WORKING PAPER 09-6

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Longhwa Chen and Tor Eriksson

Vacancy Duration, Wage Offers, and Job Requirements – Pre-Match Data Evidence

Department of Economics

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Longhwa Chen
Aletheia University, Tainan, Taiwan
Tor Eriksson
Aarhus School of Business, Aarhus University, Denmark

Abstract

Besides wage offers, credentials like education, work experience and skill requirements are key screening tools for firms in their recruitment of new employees. This paper contributes some new evidence to a relatively tiny literature on firms' recruitment behaviour. In particular, our analysis is concerned with how vacancy durations vary with firms' minimum wage offers and minimum job requirements (regarding education, skills, age, gender and earlier work experience).

The empirical analysis is based on ten employer surveys carried out by the DGBAS on Taiwan during the period 1996-2006. We estimate logistic discrete hazard models with a rich set of job and firm characteristics as explanatory variables. The results show that vacancies associated with higher wage offers take, ceteris paribus, longer to be filled. The impact of firms' wage offers and credential requirements does not vary over the business cycle. However, firms vary their skills requirements over the business cycle: our empirical analysis shows that, for a given wage offer, requirements are stricter in recessions and downturns. Separating between reasons for posting vacancies turned out important in explaining differences in vacancy durations. The duration of vacancies due to regular turnover and changing business cycle condition are less affected by skill requirements than that of other vacant jobs.

1 Introduction

Recruiting new employees and replacing workers that have left is costly for firms. Moreover, firms face several trade-offs between incurring different costs of filling vacant jobs. One is between the costs of spending more time searching for a good candidate and the loss in production associated with a longer waiting time. When firms offer a higher wage to shorten the recruitment time, they not only increase their wage costs but may also attract a larger number of applicants and thus have to spend more time in screening them. In addition to wage offers, credentials, like education and work experience, and other skill requirements are the most common screening tools for firms to weed out unqualified candidates and hence reduce screening costs. While stricter requirements may lower screening costs they can also prolong the time it takes to fill the vacancy. Adjustment of the requirements might be more efficient rather than increasing the wage offer; see Pissarides (1976) for an analysis. After this step, firms may also use other strategies like testing, psychological profiling, interviews and probation. A subtle change in the first step can significantly reduce the costs in the following steps.

Most empirical evidence on how job vacancies are filled is based on aggregate data and therefore focuses mainly on the role of aggregate level factors; see Devine and Kiefer (1991) and Mortensen and Pissarides (1999). As for individual level evidence, of which there is less, this is predominantly about the behavior of job searchers, their search strategies and channels they use and how these vary across different groups of employees; see e.g., Holzer (1987), (1988). There are considerably fewer studies of employers' search behavior. This is not because of lack of interest, but due to dearth of appropriate data sources. What evidence there is about the behavior of firms is typically concerned with the efficiency of different search methods and whom employers are interested in hiring under different labor market conditions; see Holzer, Raphael and Stoll (2006).

In this paper we exploit a data set which is rather unique insofar that it contains information about employers' recruitment behavior *before* the vacancy is matched with an employee.[1] These data are used to address a number of empirical questions regarding employers' recruitment behavior and allow us to interpret the results as reflecting "pure" demand side factors.

Some of the questions asked are: How do firms adjust their skills requirements (if at all) when they face different labor market conditions? Will firms raise their wage offers and/or lower their job requirements in response to tightened labor markets? Are vacancies with higher demands with respect with credentials filled more easily during the recession than in the boom? The repeated cross-sectional data set used in the empirical analysis encompasses a whole business cycle of Taiwan, and can thus be exploited for an analysis of the influence of changes in the macroeconomic environment. In addition, we address issues related to the role of skill certificates, especially regarding IT and language skills, in firms' search for younger employees. What is their importance relative to conventional skills credentials, like formal education?

The remainder of the paper is organized as follows. The next section provides a brief review of the related literature. This is followed by a presentation of the data set used and a descriptive analysis of the key variables. The fourth section discusses the empirical model and some identification issues. The estimation results are given in Section 5. The first subsection deals with the relation between wage offers and vacancy requirements. Next subsections look at how this changes over the business cycle, the role of firm size and specific skill requirements, changes in the relative weight of job requirements over the business cycle, and finally at different reasons for why the vacancy is posted. The last section concludes and offers some policy implications.

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[1] In a recent paper, Hall and Krueger (2008) provide some evidence for the U.S. labor market on the prevalence of new employees bargaining regarding wages before accepting a job offer versus accepting it on a take-it-or-leave-it basis. They find that about a third of newly hired workers had bargained with their current employers before accepting the job offer. We are aware of no other study shedding light on this issue.

2 Previous research

Studies of the firm's recruitment behavior are rare. Almost two decades ago, Devine and Kiefer (1991) summarized their survey of empirical research on labor market search as follows: "On balance, the supply side of the labor market is well studied if not perfect understood. The demand side is wide open…they must be supplemented by additional studies before the findings can be considered solid." Fifteen years later, DeVaro (2005) notes: "(Indeed,) labor economists, sociologists, psychologists, and human resource management specialists have spent the last half-century exploiting the meager existing data sets in efforts to learn about employer recruitment behavior." The reason for this state of affairs is largely the scarcity of demand-side data. Although firm-level data have become increasingly available, these are typically taken from the records kept by firms, and were set up for other than for research purposes, and so, relatively little progress with respect to enhancing our understanding of employers' recruitment behavior has been made.

Some previous work has focused on how vacancy durations are affected by employers' choice of recruitment channels. Roper (1988) used vacancy data collected by a U.K. employer survey in the 1970s and finds that recruitment methods significantly affect vacancy durations, whereas firms' wage offers are not found to have a clear and significant effect on the length of unfilled vacancies. Roper argues that the latter result may be caused by poor data, however. More recently, DeVaro (2005) has made use of U.S. data on newly hired workers collected in the early 1990s. Unlike Roper he finds that higher starting wages increase the duration of vacancy. He interprets this as evidence of longer waiting times inducing employers to increase their wage offers. Moreover, DeVaro's study shows that recruitment channels have important effects on the vacancy durations. In studies using more recent data you would, however, expect that recruitment methods play a less important role as

job market information circulates more efficiently.[2] Especially, the well developed internet infrastructures have provided firms with a low-cost means for recruiting educated employees.[3]

Burdett and Cunningham (1998) study how firm and job characteristics affect how long it takes to fill a vacancy.[4] In particular they examine firms facing advance notification rules and therefore can try to find an eligible employee before losses occur. Variations in the tightness of job market, captured by the local unemployment rate, did not turn out to have any impact on vacancy durations.

Holzer et al. (2006) analyze employers' hiring behavior during the tight U.S. labor markets in the 1990s. The study focuses on the hiring of disadvantaged workers, like groups with criminal records, welfare recipients and short-term employed. The authors find that in general the demand for the disadvantaged job seekers increased during the boom except for severely stigmatized individuals with a criminal background. At the same time general credentials like work experience and higher education diplomas became less important.

The study by van Ours and Ridder (1992) comes closest to ours. They have cross-sectional data on elapsed vacancy durations and some information about skills required of the applicants and a few job characteristics.[5] They find that most of the characteristics did not affect vacancy durations, some evidence of positive duration dependence and that unobserved heterogeneity is important in explaining variation in durations. van Ours and Ridder also have information about the number of applicants for each vacancy and their analysis thereof indicates that employer search is most non-sequential.

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[2] See Autor (2001), who also provides some counter-arguments.
[3] Strong competition in the Taiwanese media industry has lowered the costs of recruitment advertisement, especially for internet users. Nevertheless, the employer survey shows that most firms continue using multiple search methods.
[4] They find that large firms' vacancies are filled more quickly and that jobs with higher skills requirements take longer to fill.
[5] van Ours and Ridder (1992) did not have information about the wage offers associated with the vacancies. Their estimating sample excluded observations for job titles with multiple vacancies.

The data used in the current paper differ from those exploited in the analyses mentioned above. In particular, in earlier studies the wage is in fact the starting wage paid to the newly hired employee, whereas we focus on the pre-match wage offer associated with the job vacancy. The duration observed in most other papers also includes the testing and interview period. In our data set, it is possible to directly observe the trade-off among wage offers, requirements and time. Note also, that in the current paper (as in van Ours and Ridder (1992)) the individual characteristics are those required by the firm, and not the traits observed *ex post*. As we have only one observation per vacancy, we can not examine how wage offers and requirements develops with the duration of the vacancy. On the other hand, we have a large number of observations on vacancies, wage offers and requirements from different years during a full business cycle.

3 Data description

The analysis is based on data from an annual survey, "The Job Vacancy and Employment Status Survey", which was carried out by the Directorate-General of Budget, Accounting and Statistics of Taiwan. The data were collected by means of a mail questionnaire with a telephone interview follow-up.[6] The sample used in the analysis in this paper covers ten years from 1996 to 2006 except for 1999 that was suspended.[7] The sample was stratified by the size of the industries (number of employees) as well as by number of firms in each four digit industry. For some industries with a small number of firms, a rotating sample scheme was adopted to reduce the burden of firms in answering the questionnaire. A representative sample with about 8,000 firms was interviewed in May or June each year; see Table 1 for details. The original data set has 35,336 job vacancies and we make use of 35,137 observations after dropping some incomplete answers,

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[6] The firms have been followed for many years and the response rates, according to DGBAS exceeded ninety per cent in all years. For example, the response rates were 94% in 2003 and 2004, 92% and 90% in 2005 and 2006 respectively.
[7] This was due to a huge earth quake on Taiwan in September 1999. The survey was planned to be conducted shortly after the disaster happened.

part-time jobs and a few small industries.[8] There is not a generally accepted definition of a job vacancy. In the data source of the current study, a vacancy is characterised by the existence of at least one specific position for which the employer is actively recruiting applicants from outside the firm to fill the position. Thus, this definition excludes job openings that occur when "the right employee" turns up. These are not likely to make up a significant portion of all job openings. Notably, the vacancy concept of the Survey does not impose a restriction on the time interval during which the position has to be filled.

3.1 Vacancies, vacancy durations and wage offers

As shown in Table 1, data were mostly collected in either May or June (except in 1996 and 1998). There are both pro and con arguments for a fixed date of collecting the data. Vacancies posted in different months may have different characteristics and durations, particularly because in June and July a large number of freshmen are entering the job market. Firms usually have a periodic recruitment scheme open for them and the time to fill vacancies could consequently be shorter. Sampling in different months would allow us to test whether the duration distribution differs across months. This will be discussed further in section 4 below.

From Table 1 it can also be seen that there was a substantial decline in the number of vacancies in the deep recession year of 2001 with a historically high, negative GDP growth rate in Taiwan. However, as the economy recovered, the number of vacant jobs quickly returned to former levels. The unemployment rate decreased rather slowly, though. The period under study covers a full business cycle and thus enables us to compare firms' recruitment behaviors in boom and recession years. There is a trendwise decline in the average vacancy durations independently of the

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[8] The survey does not contain direct information on working hours. We define a job as a part-time job when the wage offer associated with the vacancy is less than half of the minimum wage.

macro-economic conditions, which is presumably due to improved matching technologies resulting in a higher pace of transmission of job information. Wages have been deflated by the yearly CPI index. The year with the lowest number of vacancies has the highest mean wage offer. Obviously, the recession reduced the job opportunities for low paid workers more than high paid workers.

Insert Table 1 here

3.2 Job requirements

Naturally, the requirements firms make for potential job applicants inform them something about the skills necessary to perform the job in question, but they can also serve a signalling function reducing the search costs for both firms and job seekers. The educational requirements, which are shown in Table 2, indicate that for most of their vacancies firms require that applicants have one of the three major educational levels in Taiwan. Vacancies for which there are no specified educational requirements are not associated with a shorter length of search.

Insert Table 2 here

Requirements that the job holder should be of a specific gender reflect job characteristics and in some cases probably also employers' preferences. Half of the vacant jobs are "gender-neutral". Of the other half, the majority is targeting male applicants. On Taiwan, the male labour force participation rate is about 20 percentage points higher than for women, whereas the unemployment rate for males has always been about one per cent higher than for woman. On average, the vacancies posted specifically for male applicants take longer to fill.

Age requirements are recorded as a range with a maximum and a minimum. The most common age limitation is an age ceiling for new entrants because young workers are more

adaptable and lower paid. Dummy variables for the minimum age required of the job holder to be forty years or above and for jobs without any age restrictions, have been created to capture vacancies available to elderly workers.

Information of certificate requirements and reasons for opening the vacancy (as reported by the firm) is available from years 2003 to 2006. More than eighty percent of the vacancies do not require a specific skills certificate or license. The most common requirements are professional licenses (such as for pharmaceutical and nurses work) and certificates of language proficiency (predominantly in English). Although modern workplaces widely apply computer technology, IT certificates do not seem to play an important role in the job search process.

A little over half of the vacancies are opened because of regular worker turnover and the average duration is shortest for these vacancies. Jobs under special working environments like Dirty, Dangerous and Difficult (3D) are associated with longer time to find workers, as are vacancies affected by affirmative action regulations (that is, jobs targeted at hiring disabled workers or the aboriginal people of Taiwan.

3.3 The empirical model

In the following we will estimate a reduced form employer's search model within the framework of a hazard function approach. A standard employer search model (Lippman and McCall, 1976) models the probability that a vacant job is filled, $\theta(t)$, during an infinitesimal short period (t, t+dt), given that it has been open until t, as the product of the arrival rate of applicants, $A(t)$, and the probability that an applicant is acceptable, $P(t)$:

$$\theta(t)dt = A(t) P(t) dt \qquad (1)$$

As our data do not contain information about arrival rates and other variables allowing us to identify the two RHS components in (1), we estimate a reduced form:

$$\theta\,(t) = \theta\,(t,\,X),$$

where X is a vector of vacancy and firm characteristics. The econometric analysis focuses on the links between vacancy durations and employers' recruitment strategies with respect to wage offers and job requirements. Why do we observe vacancies? The simple answer is because it takes time to find suitable employees.[9] In searching for new suitable employees firms face a trade-off between the speed of hiring and the quality of the worker-job match, that is, it can hire a new worker relatively quickly but at the expense of obtaining an employee who is less productive than expected.

As an applicant's productivity is not directly observed by firms, they can use two alternative strategies. First, the firm can offer higher wages than competitors in the hope of attracting better performing employees. This strategy has the advantage speeding up the hiring process but runs the risk of ending up with a poor match. A second strategy is to use of workers' characteristics and credentials to assess the productivity of workers. This increases the likelihood of a good match, but takes longer time. Since both firms and jobs differ with respect to the importance of job-worker match quality for corporate performance, we have to account for firm differences and skill levels of the vacant jobs.

Furthermore, we would expect labour market conditions to affect firms' recruitment strategies.

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[9] When a firm posts a vacancy it does not necessarily imply that there is nobody at the time performing the tasks associated with the vacant job. Many vacancies are opened because the current job holder will leave, e.g., due to retirement, promotion or a move to another job (after the advance notification period has expired).

In a tight labor market a company can choose between two policies in addressing the problem of labor shortage. It can raise its wage offer and hope this increases the pool of applicants to the vacant job. Or, it can lower its recruitment standards, that is, put less weight on job requirements such as formal education, previous experience and certificates. Again, as stressed in the analyses of Pissarides (1976) and Holzer et al. (2006), the firm's choice of strategy involves balancing of two opposing influences on profits: the speed at which the vacancy is filled and the quality of the match, respectively. The decision also depends on the importance of the vacant position for short- and long-run profits. To what extent firms' vary their wage offers and job requirements over the business cycle is an empirical issue on which this paper aims at shedding some new light. Thus, we include the firm's wage offer associated with the vacancy as well as a number of job requirement variables (age, gender, work experience, education and certificates) in X and estimate the duration models for different years during a full business cycle.

A novel feature of the empirical analysis in this paper is that we distinguish between categories of vacancies according to the reasons they were opened. We expect this to be of some importance as the different categories differ with respect to the cost and benefits from screening the employees more carefully. In particular, we expect that the duration of vacancies due to regular employee turnover is affected by different factors than the time it takes to fill new jobs, jobs created as part of organisational adjustment or jobs requiring skills that are new to the organization.

3.4 The econometric duration model

The econometric model we use for estimation of the determinants of the elapsed vacancy duration is a discrete-time logistic hazard model. In addition to the fact that this accounts for discrete time nature of our vacancy durations data it has the advantage that we do not have to

assume a specific functional form of hazard. The model is:

$$\frac{h(m, X)}{1 - h(m, X)} = \left[\frac{h_0(m)}{1 - h_0(m)}\right] \exp(\beta' X)$$

(2)

Where $h(m, X)$ is the discrete hazard rate for month m. Taking logs it follows that

$$\log it[h(m, X)] = \log\left[\frac{h(m, X)}{1 - h(m, X)}\right] = \alpha_m + \beta' X$$

(3)

where $\alpha_m = \text{logit}[h_0(m)]$

Alternatively, this can be expressed as:

$$h(m, X) = \frac{1}{1 + \exp(-\alpha_m - \beta' X)}$$

(4)

When $X = 0$, $h_0(m, X)$ is the corresponding baseline hazard. The models in this paper are estimated by using the *logit* procedure in STATA; see Jenkins (1995). The left hand side variable is a binary variable for whether a vacancy is still open or not. Right hand side variables in the estimations include besides the duration spell dummies a set of firm and vacancy characteristics.

The data set does not allow us to observe the changes in firms' requirements over time and hence no time-varying covariates are included in the models. As a consequence we cannot examine whether firms will increase their wage offers or loosen up the credentials requirements when the vacancy has been unfilled for a long time.

4 Identification issues

The data used in this study originate from a number of annual repeated cross-sections of firms. Of the 8,000 firms that were chosen most had not posted vacancies at the time of the survey. As we only make use of observations of firms that have at least one vacancy, a selection problem might arise. In the survey, firms were asked about how long the vacancies had been open up to the end of the survey month (the elapsed duration). That is, we observe the listed vacancies and how long they have been unfilled at the time of the survey. Under repeated cross-session stock sampling longer durations have a higher probability of being sampled than short durations, and hence, the probability of observing longer duration vacancies in the data is higher. If the inflow of new vacancies is constant over time, we will on average observe the vacancies in the middle of their completed durations, that is, the actual length (completed duration) will on average be twice as long as our recorded interrupted spell length measure.

The repeated stock sampling nature of the data could potentially give rise to a right hand censoring problem. After 2004, the survey does not recognize intervals exceeding 12 months, but aggregates them in to one open interval. Prior to 2004, a number of intervals exceeding 12 months were included and the maximum duration observed in the sample was 35 months. For consistency, we treat all durations exceeding 12 months as right hand censored. However, as only 1.4% of the vacancies fall in this category, it is not likely to have a major impact on the estimates obtained.

4.1 Constant entry rate and different sampling months

The cross-sectional stock sampling could cause another problem. As was first pointed out by Nickell (1979), estimation of duration models based on cross-sectional data, or what later has been called the elapsed duration (or backward recurrence time) model (Lancaster, 1990) relies on the

assumption of a stationary inflow rate of vacancies. When this condition does not hold, the estimated hazard functions using elapsed duration data can give rise to seriously misleading estimates that reflect variations in the inflow rate rather than in factors determining durations.[10] Consequently, in the following paragraphs we discuss the nature of vacancy data used and the stationarity of vacancy inflow rates at some length.

A first thing worth noting is that the vacancy durations seem to be quite randomly scattered over the year. No matter in which month vacancies are observed, the probabilities of observing short spells seem to be quite similar. In years 1996, 1997 and 1998, three waves of the survey were conducted in August, May and October, respectively. We compare these three consecutive years as during the period economics conditions in Taiwan were quite stable and so, the duration data is not likely to be influenced by the business cycle. From Figure 1 we can see that the vacancy duration distributions are quite similar in all three years.[11]

Second, the main reason firms report opening job vacancies is "dealing with regular employee turnover", which does not display any seasonal variation. Vacancies opened for seasonal variations in demand make up only 1.4 percent of the vacancies in the data set.   This is partly because most firms hire part-time workers to meet seasonal labor demand variations, and in constructing the sample for this study we have excluded vacancies for part-time work. A third factor that could affect the inflow of job vacancies is that most firms usually recruit young people close to the time after they have graduated, i.e., during the summer. To check for this, we have estimated the duration model on a smaller sample which excludes vacancies targeted for young people (below 30 years of

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[10]   One solution for handling this problem has been suggested by Guell and Hu (2006). We cannot apply it because it requires some overlapping durations in two consecutive repeated cross-section data sets in order to construct matched groups. In an early paper, Nickell (1979), who had access to cross-sectional data only, uses estimates for the probability that the individuals in his sample have entered unemployment to deal with the potential violation of the stationarity assumption.
[11]   A formal statistical test (Kolmogorov-Smirnov) for the equality of distributions marginally rejects the equality, though.

age) only. The results differ only marginally, and never in sign, as compared to those for the whole sample. Hence we conclude that there is little reason to expect that variations in the vacancy inflow rate will be significantly contaminating the elapsed duration model estimates.

Insert Figure 1 here

4.2 Unobserved heterogeneity

The attractiveness of a vacancy and how easy it is to fill it is of course influenced by several characteristics, not only of the job in question, but also of the firm. Some of these are not observed in the data. A typical factor of this kind is profitability or some other corporate performance measure. Other common considerations for job applicants include firms' dividend and bonus policies (particularly in the innovative industries), non-monetary benefits, and the overall reputation of the firm. As these factors cannot be perfectly observed, the estimated models are likely to over-estimate the degree of negative duration dependence in the hazard, or under-estimate the degree of positive duration dependence (Lancaster, 1990).

We have estimated logistic models with controls for random effects to take account for the heterogeneity; see Appendix 1. The test for heterogeneity is under the assumption that the "error term" has a Normal distribution with mean zero. The results show that for some years the model passes test of frailty and more importantly that most of the coefficients do not change much.[12] Thus, unobserved heterogeneity plays a minor role in explaining the observed variations in the vacancy durations.

5 Findings and discussion

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[12] Models that combine two successive years and control for the frailty are harder to interpret. This could be caused by the rotating sampling nature in some of the smaller industries.

We can to begin with at the baseline hazard estimates which are displayed in Figure 2. Notably, the first three months and sixth month have considerably higher exit probabilities than other months. As we will see below, the estimates change somewhat when we control for other variables, but also then we find that vacancies are more likely to be filled in first three months and during the sixth month. In particular there is a large spike at the sixth month that could be caused by a memory error or some institutional reason.[13] For example, some of the respondents may be thinking in terms of quarters, and as a consequence, answers "cluster" at three or six months.

Insert Figure 2 and Table 3 here

5.1 Wage offers

Table 3 reports estimates for specifications including both vacancy and firm characteristics. An increase in a variable that carries a positive coefficient increases the probability that a vacancy is filled, i.e., shortens the duration of the vacancy. We start by looking at the estimates in the first column which are from the whole period under study. A key finding is that the higher the (minimum) wage offer is, the longer it takes to fill the vacancy. There are two forces pushing and pulling the relationship between the wage offer and the time a vacancy is unfilled in opposite directions. The first is that firms can trade wage offers for time (the waiting cost). The other is that higher paid jobs often take longer time to fill because firms are more willing to spend time on screening in order to find the right employees for the higher paid positions. Our estimates imply that the latter effect dominates. When we add a dummy for vacancies in the highest decile of the wage offer distribution or for high level occupations, the wage offer variable still attaches a negatively signed coefficient. This result resembles those in Adams et al. (2002) and DeVaro (2005), who also found a positive relation between the starting wage and the duration of the vacancy, but

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[13] We have checked a number of possibilities but have not found any plausible institutional explanations for the sixth month spike.

differs from those obtained in other studies by Roper (1988), Burdett and Cunningham (1998), and Andrews et al. (2007), who found no relationship. It should be noted that because the starting wage in these studies is observed after the vacancy has been filled it could have been influenced by subsequent negotiations between the employee and the employer. The wage offer concept used in this study is of pre-match nature, reflecting only the behavior of the firm.

5.2 Business cycle conditions

Columns 2 to 4 in Table 3 contain estimates from different business cycle years. Column 2 has years 1997 and 1998 when both the overall economy and the labor market conditions were good. In column 3 we find years 2001 and 2002 which were recession years. The last column for years 2005 and 2006 represent a recovery. To make more efficient use of the information in the data set, we combine observations for two adjacent years.

Other things equal, firms appear to find workers more quickly in recent years. This could be due to improved job-worker matching technology (internet, ICT, etc.).[14] It is interesting to examine how firms change their recruitment requirements over the business cycle. A first point to notice is that the influence of wage offers on vacancy durations does not vary much over the business cycle. Ceteris paribus, firms paying higher wages are expected to shorten recruitment time in the recession. Surprisingly, the results show no differences across labor market conditions. As we will see below, this result is robust to inclusion of additional explanatory variables picking up variation in job requirements but not to a division of the sample into sub-samples according to reason the vacancy was posted.

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[14] This finding is not consistent with notions of jobs becoming more specialised or more demanding (requiring a broader set of skills). Note, however, that we control for at least some of these factors in the estimations.

Vacancies targeted at elderly workers, defined as the age range over 40 years of age, are relatively hard to fill in boom years, even when the Taiwanese economy recovered strongly during the last two years of the period under study. During recession years, there is no significant difference in the duration of vacancies targeting different age groups.

Education and experience are the most commonly used credentials for screening applicants. The estimates show quite surprisingly that stronger experience requirements slightly decrease the duration of a vacancy. Job vacancies requiring a bachelor's or higher university degree take somewhat shorter time to fill, save the recession years. The duration of vacancies without any specific educational requirements varies strongly with labor market conditions. They are more difficult to fill in boom years, but do not differ from other vacancies during the recovery. However, two factors complicate the interpretation of the results. First, the educational expansion after year 2000 affected the supply of highly educated workers and will therefore weaken the signaling function of education. Second, the firms employing low-skilled workers have increasingly moved their production to low labor cost countries (chiefly China) and have consequently reduced their demand for the workers with little education. These two effects interact with the impact of the business cycle on educational requirements.

5.3 Firm size

Larger firms recruit employees in shorter time than smaller firms do. This is especially the case in recessions, probably reflecting the fact that big firms are more attractive because workers are more concerned with the job security during periods of low growth and believe that larger firms are more able to cope with the business cycle risks. This result has also been found in previous studies (van Ours and Ridder (1992), Burdett and Cunningham (1998), Andrews et. al. (2007)). Larger firms are also likely to open up more vacancies than smaller firms. The number of

vacancies posted by the firm is controlled for in the estimation. As expected, the more vacancies a firm has, the longer they remain unfilled.

It should also be noted that smaller firms may be more careful in selecting their employees while large firms have better opportunities for finding alternative use for what turned out to be a bad job-worker match; see Garen (1985) for an analysis. In other words, smaller firms have to know their job applicants better. Another reason for the difference is that larger firms are more likely to have HRM departments and hence can exploit scale and scope economies in hiring.

5.4 Certificate requirements

The results concerning skill requirements are given in Table 4. As can be seen from a comparison of the two first columns, entering the certificate requirements variables leads to only minor changes in the estimates to the educational requirements variables. Computer and language (predominantly in English) are the most common required skills but only language certificates turn out to significantly affect the duration of vacancies. Also, the professional certificate limitations are associated with longer durations. However, this does not mean that computer and language certificate are not important. In wage offer regressions given in Appendix 2, both computer and language skill criteria have a positive impact on firms' wage offers.[15] The influence of skill requirements may be captured by the wage offer variable, which, as we have seen, has a positive impact on the duration of the vacancy.

Insert Table 4 here

5.5 Wage offers and requirement over the business cycle

Next we turn to consider whether and how the relationship between wage offers and the

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[15] This is consistent with learning models. When workers are new in the firm employers pay them based on observable ability, but as they learn more about their employees, wages will increasingly reflect unobserved ability factors.

qualifications requirements varies over the business cycle. Following Pissarides (1976) we expect to find that when times are good (bad) the relation between qualifications requirements and wage offers is weaker. This is because in good times when firms have difficulties recruiting employees, they are less likely to make strong demands on qualifications for a given wage offer, and in bad times the opposite applies.

In order to shed light on this we estimate simple regressions for each year where the dependent variable is the log of firm's minimum wage offer divided by the average of all minimum wage offers. The key explanatory variables are the job requirement and certificate dummies (same as in Table 4). In addition we control for the number of vacancies posted, industry, region and size of firm. The estimates to the skills requirements dummies are collected in Table 5.

We find some support for the hypothesis that for a given relative wage offer, the qualifications requirements are stronger during economic downturn years. This pattern is clearly discernible for the estimates to the experience and age requirements indicators. The age and experience requirements are stronger in the recession years and are dropped as the economy improves. As for the educational requirements, the picture is more blurred. On the one hand, if one considers the period as from 2001, which coincides with the expansion of higher education, we may notice considerably lower estimates for the recovery years (2004-6) than for the recession years (2001-2). On the other hand, the pattern in the second half of the nineties is less clear.

Insert Table 5 here

5.6 Reasons for posting a vacancy

Unlike previous studies, in this paper the data allow us to distinguish between different reasons for opening the job vacancies and hence we can see whether this makes any difference for

employers' search behavior. The reasons for posting the job vacancy are indeed found to play a critical role for the time it takes to find new employees. Firms recruiting in order to replace regular employee turnover, and large firms in particular, are able to fill their vacancies more quickly than others. In connection with these vacancies firms are likely know what type of employees they are looking for, whereas for other types of vacancies this does not necessarily hold. Thus, vacancies for other reasons take longer time to be filled; see column 3 in Table 4. Vacancies due to affirmative regulations and 3D tasks are hard to fill. Not surprisingly, vacancies which are posted because the firms need certain skills that are not available among their current workers – that is, new skills to the firm – also take longer time to fill. Controlling for the reason the job vacancy was posted, the coefficient to the large firm dummy becomes smaller. This implies that the firm size effect discussed above may in part be picking up different reasons for posting vacancies.

In Table 6 we report separate estimations for the three most common reasons of posting vacancies: regular turnover, business cycle adjustments and new positions. For job vacancies due to regular employee turnover, which make up over half of all the vacancies, firms can adopt a prior notification strategy (Burdett and Cunningham (1998)) or a "stockpiling" strategy (Bishop and Barron (1984)). We would not expect to find any differences between large and small firms here. And we do not. One additional reason for this finding could be that regular turnover jobs are typically of short-term nature and both employers and prospective employees do not therefore spend much time and effort on search.

The vacancy opened because of regular worker turnover also differs in another respect: the impact of the wage offer of the time it takes to fill the vacancy is lower than for other vacant jobs. Another thing shown by the estimations is that it is easier for large firms to fill new vacant positions. The explanation for the difference is presumably that big firms have personnel departments or human resources specialists to handle more complicated cases and new situations.

Insert Table 6 here

6 Concluding remarks

This study has made use of a unique vacancy survey data set to shed new light on the little researched topic of firms' recruitment behavior. The survey provides information from the firms about both minimum wage offers and minimum requirements of job holders and allows us to distinguish between different reasons for why the firm opened the job vacancy. Obviously, wage offers are one of the key instruments in attracting and recruiting new employees. We find that it takes longer time for firms to fill vacant jobs with higher wage offers, even after controlling for requirements regarding the job holders' gender, age, formal education, skills and previous work experience. Thus, we find no support for notions that firms are willing to offer higher wages in order to gain shorter vacancy durations.

We find no clear impact of business cycle conditions on the relation between educational credentials and vacancy durations. Also, the impact of firms' wage offers on vacancy durations does not vary over the business cycle. However, we do find some support for the notion that employers adjust their qualifications requirements (for a given wage offer) over the business cycle. Thus, as was already pointed out in Pissarides (1976), firms' search policies involve both wage and requirement adjustments.

Furthermore, we find that it takes longer time for firms to fill vacancies for low skilled and elderly workers in boom years, whereas in recession years there are no differences between target employee groups. Vacancies posted by large firms are filled faster than in smaller firms.

The most frequently required skills credentials pertain to language and IT skills. Of these two, only language certificate requirements are found to affect duration of vacancies (positively). Other less common professional certificates requirements are associated longer vacancy durations.

Distinguishing between the reasons for why the employers posted the vacancies turned out to be important. The most common reason for opening a vacancy is regular employee turnover. These vacancies are found to be filled more quickly than other vacancies and the impact of wage offers, experience requirements and firm size is different than for vacancies posted for other reasons.

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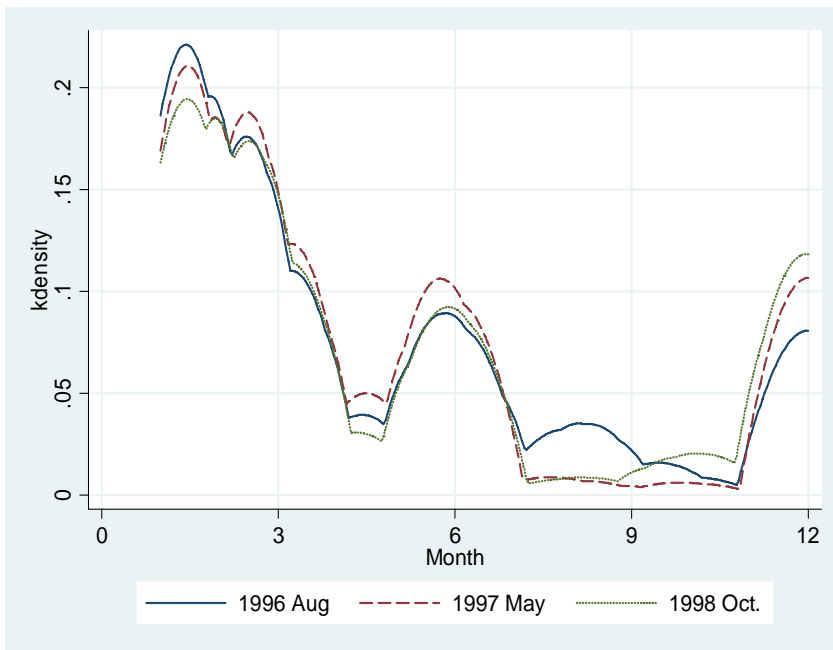**Figure 1. Distribution of vacancy durations in different months**
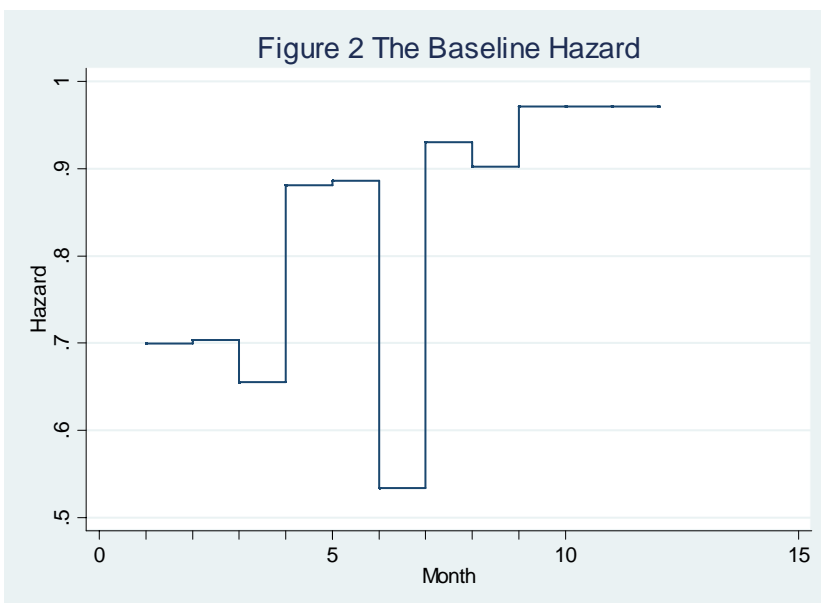

Figure 2. Baseline Hazard

Table 1. Vacancies, durations, wage offers and macro indicators, 1996-2006

Year	Survey Month	# of va- cancies	Duration mean (st dev)	Wage offer mean	Unemploy- ment(%)	GDP growth (%)
1996	August	3,082	4.45 (0.10)	27,025	2.6	6.3
1997	May	3,626	4.59 (0.18)	28,069	2.7	6.6
1998	October	2,648	5.00 (0.18)	30,257	2.7	4.6
2000	May	3,559	4.29 (0.18)	29,474	3.0	5.8
2001	May	1,931	3.85 (0.21)	31,529	4.6	-2.2
2002	May	2,667	3.48 (0.17)	29,995	5.2	4.6
2003	May	3,167	3.24 (0.06)	30,934	5.0	3.5
2004	June	4,637	3.21 (0.04)	29,569	4.4	6.2
2005	June	4,748	3.21 (0.04)	27,961	4.1	4.2
2006	May	5,072	3.02 (0.04)	28,336	3.9	4.9
Total		35,137	3.73	29,242		

Table 2. Descriptive statistics

1996-2006		Share (%)	Duration
Education	Bachelor or above	29.45	3.62
	Below bachelor's degree	62.4	3.74
	No educational requirements	8.15	4.13
Gender	Male	41.03	4.01
	Female	14.47	3.51
	No gender requirements	44.5	3.55
Firm size	1-29	11.93	3.82
(# of employees)	30-49	7.01	4.15
	50-99	15.16	4.09
	100-199	18.64	3.68
	200-499	24.31	3.68
	500 +	22.95	3.46
Age	40 or above	46.17	3.86
	40 below and no restrictions	53.83	3.63
Experience	2 year above	23.96	3.78
	1 year or No Experience	76.04	3.73
2003-2006			
Certificate	Occupational license	6.83	3.31
	Professional	2.59	3.33
	IT	1.46	3.17
	Language	6.81	3.02
	Other	0.33	4.29
	No certificate requirement	81.97	3.15
Reasons for	New position	12.99	3.15
opening of	Seasonal adjustment	1.53	3.4
vacancy	Business cycle	14.22	3.21
	Organizational adjustment	6.74	2.99
	New skills needed	4.8	4.03
	Regular turnover	54.57	2.95
	3D (dirty, dangerous, difficult)	4.16	4.55
	Affirmative action job	0.45	4.89
	Other	0.53	4.43

Table 3. Estimates of logistic hazard, 1996-2006

	(1)	(2)	(3)	(4)
	Whole period	*Boom years*	*Recession*	*Recovery*
	1996-06	*1997-98*	*2001-02*	*2005-06*
Elapsed duration (months)				
D1(0-1)	1.178	1.499	1.829	2.001
	(0.289)***	(0.661)**	(0.778)**	(0.583)***
D2(1-2)	1.196	1.622	1.852	2.110
	(0.289)***	(0.661)**	(0.780)**	(0.583)***
D3(2-3)	1.451	1.918	1.874	2.328
	(0.289)***	(0.662)***	(0.780)**	(0.584)***
D4(3-4)	0.106	0.690	0.530	0.890
	(0.290)	(0.664)	(0.783)	(0.586)
D5(4-5)	0.060	0.565	0.684	0.451
	(0.290)	(0.664)	(0.783)	(0.587)
D6(5-6)	2.016	2.507	2.321	2.959
	(0.290)***	(0.663)***	(0.782)***	(0.585)***
D7(6-7)	-0.439	-0.980	0.230	0.346
	(0.295)	(0.689)	(0.792)	(0.596)
D8(7-8)	-0.052	0.004	-0.298	0.509
	(0.293)	(0.673)	(0.802)	(0.595)
D9(9.-12)	1.179	1.921	1.569	1.674
	(0.290)***	(0.662)***	(0.780)**	(0.585)***
Ln Wage Offer	-0.227	-0.264	-0.280	-0.281
	(0.029)***	(0.065)***	(0.077)***	(0.058)***
Job Requirements				
Work experience	0.025	0.018	0.022	0.019
	(0.005)***	(0.011)	(0.014)	(0.010)*
Age 40+	-0.099	-0.152	-0.065	-0.120
	(0.014)***	(0.033)***	(0.040)	(0.028)***
Education:				
College or above	-0.034	0.070	-0.072	-0.028
(Ref: High school or below)	(0.018)*	(0.042)*	(0.046)	(0.034)
No educational requirements	-0.102	-0.204	0.105	-0.113
	(0.025)***	(0.057)***	(0.090)	(0.043)***
Firm size:				

30-49	-0.059	-0.222	-0.119	0.060
	(0.031)*	(0.070)***	(0.092)	(0.060)
50-99	-0.024	-0.180	-0.095	0.009
	(0.026)	(0.058)***	(0.079)	(0.049)
100-199	0.113	0.107	0.195	0.128
	(0.025)***	(0.058)*	(0.075)***	(0.049)***
200-499	0.130	0.152	0.169	0.162
	(0.024)***	(0.058)***	(0.070)**	(0.047)***
500 or above	0.238	0.162	0.422	0.243
	(0.026)***	(0.061)***	(0.074)***	(0.051)***
Number of vac.	-0.008	-0.014	-0.015	-0.006
	(0.001)***	(0.002)***	(0.002)***	(0.001)***
Other controls	Gender, Industry, Area and Year			
Log likelihood	-71529.76	-15095.96	-9221.86	-17958.71
#Observations	131221	29884	16701	30540

Standard errors in parentheses; significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Additional requirements and reasons for opening of vacancy, 2003-2006

	(1)	(2)	(3)
Ln Wage Offer	-0.254	-0.252	-0.218
	(0.043)***	(0.043)***	(0.044)***
Job Requirements			
Years of work experience	0.026	0.026	0.026
	(0.008)***	(0.008)***	(0.008)***
Age: 40+	-0.059	-0.057	-0.046
	(0.021)***	(0.021)***	(0.021)**
Education:			
College or above	-0.070	-0.080	-0.089
	(0.025)***	(0.025)***	(0.026)***
No educational requirements	-0.096	-0.098	-0.046
	(0.034)***	(0.034)***	(0.035)
Firm size:			
30-49	0.042	0.042	0.026
	(0.045)	(0.045)	(0.045)
50-99	0.024	0.029	0.008
	(0.037)	(0.037)	(0.037)
100-199	0.101	0.104	0.063
	(0.036)***	(0.036)***	(0.036)*
200-499	0.117	0.121	0.081
	(0.036)***	(0.036)***	(0.036)**
500 or above	0.210	0.211	0.160
	(0.038)***	(0.038)***	(0.038)***
Number of vacancies	-0.006	-0.006	-0.006
	(0.001)***	(0.001)***	(0.001)***
Certificate required			
Licence		-0.049	-0.054
		(0.053)	(0.053)
Professional		-0.176	-0.173
		(0.062)***	(0.063)***
IT		-0.010	-0.005
		(0.079)	(0.079)
Language		0.069	0.070

		(0.040)*	(0.040)*
Other		-0.344	-0.341
		(0.156)**	(0.156)**
Reason for vacancy			
New vacancy			-0.046
			(0.030)
Seasonal demand change			-0.226
			(0.077)***
Business cycle adjustment			-0.092
			(0.029)***
Organization adjustment			-0.011
			(0.040)
New skills needed			-0.400
			(0.044)***
3D vacancy			-0.521
			(0.047)***
Affirmative action			-0.573
			(0.133)***
Other			-0.464
			(0.123)***
Other controls	D1~D9 spells, Gender, Industry, Area and Year		
Log likelihood	-32812.82	-32806.09	-32617.77
Observations	55672	55672	55543

Standard errors in parentheses;* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Relative wage offer equation estimates 1996-2006

Requirement	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006
Minimum education requirement:										
College	0.166	0.212	0.226	0.262	0.178	0.190	0.193	0.123	0.121	0.151
Bachelor's degree	0.348	0.359	0.390	0.447	0.328	0.350	0.364	0.299	0.295	0.297
Graduate degree	0.480	0.482	0.540	0.520	0.446	0.525	0.544	0.461	0.458	0.448
Age and experience:										
Experience	0.088	0.068	0.036	0.079	0.074	0.074	0.072	0.057	0.071	0.050
Minimum age	0.056	0.058	0.074	0.042	0.039	0.028	0.050	0.029	0.016	0.022

Table 6. Estimates by reasons for vacancy openings 2003-2006

	(1)	(2)	(3)
	Regular Turnover	*Business Cycle*	*New Position, Org. Adjustm., New Skills needed*
Ln Wage Offer	-0.115	-0.414	-0.178
	(0.060)*	(0.132)***	(0.123)
Job Requirements			
Years of work experience	0.028	0.025	0.021
	(0.011)**	(0.020)	(0.020)
Age: 40+	-0.059	-0.123	-0.016
	(0.029)**	(0.059)**	(0.062)
Education:			
College or above	-0.063	-0.234	-0.130
	(0.036)*	(0.066)***	(0.071)*
No educational requirements	-0.046	-0.095	-0.180
	(0.047)	(0.112)	(0.114)
Firm size:			
30-49	-0.001	0.031	0.221

	(0.062)	(0.125)	(0.152)
50-99	-0.029	0.015	0.361
	(0.051)	(0.114)	(0.126)***
100-199	0.027	0.079	0.345
	(0.049)	(0.112)	(0.121)***
200-499	0.026	0.193	0.376
	(0.049)	(0.107)*	(0.120)***
500 or above	0.077	0.305	0.544
	(0.052)	(0.114)***	(0.124)***
Number of vacancies	-0.006	-0.007	-0.006
	(0.001)***	(0.002)***	(0.001)***
Certificate Required:			
Licence	-0.045	0.001	-0.273
	(0.065)	(0.218)	(0.182)
Professional	-0.307	-0.239	0.263
	(0.083)***	(0.185)	(0.205)
IT	0.034	0.022	0.090
	(0.117)	(0.179)	(0.203)
Language	-0.028	0.181	0.312
	(0.060)	(0.098)*	(0.109)***
Other	-0.329	-0.447	-0.758
	(0.215)	(0.447)	(0.482)
Other controls	D1~D9 spells, Gender, Industry, Area and Year		
Log likelihood	-17156.61	-4651.56	-8105.03
Observations	28324	8037	14142

Standard errors in parentheses;* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix 1. Estimations with controls for frailty

	1998	2001	2004	2006
Duration:				
D1 (0-1)	5.655	0.101	3.823	5.182
	(1.264)***	(2.866)	(0.933)***	(0.923)***
D2 (1-2)	5.741	1.284	2.542	5.443
	(1.265)***	(1.262)	(2.817)	(0.925)***
D3 (2-3)	6.072	0.487	4.295	5.636
	(1.266)***	(2.867)	(0.935)***	(0.926)***
D4 (3-4)	4.715	-1.078	2.879	2.593
	(1.269)***	(2.869)	(0.936)***	(3.250)
D5 (4-5)	4.044	-0.837	2.424	3.630
	(1.273)***	(2.869)	(0.938)***	(0.930)***
D6 (5-6)	6.546	0.789	3.918	4.808
	(1.268)***	(2.868)	(2.818)	(3.250)
D7 (6-7)	-4.962	-1.100	2.749	-0.491
	(2.215)**	(2.873)	(0.946)***	(0.976)
D8 (7-8)	7.604	-0.369	2.020	2.250
	(2.166)***	(1.286)	(2.821)	(3.254)
D9 (9-12)	4.917	0.233	3.181	3.739
	(1.128)***	(1.337)	(0.963)***	(0.994)***
Ln wage offer	-0.506	-0.149	-0.357	-0.462
	(0.109)***	(0.122)	(0.087)***	(0.084)***
Job Requirements				
Working Experience	0.033	-0.011	0.037	0.015
	(0.016)**	(0.022)	(0.016)**	(0.014)
Age 40+	-0.085	-0.002	0.053	-0.115
	(0.057)	(0.066)	(0.040)	(0.040)***
Education:				
College	0.101	-0.074	-0.087	-0.046
(Ref: High School)	(0.065)	(0.072)	(0.049)*	(0.050)
No restriction	-0.347	0.061	-0.057	-0.134
	(0.105)***	(0.149)	(0.074)	(0.063)**
Firm size:				
30-49	-0.117	0.399	-0.008	0.060

	(0.125)	(0.162)**	(0.089)	(0.092)
50-99	-0.061	0.174	0.099	-0.016
	(0.103)	(0.130)	(0.075)	(0.073)
100-199	0.320	0.321	0.048	0.145
	(0.100)***	(0.124)***	(0.072)	(0.072)**
200-499	0.301	0.366	0.167	0.189
	(0.098)***	(0.116)***	(0.074)**	(0.070)***
500 or above	0.356	0.775	0.274	0.406
	(0.104)***	(0.122)***	(0.079)***	(0.074)***
Vacancy number	-0.020	-0.023	-0.011	-0.011
	(0.004)***	(0.005)***	(0.001)***	(0.001)***
Other controls	Gender, Industries and Areas			
Log Likeihood	-5,125.23	-3,555.29	-8,260.30	-8,321.79
Observations	13,240	7,433	14,886	15,298

Standard errors in parentheses;* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix 2 Wage equation estimations 2003-2006

Dep. Var.: log wage	(1)	(2)	(3)	(4)
	All	Regular turnover	Business Cycle	New job vacancy
Duration	0.004	0.001	0.005	0.003
	(0.001)***	(0.001)*	(0.002)***	(0.002)*
Age 40+	0.001	-0.002	-0.031	0.015
	(0.004)	(0.005)	(0.010)***	(0.011)
Working experience	0.063	0.057	0.057	0.064
	(0.002)***	(0.002)***	(0.004)***	(0.004)***
Exp2*100	-0.005	-0.006	-0.004	-0.002
	(0.000)***	(0.001)***	(0.001)***	(0.001)
Education:				
College	0.233	0.234	0.207	0.255
	(0.004)***	(0.006)***	(0.010)***	(0.011)***
No educational requirements	-0.043	-0.053	-0.098	-0.035
	(0.006)***	(0.008)***	(0.018)***	(0.020)*
Firm size:				
30-49	0.040	0.051	-0.000	0.018
	(0.008)***	(0.011)***	(0.020)	(0.027)
50-99	0.029	0.037	0.020	-0.018
	(0.007)***	(0.009)***	(0.018)	(0.022)
100-199	0.045	0.050	0.004	0.045
	(0.006)***	(0.008)***	(0.018)	(0.021)**
200-499	0.055	0.070	0.021	0.037
	(0.006)***	(0.008)***	(0.017)	(0.021)*
500 or above	0.067	0.091	0.002	0.051
	(0.007)***	(0.009)***	(0.018)	(0.021)**
Number of vacancies	-0.000	-0.000	-0.001	-0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)**
Certificate:				
Licence	0.185	0.189	0.114	0.207
	(0.009)***	(0.011)***	(0.035)***	(0.030)***
Professional	0.022	0.029	-0.031	-0.018
	(0.011)**	(0.014)**	(0.030)	(0.032)
IT	0.039	0.035	0.055	0.099
	(0.014)***	(0.020)*	(0.029)*	(0.035)***

Language	0.069	0.070	0.047	0.076
	(0.007)***	(0.010)***	(0.016)***	(0.018)***
Other	0.004	-0.001	-0.019	0.012
	(0.029)	(0.038)	(0.073)	(0.090)
Constant	10.000	9.992	10.036	9.991
	(0.010)***	(0.013)***	(0.025)***	(0.028)***
Other controls	Gender, Industry, Area and Year			
Observations	17,624	9,593	2,500	2,284
R-squared	0.52	0.51	0.54	0.55

Standard errors in parentheses; * significant at 10%; ** significant at   5%;   ***   significant at 1%

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