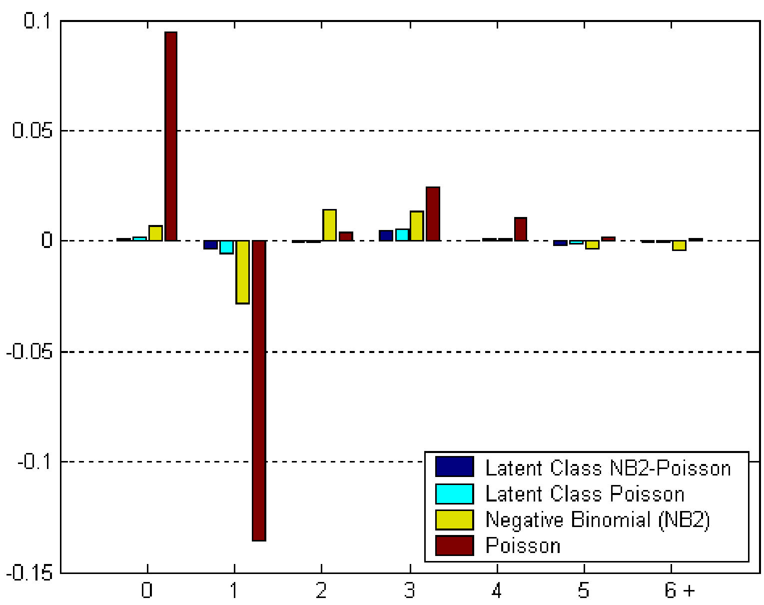

Table A.3: "Wage Equation: Switching Regime Regression"

Variables	Coefficient	Std.Error	z-Statistic	p-Value
Primary Sector:				
Constant	6.0320	0.1673	36.0550	0.0000
Married	−0.2745	0.0619	−4.4346	0.0000
Gender	1.0389	0.0463	22.4384	0.0000
Education	0.0840	0.0084	9.9053	0.0000
Foreigner	0.1512	0.0554	2.7303	0.0031
Job Satisfatction	0.0579	0.0167	3.4761	0.0002
		R^2:		0.5569
		Root MSE:		0.5285
Secondary Sector:				
Constant	6.9202	0.0403	171.717	0.0000
Married	0.2065	0.0127	16.2598	0.0000
Gender	0.2790	0.0125	22.3519	0.0000
Education	0.0570	0.0024	23.2973	0.0000
Foreigner	−0.1089	0.0135	−8.1561	0.0000
Job Satisfatction	0.0187	0.0041	4.5008	0.0000
		R^2:		0.4660
		Root MSE:		0.2542