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JOB QUEUES AND WAGES: NEW EVIDENCE ON THE
MINIMUM WAGE AND INTER-INDUSTRY WAGE STRUCTURE

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ABSTRACT

This paper uses job applications data to test the existence of non-competitive, ex-ante rents in the labor market. We first examine whether jobs that pay the legal minimum wage face an excessive supply of labor as measured by the number of job applications received for the most recent position filled by the firm. The results indicate that openings for jobs that pay the minimum wage attract significantly more job applications than jobs that pay either more or less than the minimum wage. This spike in the job application rate distribution indicates that ex-ante rents generated for employees by an above market-level minimum wage do not appear to be completely dissipated by employer actions.

The second part of the paper uses a similar approach to examine whether jobs in high-wage industries pay above market-clearing wage rates. We find a weak, positive relationship between inter-industry application differentials and inter-industry wage differentials. In addition, our results indicate that employer size has a sizeable positive effect on the job application rate even after controlling for the wage rate. The paper considers several possible explanations for these findings.

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In a labor market where workers seek rents, employers that offer a supra-competitive wage would face a long queue of qualified workers. The presence of this job queue would encourage employers to reduce their wage to the market-clearing level. Interference in the wage setting process from government regulation (e.g. an enforced minimum wage law) or from union bargaining power could prevent the forces of labor market competition from lowering wages to eliminate excessive job queues. In addition, efficiency wage, expense-preference, and insider-outsider models suggest that some firms or managers may find it in their interests to maintain above market-clearing wages.¹ In this paper we test for the presence of above market-clearing total compensation packages by examining whether firms that pay the minimum wage or that are in high-wage industries face an excessive supply of labor as measured by their number of job applicants.²

A government-enforced minimum wage law provides a natural experiment to examine the relationship between wage premia and job

¹The efficiency wage literature is surveyed by Stiglitz (1986) and Katz (1986). Insider-outsider models are surveyed by Lindbeck and Snower (1986). Jensen and Meckling (1976) discuss managerial agency models.

²The approach of examining relative application rates to determine whether earnings differentials among jobs are non-market clearing has a venerable tradition in labor economics. In their classic study of the relative wages of doctors and dentists, Friedman and Kuznets (1945) rely heavily on a comparative analysis of application rates to medical and dental schools. Given that the preliminary training required for the two professions is virtually identical, Friedman and Kuznets (p. 124) conclude that their finding that "more than four times as many persons applied annually for admission to American medical schools as for admission to American dental schools" is sufficient alone to establish that "at existing levels of remuneration, prospective practitioners consider medicine more attractive than dentistry." And H.G. Lewis (1963) uses a similar approach to examine the importance of entry barriers into the medical profession as well as the relative earnings of doctors and dentists.

queues. Unless firms find it profitable to extract all rents from workers that are generated by a binding minimum wage by cutting fringe benefits, raising effort requirements, upgrading hiring standards, or letting working conditions deteriorate, positions in which firms are constrained to increase wages to meet the legal minimum wage will confer rents to workers. A finding that jobs that offer the minimum wage tend to face an excessive queue of job applicants would support the joint hypothesis that firms do not extract all rents generated by the minimum wage, and that there is a labor supply response to the presence of these rents.

Our second application pertains to the inter-industry wage structure. Much research has documented the existence of large and persistent inter-industry wage differentials for similar workers.³ In a textbook competitive labor market model, persistent wage differentials for observationally equivalent workers must reflect either compensating differentials for nonwage job attributes or unmeasured differences in worker productive abilities. Under this market-clearing scenario, one does not necessarily expect any systematic relationship between wages and the job application rate.⁴

On the other hand, labor market segmentation models (e.g. efficiency wage, rent sharing and insider-outsider models) provide an alternative explanation for inter-industry wage differentials in which

³For recent evidence see Dickens and Katz (1987a,b) and Krueger and Summers (1987, 1988).

⁴Unqualified workers may apply for high wage jobs and give the misleading appearance of a job queue even in a market-clearing situation. We return to this issue below.

workers in high-wage industries earn rents relative to their opportunity cost. Thus, these models predict that firms in high-wage industries should attract longer queues of job applicants than firms in low-wage industries. Demonstrations of a comparatively lower quit rate in high-wage industries by Pencavel (1970) and others provide some evidence of the presence of rents in high-wage industries, although this relationship may also be attributable to specific human capital and omitted worker quality variables. While quit rate differentials provide evidence on the location of ex-post rents, the relationship between the number of job applicants per opening and wage differentials provides a more direct test of the presence of ex-ante rents in high-wage jobs.

The prediction of segmented labor market models of the presence of equilibrium ex-ante rents in some jobs has been severely criticized on theoretical grounds. The basic idea behind this critique is that if there are queues for jobs because they pay ex-ante rents, workers will be willing to pay to obtain these jobs (Carmichael, 1985). Murphy and Topel (1987) argue that even if explicit job purchases are ruled out, firms may have alternative mechanisms to extract the ex-ante rents that arise from wage premia paid for efficiency wage reasons.⁵ These arguments essentially deny the possibility of rents in almost any situation. In particular, this line of reasoning has been applied to the case of a government-imposed minimum wage. Wessels (1980a,b), Mincer (1984) and others contend that firms constrained to pay the legal minimum wage have an incentive to reduce fringe benefits and erode

⁵The fairness efficiency wage model (Akerlof and Yellen, 1987) and models based on the bargaining power of insiders are less susceptible to this bonding critique.

working conditions until all rents are completely dissipated. On the other hand, firms may choose not to extract all surplus from workers because such actions may reduce morale and productivity, or because employers may be utilitarian and the cost to workers of changing nonwage compensation may greatly outweigh the reduction in costs to employers.

In the next section, we discuss the factors likely to determine whether firms constrained to pay the minimum wage will fully dissipate rents, and discuss theoretical issues concerning the relationship between job application rates and wages. We then examine whether firms that are constrained to pay the minimum wage attract excessive queues of job seekers as measured by the number of job applications they receive per opening. The micro-level employer-reported data on job applicants, firm characteristics, and wages that we utilize is described in section two. Our empirical results concerning the minimum wage are presented in section three. The main finding is that firms that pay the minimum wage receive substantially more applicants for their job openings than firms that pay either more or less than the minimum wage. This finding makes plausible the idea that above market-clearing wage premiums can persist in the labor market.

In section 4 we examine whether jobs in high-wage industries attract more applicants than similar jobs in low-wage industries. Although the evidence on the relationship between job queues and inter-industry wage differentials is somewhat inconclusive, the results suggest that firms in high-wage industries attract a larger number of job applicants than other firms. In addition, the empirical work shows that the size of an establishment has a large, positive effect on then

number of applicants for a given job opening that cannot be explained by the higher starting wages paid by larger establishments.

1. Theoretical Considerations

A. Minimum Wages, Job Queues, and Rent Dissipation

In the standard textbook analysis of an above market-level minimum wage, employers constrained to pay the minimum wage are assumed to not offset the minimum wage by reducing other forms of compensation (Stigler, 1946). Workers remaining in minimum wage jobs are made better-off since their total compensation rises by the mandated increase in wages. The minimum wage reduces the number of jobs in the covered sector by increasing the relative cost of labor and creates rents for workers employed in minimum wage jobs. The model yields ambiguous predictions concerning the impact of the minimum wage on the welfare of workers in the uncovered sector and the workers displaced from the covered sector (Mincer, 1976). However, the standard model unambiguously predicts that jobs that are constrained to pay the minimum wage should attract a relatively large queue of job applicants.

Wessels (1980a,b), Hashimoto (1981), and Mincer (1984) have analyzed an extended model of the minimum wage in which firms attempt to offset mandated wage increases by altering other unregulated aspects of the compensation package. Firms can lower labor costs by reducing expenditures on fringe benefits, reducing on-the-job training, and worsening working conditions. Firms will continue to attract employees until total compensation is lowered to a market-clearing level. The presence of the minimum wage leads covered firms to provide an

inefficient compensation package. This reduces labor demand at the total compensation level prevailing before the minimum wage was imposed. If the labor supply schedule to the low-wage sector of the labor market is upward sloping, a minimum wage can actually reduce the total compensation in both covered and uncovered jobs.⁶

Thus, if firms can completely dissipate the rents generated by a minimum wage law, all workers -- including those holding minimum wage jobs -- can be made worse-off by the minimum wage, and in this situation minimum wage jobs would not face excessive queues of job applicants. If, on the other hand, firms do not fully dissipate rents then the welfare of those obtaining minimum wage jobs is improved, and jobs that offer the minimum wage should receive a relatively large number of job applicants.

Wessels (1980b) suggests three reasons why firms may not choose to, or may not be able to, fully offset the increase in workers' total compensation generated by the imposition of a minimum wage. First, the fixed costs of adjusting the compensation package may outweigh the potential cost savings. This is likely to be the case if the minimum wage is set in nominal terms and is expected to be rapidly eroded away by inflation. Second, the amount of adjustments possible on unregulated aspects of compensation may not be large enough to offset the minimum wage (e.g. fringe benefits are only a small part of the compensation package in low-wage jobs). Third, nonwage conditions of work (e.g.

⁶We note that as a practical matter it is unlikely that those who hold minimum wage jobs are made much worse-off as a result of the minimum wage because available econometric evidence surveyed in Brown, Gilroy and Kohen (1983) suggests that the relevant demand schedule is very inelastic.

heating and work pace) may be public goods affecting workers above the minimum wage as well as minimum wage workers, or legal requirements such as pension regulations and equal rights laws may require that all workers are treated equally and thus essentially turn some private goods into public goods.

There are two further reasons why firms may not reduce nonwage expenditures to fully eliminate the increased rents for covered employees created by a binding minimum wage. The first is related to efficiency wage models of the labor market and depends on the additional assumption of decreasing marginal utility of wages and fringe benefits.⁷ According to efficiency wage models, worker productivity is a positive function of compensation. This relationship is posited because higher compensation may reduce turnover and absenteeism, increase effort, or make it easier to recruit workers. To see that a firm will not totally offset the wage increase brought about by a minimum wage if productivity depends on worker pay, suppose that an "efficiency wage" employer were to fully offset the minimum wage by cutting fringe benefits to the point where the worker's compensation equals the pre-minimum wage level. In this situation, the compensation mix is not optimal and a dollar spent on fringe benefits has more than a dollar's value to employees. If the firm increases fringe benefits above this level, the increase in net worker productivity will more than pay for the additional cost of fringe benefits. When faced with a positive wage-productivity schedule, a firm is no longer a wage-taker -- the firm's effective labor supply is an

⁷In a similar vein, Wessels (1980b) notes that turnover costs may induce firms to only partially offset a minimum wage increase.

upward sloping function of its wage and fringe benefits, and this will inhibit the firm's desire to fully offset the minimum wage. A similar argument could be made if the firm has monopsony power over its workers.

The final reason why firms might not fully offset a minimum wage increase is related to agency problems which give firms non-profit maximizing preferences. According to this argument, because managers are not perfectly monitored by shareholders, firms will maximize objective functions that depend positively on their employees' utility as well as profits. In this situation, a firm will not totally offset a wage increase generated by the minimum wage because to do so may exact a great toll from workers while only raising profits by a small amount for the firm. To take an extreme example, if after eliminating fringe benefits workers who earn the minimum wage still receive some surplus, it seems unlikely that managers will require workers to perform arduous tasks if such activities only generate a trivial amount of additional profit for the firm.

There is limited evidence that firms adjust some nonwage aspects of their compensation package in response to binding increases in the minimum wage. Wessels (1980a,b) reports the results of a survey of offsets made by retail stores in response to the New York state minimum wage law of 1957. Only a small minority of the stores reported reductions in fringe benefits although many reduced the hours of work of minimum wage workers. Alpert (1986) finds no evidence of more than quite minor reductions in fringe benefits in response to large increases in the minimum wage in the restaurant industry in the 1970's. Lastly, Leighton and Mincer (1981) provide some evidence of reduced job training

and lower wage growth in response to increased minimum wages for workers with less than high school education.

The number of job applicants for minimum wage jobs relative to the number of applicants for other jobs provides a direct test of the standard model of the minimum wage which assumes incomplete nonwage offsets versus the full offset model. The failure of firms to completely offset the compensation increase created by a minimum wage clearly leads to the prediction of greater numbers of applicants to firms paying the minimum wage than to uncovered or noncomplying firms paying wages below the minimum wage.

Additionally, a spike in applications at minimum wage jobs relative to both jobs that pay more than the minimum wage and jobs that pay less than the minimum wage would provide even stronger evidence that rents created by the minimum wage are not totally dissipated. First, jobs paying more than the minimum wage may have different entry requirements than jobs paying the minimum wage or less. The job application rate may vary with skill levels. A finding of a discontinuous jump in applications at the minimum wage will suggest that the minimum wage is not just picking up the general application-wage profile. Second, and perhaps more important, jobs that pay more than the minimum wage may be equally desirable as jobs that pay the minimum wage or less, but may offer a higher wage to compensate workers for some disamenable working condition. In this equalizing differences equilibrium, a binding minimum wage will increase the desirability of minimum wage jobs relative to jobs that pay more than the minimum wage, and thus generate a spike in applications at the minimum wage. This latter argument is

more plausible for jobs that are only slightly above the minimum wage.

B. Job Application Rates and Wages with Homogeneous Workers

We first consider a labor market with identical workers and with firms that differ in their valuations of the benefits of filling a vacant job.⁸ Firms attract applicants by announcing the existence of the job opening and advertising its offered wage. Job seekers costlessly obtain all relevant information about job openings. Each job seeker is assumed to be able to apply to only a single firm. If the job seeker is the only applicant for the opening, he or she is hired and paid the advertised wage. If more than one person applies for the job, the firm randomly selects from the applicant pool. If a worker is unlucky and not selected for a job he is assumed to consume leisure and/or work in home production, which provides a lower level of utility than the forgone job.

The net expected benefit of applying to any job opening must be equalized across openings in equilibrium. Job seekers will then be indifferent between applying for low wage positions which have a high probability of acceptance, and applying for high wage positions which have a low probability of acceptance. Workers pick higher probabilities of applying to high wage jobs in equilibrium.⁹ Firms choose wages

⁸This section draws heavily from Montgomery's (1987) formal model of the relationship between wages and job queues. See Lang (1987) and Weitzman (1987) for related models.

⁹Montgomery assumes each job seeker can apply to only one job. The basic equilibrium condition that the expected value of applying to a opening is constant across openings even when applicants can make multiple applications as long as workers are not able to apply to all openings. If workers cannot apply to all openings, high wage jobs will receive more applicants than low wage jobs. Lang (1987) analyzes in detail the issues that arise when workers can simultaneously apply to

knowing that job seekers respond in this manner. Thus, firms with high valuations of filling a job will offer high wages in order to attract a larger expected number of applicants. A direct result of the equilibrium condition in this model is that the expected number of applicants for an opening will be positively related to the offered wage.

C. Heterogeneous Labor with Nonrandom Selection

If individuals differ in their productive capacities, and if employers make job offers to applicants on the basis of their perceptions of workers' abilities, the analysis becomes more complicated. Our purpose here is only to present a heuristic discussion of these effects.

It is probably reasonable to assume that individuals have a noisy estimate of their ability relative to the labor force, and that prospective employers have an imperfect but positively correlated measure of each applicant's ability. A final assumption is that there is a positive correlation between the applicant's reservation wage and ability.

An increase in total compensation in this situation potentially has three distinct effects on the application rate. First, a job candidate's expectation of being rated the most highly qualified applicant and therefore of being selected for the job is diminished. This occurs because individuals with higher reservation wages and therefore greater expected ability will apply for the job (Weiss, 1980; Nalebuff and Stiglitz, 1982). The average quality of the job queue

more than one firm and receive more than one offer.

increases. In the extreme case, if employees know with certainty who the most qualified applicant for the job will be, only that individual will apply for the job.

The second effect occurs because an increase in a job's wage, holding all else constant, makes it a more attractive alternative than other jobs and is therefore worth applying for even though the chance of ultimately being selected is reduced. This is the result that is discussed in the model above in the case of homogeneous labor.

Finally, some workers may find it in their best interest to apply for high-wage jobs for which they lack the required training and skills to perform the job adequately. Since employers only have an inaccurate measure of job seekers' abilities, there is a nonzero probability that unqualified workers will succeed in being selected for high-wage jobs. As a result, high wages may attract relatively many unqualified applicants. If this is quantitatively and important effect, it will be impossible to distinguish between the segmented labor market interpretation and the human capital interpretation of inter-industry wage differentials on the basis of inter-industry differences in application rates without further knowledge of the abilities of job applicants.

2. Data

The data we use are from an evaluation survey of the Employment Opportunity Pilot Project (EOPP) sponsored by the National Institute of Education and the National Center for Research in Vocational Education. Although the survey is longitudinal, we focus on the 1982 follow-up

cross-section because it contains specific information on the demographic characteristics and starting salary of the selected job applicant, as well as information on the vacant position. A total of 3,400 firms were surveyed. The surveyed firms are located in 28 geographic sites, with a disproportionate number of sites concentrated in southern and midwestern states. Twelve of the sites are SMSA's. Employers were contacted by phone between February and June of 1982, and the person who "handles the hiring activity" for the company for the area contained within the geographic site was asked to directly answer the questionnaire. The survey deliberately over-sampled low-wage firms.

The survey contains information on the recent hiring activities of firms. Specifically, the person responsible for hiring was asked several questions concerning the last position filled by a "new employee" prior to August 1981, including the number of applicants for the position, the occupational category of the position, the starting salary, and the new worker's demographic characteristics (age, sex, training, work experience and education).¹⁰ The designers of the survey intended that the question concerning the number of persons who applied for the last position filled should measure the number of individuals formally applying for the position.¹¹ A formal application typically would require a worker to submit a written application form; casual

¹⁰ Three-quarters of the firms in the survey hired their most recent employee in 1981; 15% hired their most recent employee in 1980; 7% hired their most recent employee in 1979; and 3% hired their most recent employee in 1978. The survey also contains a small number of firms whose most recent outside hire was prior to 1978, but these observations are dropped from the sample because the accuracy of the retrospective information is likely to become less accurate with time.

¹¹ Personal communication from John Bishop of Cornell University.

inquiries over the phone or personal visits that do not involve a written application were not intended to be counted as job applications.¹² In situations where multiple employees are hired for the last position filled, we divide the number of applicants by the number of workers hired.

In addition to questions on recruitment and employee characteristics, the survey contains information on several aspects of the employer, including firm and establishment size, industry, proportion of workers covered by a union contract, and geographic location. Unfortunately, the establishment size variable is defined in a nonstandard way. Instead of asking for the size of an individual establishment, the establishment size question solicits the combined size (number of employees) of all the establishments of a particular firm that are located within the geographic site. As a result, establishment size in this data set is a conglomeration of typically defined establishment size and firm size measures.

Application Rates and Unemployment

In order to crudely gauge the validity of the application variable as a measure of labor market conditions, we regress the average application rate in a city on the local unemployment rate for a sample of 28 cities. Results of estimating this regression (with standard errors in parentheses) are presented below.

¹²This interpretation of the application measure seems especially plausible since earlier in the survey respondents were asked questions that treated phone inquiries from people seeking work, visits to the company of individuals seeking work, written job applications, and formal job interviews as distinct categories.

$$(1) \quad \ln \left(\frac{\text{Applications per}}{\text{Last Opening}} \right) = 3.954 + .710 \ln(\text{UR}) \quad R^2 = .15$$

$$(.850) \quad (.329)$$

The relationship between the site level job application rate and the unemployment rate is positive and statistically significant.¹³ While we do not put a structural interpretation on this equation, it suggests that the application rate is correlated with the characteristics of the local labor market. As the fraction of the labor force that is unemployed increases, more applications are received by firms in the area. Later we compare this estimate of the responsiveness of the application rate with respect to a change in the unemployment rate to the responsiveness of the application rate with respect to a change in the wage rate.

3. Empirical Evidence on Queues for Minimum Wage Jobs

A legally enforced and binding minimum wage provides a clear opportunity to examine the relationship between job applications and wage premia. Under a wide variety of assumptions, economic models predict that imposing an above market-level minimum wage will result in an excess supply of labor to those firms. Unless firms can extract all rents by cutting fringe benefits or making work more burdensome, firms that are constrained by the minimum wage should receive more job applications than firms that are in labor markets where the minimum wage

¹³ Since other characteristics of firms and the labor force might affect the relationship between applications and unemployment, we also estimate equations that include average firm size and a dummy variable for being in an SMSA. The results are not significantly changed by including these variables.

is not constraining. The existence of a queue for minimum wage jobs would support a conclusion that employers do not fully offset the effects of a minimum wage by altering some other form of compensation or working conditions.

Table 1 reports means and standard deviations for several variables disaggregated by whether the starting wage for the job was less than, equal to, or greater than the legal minimum wage that was in effect in the year the position was filled.¹⁴ Fortunately, the survey provides a disproportionately large sample of low-wage jobs -- 197 (14%) job openings in the sample paid newly hired workers the prevailing legal minimum wage, and 65 (5%) job openings paid a starting wage below the prevailing legal minimum wage. Jobs that pay less than the minimum wage are either not covered by the minimum wage provisions of the Fair Labor Standards Act (FLSA) or are in violation of the Act. Congress raised the minimum wage six times in the 1970's. The 1977 amendments to the FLSA scheduled increases in the minimum wage for each year from 1978 to 1981.¹⁵ As a result, in years covered by our sample (1978-1981), increases in the minimum wage were expected and scheduled in advance, which should have facilitated any possible nonwage offsets by employers.

Looking at Table 1, workers who are hired into minimum wage jobs are on average less educated, younger, less experienced and more likely

¹⁴We have eliminated from the sample 40 restaurant jobs that offer a subminimum wage because workers in these jobs are likely to receive unreported tips, and as a consequence the hourly wage will not adequately reflect the total compensation of these workers.

¹⁵The minimum wage rate was \$2.65 in 1978, \$2.90 in 1979, \$3.10 in 1980 and \$3.35 in 1981. Increases in the minimum wage over this time period roughly kept pace with inflation.

Table 1

Means (Standard Deviations) by Starting Hourly Wage Rate

Variable	Subsample		
	Less than Minimum Wage	Minimum Wage	More than Minimum Wage
Log Applications Per Opening	1.34 (1.15)	1.59 (1.19)	1.42 (1.18)
Applications Per Opening	8.76 (19.96)	11.40 (25.77)	9.62 (21.67)
Male	.38 (.49)	.43 (.50)	.59 (.49)
Age	24.70 (10.82)	24.06 (8.54)	27.64 (8.98)
High School Graduate	.66 (.48)	.72 (.45)	.77 (.42)
College Graduate	.06 (.24)	.05 (.21)	.15 (.36)
Years of Relevant Experience	.62 (1.70)	.85 (1.75)	2.82 (4.83)
Hours of On The Job Training	43.22 (62.57)	39.20 (81.40)	58.31 (93.69)
Weekly Hours > 35	.31 (.47)	.53 (.50)	.78 (.41)
Weekly Hours Betw. 20 and 35	.45 (.50)	.32 (.47)	.12 (.32)
Temporary Job	.15 (.36)	.13 (.34)	.09 (.29)
Seasonal Job	.11 (.31)	.06 (.23)	.05 (.21)
Establishment Size	24.15 (66.10)	44.73 (85.29)	68.86 (228.12)
White Collar	.55 (.50)	.41 (.49)	.52 (.50)
Days Between Beginning of Search and Start of Work	7.75 (8.26)	12.18 (21.69)	17.95 (33.02)
Sample size	65	197	1,102

Note: Sample includes all workers who earn more than \$1.00 per hour. The sex, age, and education questions pertain to the worker who was hired for the job.

to be female than workers who are hired into jobs that pay more than the minimum wage; while workers whose starting wage is less than the minimum wage have similar personal characteristics and training to workers whose starting wage equals the minimum wage. In addition, as others have found using different data sets, this sample shows that jobs that pay either the minimum wage or a subminimum wage are more likely to offer part-time work compared to jobs that pay more than the minimum wage. These summary statistics suggest that workers whose starting wage is less than the minimum wage may be fairly close substitutes for workers whose starting wage exactly equals the minimum wage, but workers who earn more than the minimum wage have different skills and qualifications than workers who earn the minimum wage or less.

Most importantly for our purposes, the table indicates that the number of applicants per job opening is greater for positions that pay exactly the minimum wage to start than for positions that initially pay either more or less than the legal minimum wage. The pairwise comparisons of the difference in the mean log application rate between the subsample of workers whose starting wage rate equals the minimum wage and each of the other two groups are both statistically significant at the 10% level. These differences in application rates are not driven largely by a few outliers. The median number of applicants per job opening for jobs that paid exactly the minimum wage was 5 as compared to 4 both for jobs that paid less than the minimum wage and for jobs that paid more than the minimum wage.

In addition, we find that an apparent "spike" in application rates at the minimum wage exists when we limit our sample to the narrow band

of jobs that pay within 25 cents of the minimum wage. On average, 10.02 applicants applied per job opening that paid within 25 cents less than the minimum wage; 11.40 applicants applied per job opening that paid exactly the minimum wage; and 10.92 applicants applied per job opening that paid within 25 cents more than the minimum wage.¹⁶ These findings suggest that there is a discrete jump in applications at the minimum wage.

If a job offers an above market-clearing wage and therefore attracts a queue of qualified applicants, the duration of time required to fill a vacancy for this job will be short relative to other jobs that do not offer an above market-clearing wage rate. It follows that a complementary test of the existence of rents in minimum wage jobs would be that vacancies in jobs that offer the minimum wage will require less time to fill than vacancies in other jobs, all else equal.

Unfortunately, the EOPP survey only allows us to address this issue indirectly. The survey asks a question on the length of time elapsed "between [when the employer] started looking for someone to fill the opening and the time the new employee started work." However, one serious shortcoming of this question is that the length of time between when a new employee is hired and he or she actually begins work may increase with the skill requirements of the position (i.e. the academic job market ends in February or March but new assistant professors do not officially begin work until September). As a result, this question may

¹⁶The findings are similar when the sample includes all jobs that pay within 50 cents of the minimum wage. On average, 10.25 applicants applied per job opening that paid within 50 cents less than the minimum wage and 9.47 applicants applied per job opening that paid within 50 cents more than the minimum wage.

not adequately represent the duration of employer search time necessary to recruit a new employee for a vacancy.

In the EOPP sample the average time elapsed between the initiation of a job search and the actual date an employee begins work is shorter among jobs that pay the minimum wage than among jobs that pay more than the minimum wage, but is shorter still in jobs where the starting wage is less than the minimum wage (see Table 1). This pattern suggests that responses to this particular vacancy duration question may reflect the lag between the date a job offer is accepted and the date the new employee eventually assumes his job instead of the comparative difficulty of filling a job vacancy.

In Table 2 we estimate OLS regressions to examine whether the "spike" in applications for minimum wage jobs holds-up after controlling for a variety of alternative sets of independent variables. The dependent variable in the regressions is the natural log of the number of applicants for the last position filled by an outside hire. We include a dummy variable that equals one if the job pays the minimum wage and zero otherwise, and another dummy variable that equals one if the job pays a subminimum wage and zero otherwise. The reported coefficients should be interpreted as the proportionate excess supply of job applicants relative to firms that pay more than the minimum wage. Because workers who earn substantially more than the minimum wage may very well be in different labor markets than workers who earn the minimum wage or less, we eliminate from the sample workers whose wage rate exceeds \$5.00 an hour. However, we note that our results are qualitatively unchanged when we examine the full sample, and we report

Table 2

Application Differentials for Minimum Wage and Subminimum Wage Jobs^a
 Subsample of Workers with Wage Rate Less Than \$5.00 Per Hour

Other Independent Variables	Minimum Wage Effect ^b	Subminimum Wage Effect ^c	R ²
1. Occupation Dums. (8), Hours of Formal Training, Hours of Informal Training, Age, Sex, Experience, High School Dum., College Dum., Full-Time Dum., Seasonal Job Dum., Temporary Job Dum., Year Dums. (4)	.226 (.099)	.027 (.154)	.080
2. Row 1 Plus 27 Site Dums.	.225 (.101)	.032 (.158)	.125
3. Row 2 Plus Proportion Union	.243 (.101)	.049 (.158)	.128
4. Row 3 Plus 4 Firm Size Dums. and Log Plant Size	.228 (.100)	.124 (.157)	.150
5. Row 4 Plus 35 Industry Dums.	.260 (.103)	.145 (.119)	.175

Notes:

a. Dependent variable is $\ln(\text{Applications per last job filled})$. Sample size is 967. Standard errors are in parentheses. Regressions also include a constant.

b. Estimated coefficient for a dummy variable that equals 1 if the worker's starting wage equalled the minimum wage that was in effect in the year the worker was hired, and 0 otherwise.

c. Estimated coefficient for a dummy variable that equals 1 if the worker's starting wage was less than the minimum wage that was in effect in the year the worker was hired, and 0 otherwise.

estimates of the same equations using the full sample in Appendix Table A1.¹⁷

The regressions show a statistically significant, sizeable and positive differential in the application rate between jobs that pay the minimum wage and jobs that pay more than the minimum wage, while jobs that are above or below the minimum wage do not have a statistically significant difference in applications. According to the point estimates, jobs offering the minimum wage attract between 22.5% and 26% more applications than jobs that offer a starting wage that exceeds the minimum wage, and between 20% and 10% more applications than jobs that pay starting wages that are less than the minimum wage. The application differentials fall when employer size variables are added to the regression, but are not very much influenced by the other independent variables such as industry affiliation or union coverage. Employer size has an important effect on these results because workers who earn a subminimum wage tend to work in relatively small establishments, and results discussed more fully below show that the application rate is lower in small firms, all else equal.

These results take on added significance since it is unlikely that workers who apply for jobs for which they are unqualified in the hope of deceiving their employer will apply for minimum wage jobs. Such beguiling behavior will have a higher payoff in jobs that pay more than the minimum wage. Moreover, the finding that more workers apply for

¹⁷We also note that the spike in the application rate for minimum wage jobs becomes larger and more statistically significant when we narrow the sample to the group of workers who are age twenty-one or younger.

minimum wage jobs than for jobs paying a greater wage than the minimum wage suggests that the excess supply of applicants for minimum wage jobs relative to jobs below the minimum wage does not merely reflect an upward sloping applicant-wage relationship.

This spike in applications for firms paying the minimum wage strongly suggests that workers queue for minimum wage jobs, which in turn implies that employers do not fully offset the effects of the minimum wage by reducing fringe benefits or eroding working conditions. Since employers constrained to pay the minimum wage may be able to cut back on direct recruiting activities (e.g. advertising job openings) and still attract applicants, our estimate of the minimum wage application differential may even understate the effect of the rents generated by the minimum wage on application rates.

4. The Inter-Industry Wage Structure and Job Applications

This section examines the relationship between two-digit industry affiliation and application rates. It is well known that industry status exerts a powerful influence on workers' wages, and that the industry wage structure is extremely stable over time. However, the interpretation of these facts is not clear. If inter-industry wage differentials are equalizing differentials for nonwage aspects of work, then we would not expect to find a systematic relationship between application rates and wages at the industry level. On the other hand, if differences in wages across industries are rents to workers there should be a positive relationship between inter-industry application rates and wages.

To test whether jobs in high-wage industries offer wages above market-clearing rates, we assume that when occupation, education, geographic location, and other variables are held constant, a firm's industry does not directly influence the number of applications the firm receives for its available job openings; instead, industry operates indirectly on applications through its effect on wages. Under this exclusion restriction, a test of the market-clearing hypothesis boils down to whether using industry dummy variables as instruments for the wage rate in an application equation gives a positive estimate of the wage-application relationship. Moreover, the industry exclusion restriction is testable because there are many industry dummies to estimate only one parameter.

To fix ideas, consider the following structural model of the log of job applications per opening, A , and the log of the starting wage rate, W :

$$(2) \quad A = W\alpha_W + X\alpha_X + \epsilon_A$$

$$(3) \quad W = A\beta_A + Z\beta_Z + X\beta_X + \epsilon_W$$

where α_W is the elasticity of job applicants with respect to the wage rate, Z is an $N \times K$ matrix of K mutually exclusive industry dummy variables, β_W is a $K \times 1$ vector of industry wage differentials, and X is an $N \times q$ matrix of control variables that includes a constant.¹⁸ The ϵ_i , $i \in \{A, W\}$, are $N \times 1$ vectors of i.i.d. errors. There are N observations. We assume that Z is a valid instrument for W , so that $\text{plim } Z'W = 0$ and $\text{plim } Z'\epsilon_A = 0$. Equation (2) is over-identified

¹⁸ There are a total of $K + 1$ mutually exclusive and exhaustive industry dummies, but because the equations include constant terms, only K industry dummies are included in Z .

because there are more than one industry dummy that may be used as instruments for W .

A simultaneous system is posited because in a standard demand and supply framework the wage rate offered affects the number of applicants received, while the number of applicants simultaneously affects the offered wage. Even if the starting wage is predetermined and unresponsive to the number of job applicants, another reason for instrumenting for the wage rate in the application equation is that unobserved, omitted variables in the application equation will affect the starting wage rate, which will lead to spurious correlation between W and ϵ_A . For example, a university bookstore may attract more applicants at any given wage than a remote bookstore and may therefore choose a low wage policy. A positive estimate of α_W is consistent with the view that inter-industry wage differentials represent ex-ante rents to workers.

Results

Results of estimating equation (2) by two-stage least squares are reported in Table 3. The table reports estimates of three different specifications using alternate sets of included regressors (the X matrix). Each specification uses 34 industry dummy variables as instruments for the wage rate. The results indicate that the job application rate tends to increase with the starting wage rate, however, this relationship becomes statistically insignificant once employer size and union coverage are held constant. The point estimates of the elasticity of applications with respect to wages range from .27 to .51. Comparing the latter estimate of the application-wage relationship to

Table 3
 2SLS Estimates of the Determinants of Job Applications
 Using 34 Industry Dummy Variables as Instruments for the Wage Rate^{a,b}

Independent Variable	Mean [SD]	Equation		
		1	2	3
Intercept	1.00 [.00]	-1.747 (1.503)	-1.635 (1.752)	-.758 (1.747)
Log(Wage)	6.19 [.40]	.512 (.268)	.489 (.315)	.271 (.317)
Proportion Union	.12 [.30]	---	.167 (.154)	-.049 (.153)
Log (Estab. Size)	2.80 [1.53]	---	---	.157 (.027)
<u>Firm Size</u>				
50-99	.08 [.26]	---	---	.139 (.130)
100-499	.03 [.17]	---	---	.242 (.205)
500-1,999	.07 [.26]	---	---	.249 (.138)
≥ 2,000	.03 [.17]	---	---	.106 (.209)
<u>Demographic</u>				
Male (1=yes)	.58 [.49]	-.104 (.105)	-.102 (.109)	-.066 (.108)
Age	27.48 [9.11]	-.002 (.005)	-.002 (.005)	-.000 (.005)
Experience	2.69 [4.76]	-.009 (.010)	-.009 (.011)	-.004 (.011)
High School Grad	.77 [.42]	-.043 (.130)	-.033 (.134)	-.048 (.131)
College Grad	.14 [.35]	-.114 (.167)	-.102 (.174)	-.124 (.170)
<u>Occupation</u>				
Prof/Tech.	.05 [.22]	.022 (.214)	.032 (.225)	.177 (.223)
Management	.05 [.22]	-.313 (.229)	-.311 (.239)	-.268 (.235)
Sales	.15 [.36]	.150 (.131)	.152 (.131)	.240 (.129)
Clerical	.23 [.42]	.422 (.129)	.424 (.131)	.442 (.128)
Craft	.01 [.08]	.585 (.425)	.597 (.424)	.720 (.414)
Operative	.02 [.13]	.576 (.278)	.572 (.278)	.612 (.271)
Laborer	.01 [.07]	-1.223 (1.207)	-1.199 (1.208)	-1.094 (1.179)
Occ. Unknown	.36 [.48]	-.123 (.130)	-.134 (.130)	-.044 (.129)

Table 3 -- Continued

2SLS Estimates of the Determinants of Job Applications
Using 34 Industry Dummy Variables as Instruments for the Wage Rate

Independent Variable	Mean [SD]	Equation		
		1	2	3
<u>Hours Training</u>				
Formal	10.46 [44.87]	.0025 (.0008)	.0024 (.0008)	.0023 (.0007)
Informal	57.47 [92.27]	.0003 (.0003)	.0003 (.0004)	.0004 (.0004)
σ^2_{ϵ}		1.315	1.312	1.248
<hr/>				
χ^2 Statistic for GMM Specification Test of Industry Exclusion Restrictions (DF = 33)		55.73	57.80	49.31
Prob. Value for Hausman Test of Simultaneity Between Starting Wage and Applications		.102	.119	.288

Notes:

- Asymptotic standard errors in parentheses. Sample size is 1,167. Mean of log(Applications) is 1.423 [1.174].
- Equations also include 27 site dummy variables and 4 year dummy variables. Omitted occupation is service workers.

the estimate of the application-unemployment relationship reported earlier in equation (1), a 10% increase in the starting wage rate has about as much of an enhancing effect on the application rate as a half of a percentage point increase in the unemployment rate.

The specification tests reported in the bottom of Table 3 test the assumption of the orthogonality of the industry dummies and the error term in the application equation, and also summarize results of Hausman tests of simultaneity between the starting wage and application rate. The Generalized Method of Moments (GMM) error-orthogonality test involves regressing the two-stage least squares residuals on the industry dummy variables and included regressors; N times the R^2 from this regression asymptotically follows a chi-squared distribution (see Newey, 1985). A weak relationship between the residuals and instruments would indicate that the equation is properly specified. The reported chi-squared test of the null hypothesis that industry is properly excluded from equation (2) accepts at the .01 level and rejects at the .05 level for each of the specifications in Table 3. Given the large sample size, however, the industry exclusion assumption may not be too bad an approximation.¹⁹

In addition, the Hausman tests for endogeneity of the wage in the application equation (which are based on the assumption that industry dummy variables are valid instruments for the wage) are suggestive of a simultaneous relationship between applications and starting wages. We note, however, that even though the probability values for the Hausman

¹⁹The exclusion restriction would not be rejected using the Schwartz criterion $((K-1) \times \ln(N) = 233)$, which allows the probability of making a type I error to shrink as the sample size grows.

tests are greater than .10, there is a qualitative difference in the estimated application-wage elasticity when equation (2) is estimated by OLS and when it is estimated by two-stage least squares using industry dummy variables to identify the wage. For instance, the OLS estimate of the application-wage elasticity and standard error using the control variables in column (2) is .03 (.11).

To look more deeply into the relationship between the inter-industry wage structure and applications, Figure 1 presents a plot of industry application differentials against industry wage differentials with the OLS line drawn through the points.²⁰ Each set of differentials is obtained from a reduced form regression of applications or wages on industry dummy variables and the included variables used in column (3) of Table 3 (i.e. including employer size, union coverage, and other X-variables).²¹ Extreme points are identified in the plot.

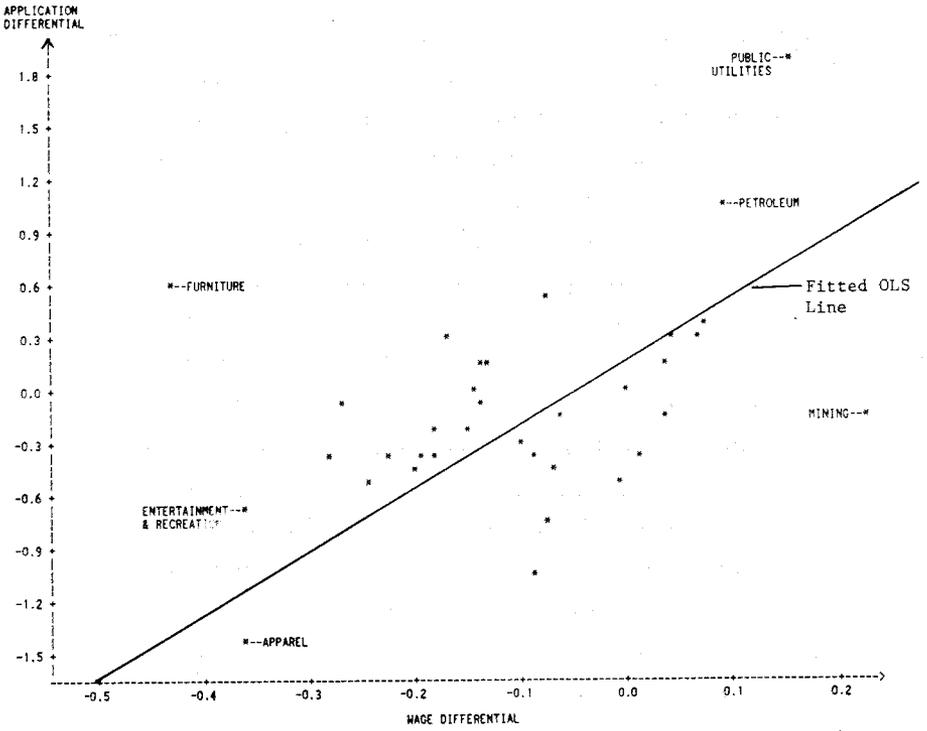
The plot reveals a linear relationship between application differentials and wage differentials. Some high-wage industries such as public utilities and petroleum have extremely high application rates, while low-wage industries such as apparel have relatively low application rates. While too much should not be made about individual points in the plot because of sampling error in estimating the wage and application differentials, it is interesting that the mining industry

²⁰The OLS regression through these points can be shown to give a consistent estimate of the elasticity of applicants with respect to wages. This estimator, which we denote visual instrumental variables, is an instrumental variables estimator although it differs from 2SLS.

²¹The omitted industry in each of these regressions is given a value of zero.

FIGURE 1

PLOT OF INDUSTRY APPLICATION DIFFERENTIALS VS. INDUSTRY WAGE DIFFERENTIALS



lies far below the fitted line. In spite of the high wages paid to miners, relatively few applicants apply for each job opening in the mining industry. This finding is consistent with the obvious interpretation that a significant element of the high average wage in the mining industry is a compensating differential for disagreeable work.

Turning next to the other variables in the application equation, it is interesting to note that personal characteristics such as age, education and sex have an insignificant effect on the application rate. Jobs with more formal and informal on-the-job training, however, tend to receive more applicants than other jobs, and there is substantial dispersion in job application rates across occupations.

The size of an employer has a tremendous effect on the application rate. The number of applications per job opening rises sharply with establishment and firm size, all else equal.²² In addition, controlling for employer size greatly reduces the effect of wages and union coverage on the application rate. Moreover, a GMM specification test that adds employer size variables to the list of excluded variables (Z) fails, which suggests that employer size enters directly into the application equation rather than indirectly through its effect on wages.

There are at least four plausible explanations for the significant establishment size-application relationship that exists even after wages

²²This finding is consistent with results reported in Barron and Bishop (1985). In addition, Brown and Medoff (1987) find that looking at only a sample of minimum wage jobs, large employers report more applicants per job opening than small employers.

are held constant.²³ First, large firms are more visible and better known by job seekers compared to small employers. As a result, there may be better information about job openings at larger firms. Second, if there are fixed costs in applying to firms it may be advantageous for job seekers to apply to large firms because the same application may be used for multiple openings. Third, our application measure is a stock, not a flow, and large firms may maintain a greater inventory of applications in their files compared to small firms. There is some indirect evidence for this explanation in the EOPP survey because we find that large employers are more likely than small employers to report that they interviewed applicants who had previously applied for positions in their firm. Finally, there may be nonwage aspects of work such as fringe benefits and favorable working conditions that make large firms more attractive employers than small employers. The last explanation, it should be noted, runs counter to explanations of the positive employer-size wage effect that are based on equalizing differences.

5. Conclusion

Our empirical examination of application rates for job openings that pay the minimum wage finds that positions that offer the minimum

²³ Furthermore, this finding could be, at least partially, an artifact related to the particular application measure utilized. Large firms tend to make greater use of formal application procedures than small firms. Casual inquiries concerning job openings are more likely to lead to the completion of a written application form in large employers. The greater use of written application forms by large firms may mean that casual applications are more likely to be picked up in our application measure for large firms than for small firms.

wage attract substantially more applicants than jobs that pay either more than the minimum wage or less than the minimum wage. This spike in applications for minimum wage jobs supports the view that the minimum wage confers rents to low-wage workers. This result suggests that worker who obtain minimum wage jobs are made better-off than they otherwise would have been in the absence of a minimum wage law. In addition, if true this finding casts doubt on models of the minimum wage which predict that employers will fully offset the effects of a minimum wage by reducing fringe benefits, on-the-job training and eroding working conditions. Since employers do not appear to extract all rents created by the minimum wage, there is reason to believe that employers might not extract rents in other contexts in the labor market.

In the second half of the paper we examine the relationship between inter-industry wage differentials and application rates. There appears to be a weak, positive relationship between inter-industry job application differentials and inter-industry wage differentials. This finding complements the work of Pencavel (1970) and others who document a negative effect of industry wage differentials on turnover. The apparent low quit rate and relatively long queue of job applicants in high-wage industries suggests that differences in earnings across industries do not entirely reflect equilibrium compensating differentials for nonwage work attributes. However, it is not clear from these results whether the effects of industry wage premia on turnover and application rates stem from unobserved worker abilities or from a labor supply response to ex-ante rents.

There are three reasons to believe that the observed positive

relationship between wages and job applications at the industry level represents a queuing response by workers to ex-ante rents and not a hoard of unqualified workers attempting to obtain high-skilled jobs. First, the results of the analysis of queues for minimum wage jobs suggests that the application rate successfully measure job queues in a situation where there is a strong presumption that ex-ante rents exist. Second, the industry dummy variables pass a specification test for orthogonality with the error, which suggests that industry is not correlated with omitted quality variables. And finally, evidence presented in Krueger (1988) finds that the fraction of applicants for federal jobs who pass qualifying standards increases with the relative wage of federal workers.

This paper suggests several important directions for future research to further examine the existence of ex-ante rents in the labor market. First, the reasons why employers seem to only partially extract rents created by the minimum wage need to be identified and explored directly. Second, data on the average quality of job seekers across industries can be brought to bear on the issue of whether inter-industry job application differentials represent queues of qualified workers. Finally, an examination of the relationship between appropriately measured vacancy duration and wage premia would provide an alternative approach to measuring job queues.

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Table A1

Application Differentials for Minimum Wage and Subminimum Wage Jobs^a
Full Sample

Other Independent Variables	Minimum Wage Effect ^b	Subminimum Wage Effect ^c	R ²
1. Occupation Dums. (8), Hours of Formal Training, Hours of Informal Training, Age, Sex, Experience, High School Dum., College Dum., Full-Time Dum., Seasonal Job Dum., Temporary Job Dum., Year Dums. (4)	.180 (.097)	-.001 (.154)	.073
2. Row 1 Plus 27 Site Dums.	.191 (.098)	.008 (.157)	.107
3. Row 2 Plus Proportion Union	.224 (.098)	.034 (.156)	.113
4. Row 3 Plus 4 Firm Size Dums. and Log Plant Size	.216 (.097)	.112 (.155)	.142
5. Row 4 Plus 35 Industry Dums.	.255 (.098)	.127 (.159)	.172

Notes:

a. Dependent variable is $\ln(\text{Applications per last job filled})$. Sample size is 1,364. Standard errors are in parentheses. Regressions also include a constant.

b. Estimated coefficient for a dummy variable that equals 1 if the worker's starting wage equalled the minimum wage that was in effect in the year the worker was hired, and 0 otherwise.

c. Estimated coefficient for a dummy variable that equals 1 if the worker's starting wage was less than the minimum wage that was in effect in the year the worker was hired, and 0 otherwise.