THREE ESSAYS IN LABOR ECONOMICS

by

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ABSTRACT

This dissertation consists of three independent essays in labor Economics.

The first essay asks why union labor contracts generally give management exclusive control over employment? Economists since Leontief [1946] have argued that such a contract is puzzling because it is Pareto-inefficient. I argue that employment, as a non-compulsory subject of bargaining, can be unilaterally excluded from contracts by the firm, and in many cases this exclusion improves the firm's negotiated payoff. The primary insight of the model is that the efficiency consequences of wage-only contracts (which have been the focus of economists) may be of secondary importance as compared to the distributive consequences of such contracts.

The second essay investigates the impact of hospital regulatory change on the wages of hospital employees. Recent regulatory changes replaced a cost-based reimbursement system for hospitals with a prospective, fixed-price system. I find that a prospective system appears to lower both union and non-union wages for all occupations by about 5-10%. This evidence is consistent with a model of rent-sharing or efficiency wages in the hospital industry.

The final essay looks at the role of personal contacts in the careers of young workers. I develop a simple model in which a personal contact provides information about the match quality of a job. This model suggests that wage and turnover patterns differ significantly between jobs found through personal contacts and jobs found by more formal means. Empirical support for the model is somewhat mixed. I present evidence of significant differences in wages and wage growth on jobs found with and without a personal contact. These differences are quite consistent with my model. The most striking difference is in the gains to mobility: Individuals who change jobs with the help of a personal contact experience roughly 15% higher wage growth than do other job switchers. In contrast, the model predicts turnover differences that are not found in the data.
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INTRODUCTION

This dissertation consists of three independent essays in Labor Economics. The first essay develops a simple model of bargaining between a union and a firm that may explain why union contracts exclude employment. The second essay is an empirical investigation of hospital wages showing a significant impact of regulatory change on these wages. This finding supports a model of rent-sharing in the hospital industry. The third essay presents empirical evidence that connections effect the wages and mobility of young workers. Further, I present a model in which a connection provides information about the match quality of a job.

Each essay is presented as a separate chapter. The tables, figures, and references for each essay can be found at the end of each chapter.
CHAPTER 1

WHY DO UNION CONTRACTS EXCLUDE EMPLOYMENT?
The Importance of Mandatory Subjects of Bargaining
I. Introduction

What determines the subjects of bargaining in labor negotiations? Two long-standing and active debates, one among economists and another among legal scholars, address this question from distinct perspectives. Economists are puzzled by the exclusion of employment guarantees from most union labor contracts. Since Dunlop [1944] and Leontief [1946], it has been known that such a contract (which gives the firm exclusive control over employment) leads to Pareto-inefficient outcomes in a simple complete-information setting. This contradicts a belief among many economists that contract designs arise to facilitate Pareto-efficient trade. Work by Hall and Lillien [1979] and Hart [1983] resolves the contradiction by abandoning complete information and arguing that giving the firm control of employment may be Pareto-efficient ex ante if the firm will be better informed about demand conditions ex post. In contrast to economists, many legal scholars argue that contracts will generally include only compulsory subjects of bargaining. In this view, the scope of bargaining subjects is determined largely by the NLRB and the courts through rulings on which subjects are compulsory. The legal debate, therefore, has focused on which subjects should be designated as compulsory.

This chapter bridges the gap between the economic and legal debates with a complete-information bargaining model that distinguishes between

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compulsory and non-compulsory bargaining subjects. The premise of the model is that the legal distinction between compulsory and non-compulsory subjects gives the firm veto power over non-compulsory subjects in general, and employment in particular. Whether the firm exercises its veto will depend on the economic consequences of including a given subject in negotiations. This model illustrates the potential role of legal constraints in determining the scope, efficiency, and distributive consequences of bargaining. In particular, I show that employment (as a non-compulsory bargaining subject) may be excluded from negotiations by the firm for strategic reasons, in spite of the resulting social efficiency loss.

The issues this chapter addresses are clearly presented with a simple diagram made famous by McDonald and Solow [1981] (see Figure 1). The axes measure wages (w) and employment (L). The curves U₀ and U₁ represent union indifference curves, and Π₀ and Π₁ represent isoprofit curves for the firm. The horizontal tangencies of the firm's isoprofit curves map out the labor-demand curve (DD), while the tangencies between the firm's isoprofit curves and the union's indifference curves map out the contact curve (CC). Point A is a representative outcome of negotiations when employment is excluded from negotiations. Point A is Pareto-inefficient because all the points in the shaded region are preferred by both the firm and the union. Consider the situation in which the firm can choose to include employment in negotiations. Including employment in negotiations will yield an outcome on the

\[\text{[Image of diagram]}\]
contract curve. If the outcome of negotiations that include employment is a point within the shaded region (e.g., point B) then the firm will choose to include employment. If, however, the outcome of negotiations cannot be limited to the shaded region and is a point such as point C, then the firm will choose not to include employment in negotiations. At issue, therefore, is whether the firm has such veto power over bargaining subjects and whether negotiations that include employment can be limited to the Pareto-improving shaded region in Figure 1.

The next section of this chapter discusses the legal distinction between compulsory and non-compulsory bargaining subjects, referred to by the courts as Mandatory and Permissive subjects. Only mandatory subjects require good-faith bargaining. Permissive subjects may be discussed if both parties concur, but the NLRA does not protect a party who forces an impasse over such an issue. Therefore, if one party refuses to negotiate over a permissive issue, there is little the other party can do in response. As described in Section II, a wide range of bargaining subjects which would restrict the firm's control of employment have been found by the courts to be permissive. These court decisions favored firms who wished to exercise their veto and so exclude employment issues from negotiations. Thus, it appears that the mandatory-permissive distinction plays a role in the bargaining process and is used by firms to maintain their control over employment. The question, therefore, is why is it in the firm's interest to keep employment out of negotiations?

Section III develops a model in which the firm decides whether to include employment in negotiations. This decision is based on how the additional subject affects the negotiated outcome. I argue that excluding employment from negotiations has a strategic effect that
improves the bargaining position of the firm: when employment is excluded, the firm will choose employment along the labor-demand curve and therefore is committed to reducing employment when wages increase. This commitment discourages the union from pursuing wage concessions from the firm because higher wages yield decreasing marginal returns to the union. When employment is included in negotiations the firm cannot credibly make such a commitment. The strategic value of this commitment may lead firms to exclude employment from negotiations in spite of the resulting social inefficiency. In other words, excluding employment may give the firm a much larger fraction of a smaller pie.

Section III also highlights the reasons why negotiations that include employment cannot be limited to outcomes that are a Pareto-improvement over the socially inefficient bargaining outcome on the labor-demand curve. Legally, there is the problem that contracting on employment sets a precedent which may lead to employment being a mandatory subject in future negotiations. Thus, the firm may lose its power to influence future bargaining outcomes (through the ability to exclude employment from negotiations) when it signs a contract that covers employment.

A more subtle aspect of the bargaining model in Section III explains why the outcome of a potential negotiation that excludes employment is not used to influence the outcome of a current negotiation that includes employment. Negotiation can be thought of as an alternating-offer bargaining game in which the firm has the option of excluding employment as a bargaining subject at any point in the game. Binmore, Rubinstein and Wolinsky [1986] analyze such a game and show that if the option payoff (i.e., the payoff to the firm from excluding employment) is
preferable to bargaining without the option, then the firm should take the option at the first opportunity. In this case, the best the firm can do is to receive the option payoff. Any delay in taking the option gives the union an opportunity to exploit its improved bargaining position and lowers the firm's payoff below that of the option. In other words, if the firm prefers the outcome of a negotiation that excludes employment, then the firm cannot benefit from any negotiation that includes employment.

The concluding section discusses recent evidence on the impact of the Mandatory-Permissive distinction on contract negotiations. Delaney and Sockell [1989] demonstrate the importance of the Mandatory-Permissive distinction using data from union contracts and from controlled experiments. Their empirical evidence is largely consistent with the model developed in this chapter: permissive subjects are infrequently included in actual contracts, and union outcomes are significantly higher among contracts that include permissive subjects. Their experimental evidence also indicates that union outcomes improve significantly when employment is made a mandatory subject, and this too is fully consistent with the implications of the model developed in this chapter: Firms exclude permissive subjects (in particular, employment) from negotiations as a way of improving their negotiating position at the expense of the union.

The concluding section also discusses how these results can be extended into a repeated-game model of the kind analyzed in Espinosa and Rhee [1989]. Their analysis indicates that repeated wage-only negotiations can support an implicit agreement that is Pareto-efficient. This chapter provides the missing economic rationale for the existence of
wage-only contracts in the first place. Together, the two papers provide a coherent explanation for the existence of efficient contracts that exclude employment.

II. The Mandatory-Permissive Distinction

American labor law distinguishes between mandatory and permissive subjects of bargaining. Sockell [1986] summarizes this distinction nicely:

The duty to bargain in good faith does not extend to these so-called "permissive" subjects.... Provisions dealing with such subjects may be lawfully included in contracts if both parties agree to do so, but neither party may pursue a permissive subject to impasse, that is, use its full economic power to compel concessions from its opponent. For this reason, many believe that concessions over permissive subjects are unlikely, and... that these subjects are, in effect, within the exclusive control of one side or the other... [p. 20].

Mandatory subjects of bargaining include "layoffs and recalls, sick leave, incentive pay, paid holidays, vacation schedules, hours of work, and such fringe benefits as cost-of-living adjustments and profit-sharing plans" [Gould, p.111]. Permissive subjects include both trivial subjects and subjects regarded as managerial decisions. In particular, employment appears to be a managerial decision, although the legal line defining such decisions is vague. The basic thinking, as summarized by Justice Stewart in a 1964 Supreme Court opinion, is that permissive subjects cover such "larger entrepreneurial questions as what shall be produced, how capital shall be invested in fixed assets, or what the basic scope of

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3 The following discussion relies heavily on Gould [1986], Gregory and Katz [1979], and Sockell [1986].
the enterprise shall be" [as cited in Gould, p.115].

The Supreme Court and National Labor Relations Board have made no specific ruling on whether "employment level" is a mandatory subject. They have ruled, however, that both complete and partial closings are permissive subjects of bargaining because,

"an employer's need to operate freely in deciding whether to shut down part of its business purely for economic reasons outweighs the incremental benefit that might be gained through the union's participation in making the decision" [as cited in Gould, p.118].

Sockell [1986] cites rulings in which other employment-related subjects have been found by the board to be permissive. These permissive subjects include changes in production methods (such as automation), sales decisions (such as discontinuing a product line), and decisions involving the allocation of capital (such as the sale of assets and the relocation or consolidation of operations). These rulings and the basic philosophy behind them indicate that the number of employees is a permissive subject of bargaining.4

Given that employment is a permissive subject, the firm can refuse to bargain over it, leaving the union two options. The union can either give in to the firm and bargain over wage only, or it can insist upon bargaining over employment until an impasse is reached. At such an impasse the union can lose its NLRA protection, i.e., a high cost would

4I focus on employment because it is central to the literature, but the approach of this paper could be applied to any permissive subject of bargaining. For example, lump-sum payments to the union (not to individual workers) are commonly proposed as a way of reaching an efficient solution. There is no precedent for such payments and, therefore, they may be considered a permissive subject by the courts.
be imposed on the union. Assuming that the cost of losing NLRA protection is prohibitively high, then the firm can force the union to bargain over just the wage by simply refusing to bargain over employment.

There is general agreement that the Mandatory-Permissive (M-P) distinction affects the scope and outcome of bargaining by giving the firm or the union unilateral control over certain subjects.\textsuperscript{5} Skeptics, however, might question the actual effectiveness of the M-P distinction in practice, particularly given the court's difficult task of determining the true reason behind an impasse. Sockell [1986] addresses this issue quite clearly:

This reasoning (that the M-P distinction is ineffective) suggests that the dichotomy leads to "duplicitous" negotiations wherein parties insist to impasse on mandatory items to gain concessions on permissive ones.... Although this argument may have some truth as applied to the more powerful unions and those with negotiating savvy, the many cases arising over the application of the distinction suggest that a complete circumvention of the law has not been possible [pp. 28-29].

Delaney and Sockell [1989] use contract and experimental evidence to conclude that the M-P distinction has a significant and systematic impact on negotiations.\textsuperscript{6} On balance, the evidence indicates that the M-P distinction affects both the scope and outcome of negotiations.

The determination of mandatory subjects is based on a variety of vague and arbitrary (from an economic perspective) rationales. In particular, past practice has played a large role in determining which subjects are mandatory. The Supreme Court, for example, has explicitly

\textsuperscript{5}For example, see Cox [1958], Duvin [1964], St. Antoine [1973], Stone [1981], Klare [1982], Sockell [1986], and Delaney and Sockell [1989].

\textsuperscript{6}This evidence is discussed in Section IV.
stated that mandatory subjects of bargaining should be determined, in part, by subjects included in past agreements. This reliance on precedent is not only arbitrary from an economic viewpoint, but also means that firms may be particularly reluctant to contract on employment. If the firm can potentially benefit from its unilateral power over employment it will not want to set a precedent that eliminates this power in future negotiations.

The interpretation of labor law given in this section emphasizes three important aspects of firm-union negotiations. First, firms can restrict negotiations unilaterally to the wage only, and appear to do so in practice. Second, this power does not prohibit negotiations that cover employment. As a permissive subject, employment can be included in negotiations as long as the firm approves. Finally, including employment in a contract sets a precedent that may lead to employment becoming a mandatory subject in future negotiations.

The key question that remains is why do firms restrict negotiations to the wage only? Such an action constrains bargaining to be Pareto-inefficient and therefore appears to be unnecessarily wasteful and perhaps irrational in an economic sense. The remainder of this chapter analyzes this puzzling decision to exclude employment from negotiations. The analysis highlights the strategic benefits of excluding employment from bargaining, which can outweigh the social efficiency costs of such an action.

III. A Model of Firm-Union Bargaining

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This section develops and analyzes a model of negotiations between a firm and a union. The central assumption of the model is that the firm decides whether employment is a subject of negotiations. Based on this decision, the parties either negotiate over only the wage or negotiate over both the wage and employment. I model the outcomes of these negotiations using the well known Nash bargaining solution. The first part of this section argues that the model's simple structure, in which the firm chooses between two Nash bargaining problems, is an appropriate characterization of bargaining when employment is a permissive subject. The now well established relationship between the Nash solution and non-cooperative bargaining games is particularly useful in this regard. The second part of this section compares the firm's payoff from negotiations with and without employment. I show that, under reasonable conditions, the firm will choose to exclude employment from negotiations.

Consider the following simple model. The firm decides whether employment will be a subject of negotiations. Given the firm's decision, the union and the firm then negotiate. When employment is included in negotiations, the bargaining outcome is characterized by the following Nash problem:

\[
\begin{align*}
\text{Maximize} & \quad (\pi - \pi_0)^\alpha (U - U_0)^{1-\alpha} \\
\text{subject to} & \quad \pi = \pi(w, L) \text{ and } U = U(w, L),
\end{align*}
\]

where \( w \) and \( L \) are the negotiated wage and employment levels, \( \pi \) and \( U \) are payoffs to the firm and the union, \( \pi_0 \) and \( U_0 \) are the Nash threat points, and \( \alpha \) represents the firm's relative bargaining power. When employment is excluded from negotiations, the firm retains the power to set employment (conditional on the wage) in order to maximize profits. The
bargaining outcome in this case is characterized by a slightly (but importantly) different the Nash problem:

\[
(2) \quad \max_{\pi, u} \left( \pi - \pi_0^* \right)^\alpha \cdot (U - U_0)^{1-\alpha} \quad \text{s.t.} \quad \pi = \pi(w, L), \ U = U(w, L), \\
\text{and} \quad (2a) \quad L \text{ solves } \max_L \pi(w, L).
\]

The firm chooses to exclude employment from negotiations whenever the profit resulting from the wage-only bargaining described in (2) is greater than the profit resulting from the wage-employment bargaining described in (1).

The simple model considered above contains three important ingredients. First, the Nash bargaining problems given in (1) and (2) rely on identical payoff functions, bargaining power and threat points. The problems differ only in that the wage-only solution must satisfy the additional constraint (2a): the outcome must lie on the labor-demand curve. A second ingredient of the model is that the firm faces a choice between two independent bargaining games. Finally, the model assumes that union-firm bargaining is a one-shot game and, thereby, ignores the long-run nature of the bargaining relationship. These three ingredients are key to the model's implications and, therefore, require justification.

If the Nash problems given in (1) and (2) are interpreted as reduced-form solutions for an underlying non-cooperative alternating-offer game, as discussed in Binmore, Rubinstein and Wolinsky [1986], then the two problems should depend on identical payoff
functions, bargaining powers and threat points.\textsuperscript{8} The payoff functions, $U=U(w,L)$ and $\pi=\pi(w,L)$, correspond to the players' utilities for any given wage and employment combination. Excluding employment from negotiations restricts the feasible wage and employment combinations to the labor-demand curve, but does not affect the players' utilities for any given combination. Therefore, the payoff functions in the two bargaining problems should be identical. The relative bargaining power, $\alpha$, is determined by the players' relative discount rates, with a more impatient player having less bargaining power. Excluding employment from negotiations does not affect the players' discount rates. Therefore, bargaining power in the two bargaining problems should be identical. Finally, the threat points, $U_0$ and $\pi_0$, correspond to the payoff streams accruing to each party while negotiations are in progress. For example, the firm's payoff stream depends on inventories and how much the strike disrupts production, while the union's payoff stream depends on strike benefits. Excluding employment from negotiations does not affect such payoff streams. Therefore, the threat points in the two bargaining problems should be identical.\textsuperscript{9}

The results of Binmore, Rubinstein and Wolinsky [1986] also help to explain why it is appropriate to model the firm's power over employment

\begin{footnotesize}
\textsuperscript{8}See Binmore, Rubinstein and Wolinsky [1986] for a detailed description of the relationship between Nash and alternating-offer games of the type first proposed by Rubinstein [1982]. Experimental evidence in Binmore et al. [1989] and Binmore et al. [1985] suggests that this analysis of alternating-offer games is a useful approximation of reality.

\textsuperscript{9}This explains why the wage-only bargaining outcome cannot be incorporated as a threat point in the wage-employment bargaining solution; the wage-only outcome does not affect the payoff stream during wage-employment negotiations.
\end{footnotesize}
as a simple choice between two independent bargaining games. The firm and the union can be viewed as engaging in wage-employment negotiations while the firm retains the option of excluding employment from negotiations. In the terminology of Binmore et. al., wage-only negotiations are the outside option available to the firm. Binmore et. al. establish two results (see pages 184-187). First, if the firm prefers wage-employment bargaining without an outside option to the outside option itself, then the outside option will never be used and will have no affect on negotiations; the outside option (wage-only bargaining) is not a credible threat. Second, if the firm prefers the outside option to wage-employment bargaining without an outside option, then the firm will immediately take the option and exclude employment from negotiations; delay in taking the option only lowers the firm's payoff, because the firm must temporarily negotiate in an unfavorable setting (wage-employment negotiations). If the firm moves first, the game therefore simplifies to the firm choosing in the first period between wage-employment negotiations and wage-only negotiations.

This treatment of wage-only bargaining as an outside option is technically correct, but the analysis is quite sensitive to arbitrary timing assumptions. For example, suppose the firm prefers wage-only bargaining but does not move first. If the union makes the first offer, it can make a wage-employment offer lying on the contract curve which gives the firm the same payoff as in wage-only bargaining, but leaves the union better off than the wage-only outcome. In this situation, the payoff to the firm is the same as in wage-only negotiations but the final contract includes employment.

A more compelling explanation of why the firm faces a choice between
two independent games is related to the fact that the model ignores the repeated, long-run nature of the bargaining relationship. This chapter ignores the long-run relationship between firms and unions in order to focus on the firm’s power over the scope of bargaining. This simplification, however, does not acknowledge the potential importance of precedent. The firm must consider the possibility that employment may become a mandatory subject in future negotiations because of the precedent set by including employment in the current contract. If the firm does not benefit by excluding employment from negotiations, then setting such a precedent is of no consequence. On the other hand, if the firm can benefit from its existing power to exclude employment, then it will place a value on maintaining this power in future negotiations. If the present value of excluding employment in future negotiations is substantial, then the firm will not consider any precedent-setting union proposal that involves employment.\(^{10}\)

To summarize, the firm’s decision whether to exclude employment from negotiations is modeled as a simple choice between two Nash bargaining outcomes, representing a choice between wage-employment and wage-only negotiations. The two Nash bargaining problems are identical except that wage-only outcomes are constrained to lie on the labor-demand curve. The above analysis of the legal institutions and of the extensive-form bargaining model underlying the Nash bargaining problem indicates that this model is an appropriate representation of the firm’s decision.

The remainder of this section solves the wage-employment and

\(^{10}\)Section IV discusses the long-run nature of the relationship and how the results of this section might be extended to a repeated-game framework.
wage-only bargaining problems defined above, and compares the firm's payoff from these two games. Making this comparison requires that an objective function be specified for the union. The correct specification of a union objective function is an ongoing debate and beyond the scope of this chapter. Therefore, the remainder of this section assumes that the union maximizes the wage-bill i.e., \( U(w, L) = w \cdot L \). The properties of this objective function are well known and it provides a useful benchmark. The specific results of this chapter depend on the assumed objective function, but the general method of proof and underlying intuition apply to any alternative specification.\(^{11}\)

Given that the union maximizes the wage-bill, the Nash outcome to bargaining over both wage and employment solves the following:

\[
(4) \quad \max_{\pi, u} \pi^{\alpha} u^{1-\alpha} \quad \text{subject to} \quad u = w \cdot L \quad \text{and} \quad \pi = R(L) - w \cdot L, 
\]

where \( R(L) \) is assumed to be a continuous, concave revenue function. Threat points are set equal to zero for simplicity. The solution to (4) lies along the contract curve, which is easily shown to be \( L = L_0 \), where \( L_0 \) is chosen to maximize revenue.\(^{12}\) The Nash outcome to wage-only bargaining solves the same maximization problem, with the additional constraint that \( R'(L) = w \) (i.e., outcomes must lie on the labor-demand curve).

These maximization problems can be simplified by combining the constraint equations to form a single constraint that depends on only \( \pi \)

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\(^{11}\)Assuming that the union maximizes rents, \( U(w, L) = (w - w_a) L \), does not change any of the results of this section.

\(^{12}\)This contract curve is often referred to as strongly efficient because the union's power over the wage does not distort employment or production decisions.
and \( u \). This simple constraint represents the utility frontier. The constraints on wage-employment bargaining (\( U = \omega \cdot L, \pi = R(L) - \omega \cdot L, \) and \( L = L_0 \)) imply that \( u = R(L_0) - \pi \). Similarly, the constraints on wage-only bargaining (\( U = \omega \cdot L, \pi = R(L) - \omega \cdot L, \) and \( R'(L) = \omega \)) define a utility frontier \( u = \psi(\pi) \). Unfortunately, the function \( \psi \) does not take a simple closed form. It is easily verified, however, that:

a) \( \psi(R(L_0)) = 0 \) and

b) \( R(L_0) - \pi > \psi(\pi) \) for all \( \pi < R(L_0) \).

In other words, the utility frontier for wage-only bargaining is Pareto-dominated by the utility frontier for wage-employment bargaining, except in the trivial case of the firm extracting all rents (corresponding to a wage of zero). This is of course simply another way to express the reason economists are puzzled by the appearance of wage-only bargaining: it is socially inefficient.

To summarize, the firm must decide whether to include employment in negotiations. When employment is included in negotiations, the outcome satisfies:

\[
(1') \quad \max_{\pi, u} \pi^\alpha \cdot u^{1-\alpha} \quad \text{subject to} \quad u = R(L_0) - \pi .
\]

Alternatively, if the firm excludes employment from negotiations, then the outcome satisfies:

\[
(2') \quad \max_{\pi, u} \pi^\alpha \cdot u^{1-\alpha} \quad \text{subject to} \quad u = \psi(\pi) .
\]

The firm's decision to include or exclude employment hinges on properties of the function \( \psi \). The following proposition provides a simple
characterization of $\psi$ that is sufficient for the firm to exclude employment from negotiations.

**Proposition 1:** For any firm bargaining power, $\alpha \in [0,1]$, if the utility frontier for wage-only negotiations, $u = \psi(\pi)$, is concave, then the firm receives a higher payoff from wage-only bargaining. Therefore, the firm chooses to exclude employment from negotiations.

**PROOF**

Proposition 1 can be proven algebraically along the lines of Kihlstrom, Roth and Schmeidler [1981]. A graphical proof is provided here. Without loss of generality, the proof only considers firm payoffs over the range in which $\psi$ is downward sloping.\(^{13}\)

Figure 2 compares the Nash outcomes for wage-employment and wage-only bargaining. Recall that the utility frontier for wage-employment bargaining ($u = R(L_0) - \pi$) is linear, the utility frontier for wage-only bargaining ($u = \psi(\pi)$) is assumed to be concave, and the two frontiers intersect at the point where $\pi = R(L_0)$ and $u = 0$ (point C in Figure 2). Point A in Figure 2 illustrates the Nash solution to wage-employment bargaining. The Nash solution is the point at which $\pi^\alpha \cdot u^{1-\alpha} = N_0$ (for some $N_0$) is tangent to the utility frontier $u = R(L_0) - \pi$.

Now consider the point $\tilde{A}$ in Figure 2. This point lies on the wage-only frontier ($u = \psi(\pi)$) and corresponds to the same profit level as

\(^{13}\)The wage-only bargaining outcome must lie in the downward sloping range of $\psi$. If the profit from wage-employment bargaining is below this range, the firm will trivially prefer wage-only bargaining.
the wage-employment solution (point A). Furthermore, it is easy to prove that the dashed line connecting points $\tilde{A}$ and C is tangent to $\pi^\alpha \cdot u^{1-\alpha} - N_1$ (for some $N_1$) at the point $\tilde{A}$.\(^{14}\) The wage-only frontier is concave, so it lies above the dashed line (and, therefore, also above $\pi^\alpha \cdot u^{1-\alpha} - N_1$) to the right of point $\tilde{A}$. Therefore, $\pi^\alpha \cdot u^{1-\alpha}$ reaches a maximum on $u=\psi(\pi)$ somewhere to the right of point $\tilde{A}$ (e.g. point B in Figure 2). In other words, the Nash outcome for wage-only bargaining lies to the right of points $\tilde{A}$ and A. Thus, the firm's profit from wage-only bargaining exceeds the firm's profit from wage-employment bargaining. Q.E.D.

The above proof relies on the linearity of the wage-employment frontier, $u=R(L_0)\cdot\pi$. This linearity implies that simple concavity of $\psi$ is sufficient for the firm to exclude employment from negotiations. Alternative specifications of the union objective function will lead to a utility frontier from wage-employment bargaining that is not linear. Therefore, simple concavity of $\psi$ will not, in general, be sufficient. However, the method of proof given above still applies when the wage-employment frontier is not linear. In the more general case, one must show that $\psi$ is a concave transformation of the efficient frontier.

I have shown that (when the union's objective is to maximize the wage-bill) a sufficient condition for wage-only bargaining is a concave

\(^{14}\)The Nash solution for any linear utility frontier passing through point C yields the same profit as the wage-employment solution and, therefore, implies such a tangency. To see this, consider the problem:

$$\operatorname{Max}_{\pi, u} \pi^\alpha \cdot u^{1-\alpha} \quad \text{subject to } \ u = k \cdot [R(L_0) - \pi].$$

The first order conditions imply that $(1-\alpha)\pi = \alpha \cdot [R(L_0) - \pi]$, which is independent of $k$, the slope of the frontier.
utility frontier $\psi$. Intuitively, a concave utility frontier implies that marginal utility gains by the union lead to increasingly large marginal utility losses by the firm. Under wage-employment bargaining, however, the marginal utility trade-offs are one-for-one. Therefore, by restricting bargaining to the wage only, the firm has committed itself to a position where it cannot make concessions to the union because these concessions are increasingly costly, at the margin, to the firm.

The sufficient condition of Proposition 1 can be restated in terms of $\pi$ and $u$. By definition, $u = \psi(\pi)$ is concave if and only if $d^2u/d\pi^2 < 0$. Both $\pi$ and $u$ can be expressed solely in terms of $w$, using the fact that $w = R'(L)$ for wage-only bargaining. Implicit differentiation implies that $\psi$ is concave if and only if:

$$\frac{-d^2\pi/dw^2}{d\pi/dw} < \frac{-d^2u/dw^2}{du/dw}$$

It is perhaps misleading to interpret this condition in terms of risk aversion since there is no uncertainty in this model. Instead, using the analogy described above between extensive-form bargaining games and Nash bargaining problems, this condition indicates the relative impatience of each party through the concavity of their preferences; the union's marginal benefits from wage increases are increasingly small (relative to the firm's marginal benefits from wage decreases), so the union is less willing to wait for a high wage.

Proposition 1 can be restated in terms of the elasticity of the labor-demand curve. The following lemma is proven in the appendix:

**Lemma 1**: Let $\epsilon = \frac{\partial L}{\partial w} \frac{w}{L}$. 

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\[ \frac{d^2 u}{d\pi^2} < 0 \text{ if and only if } \frac{\partial \epsilon}{\partial w} > 0. \]

This leads to an alternative formulation of Proposition 1:¹⁵

**Proposition 1'**: For any firm bargaining power, \( \alpha \in [0,1] \), if the labor-demand curve is increasingly elastic with respect to the wage, then the firm receives a higher payoff from wage-only bargaining. Therefore, the firm chooses to exclude employment from negotiations.

Proposition 1' is a straightforward statement about the labor-demand curve and, therefore, is more easily interpreted than the earlier statement about the utility frontier. If the labor-demand curve is increasingly elastic, then the firm benefits by excluding employment from negotiations. The firm benefits because, as the wage increases, the union's marginal gains are increasingly small due to the increasingly large reductions in employment. Therefore, the union has less incentive to push for higher wages.

A simple example illustrates the implications of Proposition 1' for a firm with a linear labor-demand curve. Suppose that

\[ R(L) = \frac{a}{b} \cdot L - \frac{1}{2 \cdot b} \cdot L^2, \quad a, b > 0 \]

so that the labor-demand curve is \( L = a - bw \). Let the firm and the union

¹⁵Dowrick [1988] independently develops a less general, but similar proposition. He compares the wage-only and wage-employment solutions and finds that when the labor demand curve is linear or concave the firm does better in wage-only negotiations. Dowrick uses a more algebraic approach, and does not address the underlying bargaining issues, but his result is close in spirit to Proposition 1'.
have equal bargaining power, \( a = \frac{1}{2} \). The Nash bargaining solution when employment is included in negotiations is \( \pi = U - \frac{a^2}{4 + b} \). When employment is excluded from negotiations, the Nash outcome is \( \pi = \frac{9a^2}{32 + b} \) and \( \pi = \frac{6a^2}{32 + b} \). The efficiency loss due to wage-only bargaining (a 6.7% fall in revenue) is relatively small compared to the distributive consequences -- profits increase 12.5% while the union's rewards (as measured by the wage bill) fall by 25%. As the union's bargaining strength increases (\( a \) falls to 0) these effects become more pronounced, with both the efficiency and distributive effects becoming as much as four times larger. It is also interesting to note that the negotiated wage in this case is the same for negotiations with and without employment. In other words, including employment in negotiations does not result in any wage concessions by the union.

The analysis of this section points to a simple reason motivating the firm's decision to exclude employment from negotiations: Bargaining only over the wage gives the firm higher profits than when employment is included in negotiations. Excluding employment is a way for the firm to commit to reducing employment when wages increase. This commitment strengthens the firm's bargaining position relative to the union. The result is that the firm is able to increase profits by excluding employment, in spite of the efficiency cost.

**IV. Conclusion**

In this chapter I have tried to combine the views of economists and legal scholars into a coherent model of firm-union negotiations. The result is a possible explanation for contracts that do not specify employment: employment, as a permissive subject of bargaining, can be
unilaterally excluded from negotiations by the firm, and in many cases this exclusion improves the firm's negotiated payoff. The primary insight of the model is that the efficiency consequences of wage-only contracts (which have been the focus of economists) may be of secondary importance as compared to the distributive consequences of such contracts.

The three key results of the analysis presented in Section III are (1) the Mandatory-Permissive distinction matters, (2) firms are not likely to contract on employment, and (3) negotiations that include employment generally benefit the union at the expense of the firm. Is there any evidence to support these results? Delaney and Sockell [1989] provide the only existing evidence on the subject. They analyze a large sample of major private-sector collective bargaining agreements for the year 1975 [see pp. 569-576]. Sixteen percent of the contracts in their sample cover a permissive issue, and only 3% cover more than one permissive issue. Contracts with permissive subjects scored higher on a union-favorableness index than did contracts without permissive subjects, even when the index considered only mandatory subjects. Regression analysis, controlling for union and firm characteristics, indicated that including permissive issues did not lead to concessions on mandatory issues. One puzzling finding is that contracting on permissive subjects is more likely among strong unions. The example at the end of Section III, in contrast, indicates that an increase in union bargaining power increases the cost to the firm of bargaining over employment. Therefore, contracting on permissive subjects should be less likely among strong unions. Except for this last fact, the contract evidence is consistent with the key results of the analysis in Section III.
Delaney and Sockell also present evidence from controlled experiments in which employment was mandatory in some negotiations and permissive in others (see pp. 576-580). The experimental results support the model's predictions as well. Negotiations in which employment was mandatory yielded significantly better outcomes for the union and worse outcomes for the firm, as compared to negotiations in which employment was permissive. Overall, Delaney and Sockell's results support this chapter's conclusion that firms choose to exclude employment from contracts as a means of improving their negotiating position.

The analysis in this chapter, if correct, helps to explain why contracting on employment does not necessarily lead to a Pareto-improvement over the socially inefficient wage-only outcome. There may be alternative mechanisms, though, that support efficient outcomes without explicitly contracting on employment. For example, Rhee and Espinosa [1989] argue that repeated wage-only negotiations can lead to Pareto-improvements over the static wage-only outcome. Their basic argument is that repeated negotiations allow the parties to play supergame strategies that enforce an implicit agreement off of the labor-demand curve. This type of mechanism strengthens the conclusions of this chapter; repeated negotiations make wage-only bargaining even more attractive to the firm. Furthermore, the analysis of this chapter compliments Rhee and Espinosa's results by providing an economic rationale for negotiations that exclude employment and that rely on an implicit agreement over employment. Together, these papers provide a coherent explanation for the existence of efficient contracts that exclude employment.

On a broader level, this chapter formalizes the idea that control
over the bargaining agenda can be used strategically to the advantage of one party. On this level, the model may be useful in analyzing a wide range of negotiating situations ranging from contracts between retailers and wholesalers, to the decisions of congressional committees where the committee chairperson controls the agenda. In any of these situations, a limited (and socially inefficient) scope of negotiations may be in the interest of one of the negotiating parties.
APPENDIX

Lemma 1: Let \( \epsilon = \frac{\partial L}{\partial \omega} \frac{w}{L} \).
\[
\frac{d^2 u}{d\pi^2} < 0 \quad \text{if and only if} \quad \frac{\partial \epsilon}{\partial \omega} > 0.
\]

PROOF:

Recall \( \pi = R(L) - \omega \cdot L, \quad U = \omega \cdot L, \quad w = R'(L) \)
so that \( \pi = R(L) - R'(L) \cdot L, \quad U = R'(L) \cdot L, \)
\[
\frac{\partial w}{\partial L} = R''(L) < 0, \quad \epsilon = \frac{R'}{R'' \cdot L}.
\]

Therefore:
\[
\frac{\partial u}{\partial \pi} = \frac{u'}{\pi'} - \frac{R' + L \cdot R''}{-R'' \cdot L} = -1 - \frac{R'}{R'' \cdot L} = -1 + \epsilon.
\]
and:
\[
\frac{\partial^2 u}{\partial \pi^2} = \frac{\partial [\partial u/\partial \pi]}{\partial L} \frac{\partial \epsilon}{\partial L} = \frac{\partial \epsilon}{\partial \pi'}
\]
so that:
\[
\frac{d^2 u}{d\pi^2} < 0 \iff \frac{\partial \epsilon}{\partial \pi'} < 0
\iff \frac{\partial \epsilon}{\partial L} < 0
\iff \frac{\partial \epsilon}{\partial \omega} > 0 \quad \text{Q.E.D.}
\]
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Possible Outcomes of a Negotiation Between a Firm and a Union

FIGURE 1
Comparison of The Wage-Employment and The Wage-Only Bargaining Solutions
CHAPTER 2

REGULATION AND LABOR EARNINGS IN HOSPITALS
I. Introduction

The relationship between regulation, unionization, and labor earnings depends crucially on labor market structure. The link between industry rents and wages is of particular interest because of recent findings linking inter-industry wage differentials to industry profitability. Studies by Rose [1987] and Card [1989] have used changing regulations in the trucking and airline industries to test competing models of the labor market. Feldstein [1971] has proposed that rent-sharing with workers may also play a large role in hospital labor markets, because non-profit hospitals may practice "philanthropic wage setting." In this study I exploit changes in the state and federal regulatory structure regarding hospitals since the 1970's to identify the structure of the labor market for hospital workers and to examine the effect of unions on hospital wages.

Cost-containment regulations implemented by some states in the 1970s and by Medicare nationwide in 1984 replaced a cost-based reimbursement system for hospitals with a prospective, fixed-price system. Since labor costs account for over half of all hospital costs it is likely that employment and/or wages will be affected by the change in incentives. In general, the new system not only lowered the total rents available to the hospital industry, but also changed hospitals' marginal incentives; labor costs went from being roughly 50% subsidized at the margin to having no subsidy. These changes have testable implications for union and non-union wages that can help distinguish competing models of labor markets. Nearly all models imply that union wages are lower under the new regulations. In a standard competitive model, non-union wages should
be unaffected by the regulations. If hospitals have monopsony power in labor markets for some skills, then non-union wages should fall only for those occupations with skills unique to hospitals (e.g. nurses and not food-service workers). Finally, if either there is a union threat effect on non-union wages or hospitals simply share rents with non-union workers, then non-union wages should fall across the board in response to the new regulations.

To test these competing models, I use data from the Current Population Survey (CPS) for 1973-1987. The CPS data provide sufficiently large samples within the hospital industry to look at a range of occupations. The tests exploit the different timing of regulations across states, i.e., states with no change in regulation are compared to states that changed. I find support for the union-threat/rent-sharing hypothesis: Prospective payment appears to lower both union and non-union wages for all occupations by about 5-10%.

The remainder of this chapter is organized as follows. The next three sections discuss the regulatory changes of interest in the hospital industry, predictions of how these changes may effect the labor market, and existing evidence on the impacts of regulatory changes on labor. Sections V and VI present the estimation strategy and data to be used in this chapter. The final section presents evidence on the impact of prospective payment on wages.

II. Regulatory Background

BRIEF HISTORY

Health care expenditures in the U.S. have exploded over the last
sixty years. Since 1929 expenditures on health care as a percentage of GNP have grown from 3.5% to 10.7% (as of 1985). Over the same period, the fraction of health care expenditures spent on hospital care has grown from 18% to 39%.

Obviously, much of the cost increase in hospitals comes from advances in health care technology that have increased the effectiveness of hospital care. However, as Feldstein [1971] and others have noted, part of the problem may be due to increased coverage of health care expenses by third party payers such as Blue Cross and Medicare. Third party payment has grown from covering just 12% of personal health expenditures in 1929 to 72% in 1985. By 1985, third party payers covered 91% of all hospital expenditures [Gibson et.al., 1986]. The remainder of this section discusses the problems with third party payment, the regulatory response to these problems, and the impacts of these changes.

Most of the growth in third party coverage has come from two sources: Commercial insurance (primarily Blue Cross) begun in the 1930's, and federal health insurance (Medicare for the elderly, Medicaid for the poor) implemented in the mid 1960's. In 1985 Medicare and Medicaid paid for roughly 40% of all hospital expenditures while commercial insurers paid for another 35% [Gibson 1986]. Until the 1970's commercial and federal insurance programs relied on cost-based reimbursement for hospitals combined with fairly low deductibles and copayments for patients. This system encouraged cost growth in two ways. First, hospitals were given very little incentive to produce services

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1See Temin [1988] and Gibson et.al. [1986].
efficiently, since the majority of costs were simply passed on to third party payers. Second, the system encouraged over-production, because hospitals and patients received all the marginal benefits from additional services while paying very little of the marginal cost. Roughly speaking, hospitals were handed a blank check for their expenses and encouraged to produce services to the point of zero marginal benefit.

EARLY PROSPECTIVE PAYMENT EXPERIMENTS

In the early years of Medicare and Medicaid expenses grew rapidly, placing a large financial burden on both federal and state budgets. Policy makers quickly realized the incentive problems with cost-based reimbursement and in the late 1960's began experimenting at the state level with alternative reimbursement mechanisms. These state cost-containment programs differed widely with respect to the services, payers and providers covered, and also differed in their basic approaches to controlling costs. Many of these experimental programs were ineffective in controlling costs. However, programs that covered a large fraction of patients, required mandatory participation of hospitals, and paid hospitals on a prospective basis were found to have significant impacts on the levels and growth rates of hospital costs [Coelen and Sullivan 1981].

For the purposes of this study, seven states can be grouped as having effective prospective rate-setting programs: Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Washington. All of these programs began operating in late 1975 or early

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2Colorado and Wisconsin also had mandatory prospective programs, but Coelen
1976 with the exception of New York's program which began in 1971. Kidder and Sullivan [1982] and Schramm [1978], however, provide convincing evidence that New York's program was ineffective until it was revised in 1976. Therefore, the prospective systems in all seven states can be thought of as taking effect in 1976.

MEDICARE PROSPECTIVE PAYMENT

Following the apparent success of prospective rate-setting at the state level, the federal government instituted prospective payment for Medicare patients nationwide. During late 1982 and 1983, hospitals were reimbursed for Medicare patients under the TEFRA system. TEFRA prospectively set a target rate per admission for each hospital, and paid hospitals a weighted average of the target rate and actual costs up to some limit. Beginning in late 1983, Medicare switched to the Prospective Payment System (PPS). PPS eliminated costs as a basis for payment and paid hospitals a fixed price per admission, based on the patient's diagnosis. TEFRA can be thought of as a transition period between the pre-1982 cost-based system and the fully prospective PPS.

III. Predicted Wage Responses to Prospective Payment

There are three potential models of the labor market that can be used to predict wage responses to prospective payment: The competitive model, the monopsony model, and the rent-sharing model. This section analyses wage-setting under these three alternative models for union and

[1984] found that these programs were relatively ineffective.

3Tax Equity and Fiscal Responsibility Act.
non-union workers.

Before outlining the implications of specific models, there is a basic relationship that is common to all models and plays a critical role in understanding the impacts of prospective payment. Under a cost-based reimbursement system, hospital costs are significantly subsidized at the margin: Roughly 40% of any increase in costs can be passed on directly to Medicare and Medicaid. A prospective system eliminates this marginal subsidy. Therefore, prospective payment affects labor market incentives in two ways. First, the marginal cost of labor is increased since the wage is no longer being subsidized. This affects a hospital's employment incentives. The second effect is that wage increases (or decreases) under prospective payment are fully borne by the hospital; under cost reimbursement a large fraction of any wage change was passed on to Medicare and Medicaid. This may affect a hospital's wage setting incentives since increases in wages are more costly to the hospital. The remainder of this section analyses how these changes in incentives affect non-union and union wages under alternative models of the labor market.

NON-UNION WAGES

Three competing models of the labor market have been applied to the hospital industry: The standard competitive model; the monopsonist model first applied by Yett [1970] to professional nurses; and the rent-sharing model first proposed in Feldstein [1971]. Each model has unique and testable implications for the response of non-union wages to prospective payment.

In the competitive model of the labor market, labor supply is horizontal at a given wage, and changes in hospital employment have no effect on wages. As discussed earlier, prospective payment increases the
marginal cost of labor for a given wage. Therefore, in the competitive model hospitals respond to prospective payment by reducing employment, but this does not effect the non-union wage of workers who remain employed.

If hospitals have monopsony power in the labor market then they must face an upward sloping labor supply. Prospective payment increases the marginal cost of labor, thereby reducing a hospital's demand for labor. This fall in employment, with an upward sloping supply curve, will drive down wages.\(^4\) An upward sloping supply of labor applies most readily to occupations with hospital-specific skills, such as RNs, LPNs and Medical Technicians. It is unlikely, however, that hospitals face an upward sloping supply of unskilled workers such as Aides, Orderlies or Clerical workers. These workers are easily employed in other industries and can switch to alternative employment if hospitals lower wages. Therefore, if upward sloping labor supply is important, then prospective payment should lower wages only for those occupation with hospital-specific skills.

The rent-sharing model does not assume that wages are directly tied to labor supply. Feldstein [1971 pp.68-69] originally argued that hospitals practice "philanthropic wage setting" because of their non-profit status.\(^5\) The basic premise is that workers are paid a rent, in the form of a wage higher than that needed to attract the current

\(^4\)This is an implication of upward sloping labor supply in general. It is therefore a necessary, but not sufficient, condition for monopsony behavior. For example, the aggregate supply of nurses may be upward sloping, but individual hospitals may compete heavily for employees and thereby face a relatively horizontal supply.

\(^5\)Roughly 90% of all hospital employment is in non-profit or government hospitals.
workers. Aside from philanthropy, there are many alternative models that explain why hospitals pay workers rent. These alternatives include efficiency wage, gift exchange, and union-threat models. These models have similar implications for the impact of prospective payment on non-union workers. As in the competitive and monopsony cases, prospective payment increases the marginal cost of labor and, therefore, reduces hospital employment. Furthermore, prospective payment increases the marginal cost (to the hospital) of rent sharing. A one dollar increase in worker rents costs the hospital one dollar under prospective payment. In a cost-based system the hospital would pay less than a dollar for this increase in worker rents. In response to the higher marginal cost of rent-sharing, hospitals should reduce rent-sharing with non-union workers by lowering the wage. The testable difference between the rent-sharing and monopsony models is that monopsony only applies to certain occupations. Rent-sharing models such as philanthropy do not necessarily draw a distinction between occupations. Therefore, in the rent-sharing model hospitals respond to prospective payment by reducing non-union wages in all occupations.

UNION WAGES

Unions are commonly modeled as rent-seeking organizations. In such a model, unions bargain with firms over wages in order to transfer rents from firms to workers. Rent-seeking unions should thrive under cost-based reimbursement. Wage and employment increases are only partially paid for by the hospital, so that hospitals have little

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6See Katz [1986] for a good summary of these models.
incentive to resist union demands. A prospective system eliminates the hospital's subsidy for labor costs, so that the hospital bears the full cost of both employment and wage increases. Clearly, the hospital's incentive to resist union demands increases. Furthermore, prospective payment most likely reduces the total rents available to hospitals. \(^7\) In a standard bargaining model, unions receive a relatively constant share of rents so that when total rents decrease, so do union wages. Therefore, in a rent-seeking union model, prospective payment should lower wages for union workers. Not surprisingly, rent-sharing in the union or non-union labor markets leads to similar conclusions about the impacts of prospective payment on wages. In both cases wage outcomes depend on the marginal tradeoffs between hospital and worker benefits, and these marginal tradeoffs are altered by prospective payment.

SUMMARY OF PREDICTIONS

The alternative models discussed above present contrasting and testable predictions for wages under prospective payment. These are:

1) Union wages should fall, as long as unions are rent-seeking organizations.

2) In a standard competitive labor market, non-union wages should be unaffected, implying that union wage premiums decline.

3) If hospitals face an upward sloping supply of labor, then non-union wages should fall most for those occupations with skills unique to hospitals. The union wage premium may not decline in these occupations, but should decline in other less skilled occupations.

\(^7\)Prospective rates are generally based on historic costs plus inflation less a productivity factor. Over time, the real value of payment for services decreases dramatically
4) If hospitals practice rent-sharing with non-union workers, then non-union wages should decline for all occupations. The union wage premium may not decline substantially since both union and non-union wages are falling.

IV. Evidence on Regulatory Impacts in the Labor Market

A number of empirical studies have looked at the response of wages to regulatory change. For example, Rose [1987] and Card [1986, 1988] have studied wage responses to deregulation in the trucking and airline industries, respectively. As in this study, both authors use data on individuals from the CPS across a number of years to test the competitive labor market model against one of rent sharing. Card finds little evidence of rent-sharing for either union or non-union wages. Rose finds strong evidence of rent sharing for union workers, but there is no evidence that deregulation affected non-union wages. One weakness of these studies is that both consider a single, nationwide regulatory change. It is difficult to attribute the one-time changes in wages to the regulatory event, rather than some other unobserved event. This attribution problem is alleviated when there are a number of regulatory events that are spread over time, as is the case with prospective payment in hospitals.

Studies of wages in the hospital industry have generally used hospital-level data, rather than data on individuals.⁸ These studies generally find union effects on wages ranging from 5% for RNs to 10% for unskilled occupations. Recent evidence indicates that monopsony is not an important factor in hospital labor markets. Adamache and Sloan [1982]

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⁸For a good summary of hospital wage studies see Adamache and Sloan [1982].
and Sloan and Steinwald [1980a] find that hospital concentration is unrelated to wages once inter-area price variation is controlled for. This evidence indicates that individual hospitals do not face upward sloping labor supply, although aggregate labor supply may still be sensitive to the wage in some occupations.

Kidder and Sullivan [1982] use a ten year panel of hospital-level data to conduct a careful analysis of the effects of state prospective payment programs on hospital wages, productivity, and employment. They find that prospective payment lowers payroll costs through lower employment and increased productivity. Prospective payment did not appear to lower wages. The wage result, however, is potentially biased because hospital level data cannot control for changing worker characteristic such as experience and education. Average worker characteristics may have changed dramatically under prospective payment because of reductions in employment. Some recent evidence in Sullivan [1989] suggests that reductions in employment, as a response to prospective payment, lead to higher levels of worker education and tenure. This finding is consistent with the view that employment reductions occur through hiring freezes and layoffs in order of reverse seniority. If this is the case, then Kidder and Sullivan may underestimate the wage reduction associated with prospective payment because the underlying skill level of the work force may have increased. This potential bias can be addressed with data on individuals available from the CPS.

V. Estimation Strategy

To estimate the impacts of prospective payment on hospital wages I
examine wages before and after the regulations are implemented. Estimates from a simple pre/post comparison of wages are difficult to attribute to prospective payment because other aspects of the hospital industry or the economy in general may be affecting wages. A control group is needed to provide estimates of what hospital wages would have been without prospective payment.⁹ The primary estimation strategy of this chapter is to exploit the different timing of regulations across states, i.e. hospital wages in states with no change in regulations are used as a control group and compared to wages in states that changed.

This estimation strategy provides two separate estimates of the wage impacts of prospective payment. The first estimate comes from the states that implemented prospective payment experiments in 1976, using the states that remained on cost-based reimbursement as a control group. The second estimate focuses on the nationwide Medicare changes in 1983-84, using the states that were on prospective payment since 1976 as a control group. The second estimate is likely to be less reliable because the control group is also implementing regulatory changes during the 1983-84 period.¹⁰ If anything, the regulatory changes in the control states strengthened the prospective incentives during the 1983-84 period. Therefore, the estimates may be biased toward finding no effect on wages of the 1983-84 nationwide prospective payment system, because wages in

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⁹Coelen and Sullivan [1982], for example, discuss the advantages of a pre/post, experimental/control research design.

¹⁰Connecticut, Rhode Island and Washington all switched from their own systems to the Medicare system in 1982. The other four states received waivers from Medicare to continue their own payment systems. The New York and Massachusetts programs were expanded in 1984 to cover more payers, but in 1986 these states switched from their own systems to the Medicare system.
the control states may be responding to similar incentive changes.

Wages in other industries could also be used to control for wage changes unrelated to prospective payment. I do not use this approach because hospital wages are not necessarily closely related to wages in other sectors. Hospital wages have grown considerably faster than wages in other industries. There is also evidence that hospitals are more insulated from cyclical variation in demand that effects the labor market in other sectors.\textsuperscript{11} Furthermore, hospital labor markets may be influenced by rapid changes in production technology that are unique to medical care.

One potential bias, however, comes from using hospital wages in other states as a control, rather than wages from other industries in the same states. Most of the states that adopted prospective payment in 1976 are located in the northeast. Some of the hospital wage change in prospective payment states relative to other states may be due to broad trends in regional wage differences, rather than a direct effect of prospective payment. Therefore, estimates of wage growth in other industries are used to measure the potential magnitude of the regional bias.

Data on hospital workers from the CPS are used to estimate standard human capital semilog wage equations.\textsuperscript{12} As mentioned earlier, the

\textsuperscript{11}See Freidman [1971] for example.

\textsuperscript{12}Hospital workers include some employees of hospitals that are not covered by prospective payment, e.g. psychiatric or rehabilitation hospitals. According to the AHA, these types of hospitals employ a relatively small fraction of all hospital employees (approximately 10 percent).
advantage of estimating a human capital model is that it controls for worker characteristics which may change in response to prospective payment. Two basic wage equations are estimated to test the predictions outlined in Section III. The first looks at how relative wages (between states) for non-union workers change over time in response to the adoption of prospective payment in particular states. The second basic wage equation looks at how the union wage premium changes over time in response to prospective payment. Both equations are estimated for hospital workers in six separate occupational groups: registered nurses (RNs), licensed practicing nurses (LPNs), medical technicians (MTs), aides and orderlies (AIDE), clerical workers, and all other non-supervisory workers.

VI. Data

The estimation combines data from the May CPS for 1973 - 1981 with the CPS Annual Earnings file (CPSAE)\textsuperscript{13} available for 1979 - 1987. The May CPS provides data on worker characteristics as well as wages and union status, but the sample size fall considerably for 1979 - 1981. The CPSAE contains information similar to the May CPS, but for a much larger sample. Data are collected each month for individuals in outgoing rotation groups, roughly 1/4 of the sample. The main drawback of the CPSAE is that it does not provide information on union status until 1983. The May CPS and the CPSAE together provide large yearly samples for 1973

\textsuperscript{13}This file is also referred to as the Outgoing Rotation Group file.
- 1987 if information on union status is not needed. For estimates in which union status is required, these data sets provide large samples for 1973 - 1978 and 1983-1987, small samples for 1979 - 1981 and no information for 1982.

Table 1 presents the average characteristics of hospital workers in the CPS in 1973 and 1987. Hospital employment grows steadily from 3.1 million in 1973 to 4.4 million in 1983, where it remained until 1987. This halt in employment growth may in part reflect the prospective payment system's incentives to reduce employment.\(^{14}\) Government owned hospitals have a steadily falling proportion of hospital workers. Occupation mix has also changed steadily over the years, with RNs and Supervisors accounting for larger proportions of employment at the expense of aides and orderlies and other non-supervisory personnel. Throughout the period, LPNs and MTs account for relatively small fractions of total employment. As a result, the estimates presented for these two occupations are based on smaller samples and, therefore are less precise.

Table 2 presents the average characteristics of non-supervisory personnel in 1973 and 1987. Hospital personnel have remained disproportionately female and single. Wages and education grew steadily throughout this period, although some of this growth is attributable to the shift towards RNs that is evident in Table 1. Worker experience (defined as Age-Education-6) declined rapidly in the mid-1970s, and has remained fairly constant since. Unionization increases rapidly from 1973

\(^{14}\)There was also a substantial decline in demand (i.e. number of admissions) over the 1984 - 1986 period.
to 1978, undoubtedly in response to the 1974 amendments that expanded NLRA protection to non-profit hospital employees. Unionization stayed near 20 percent until 1985, when it dropped sharply to 17 percent, where it remained through 1987. This may indicate that the prospective payment system has had an impact on union membership, although unionization rates in general had also been falling during this period.

VII. Results

EVIDENCE FROM THE 1976 PROSPECTIVE PAYMENT EXPERIMENTS

Seven states adopted prospective payment systems that became effective in 1976. Unfortunately, prior to 1977, the May CPS does not identify workers from three of these states (MD, RI, WA). Therefore, all the evidence I present on the early prospective payment experiments is based on the four remaining states (CT, MA, NJ, NY).

The estimated impact of early prospective payment experiments on non-union wages is summarized in Table 3. Conventional semilog wage equations were estimated by occupation on pooled data for 1973 - 1987. Year dummies were included to capture underlying trends in wages. For the early prospective payment states, a separate intercept was estimated, which was allowed to change post-prospective payment. The estimates indicate that prior to 1976, wages in the early prospective payment states were well above wages in other states. The estimated pre-1976 wage premium in these states range from 11.5 percent for medical technicians to 29.8 percent for aides and orderlies. In the period immediately following adoption of prospective payment (1976 - 1981) wages for all occupations declined relative to wages in other states. RNs, LPNs, Aides and Orderlies, and Other non-supervisory personnel all

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experiences average wage declines estimated in the 8 - 12 percent range. Medical Technicians and Clerical workers experience smaller wage reductions of roughly 4 percent. Wages in the early prospective payment states continued to fall relative to other states. The wages of RNs, Aides and Orderlies, and Other non-supervisory personnel fell an additional 4 - 6 percent between the 76 - 81 and 83 - 84 periods. By the time that prospective payment was being implemented nationally, wages in the early prospective payment states had gone from being 11 - 30 percent above the wages of non-prospective payment states to being within 10 percent of these other states.

The evidence in Table 3 is consistent with rent-sharing among non-union workers. Wages clearly fell for non-union employees in response to prospective payment. Furthermore, the pattern of wage reductions across occupations cannot be explained by inelastic labor supply in occupations with hospital-specific skills. Aides, orderlies, and other non-supervisory personnel possess few, if any, industry-specific skills, yet these occupations experience wage reductions as large as those for RNs and LPNs. On balance, the experience of the early prospective payment states provides striking support for a model of rent-sharing in the hospital industry.

Table 4 can be used to investigate the results of Table 3 at a more disaggregate level. Table 4 presents estimates of the non-union wage premiums in the early prospective states, based on separate wage equations for each occupation and year. This amount of disaggregation leads to less precise point estimates, particularly in the 1979 - 1981 period when sample sizes are quite small. Nevertheless, the impacts of prospective payment on wages are still apparent. Between 1975 and 1977
wages fell sharply in the early prospective payment states, relative to wages in other states. The point estimates indicate that RNs, LPNs, and Other non-supervisory workers experienced wage reductions on the order of 20 percent over the first two years of prospective payment. The remaining three occupational groups experienced waged reductions near 10 percent. While these estimated wage reductions are larger than the estimates of Table 3, they are also considerably less precise.

Evidence in Schramm [1978] indicates that although New York enacted its revised prospective payment program in March 1976, it did not begin to affect wages until late in the year. This could explain what appears to be a steady decline in wages over the 1975 - 1977 period. 1976 may be a transition year in which only a fraction of workers have been affected by prospective payment. If the data for 1976 are dropped from the analysis reported in Table 3, the resulting estimates of wage reductions caused by prospective payment increase by up to 5 percentage points. Thus, the true impact of prospective payment on non-union wages may be somewhere between the estimates of 5 - 10 percent reductions given in Table 3 and the estimate of 10 - 20 percent reductions based on comparing 1975 and 1977 wages.

It does not appear that much of the wage changes in the early prospective payment states are due to a broad change in regional wages, rather than the effects of prospective payment. The right-most column of Table 4 provides the yearly differential for the early prospective payment states relative to other states, based on estimating a wage

15Estimates of wages for New York apart from the other early prospective payment states indicate that New York’s wages fell a year later than the other states, although the point estimates are not very precise.
equation for all non-manufacturing workers. Non-manufacturing wages in the early prospective payment states relative to other states steadily declined over 1973-1980. This gradual decline, however, seems unrelated to the decline in hospital wages. As can be seen in Table 4, hospital wages are stable through 1975, decline rapidly in 1976-77, and then show no particular trend. Therefore, it is unlikely that the estimates of wage declines due to prospective payment are the result of regional bias.

Unfortunately, estimates analogous to those in Tables 3 and 4 for union workers are extremely imprecise because of the relatively small sample of union workers in the early prospective payment states. When union wage premiums are estimated on pooled years, in a format similar to Table 3, no significant changes in the union wage premium are found for any occupation. The point estimates also do not indicate any consistent effect of prospective payment on union wage premium.

EVIDENCE FROM THE NATIONAL MEDICARE CHANGES IN 83-84

The estimates presented in Tables 3 and 4 suggest that non-union wages may have fallen after 1984 in states that did not adopt prospective payment in the 1970's. Wages in states that adopted in 1976 fell steadily relative to other states until those states came onto the national prospective payment system in 1983-84. At this point, wages in states that adopted in 1976 appear to turn around and climb relative to other states. The trend is most apparent in the estimates of Table 3. This evidence is consistent with the idea that states changing to prospective payment responded by reducing wages, relative to those states that had been on prospective payment since the 1970's.

The difference between the 83-84 estimates and the 85-87 estimates
in Table 3 provides a lower bound for the impact of the 83-84 prospective payment system on wages. These estimates indicate that wages declined 2-5% in states that switched to prospective payment in 83-84, relative to wages in states that adopted prospective payment in 76. There are a number of reasons why these estimates may be biased toward zero. First, in the absence of the 83-84 prospective payment system, relative wages in states that did not adopt prospective payment may have continued to increase. The relative decrease in wages for these states between 83-84 and 85-87 would then understate the true impact of prospective payment on wages. Another weakness of these estimates is that the states which adopted prospective payment in the 1970's were also changing regulatory constraints during the 83-84 period, although to a lesser extent than the Medicare changes. The effects of the 83-84 Medicare program could be understated if wages in all states are being reduced in response to increased cost-containment incentives. Finally, the impacts of prospective payment may already be present in the 83-84 estimate of wages, since TEFRA was in effect for most of this period. To accurately estimate the full impacts of prospective payment requires accurate estimates of non-union wages for the 1979-82 period. The May CPS provides small samples for 79-81 and no information on union status for 82.

An alternative approach is to ignore union status and estimate the overall wage differential using the large samples available from the CPS Annual Earnings file. Estimates based on this approach are provided in Tables 5 and 6. If the National Medicare PPS had an impact on wages, then the relative wages in the early prospective payment states should appear to increase (or perhaps stop decreasing) after 1983 as wage
reductions took place in other states. This is exactly what appears to happen. Table 5 compares wages in states that adopted the national PPS in 1983-84, to wages in the four early prospective payment states which were the focus of Tables 3 and 4. Table 6 uses a slightly different comparison group: The four states which received waivers from Medicare's PPS and continued their own systems.¹⁶ Both tables lead to the same conclusions. Again, we see that relative wages in the early prospective payment states fell immediately after 1976. Relative wages continued falling in these four states until 1981-82. In 1983-1987 this trend is reversed, with the relative wages in the comparison states returning to their mid- to late-70's levels.

The point estimates in Tables 5 and 6 indicate that relative wages in the early PPS and Waiver states increased for all occupations between 81-82 and 85-87, with increases ranging from 0.1% for Medical Technicians to 6.9% for LPNs, Clerical workers, and other non-supervisory employees. To the extent that the early PPS states and the Waiver states provide reliable estimates of wage growth without regulatory change, these estimates again indicate a 5-10% reduction in wages for most occupations due to prospective payment.

Estimates of the impact of Medicare's prospective payment system on union wage premium are presented in Table 7. Again, these estimates are limited by the lack of precise estimates for the union premium during the 79-82 period. Compared to the average union premium during 1977-81, there were no significant changes in 83-84 or 85-87. Point estimates

¹⁶This restricts the analysis of Table 6 to the years after 1977 because the CPS did not identify Maryland residents before 1977.
indicate a decrease in the union premium of 2 or 3 percentage points for some occupations, but there is no clear pattern to these decreases either across time or across occupations. Given the general decline of union wages in other industries during the 1980's, these estimates provide no evidence of a significant impact of prospective payment on union wage premiums.

SUMMARY

Wage equations estimated for six major hospital occupations using CPS data provide three pieces of evidence on the impacts of prospective payment. First, it is clear that early prospective payment experiments reduced non-union wages by at least 5-10% for all occupations. Second, the Medicare prospective payment system implemented in 1983-84 appears to have also decreased non-union wages in the 5-10% range for most occupations in states that did not already have programs. Finally, the Medicare prospective payment system has had no clear impact on union wage premiums. This last fact implies that union wages have fallen along with non-union wages as a result of prospective payment.

This evidence supports a model of rent sharing in hospital labor markets. Based on the evidence overall, prospective payment lowered all workers' wages by 5-10%. A rent sharing model predicts that prospective payment gives hospitals an incentive to reduce rent sharing with all workers, which is consistent with the evidence. In contrast, a monopsony model predicts that hospitals reduce wages for skilled workers only, and a competitive model predicts that prospective payment has no impact on hospital wages.

There are two reasons prospective payment may have lowered the rents
going to workers. First, to the extent that prospective payment limited the growth in revenues, the total rents available to the hospitals and their employees may have fallen.\textsuperscript{17} Under this scenario both workers and hospitals are made worse off because there are less rents available to be shared. A second reason for lower worker rents is that under prospective payment the government no longer paid half of workers salaries. Therefore, even if total rents are unchanged, hospitals have more incentive to resist wage increases.\textsuperscript{18} In this case, workers are still made worse off under prospective payment, but hospitals may benefit from prospective payment if labor costs fall more than revenues.

Evidence on hospital operating margins indicates that hospitals benefited from Medicare's Prospective Payment System. Hospital operating margins increased sharply in 1983 and 1984. the average margin in hospitals for 1984 was a record 6.2\%. During the first three years of PPS, margins were roughly three percentage points higher the what they were in the 1970's.\textsuperscript{19}

The evidence implies that the reason for lower wages during the early years of PPS was not a general fall in rents available in the hospital industry. Instead, PPS encouraged a transfer of rents from workers to hospitals. Assuming that labor accounts for one-half of hospital expenses, wage reductions of 5-10\% translate to a reduction of

\textsuperscript{17}This argument, for example, is the basis of the studies by Rose [1987] and Card [1989] in which deregulation is assumed to lower total rents.

\textsuperscript{18}In fact, a primary intent of prospective payment was to give hospitals an incentive to lower costs by making the payment for services independent of costs.

\textsuperscript{19}See Guterman, et.al. [1988] for an overview. Margins have fallen more recently as the growth in PPS payment rates has been reduced.
2-5% in total hospital costs due to prospective payment. Correspondingly, hospital margins increased by roughly the same amount. Thus, the evidence suggests that prospective payment led to a substantial rent transfer (on the order of $3b in aggregate) from workers to hospitals, in the form of lower wages for all employees.
REFERENCES


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\(^{20}\)Estimates based on 1973 May CPS.

\(^{21}\)Estimates based on 1987 CPSAE.
TABLE 2

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<sup>22</sup>Estimates based on 1973 May CPS.
<sup>23</sup>Estimates based on 1987 CPSAE.

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1 Year dummies are included in all regressions, but not presented.
2 PPS is the intercept for the early prospective payment states in 73-75. PPS76-81, PPS83-84 and PPS85-87 are changes between 73-75 and the given years.
# TABLE 4

**YEARLY WAGE PREMIUMS**

**IN STATES WITH PROSPECTIVE PAYMENT EXPERIMENTS**

from Semilog Wage Equations by Occupation and Year

Non-Union Personnel Only

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<td>.084</td>
<td>-.007</td>
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<tr>
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<td>.005</td>
<td>-.005</td>
<td>.017</td>
<td>-.059</td>
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</tr>
<tr>
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<td>.074</td>
<td>.103</td>
<td>.043</td>
<td>.055</td>
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</tr>
<tr>
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<td>.006</td>
<td>.035</td>
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<td></td>
</tr>
<tr>
<td>$R^2$</td>
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<td>.46</td>
<td>.48</td>
<td>.49</td>
<td>.48</td>
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</tr>
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<td>6323</td>
<td>9294</td>
<td>11658</td>
<td>10667</td>
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</table>

$^3$ EXP, EXP2, EDUC, MALE, NONWHITE, SINGLE, GOVERNMENT, and Year dummies are included in all regressions, but not presented.

$^4$ CT, MA, NY, and NJ are state dummies corresponding to the 81-82 period. PPS73-75, PPS76-78, PPS79-80, PPS83-84, and PPS85-87 are differences between the 81-82 period and the given years.
### TABLE 6

**SEMILOG WAGE EQUATIONS BY OCCUPATION**

*Hospital Personnel*

*State Effects for Waiver States*

*1977 - 1987 Pooled*

<table>
<thead>
<tr>
<th></th>
<th>RN</th>
<th>LPN</th>
<th>MT</th>
<th>AIDE</th>
<th>CLERICAL</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WAIV77-78</strong>&lt;sup&gt;6&lt;/sup&gt;</td>
<td>.021</td>
<td>.099</td>
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<td>.100</td>
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<td>.031</td>
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<td>(.034)</td>
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<td>(.033)</td>
<td>(.040)</td>
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</tr>
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<td>(.028)</td>
<td>(.022)</td>
<td>(.030)</td>
</tr>
</tbody>
</table>

| R<sup>2</sup> | .38  | .44  | .38  | .35  | .38     | .39  |
| N         | 12815 | 3208 | 5725 | 8063 | 10391   | 9389 |

---

5. **EXP, EXP2, EDUC, MALE, NONWHITE, SINGLE, GOVERNMENT**, and Year dummies are included in all regressions, but not presented.

6. **MA, NY, NJ, and MD** are state dummies corresponding to the 81-82 period. **WAIV77-78, WAIV79-80, WAIV83-84**, and **WAIV85-87** are differences between the 81-82 period and the given years.
### TABLE 7

**SEMINLOG WAGE EQUATIONS BY OCCUPATION**

**Hospital Personnel**
**States With No Early Prospective Payment Program**
**1973 - 1987 Pooled**

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<tr>
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<td>(.03)</td>
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<td>(.01)</td>
<td>(.01)</td>
<td>(.01)</td>
<td>(.01)</td>
<td>(.01)</td>
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</tbody>
</table>

| R²     | .54 | .67 | .52 | .57  | .57      | .55   |
| N      | 7128| 1962| 3285| 4502 | 5901     | 5255  |

---

7 Year dummies are included in all regressions, but not presented.

8 UNION is the average union wage premium for 73-76. UN77-81, UN83-84 and UN85-87 are changes in the union wage premium between 73-75 and the given years.
CHAPTER 3

THE EFFECT OF CONNECTIONS ON THE WAGES AND MOBILITY OF YOUNG WORKERS
I. INTRODUCTION

How important are personal contacts in the careers of young workers? A number of surveys have found that roughly half of all workers locate their jobs through friends and relatives.\(^1\) In spite of this fact, the role of personal contacts is ignored in most theoretical and empirical economic models of the labor market. There are at least two reasons for studying the role of personal contacts in the labor market in more detail. First, to the extent that social ties may vary across demographic groups, understanding the importance of personal contacts may shed light on the differences in labor market outcomes between men and women or whites and non-whites. Second, given the importance of personal contacts in finding a job, an understanding of how personal contacts affect wages and turnover will also go a long way towards understanding wage determination and turnover in general.

Three explanations have been developed to explain why personal contacts are such a common method of finding a job. First, a personal contact may provide additional information to the worker and/or firm. For example, a personal contact may help a firm to learn about the productivity of heterogeneous workers (see Montgomery [1989] for a model of this type). Alternatively, a contact may help a worker learn how well she is suited to a particular firm (see Granovetter [1974] or Wanous [1980] for this kind of explanation). A second explanation for personal contacts is that they are simply a way of getting a good job, i.e. high

\(^{1}\)Estimates of the fraction of workers who found their job through friends and relatives are: 36-62\% (Myers and Shultz [1951], textile workers), 23-67\% (Rees and Shultz [1970], Chicago labor market), 43-65\% (Granovetter [1974], professionals in Newton, MA), 43-58\% (Corcoran, et al. [1980], PSID 11th wave), and 40-70\% (NLSY sample in this paper).
paying jobs are scarce and rationed to workers with contacts. A final explanation for personal contacts may be that they are a low cost search method for either the worker or the firm (see Holzer [1988] for a model of worker search, and Rees and Shultz [1970] for a model of firm search).

This chapter has two goals. The first goal is to establish empirically the differences between jobs found with and without a personal contact, in terms of labor market outcomes such as wages and turnover. Finding that these differences exist is an obvious first step in establishing that personal contacts play a meaningful and interesting role in the labor market. The second goal is to determine which, if any, of the explanations given above are consistent with the wage and turnover facts. In particular, I develop and test some implications of a model in which the personal contact provides information about the match quality of a job.

This chapter's focus is admittedly narrow. I analyze only the impact of a personal contact on the wages and turnover patterns of young workers in the early part of their careers. Other areas of interest might include what types of workers have access to personal contacts, the role of a worker's relationship to a contact (relative, friend, acquaintance), the affect of personal contacts on unemployment, the different role of contacts across sectors of the economy, and the changing role of contacts as a career progresses. Most of these issues, however, would be irrelevant if personal contacts did not in fact provide a worker with any job-related benefits. Therefore, this chapter can be seen as a building block on which future work can be based.

The remainder of this chapter is organized as follows. The next section describes evidence on wages and turnover for jobs found through
personal contacts as compared to jobs found through other means. The evidence is based on a sample from the NLSY of full-time employed youths who were between the ages of 17 and 25 in 1982 and who have had no more than three years of labor market experience since leaving school. The preliminary analysis looks at three interesting labor market outcomes: wage levels, turnover rates, and wage growth. Individuals with jobs found through personal contacts have higher wages during their first year of tenure, but are indistinguishable from other workers after the first year on the job. In contrast, there is no apparent difference in turnover on jobs found through a personal contact. An analysis of wage growth indicates that higher wage growth for job switchers (as compared to workers who stay on their job) is solely due to individuals moving onto jobs found through personal contacts. Furthermore, none of the higher wage growth for these individuals can be explained by observable changes in job characteristics. On balance, this evidence suggests that a personal contact may provide information that helps an individual find a good match.

Section III develops a three-period model of mobility and wages in which individuals receive offers each period through both a personal contact and a more formal labor market. The key to the model is that a personal contact provides ex ante information about match quality that is not available for jobs found through the formal labor market. Hence, a job found through a personal contact is a pure inspection good (as in Burdett [1978]) and a job found through the formal labor market is a pure experience good (as in Jovanovic [1979]). Section III concludes by characterizing the optimal mobility rules for a worker.

The empirical implications of the model cannot be derived
analytically. Therefore, Section IV derives some implications of the model using computer simulations. The simulations predict wage patterns very similar to those found in Section II. In contrast, the model predicts turnover patterns quite different from those found in Section II. The second half of Section IV examines the implications of the model in more detail. I present further empirical evidence that is broadly consistent with the model's more detailed implications regarding wages. The model's more detailed implications regarding turnover are contradicted by further empirical evidence. Thus, the model performs reasonably well with regard to wages but totally misses on turnover. Overall, the empirical evidence suggests that the very simple model developed in this chapter may be a useful framework for thinking about the role of personal contacts in the labor market.
II. EVIDENCE ON WAGES AND TURNOVER

This section presents evidence on the wage and turnover patterns for young workers who found a job through a personal contact, as compared to young workers who found a job through more formal means. The estimates given in this section are not structural in any way, and are simply intended to capture some interesting correlations in the data. The basic facts presented below are primarily intended to (1) provide background information on the extent of personal contacts as a method of job-finding, (2) demonstrate that wage patterns are different for individuals who did and did not find their job through a personal contact, particularly in the first year of a job, and (3) motivate the model that is presented in Section III.

This section is organized as follows. Following a description of the data, I discuss the basic characteristics of the sample and contrast workers with jobs found through a personal contact to workers with jobs found in other ways. The second half of this section investigates how a personal contact is related to an individual's wage and turnover pattern. I find that individuals with jobs found through personal contacts have higher wages during their first year of tenure, but are indistinguishable from other workers after the first year on the job. Furthermore, individuals who use a personal contact to find a new job experience much higher wage growth in moving to that job than do either individuals who remain on a job or individuals who move from one job to another with no help from a personal contact. I conclude that these results are generally consistent with a matching model, in which personal contacts provide the worker and firm with information about a prospective job match.
DATA

The data source is the NLS Youth Cohort. The NLSY contains detailed school- and work-history information from annual surveys between 1979 and 1987. The full sample includes 11,406 individuals between the ages of 14 and 21 in 1979.\(^2\) The 1982 survey includes detailed questions on the method used to find the current job, asked of all respondents who were working at the time of interview. Based on these questions, I have defined the 1982 job as found through a personal contact whenever the respondent replied "yes" to both of the following two questions:

1. Was there anyone specifically who helped you get your job with (employer name)?
2. Was this person working for (employer name) when you were first offered this job?

This definition of a personal contact is somewhat restrictive. It does not include workers who had help getting their job from a person outside of the firm, nor does it include workers who had no help but knew someone at the firm. By restricting the definition in this way, I hope to focus on the kinds of contacts that are central to most theories, i.e. contacts who are closely linked to both the worker and the firm, and who played an active role in getting the worker hired.\(^3\) Even with this restrictive definition, almost 40% of the workers in my sample found their 1982 job through a personal contact.

The sample is restricted to full-time workers (more than 34 hours per week) who are not self-employed, in school, or in the military at the

\(^2\)The NLSY also has a special military sub sample that has been excluded from this analysis.
\(^3\)I am also using a definition that is suited to the analysis of matching in sections III and IV.
time of the 1982 interview. There are 4756 individuals in the NLSY who satisfy these conditions. In order to observe each individual's entire work history, the sample is further restricted to those who were in school as of the 1979 interview, but have since left. Since I wish to abstract from the schooling decision, individuals must remain out of school for at least three years to be included in the sample. These restrictions reduce the sample size considerably, to 1401 individuals. Finally, the analysis considers only those individuals who are employed at the time of interview for three years after leaving school, i.e. workers with a strong attachment to the labor force. This restriction reduces the sample to 965 individuals.

There are a number of potential pitfalls in the final sample. The sample selection focuses on young workers in the first years of their careers, so the results may be hard to generalize. Furthermore, the critical year of data (1982) falls at the trough of the worst recession in 50 years. In spite of these limitations, there are at least two reasons to be interested in the results of an analysis based on this sample. First, the very early stage of a career, when workers experience high turnover and rapid wage growth, is a likely period to find evidence that can distinguish between competing explanations for the role of personal contacts in job search. Second, when I ignore the information on personal contacts and use the data to re-estimate existing empirical work, the results are generally consistent with earlier studies,

---

4 Thus, the individual must be either (i) in school in 1979 but not in 1980-82, (ii) in school in 1980 but not in 1981-83, or (iii) in school in 1981 but not in 1982-84.

5 In terms of cases (i), (ii), and (iii) in the previous footnote, the individual must be employed in 1980-82, 1981-83, or 1982-84, respectively.
suggesting that the 1982 timing of the survey does not drive the results (e.g., a wage or wage growth equation estimated from this restrictive data set looks very similar to wage or wage growth equations estimated from any representative data set).

The final sample includes 965 individuals between the ages of 17 and 25 in 1982. In this sample, 39.3% report that they found their job through a personal contact. Column 1 of Table 1 summarizes the average characteristics of the sample as a whole. The characteristics of the sample reflect the focus on young workers: the average age is 21.5, less than 20% of the sample have college degrees, and nearly half are employed in clerical, sales, or service occupations.

Columns 2 and 3 of Table 1 contrast the characteristics of individuals who did and did not find their 1982 job through a personal contact. Individuals who found their 1982 job through a personal contact are younger, less educated, more likely to be male, and less likely to live in an SMSA. The individuals with personal contacts also have longer job tenure and are more likely to be on blue-collar jobs. These characteristics of individuals with jobs found through a personal contact are broadly consistent with previous studies that have found the use of contacts most prevalent among less educated men working on blue-collar jobs (see Corcoran et. al. [1980], Granovetter [1974], Myers and Shultz [1951], and Rees and Shultz [1970]).

The final rows of Table 1 summarize the nature of the personal

---

6 The results in Table 1 are unweighted. There is no significant change when these estimates are calculated using the sample weights provided by the NLSY.

7 Logit analysis of having found a job through a contact provides no insights that are not already clear in Table 1.
contact for those individuals who found their 1982 job through a personal contact. Over 60% of individuals who used a personal contact report that the contact is male.\(^8\) Roughly one quarter of personal contacts are close family members.

**WAGES AND TURNOVER**

From the above discussion it is clear that the use of a personal contact in finding a job is quite pervasive. Does help from a personal contact appear to be related to an individual's labor market success? To address this question, I present some preliminary evidence comparing wages and turnover for individuals who did and did not find their job through a personal contact. I reiterate that these estimates are not intended to be structural in any way but rather serve only to summarize some of the correlations that exist in the data.

Estimates of wage equations that measure the return to experience and the return to tenure are quite common in the literature. Mincer and Jovanovic [1981] provide the following estimates, based on a sample of 1442 young men in 1971 (t statistics in parentheses):

\[
\ln(\text{wage}) = 0.002 + 0.079 \times \text{Education} + 0.043 \times \text{Experience} - 0.001 \times \text{Experience}^2 \\
(16.5) \hspace{2cm} (4.7) \hspace{2cm} (1.5)
\]

\[
+ 0.070 \times \text{Tenure} - 0.005 \times \text{Tenure}^2. \\
(7.3) \hspace{2cm} (5.2)
\]

These findings are typical: there are large but declining returns to additional years of both experience and tenure. Using 1982 wages for 932

---

\(^8\) It is interesting to note that 85% of men and only 30% of women report having a man as their personal contact.
individuals in the NLSY sample produces the following estimates:

$$\ln(\text{wage}) = 4.9 + 0.084 \times \text{Education} + 0.120 \times \text{Experience} - 0.022 \times \text{Experience}^2$$

$$(13.9) \quad (1.9) \quad (1.2)$$

$$+ 0.092 \times \text{Tenure} - 0.016 \times \text{Tenure}^2.$$  

$$(1.9) \quad (1.0)$$

The estimated returns to education, experience, and tenure are reasonably close to those found by Mincer and Jovanovic although these estimates are quite imprecise.

Table 2 presents more detailed wage equation estimates based on the NLSY sample of 965 individuals. The first column estimates the standard specification presented above with an added dummy variable for jobs found through personal contacts and interaction terms between this dummy variable and the tenure term. The personal contact dummy and interactions are neither individually nor jointly significant. The point estimates suggest a lower return to tenure on jobs found through a personal contact.

The second and third columns of Table 2 break the sample into individuals with a year or less of tenure and individuals with more than a year of tenure. The squared tenure terms have been dropped because neither sub-sample has enough variation in tenure to identify the quadratic term. For individuals with more than a year of tenure there is once again no significant difference between wages on jobs found with and

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9 This regression also controls for union membership, number of years of experience prior to the most recent period in school, residence in an SMSA, marital status, sex, and race.

10 When the personal contacts dummy is interacted with experience the results are unchanged and the coefficients on the experience interactions are small and insignificant.
without a personal contact. In contrast, jobs found through a personal contact have significantly different wage behavior during the first year of tenure.\textsuperscript{11} The estimates given in column 2 indicate that jobs found through personal contacts have 16% higher initial wages, but a much lower return to tenure during the first year.\textsuperscript{12} In fact, the point estimates suggest essentially no return to tenure on jobs found through contacts, compared to a 27% return to tenure in the first year for other jobs.

A number of models are consistent with the estimates of Table 2. A matching model, in which personal contacts provide a worker with information about the job match, generates a (measured) return to tenure for jobs with no personal contact (because workers are learning about the match over time and stay in only a good match, as in Jovanovic [1979]) but no return to tenure for jobs found through a personal contact (because the match quality is known at the start of the job). Alternatively, a model of mover-stayer heterogeneity might explain the estimates of Table 2. Suppose that stayers are paid more than movers and are more likely to find jobs through a personal contact. In this case, wages will appear to rise quickly with tenure on jobs with no personal contact (because these jobs start with a large proportion of low-paid movers who rapidly leave the job) and wages will appear to rise less quickly on jobs found through a personal contact (because these jobs start with fewer movers).

Both the matching and mover-stayer explanations suggest that there

\textsuperscript{11}The dummy and interaction terms for personal contacts are jointly significant at the 5% level.

\textsuperscript{12}Corcoran et. al. [1980] find a similar pattern in the PSID. They estimate that jobs found through a personal contact pay higher initial wages (point estimates range 5%-20%) and a significantly lower return to tenure (point estimates of the difference range 1-4%).
will be lower turnover on jobs found with a personal contact. A number of studies in the personnel literature have found lower turnover for workers who found their job through a personal contact (see Schwab [1982] for a summary of the evidence). Evidence on turnover rates from my sample, however, indicates no difference in turnover for individuals who found their job through a personal contact. In order to focus on turnover early in a job, I have taken a sub-sample of workers who had held their jobs for less than six months at the time of the 1982 interview. Table 3 presents the turnover rate for this sample between the 1982 and 1983 interviews, and between the 1983 and 1984 interviews. There is again very little difference in turnover for jobs found through personal contacts. 13 These simple turnover patterns are not consistent with the matching or mover-stayer models of personal contacts discussed above.

Given the conflicting evidence thus far on wages and turnover, there are a number of reasons to think that looking at wage growth might provide useful information on the role of personal contacts. Since many models (such as the matching model discussed above) imply that contacts help workers to find a better wage, it seems natural to look directly at the wage growth for workers moving from job to job rather than making an indirect inference based on turnover and the return to tenure. Furthermore, if individual heterogeneity is important (as in the mover-stayer model discussed above), wage growth will tend to difference out these individual effects and may provide different estimates of how

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13 The basic relationships found in Table 3 are unaltered when I estimate the probability of turnover with logits that control for individual characteristics.
personal contacts affect wages.

Three recent studies have analyzed the wage growth of workers who stay on their job (stayers) and workers who move to a new job (movers): Bartel and Borjas [1981], Mincer [1986], and Topel and Ward [1989]. All of these studies find that the wage growth of movers exceeds the wage growth of stayers among young workers. The Bartel - Borjas and Mincer estimates are that wage growth is 1-3% higher for movers, while Topel and Ward's estimates are much larger (14%).\textsuperscript{14} Bartel - Borjas and Mincer find that the wage growth of movers is due to quits, as opposed to layoffs.

Table 4 presents wage growth equations estimated using workers in the NLSY sample who were employed in both 1981 and 1982. The estimates compare wage growth between 1981 and 1982 for movers and stayers, conditional on whether the 1982 job was found through a personal contact. The estimates of Table 4 are relatively unchanged when I include measures of experience and tenure in the regressions. Columns 1 and 3 estimate some common specifications, ignoring personal contacts. Note that the constant refers to the wage growth of stayers, while other coefficients measure the difference in wage growth between movers and stayers. In Column 1 I find the usual result that workers who changed jobs between 1981 and 1982 had roughly 3% higher wage growth than workers who stayed on their job. Column 3 breaks movers into quits and layoffs. All of the higher wage growth associated with moving is due to quits.

Columns 2 and 4 of Table 4 include estimates of the difference in

\textsuperscript{14}Topel and Ward [1989] argue that their higher estimates are the result of less measurement error in their LEED data. If this is correct, I would expect estimates from the NLSY to be closer to the survey-based estimates of Bartel and Borjas [1981] and of Mincer [1986].
wage growth for workers who found their 1982 job through a personal contact. For example, the constant in Column 2 estimates that a worker who stays on a job found with no contact has an average growth in log wages of .12. The fifth row of column 2 (i.e., the coefficient on the Personal Contact * Stay on Job 81-82 interaction) estimates that a worker who stays on a job found through a personal contact has a .028 higher growth in log wages than does a worker who stays on a job found with no contact. In other words, within-job wage growth is roughly 3% higher for jobs found through a contact, although this difference is not significant.

The results for movers are more striking. A worker who moves 1981-82 to a job found without a personal contact does no better than does a stayer without a personal contact: row 2 shows that movers have .010 lower growth of log wages and that this difference is not significant. In contrast, a mover who moves to a job found through a personal contact has significantly higher log wage growth than does any other mover or stayer: .141 more than movers who did not use a personal contact, .141-.010=.131 more than stayers with no contact, and .141-.010=.028=.103 more than stayers with a contact. Thus, the 3% higher wage growth for movers estimated in column 1 is composed of a 1% lower wage growth for people moving onto jobs without contacts, and a 10-15% higher wage growth for people moving onto jobs found through contacts. The conclusion from these estimates is that most of the gains from moving are related to moving onto a job found through a contact.

Column 4 separates movers into quits and layoffs. The conclusions are as would be anticipated from Columns 2 and 3. Workers who quit and move to a job found through a personal contact have much higher wage
growth than either stayers or workers who quit with no personal contact. Among the workers who were laid off, those who found a job through a personal contact had only slightly higher log wage growth (by 0.036) than those who did not use a personal contact (who had log wage growth of 0.118-0.101=0.017): laid off workers simply fare poorly.

The clear conclusion to be drawn from the analysis presented in Table 4 is that large wage growth is associated with (voluntarily) moving to a job found through a personal contact. Therefore, it is not likely that the effect of personal contacts on wages can be explained by a pure heterogeneity story (i.e. an individual fixed effect in a cross-section wage equation, as in the mover-stayer model, that is correlated with finding a job through a contact). Instead, the evidence suggests that workers use contacts to shop for jobs: personal contacts allow a worker to move from a given job to a higher paying job. There are at least two reasons why a worker with a personal contact may be better able to shop for jobs. First, if high-paying jobs are rationed, it may be that workers with contacts can jump to the front of the queue. Second, if there is a large match component in wages, then workers need prior information on match quality (which is available from a personal contact) in order to job shop. These two explanations are quite similar, with the key difference being that the first assumes that a contact provides access to a better wage distribution, while the second assumes that a contact simply provides information.

Column 5 of Table 4 provides evidence that the wage growth for movers with contacts is not due to personal contacts getting a worker a "good job" (e.g. a union job, or a job in a high-paying industry). I estimate a wage growth equation for movers only, controlling for the
union status, industry, and occupation of both the 1981 and 1982 jobs. Comparing the estimate of column 5 to column 2 it is apparent that the controls do not affect the basic findings. Individuals who move to a job found through a personal contact still have wage growth roughly 15% higher than do individuals who move with no help from a personal contact. In other words, none of the higher wage growth for movers with contacts can be explained by observable differences in the characteristics of jobs found through contacts.

On balance, the evidence presented in this section suggests that a personal contact may provide information that helps a worker find a good match. Alternative explanations of the measured effect of personal contacts, such as mover-stayer heterogeneity and job-rationing, are less consistent with the evidence. In particular, a matching model (unlike the alternatives) may explain the observed high wage growth for movers with contacts that is unrelated to changes in job characteristics. Therefore, the remainder of this chapter focuses on matching as an explanation for the role of personal contacts in the labor market. The next section develops a formal model of matching in which personal contacts provide ex ante information about match quality. Section IV tests some empirical implications of this model.

III. THE MODEL

This section presents a formal model of mobility and wage growth in which workers may find jobs through either a personal contact or a more

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15 Industry and occupation are measured at the one-digit level. The specification enters the 1981 and 1982 dummy variables separately, which is less restrictive than using the first differences.
formal labor market. The key to the model is that a personal contact provides a worker with up-front information about the match quality of a prospective job. A job found through the formal labor market, in contrast, provides no up-front information about match quality. In the terminology of the search literature, I model a job found through a personal contact as a pure inspection good, while a job found through the formal labor market is a pure experience good. Hence, the model combines elements of two well known models of job mobility: Jovanovic [1979] in which jobs are pure experience goods, and Burdett [1978] in which jobs are pure inspection goods.

The model is very simple. Workers live three periods. Firms are represented by a zero-profit constraint in each period. Job offers come from two sources. Offers from the formal labor market provide no information about match. Offers from a personal contact provide perfect information about match. All workers are assumed to have equal access to personal contacts.\(^\text{16}\) All offers come from the same underlying match distribution that does not vary with experience or tenure. The model assumes no mobility cost and no true return to tenure. Thus, I have abstracted from some potentially important factors in mobility decisions in order to focus on the implications of matching.

This section is organized as follows. I begin by presenting the assumptions of the model regarding (1) production and preferences, (2) information, (3) timing, and (4) contracts. The section concludes by characterizing the optimal mobility rules for a worker. The optimal mobility rules take the form of reservation values for each period that

\(^{16}\) Future work will consider a model in which some fraction of unidentified workers have no personal contacts.
determine whether a worker takes a new job from a personal contact, takes a new job from the formal labor market, or stays on an old job. Many of the empirical implications of this model cannot be derived analytically. I therefore derive empirical predictions regarding wages and mobility with the help of computer simulations. Discussion of these simulations and their implications is found in Section IV.

ASSUMPTIONS

The model has three periods. I make the following assumptions.

(1) Production and Preferences. Firms and workers are risk neutral. Workers maximize income and discount future earnings using a one-period discount factor of $\delta$. A worker's output at firm $i$ in period $t$ is given by $Y_{it} = \mu_i \varepsilon_{it}$, where $\mu_i$ is a firm-specific match component of productivity and $\varepsilon_{it}$ is white noise. Match quality for a given worker is distributed $N(0,1)$ across the population of firms.\footnote{Assuming that $\mu$ is distributed $N(m,\sigma^2)$ complicates the presentation without affecting the qualitative predictions of the model.} The noise component of output, $\varepsilon_{it}$, is i.i.d. and distributed $N(0,\sigma^2_{\varepsilon})$.

(2) Information. Output, $Y_{it}$, is observable by both workers and firms. A worker's unconditional prior on match quality is $\mu_i \sim N(0,1)$, i.e. match quality on job $i$ is a random draw from the distribution of possible matches. A job offer that arrives from the formal labor market contains no additional information about match quality. In contrast, a job offer that arrives from a personal contact includes a perfect signal $(s_i = \mu_i)$ of match quality that is observable to both the worker and the firm.

(3) Timing. Events occur and decisions are made in the following
PERIOD 1

A) The worker receives two offers. One offer arrives from a personal contact and one offer arrives from the formal labor market.

B) The worker accepts one of the two offers.

C) Output is observed on the chosen job, and a wage is paid.

PERIOD 2

A) The worker again receives two offers, one from a personal contact and one from the formal labor market.

B) The worker either remains on the job held in the previous period, or accepts one of the two new offers.

C) Output is observed on the chosen job, and a wage is paid.

PERIOD 3

Same as Period 2.

(4) Contracts. I assume that firms earn zero expected profits in each period.¹⁸ Therefore, at the beginning of each period the expected wage must equal the expected productivity of the worker. A large variety of contracts are possible.¹⁹ The possibilities range from contracts that are fully contingent on output (i.e., \( w_{it} = Y_{it} \)) to contracts that do not vary at all with current output and simply pay expected productivity based on the information available at the beginning of the period. For

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¹⁸This assumption is common in matching models, e.g. see Jovanovic [1979]. The assumption requires some form of reputation or commitment on the firm’s part because the worker’s output is match-specific.

¹⁹For example, there exist a continuum of possible wage contracts that are linear in realized output and satisfy the zero-expected-profit constraint: \( w_{it} = b \cdot Y_{it} + (1-b) \cdot E(Y_{it}) \).
concreteness, I choose (and motivate) a particular type of contract that lies somewhere between these two extremes. The contracting assumption in the model does not affect the optimal mobility rules that are derived below, but different contracting assumptions can lead to quite different implications for the behavior of wages. Therefore, in Section IV I point out the implications of the model that depend on the contracting assumption.

I assume the following form of contingent contract. A worker is paid the expected value of match quality, conditional on all the information available through the end of the period, including output during the period. For example, the wage in period 1 for a job found through the formal market is \( w_{11} (Y_{11}) = E(\mu_1 | Y_{11}) = Y_{11} / (1 + \sigma^2) \). Similarly, the wage in period 1 for a job found through a personal contact is \( w_{11} (Y_{11}) = E(\mu_1 | Y_{11}, s_1) = s_1 \), independent of \( Y_{11} \). One important characteristic of this type of contract is that the wage in period \( t \) incorporates all of the information about the current job that will be available to the worker when mobility decisions are made at the beginning of period \( t+1 \). Since the data reveal wages and mobility decisions but not outputs, it is convenient that the wage in period \( t \) summarizes all the information the worker will use in deciding about mobility between periods \( t \) and \( t+1 \). Note that neither of the more conventional contracting assumptions share this feature: a pure piece-rate (i.e., \( w_{1t} = Y_{1t} \)) conveys no information about past outputs, while wages paid in advance (i.e., \( w_{1t} = E(Y_{1t}) \)) conveys no information about current output.

The wage contract I have imposed can be thought of in terms of a lag between the time when output is observed and the time when new job offers
arrive for a worker. Suppose that the worker and the firm observe productivity early in the period. The wage adjusts during the period to reflect the updated prior on match quality. Based on this new information, the worker may wish to leave the job, but must wait until the start of the next period when new offers arrive. Therefore, the wage observed during some (possibly large) fraction of the period is already conditioned on current output. Alternatively, one could think of a richer model in which wages are paid in advance and adjusted every period, but offers arrive stochastically at the beginning of each period. Both models simply require that wages adjust faster than offers arrive. In reality, it seems likely that the lag between observing output and finding a new offer is longer than the lag between observing output and adjusting the wage. Therefore, this contracting assumption may be a useful approximation to reality.

OPTIMAL MOBILITY RULES

The remainder of this section discusses the optimal mobility rules for workers in the above model. These mobility rules state the conditions in which a worker accepts a new offer from the formal labor market, accepts a new offer from a personal contact, or stays on an old job.20

The optimal mobility rules can be summarized in the following way. Let $V^H_t$ be the expected PDV of wages (conditional on information available at the start of period $t$) assuming that the worker accepts a new formal labor market job offer in period $t$ and behaves optimally in any remaining

\[20\text{Note that a worker has the option of staying on an old job only in periods 2 and 3.}\]
periods. Similarly, let $V_{t}^{PC}$ be the expected PDV of wages assuming that the worker accepts a new personal contact job offer in period $t$ and behaves optimally thereafter. Finally, let $V_{t}^{S}$ be the PDV of wages assuming that a worker stays on an old job in period $t$ and behaves optimally thereafter. Optimal mobility requires that a worker take the action that maximizes the expected PDV of wages. Therefore, a worker (1) accepts an offer from the formal labor market whenever $V_{t}^{M} = \max\{V_{t}^{M}, V_{t}^{PC}, V_{t}^{S}\}$, (2) accepts an offer from a personal contact whenever $V_{t}^{PC} = \max\{V_{t}^{M}, V_{t}^{PC}, V_{t}^{S}\}$, and (3) stays on the old job whenever $V_{t}^{S} = \max\{V_{t}^{M}, V_{t}^{PC}, V_{t}^{S}\}$.

Analytical expressions for $V_{t}^{M}$, $V_{t}^{PC}$, and $V_{t}^{S}$ in periods 1-3 are provided in Appendix 1. Some general properties of these expressions are worth noting. As in Jovanovic [1979], the value of a job found through the formal labor market incorporates both the expected wage on that job plus an option value that comes from the uncertainty about match. The intuition for the option value is that a worker can limit the down-side risk by leaving any job that is found to be a bad match ex post. The option value of a formal labor market job decreases with tenure because as output is observed the uncertainty about the match decreases. In response to the declining option value, the value of a job found through the formal labor market declines with tenure for a given expected match quality.

Because this model includes offers through personal contacts as well as through the formal labor market, a new effect arises that does not appear in Jovanovic's model: the option value of a formal labor market job is reduced by the presence of offers from personal contacts. The intuition is that in future periods there is a positive probability of leaving any formal labor market job to take a better offer from a
personal contact. This added possibility of leaving the formal labor market leads workers to discount the future value of any job.

The value of a job found through a personal contact, in contrast, has no option value because there is no uncertainty about the match. To be accepted by a worker, a job offer from a personal contact must have a higher than average match value to offset the option value available on formal labor market jobs. Thus, workers accepting jobs through personal contacts are self-selecting into better than average matches. Furthermore, once a worker accepts a job from a personal contact, it is never optimal to leave that job to go back to the formal labor market. In other words, a worker leaves a personal contact job only if he finds a better match through another personal contact. Therefore, a worker on a personal contact job behaves exactly as if jobs are pure inspection goods.

In summary, this section has developed a very simple model. The model focuses on matching as an explanation of wages and turnover. Personal contacts provide perfect information about the match on a potential job. Workers are able to use personal contacts to self-select into good matches, and to job-shop for better matches. Unfortunately, the testable properties of this model cannot be derived analytically. The next section empirically tests some implications of the model that are developed through computer simulations.

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21 A formal proof of this statement is not yet worked out. However, the property is found to hold in the simulations discussed in Section IV. The intuition is that the option value on formal labor market jobs is largest in period 1, smaller in period 2, and zero in period 3 when there is no future. Therefore, a personal contact job with a match that overcomes the option value of formal labor market jobs in one period will certainly overcome the option value in subsequent periods.
IV. RESULTS

This section develops and empirically tests the implications of the model analyzed in Section III. The implications of the model cannot be derived analytically and must be derived with computer simulations. The simulations provide a number of testable implications of the model with respect to wages, wage growth, wage variance, and turnover. In general, I find the model to be consistent with empirical evidence for wages but not for turnover.

The section is organized as follows. I begin with a brief overview of the simulation technique and discuss the robustness of the simulation results to certain assumptions. Next, I present simulation results comparing wages, turnover, and wage growth on jobs found with and without a personal contact. These simulation results are largely consistent with the empirical findings concerning wages in Section II. I then test three more detailed implications of the model. The simulations suggest that wage growth is negatively related to future mobility, and this relationship is much stronger for workers who do not find jobs through connections. Estimates of wage growth conditional on future mobility are presented that are consistent with this implication of the model. The model also predicts that the variance of wage growth within a job is higher on jobs found without connections (because wage change on jobs found without connections reflects learning about match). As predicted, estimates of the variance of wage growth are significantly higher on jobs found without a connection. Finally, the model predicts that turnover on jobs found with connections is less sensitive to the wage, particularly at lower than average wages. The empirical results suggest that turnover
on jobs found with connections is, in fact, less sensitive to the wage. However, turnover on connection jobs continues to be less sensitive to the wage even at high wages (in contrast to the model’s prediction). In the concluding section I discuss a simple extension of the model (adding workers with no connections) that may bring the model’s turnover predictions more in line with the empirical evidence.

SIMULATION OVERVIEW

The simulations are quite straightforward. For 5000 individuals, I randomly generate the match component \( \mu_i \sim N(0,1) \) and subsequent output \( Y_{it} = \mu_i + \epsilon_{it}, \epsilon_{it} \sim N(0,\sigma^2) \) corresponding to a personal-contact job offer and a formal-labor-market job offer in each of the three periods. The resulting set of offers and outputs are used to determine each individual’s optimal mobility pattern as discussed in Section III, using the results provided in Appendix 1. Given an individual’s mobility pattern, wages are easily calculated. Thus, the simulation produces a three-period work history of 5000 individuals under the assumptions of the model given in Section III.

The simulation results depend on two parameters of the model: the discount rate \( \delta \) and the variance of the noise component of output \( \sigma^2 \). This section provides the results of simulations in which \( \delta = .95 \) and \( \sigma^2 = 1 \). The implications that I highlight are unchanged when \( \delta \) is assumed to be .9 or 1, and when \( \sigma^2 \) is assumed to be .5 or 2.

WAGES, TURNOVER, AND WAGE GROWTH

I now turn to the model’s implications regarding wages, turnover, and wage growth. Recall that the empirical evidence in Section II
suggested two basic relationships. First, jobs found through personal contacts have higher wages in the first year of tenure, but are not different from other jobs after the first year. Second, individuals who use a personal contact to move from one job to another have higher expected wage growth than any other individual. Furthermore, the evidence in Section II suggests no difference in turnover on jobs found through a personal contact.

Table 5 presents the simulation results for wages and turnover broken down by experience, tenure, and whether the job is found through a personal contact. Jobs found through personal contacts have relatively high wages, relatively low turnover, no measured relation between tenure and either wages or turnover, and perhaps slight (positive) measured relations between experience and both wages and the probability of not turning over. In contrast, the model predicts that jobs found without a personal contact have relatively low wages, relatively high turnover, strong (positive) measured relations between tenure and both wages and the probability of not turning over, and no measured relation between experience and either wages or turnover.\(^{22}\) In sum, comparing jobs found with and without contacts, two things are apparent from these simulations. First, at the start of a job (tenure = 0) wages are higher and turnover is lower for jobs found through personal contacts. Second, these wage and turnover differences shrink at higher tenure levels. Overall, these implications of the model are quite consistent with the wage facts presented in Table 2. In contrast, the turnover implications are not consistent with the finding in section II of no difference in

\(^{22}\) The return to tenure is purely the result of selection -- individuals in bad matches are leaving so that average wages increase.
turnover rates on jobs found through a personal contact.

Table 6 presents the simulation results for wage growth, broken down by experience, tenure, whether the individual stays on a job or switches jobs, and whether the individual ends on a job found through a personal contact. Three things are apparent from Table 6. First, a personal contact is unrelated to the wage growth of stayers: all stayers have zero wage growth. Second, movers have higher wage growth than stayers. Third, individuals who move to a job found through a personal contact have higher wage growth than individuals who move to a job with no personal contact. Once again, these implications of the model are broadly consistent with the facts of Section II (see Table 4 for the specific results). The one exception is that the wage growth estimates from Section II find no significant difference between stayers and movers who do not use a contact.

FURTHER TESTS OF THE MODEL

Given that the model does a fairly good job of explaining the findings of Section II, I now turn to testing three additional empirical implications that are central to the model.

1. Wage Growth and Future Mobility

A number of studies of wage growth (Mincer[1986] and Topel and Ward [1989]) have found that future mobility is related to low current wage growth, i.e. low wage growth tends to precede a job change. This relationship holds for both stayers (low within-job wage growth precedes a move) and movers (low between-job wage growth precedes another move). The model developed in Section III generates such relationships between
low wage growth and future mobility because 1) low wage growth increases the probability that a worker prefers an offer from a personal contact to the current job, and 2) low wage growth leads some workers to prefer an offer from the formal labor market to the current job. The latter reason does not apply to jobs found through personal contacts because a worker never goes from a personal-contact job to a formal-labor market job. Thus, there will tend to be less of a relationship between wage growth and future mobility on jobs found through personal contacts.

Table 7A presents simulation results of the relationship between wage growth and future mobility. The wage growth of movers and stayers between periods 1 and 2 is broken down by whether the period 2 job is found through a personal contact and by whether the worker is still on the job in period 3. Among stayers, there is no relationship between wage growth and future mobility on personal-contact jobs and a slight negative relationship between wage growth and future mobility on no-personal-contact jobs. Among movers, there is a slight negative relationship between wage growth and future mobility on personal-contact jobs, and a large negative relationship between wage growth and future mobility on no-personal-contact jobs. In other words, the model predicts that future mobility is more strongly related to wage growth on jobs found without personal contacts. This relationship should be particularly strong for the wage growth of movers who do not use a personal contact.

Another way of seeing the implications of the model is to focus on the wage growth of workers who stay on the job in the next period. Among these workers the simulations show no effect of a personal contact -- movers simply do better than stayers. Thus, the model predicts that the
relationship between personal contacts and high wage growth disappears if we consider only workers who subsequently remain on their jobs.

Table 7B presents empirical estimates of the relationship between wage growth and future mobility. The table gives average wage growth between 1981 and 1982, conditional on whether the worker held the 1982 job at the 1983 interview. Estimates in the first column are based on workers who still held their 1982 job at the 1983 interview. Estimates in the second column are based on workers who left their 1982 job by the 1983 interview. The third column presents the difference in wage growth between workers who were still on the job in 1983 and those who had left.

The estimates of Table 7B are relatively consistent with the implications of the model. Among stayers, there is a slight relationship between future mobility and low wage growth: Leaving the job before the 1983 interview is associated with .035 lower growth in log wages for jobs found without connections, and .073 lower growth for jobs found with connections. Although the relationship between future mobility and the wage growth of stayers appears to be slightly stronger on connection jobs (in contrast with the theory), one cannot reject the hypothesis that the effect of future mobility is the same on jobs found with and without connections.\(^{23}\)

The wage growth of movers provides stronger support for the model (see rows 3 and 4 of Table 7B): Future mobility is associated with significantly lower wage growth for workers without connections but not for workers with connections. One can easily reject the hypothesis that the effect of future mobility on wage growth is the same for movers with

\(^{23}\) The t statistic for this test is 0.67.
and without connections. Thus, as predicted by the model, future mobility is most strongly associated with low wage growth among individuals who change jobs without a personal contact.

Finally, the wage growth of workers who subsequently remain on their jobs (Column 1 of Table 7B) provides further support for the model. There is no relationship between the use of personal contacts and the wage growth of these workers; movers with and without personal contacts have higher wage growth than stayers. In contrast, the wage growth of individuals who subsequently leave their job (Column 2 of Table 7B) is significantly higher among movers who use a personal contact. Thus, the main result of Section II, that movers using personal contacts have higher wage growth than other workers, only holds among workers who move again within a year. This is precisely what is found in the simulations.

2. Variance of Wage Growth

A central assumption in any matching model like the one developed in Section III is that the wage reflects, at least in part, beliefs about match quality. Therefore, within-job wage changes reflect changing beliefs about match. If beliefs about match quality are very precise (as is the case on jobs found through personal contacts) then the wage will not change much over time. If beliefs about match are not precise (as is the case on jobs found without personal contacts, particularly early in the job when very little information has been accumulated about productivity) then the wage will change substantially over time in response to learning about the match. Thus, there will tend to be a

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24 The only time this is not true is when workers are paid piece rates. Otherwise, the wage must reflect expected productivity to some degree.
higher variance of within-job wage growth on jobs found without connections.

Table 8A presents simulation results of the variance of within-job and between-job wage growth, broken down by experience, tenure, and personal contacts. Three things are clear from the simulations. First, the variance of between-job wage growth is higher than the variance of within job wage growth. The higher variance of between-job wage growth reflects the change in the underlying match quality when changing jobs. Second, the variance of within-job wage growth is markedly lower on jobs found through personal contacts. Finally, the variance of between-job wage growth is similar for workers who move with and without personal contacts.25

Table 8B presents empirical estimates of the variance of within-job and between-job wage growth, broken down by personal contacts. These estimates use the errors from wage growth regressions run separately for stayers and movers, and run separately for jobs found with and without personal contacts. The regressions control for demographic characteristics as well as changes in tenure, tenure squared, and experience squared.

The variance estimates in Table 8B are consistent with the implications of the model. In particular, the variance of between-job wage growth is higher than the variance of within-job wage growth and the variance of within-job wage growth is lower on jobs found through

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25 The variance of the between-job wage growth of movers who do not use personal contacts is quite sensitive to $\sigma^2$, the variance of output around match. Therefore, the model has no strong (testable) implications for the variance of between-job wage growth.
connections. These differences are highly significant.26

These variance estimates are sensitive to outliers. The finding of lower within-job wage variance on jobs found through connections is not as evident when we consider measures of dispersion that are less sensitive to outliers. For example, the interquartile range of within-job wage growth is 0.190 for jobs found through a personal contact, and 0.200 for jobs found without a personal contact. A number of tests that are robust to outliers are available for comparing the dispersion between two samples. The Seigel/Tuckey rank test, for example, cannot reject (at the 10% level) the hypothesis that the dispersion of within-job wage growth is the same on jobs found with and without personal contacts. Therefore, the apparent success of the model in predicting the variance of wage growth in Table 8B should be qualified by the sensitivity of the finding to outliers.

3. The Impact of Wages on Turnover

Many studies have found a negative effect of the wage on an individual's probability of turnover. In the model developed in Section III the wage has a very discontinuous effect on the probability of turnover. Below some reservation wage, workers leave their job with probability one to take an offer from the formal labor market. Above this reservation wage, workers only leave their job if they receive a

26There are two ways of testing equality of these variances: 1) use a standard F-test for the ratio of two variance estimates, and 2) run a regression of the squared errors on a constant and a personal contact dummy, and then test the significance of the coefficient on the dummy using robust standard errors. The second method allows the fourth moment of the errors to be different across groups and may be a more accurate test of significance. Using either the F-test or the robust regression the differences discussed in the text are significant at the 1% level.
sufficiently high wage offer from a personal contact, i.e. if they receive a wage offer that is greater than the wage plus option value of their current job.\textsuperscript{27} In other words, the probability of turnover jumps from less than fifty percent to one hundred percent as the wage falls below the formal-labor-market reservation wage, and above this reservation wage turnover declines gradually with the wage. Wages on jobs found through personal contacts are always above the formal-labor-market reservation wage because the worker only accepts an offer from a personal contact if it is better than the formal labor market. Therefore, we should not observe a discontinuous effect of wages on turnover for jobs found through personal contacts.

Table 9A presents simulation results for the relationship between wages and turnover. The table provides logit estimates of turnover between periods 1 and 2, conditional on the wage in period 1. The simulations show a strong negative effect of wages on turnover for jobs found without a personal contact, but less of an effect of wages on turnover for jobs found with a personal contact. Among jobs found without connections, the strong effect of the wage reflects the discontinuous relationship between wage and turnover: Workers below a certain wage turnover with probability one while turnover above that wage is much less likely. If we restrict the sample to individuals with above average wages (and thereby eliminate workers who turnover with probability one) then the wage has the same impact on turnover for jobs found with and without a personal contact.

\textsuperscript{27}Jobs found through personal contacts have no option value. Therefore, turnover for a given wage is slightly higher on jobs found with personal contacts compared to jobs found without personal contacts.
Table 9B presents empirical estimates of the relationship between wages and turnover. The table provides logit estimates of the effect of wages on turnover between the 1982 and 1983 interview for a sample of workers who had held their jobs for less than six months at the time of the 1982 interview. A separate wage effect is estimated for jobs found with and without personal contacts by including the wage, a dummy for a personal contact, and an interaction of the wage with the personal contact dummy. These estimates also control for individual characteristics including experience and tenure.

The first column of Table 9B contains logit estimates for the entire sample that appear to be consistent with the implications of the model. Wages have significantly less effect on turnover for jobs found with personal contacts: The wage has a significant negative effect on turnover for jobs found without a personal contact (-1.88) and essentially no effect on turnover for jobs found with a personal contact (-1.88+1.76=0.12). The second column of the table restricts the sample to workers with above average wages. Wages still have significantly less effect on turnover for jobs found with personal contacts. This result contradicts the implications of the model. On balance, the evidence on turnover presented here and in Section II is not well explained by the simple model developed in this chapter.
V. Conclusion

Evidence presented in this chapter suggests that wage and turnover patterns differ significantly between jobs found through personal contacts and jobs found by more formal means. The most striking difference is in the gains to mobility: Individuals who change jobs with the help of a personal contact experience roughly 15% higher wage growth than do other job switchers. A simple model, in which a personal contact provides information about the match quality of a job, explains these differences fairly well. The empirical evidence is quite consistent with the model's implications for wages and wage growth on jobs found with and without a personal contact. In contrast, the model's predictions for turnover are not found in the data.

A simple extension of the model may help to reconcile the theory with the turnover evidence. Recall that the model suggests that turnover should be higher on jobs found without personal contacts but I find no evidence of higher turnover on these jobs. One reason for this may be that many individuals on jobs without personal contacts simply do not have personal contacts. A person who does not receive an offer from a personal contact every period would have a lower turnover rate than predicted by the model. In other words, a person on a job found with a contact is likely to have lots of contacts and therefore may change jobs often, while a person on a job found with no contact is likely to be less well connected and therefore change jobs less often. Extending the model to allow for people with and without connections is a clear priority for future work.

There appears to be a strong link between the use of personal
contacts and the early labor market experience of young workers. My results suggest that young workers may use their connections to gather information about the match quality of prospective jobs, thereby helping them to locate productive jobs. If correct, these results have two important implications. The results support both the job-matching and job-shopping models of wages and turnover, to the extent that uncertainty about job-specific productivity (i.e. match quality) is an important constraint on the mobility of young workers which is overcome with the use of connections. Furthermore, the results imply that young workers' social connections may play a central role in their early labor market success.
REFERENCES


APPENDIX 1

This appendix provides the analytic formulas for $V_{t}^{M}$, $V_{t}^{RC}$, and $V_{t}^{S}$. These formulas are derived using standard integration techniques, and checked using simulation techniques. Note that $V_{1}^{M}$ cannot be derived analytically, but is easily simulated. Also note that $V_{2}^{S}$ for an individual who held a formal labor market job in period 1 requires a numerical integration.

PRELIMINARY RESULTS

I begin with three preliminary results that will be useful later.

Result 1: Suppose $\mu \sim N(m_{0}, h_{0})$, where $h$ is precision (i.e. $h=1/\sigma^2$).

Let $Y_{i} = \mu + \epsilon_{i}$, where $\epsilon_{i} \sim N(0, h_{\epsilon})$.

Then $E[\mu|Y_{1}, \ldots, Y_{t}] = \frac{h_{0} \cdot m_{0} + h_{\epsilon} \cdot (Y_{1} + \ldots + Y_{t})}{h_{0} + t \cdot h_{\epsilon}}$

and $h[\mu|Y_{1}, \ldots, Y_{t}] = h_{0} + t \cdot h_{\epsilon}$.

Proof: See DeGroot [...], Chapter 9.

Result 2: Suppose $Z \sim N(m, \sigma^2)$.

Then $E[Z|Z>c] = m + \sigma^2 \cdot \frac{\phi(c)}{\Phi\left(-\frac{m-c}{\sigma}\right)}$,

where $\phi$ and $\Phi$ are the PDF and CDF of the standard normal.

Proof: See Heckman and Honore [198_].
Result 3: Suppose $X \sim N(0,1)$, and $Z \sim N(m, \sigma^2)$,

where $\Phi$ and $\phi$ are the CDF and PDF of the standard normal,

and $F$ and $f$ are the CDF and PDF of $Z$ (Note: $F(c) = \Phi[(c-m)/\sigma]$).

Then

$$E[\max(0,X,Z)] = (2\pi)^{-1/2} \Phi(-m/\sigma) + (\sigma^2/2) \cdot f(0) + \left[\frac{1+\sigma^2}{2\pi}\right]^{1/2} \exp\left[-\frac{m^2}{2(1+\sigma^2)}\right] \cdot \Phi\left[\frac{m}{\sigma \cdot \sqrt{1+\sigma^2}}\right] + m \cdot \Phi(m/\sigma) - m \int_0^\infty f(y) \cdot \Phi(-y) \, dy.$$

Proof:

Define $Y = \max(X,Z)$.

Then, the CDF of $Y$ is:

$$G(y) = \Pr[Y \leq y] = \Pr[X \leq y \text{ and } Z \leq y] = \Pr[X \leq y] \cdot \Pr[Z \leq y] = \Phi(y) \cdot F(y)$$

and the PDF of $Y$ is:

$$g(y) = G'(y) = \Phi(y) \cdot f(y) + \phi(y) \cdot F(y)$$

Now,

$$E[\max(0,X,Z)] = E[\max(0,Y)]$$

$$= 0 \cdot \Pr[Y < 0] + \Pr[Y > 0] \cdot E[Y | Y > 0]$$

$$= 0 + [1-G(0)] \cdot \int_0^\infty y \cdot \frac{g(y)}{1-G(0)} \, dy$$

$$= \int_0^\infty y \cdot g(y) \, dy$$

$$= \int_0^\infty y \cdot \phi(y) \cdot F(y) \, dy + \int_0^\infty y \cdot f(y) \cdot \Phi(y) \, dy$$
Note that \( \phi'(y) = -y \phi(y) \), and \( f'(y) = -\sigma^{-2} y f(y) + \sigma^{-2} m f(y) \).

Therefore, integrating by parts gives:

\[
\int_0^\infty y \phi(y) F(y) \, dy + \int_0^\infty y f(y) \Phi(y) \, dy
\]

\[= \phi(0) F(0) + \int_0^\infty \phi(y) f(y) \, dy\]

\[+ \sigma^2 f(0) \Phi(0) + \sigma^2 \int_0^\infty \phi(y) f(y) \, dy + m \int_0^\infty f(y) \Phi(y) \, dy\]

\[= (2\pi)^{-1/2} \Phi(-m/\sigma) + (\sigma^2/2) f(0) +\]

\[+ (1+\sigma^2) \int_0^\infty \phi(y) f(y) \, dy + m \int_0^\infty f(y) \Phi(y) \, dy\]

The last two terms in this expression can be restated:

\[(1+\sigma^2) \int_0^\infty \phi(y) f(y) \, dy\]

\[= (1+\sigma^2) \int_0^\infty (\sigma \cdot 2\pi)^{-1} \exp\left\{- (1/2) \left[ \left( \frac{y-m}{\sigma} \right)^2 + y^2 \right]\right\} \, dy\]

\[= \left[ \frac{1+\sigma^2}{2\pi} \right]^{1/2} \cdot \exp\left[- \frac{m^2}{2 \cdot (1+\sigma^2)}\right] \cdot \Phi\left[ \frac{m}{\sigma \sqrt{1+\sigma^2}} \right]\]

and

\[m \int_0^\infty f(y) \Phi(y) \, dy\]

\[= m \int_0^\infty f(y) \, dy - m \int_0^\infty f(y) \Phi(-y) \, dy\]

\[= m \Phi(m/\sigma) - m \int_0^\infty f(y) \Phi(-y) \, dy\]

Therefore, we have

\[E\left[\max(0, X, Z)\right] =\]

\[(2\pi)^{-1/2} \Phi(-m/\sigma) + (\sigma^2/2) f(0) +\]

\[\left[ \frac{1+\sigma^2}{2\pi} \right]^{1/2} \cdot \exp\left[- \frac{m^2}{2 \cdot (1+\sigma^2)}\right] \cdot \Phi\left[ \frac{m}{\sigma \sqrt{1+\sigma^2}} \right] +\]

\[m \Phi(m/\sigma) - m \int_0^\infty f(y) \Phi(-y) \, dy\]

Q.E.D.
FORMULAS AND PROOFS FOR $V^M_t$, $V^{FC}_t$, AND $V^S_t$

I now turn to deriving $V^M_t$, $V^{FC}_t$, and $V^S_t$. I begin with period three and work backwards.

**PERIOD THREE**

In the last period, the value of a job is simply expected productivity.

**P1:**

$V^M_3 = E(\mu_1) = 0$.

Proof: Trivial -- $\mu = N(0,1)$.

**P2:**

$V^{FC}_3 = E(\mu_1 | s_{13}) = s_{13}$, where $s_{13}$ is the signal for a personal contact offer in period 3.

Proof: Trivial -- $s_{13} = \mu_1$.

**P3:**

If the old job was found through a personal contact in periods 1 or 2 then:

$V^S_3 = E(\mu_1 | s_{12}, Y_{12}) = s_{12}$, or

$V^S_3 = E(\mu_1 | s_{11}, Y_{11}, Y_{12}) = s_{11}$.

Proof: Trivial -- $s_{1t} = \mu_1$ for a job found in period $t$.

**P4:**

If the old job was found through the formal labor market in period 2, then:

$V^S_3 = E(\mu_1 | Y_{12}) = \frac{Y_{12}}{1 + \sigma^2_{\epsilon}}$.

Proof: See Result 1.

**P5:**

If the old job was found through the formal labor market in period 1, then:

$V^S_3 = E(\mu_1 | Y_{11}, Y_{12}) = \frac{Y_{11} + Y_{12}}{2 + \sigma^2_{\epsilon}}$.

Proof: See Result 1.
PERIOD TWO

In period two, the value of a job is the expected productivity on that job in period two, plus the discounted expected productivity in period three given that the individual behaves optimally (i.e. chooses the largest of \( v^M_3, v^{PC}_3, \) and \( v^S_3 \)).

\[
P6: \quad v^M_2 = E(\mu_1) + \delta \cdot E \left[ \max \left( v^M_3, v^{PC}_3, v^S_3 \right) \right] \\
\quad \quad = 0 + \delta \cdot E \left[ \max \left( 0, s_{13}, \frac{y_{12}}{1 + \sigma^2_\epsilon} \right) \right] \\
\quad \quad = \frac{\delta}{2 \cdot \sqrt{2 \cdot \pi}} \cdot \left[ 1 + \frac{1}{1 + \sigma^2_\epsilon} + \sqrt{\frac{2 + \sigma^2_\epsilon}{1 + \sigma^2_\epsilon}} \right]
\]

Proof: In period 2, the worker is paid \( E(\mu_1)=0 \).

In period 3, the worker will be paid the maximum of \( v^M_3, v^{PC}_3, \) and \( v^S_3 \). These values are defined by P1, P2 and P4 above.

Therefore:

\[
v^M_2 = 0 + \delta \cdot E \left[ \max \left( 0, s_{13}, \frac{y_{12}}{1 + \sigma^2_\epsilon} \right) \right]
\]

Now, \( s_{13}=\mu_1 \), so that \( s_{13} \sim N(0,1) \).

Furthermore, it is straightforward to show that

\[
\frac{y_{12}}{1 + \sigma^2_\epsilon} \sim N[0,1/(1+\sigma^2)]
\]

Therefore, using Result 3 and simplifying gives:

\[
v^M_2 = \frac{\delta}{2 \cdot \sqrt{2 \cdot \pi}} \cdot \left[ 1 + \frac{1}{1 + \sigma^2_\epsilon} + \sqrt{\frac{2 + \sigma^2_\epsilon}{1 + \sigma^2_\epsilon}} \right]
\]

Q.E.D.
\[ V_{2}^{PC} = E(\mu_{1} | s_{12}) + \delta \cdot E \left[ \max \left( V_{3}^{M}, V_{3}^{PC}, V_{3}^{S} \right) | s_{12} \right] \]

\[ = s_{12} + \delta \cdot E \left[ \max \left( 0, s_{13}, s_{12} \right) | s_{12} \right] \]

\[ = s_{12} + \delta \cdot \left[ s_{12} \cdot \Phi(s_{12}) + \phi(s_{12}) \right] \]

where \( \Phi \) and \( \phi \) are the CDF and PDF of the standard normal.

**Proof:**

In period 2, the worker is paid \( E(\mu_{1} | s_{12}) = s_{12} \).

In period 3, the worker will be paid the maximum of \( V_{3}^{M}, V_{3}^{PC}, \) and \( V_{3}^{S} \). These values are defined by P1, P2 and P3 above.

Therefore:

\[ V_{2}^{PC} = s_{12} + \delta \cdot E \left[ \max \left( 0, s_{13}, s_{12} \right) | s_{12} \right] \]

In equilibrium, we need only consider \( s_{12} > 0 \) (no worker accepts a period 2 job from a personal contact if \( s_{12} < 0 \)). This simplifies the problem to:

\[ V_{2}^{PC} = s_{12} + \delta \cdot \left[ \Pr(s_{13} < s_{12}) \cdot s_{12} + \Pr(s_{13} > s_{12}) \cdot E[s_{13} | s_{13} > s_{12}] \right] \]

Using Result 2 and the fact that \( s_{13} \sim N(0,1) \) gives:

\[ V_{2}^{PC} = s_{12} + \delta \cdot \left[ s_{12} \cdot \Phi(s_{12}) + \phi(s_{12}) \right] \]

Q.E.D.

---

**P8:**

If the old job was found through a personal contact

in period 1, then:

\[ V_{2}^{S} = E(\mu_{1} | s_{11}) + \delta \cdot E \left[ \max \left( V_{3}^{M}, V_{3}^{PC}, V_{3}^{S} \right) | s_{11} \right] \]

\[ = s_{11} + \delta \cdot E \left[ \max \left( 0, s_{13}, s_{11} \right) | s_{11} \right] \]

\[ = s_{11} + \delta \cdot \left[ s_{11} \cdot \Phi(s_{11}) + \phi(s_{11}) \right] \]

where \( \Phi \) and \( \phi \) are the CDF and PDF of the standard normal.

**Proof:**

See the proof of P7.
If the old job was found through the formal labor market in period 1, then:

\[ V_2^s = E(\mu_1 | Y_{11}) + \delta \cdot E \left[ \max \left( V_3^m, V_{33}^{PC}, V_3^S \right) | Y_{11} \right] \]

\[ = \frac{Y_{11}}{1 + \sigma_\epsilon^2} + \delta \cdot E \left[ \max \left( 0, s_{13}, \frac{Y_{11} + Y_{12}}{2 + \sigma_\epsilon^2} \right) | Y_{11} \right] \]

\[ = \frac{Y_{11}}{1 + \sigma_\epsilon^2} + \delta \cdot \left[ \frac{1}{\sqrt{2\pi}} \phi\left( -\frac{m}{s} \right) + \frac{s^2}{2} f(0) + \frac{\sqrt{1+s^2}}{\sqrt{2\pi}} \exp \left( -\frac{m^2}{2+s^2} \right) \phi \left( \frac{m}{s \sqrt{1+s^2}} \right) \right. \]

\[ + m \cdot \Phi(m/s) - m \int_0^\infty f(x) \cdot \Phi(-x) \, dx \]

where \( \Phi \) and \( \phi \) are the CDF and PDF of the standard normal, \( f \) is the PDF of a normal with mean \( m \), variance \( s^2 \), and

\[ m = \frac{Y_{11}}{1 + \sigma_\epsilon^2}, \quad s^2 = \frac{\sigma_\epsilon^2}{[1+(1+\sigma_\epsilon^2)(2+\sigma_\epsilon^2)]}. \]

**Proof:** In period 2, the worker is paid \( E(\mu_1 | Y_{11}) \). Using Result 1:

\[ E(\mu_1 | Y_{11}) = \frac{Y_{11}}{1 + \sigma_\epsilon^2} \]

In period 3, the worker will be paid the maximum of \( V_3^m, V_3^{PC}, \) and \( V_3^S \). These values are defined by P1, P2 and P5 above.

Therefore:

\[ V_2^S = \frac{Y_{11}}{1 + \sigma_\epsilon^2} + \delta \cdot E \left[ \max \left( 0, s_{13}, \frac{Y_{11} + Y_{12}}{2 + \sigma_\epsilon^2} \right) | Y_{11} \right] \]

Now, \( s_{13} \sim \mu_1 \), so that \( s_{13} \sim N(0,1) \).

Furthermore, it is straightforward to show that

\[ \left( \frac{Y_{11} + Y_{12}}{2 + \sigma_\epsilon^2} | Y_{11} \right) \sim N(m, s^2) \]
where \( m = Y_{11}/(1 + \sigma^2_\epsilon) \), \( s^2 = \sigma^2_\epsilon / [(1+\sigma^2_\epsilon) \cdot (2+\sigma^2_\epsilon)] \).

Therefore, using Result 3 gives:

\[
V^S_2 = \frac{Y_{11}}{1 + \sigma^2_\epsilon} + \\
\delta \cdot \left[ \frac{1}{\sqrt{2\pi}} \cdot \Phi(-m/s) + \frac{s^2}{2} f(0) + \frac{\sqrt{1+s^2}}{\sqrt{2\pi} \cdot s} \cdot \exp\left( -\frac{m^2}{2 + s^2} \right) \cdot \Phi\left( \frac{m}{s \cdot \sqrt{1+s^2}} \right) \\
+ m \cdot \Phi(m/s) - m \int_0^\infty f(x) \cdot \Phi(-x) \, dx \right]
\]

Q.E.D.

PERIOD 1

In period one, the value of a job is the expected productivity on that job in period one, plus the discounted expected productivity in periods two and three given that the individual behaves optimally (i.e. chooses the largest of \( V^H_3 \), \( V^C_3 \), and \( V^S_3 \) in period 3 and chooses the largest of \( V^H_2 \), \( V^C_2 \), and \( V^S_2 \) in period 2).

\[ P10: \quad V^H_1 = E(\mu_1) + \delta \cdot E\left[ \max\left( V^H_2, V^C_2, V^S_2 \right) \right] \]

\[ = 0 + \delta \cdot E\left[ \max\left( V^H_2, V^C_2, V^S_2 \right) \right] \]

This expression can be simulated as follows:

1) Randomly generate \( Y_{11} \) and \( s_{12} \) for a large sample.

2) Calculate \( V^H_2 \), \( V^C_2 \), and \( V^S_2 \) using the formulas given in P6, P7, and P9.

3) Then \( E\left[ \max\left( V^H_2, V^C_2, V^S_2 \right) \right] \) is approximated by the average of \( \max\left( V^H_2, V^C_2, V^S_2 \right) \) in the randomly generated sample.
\[ V_{1}^{PC} = E(\mu_{1}|s_{11}) + \delta \cdot E\left[ \max\left( V_{2}^{H}, V_{2}^{PC}, V_{2}^{S} \right) \mid s_{11} \right] \]
\[ = s_{11} + \delta \left[ s_{11} \cdot \Phi(s_{11}) + \phi(s_{11}) \right] \]
\[ + \delta^2 \cdot \left[ s_{11} \cdot \Phi^2(s_{11}) + 2 \cdot \phi(s_{11}) \cdot \Phi(s_{11}) + \frac{1}{\sqrt{2\pi}} \cdot \phi(-s_{11} \cdot \sqrt{2}) \right] \]

where \( \Phi \) and \( \phi \) are the CDF and PDF of the standard normal.

**Proof:**

In period 1, the worker is paid \( E(\mu_{1}|s_{11}) = s_{11} \).

In period 2, the worker will either stay on the period 1 job or accept an offer for a new personal contact job. Thus, in period 2 the worker receives:

\[ E\left[ \max\left( s_{11}, s_{12} \right) \mid s_{11} \right] \]
\[ = \Pr(s_{12} < s_{11}) \cdot s_{11} + \Pr(s_{12} > s_{11}) \cdot E[s_{12} \mid s_{12} > s_{11}] \]

Using Result 2 and the fact that \( s_{12} \sim N(0,1) \) gives:

\[ E\left[ \max\left( s_{11}, s_{12} \right) \mid s_{11} \right] = s_{11} \cdot \Phi(s_{11}) + \phi(s_{11}) \]

In Period 3, the worker will either hold the job found in period 1, hold a personal contact job found in period 2, or hold a personal contact job found in period 3. Thus, in period 3 the worker receives:

\[ E\left[ \max\left( s_{11}, s_{12}, s_{13} \right) \mid s_{11} \right] \]

Let \( Z = \text{Max}(s_{12}, s_{13}) \), so that the CDF and PDF of \( Z \) are:

\[ G(z) = \Pr(s_{12} < z \text{ and } s_{13} < z) = \Phi(z) \cdot \Phi(z) \]
\[ g(z) = G'(z) = 2 \cdot \phi(z) \cdot \Phi(z) \]

Then:

\[ E\left[ \max\left( s_{11}, s_{12}, s_{13} \right) \mid s_{11} \right] = E\left[ \max\left( s_{11}, Z \right) \mid s_{11} \right] \]
\[ = \Pr(Z<s_{11}) \cdot s_{11} + \Pr(Z>s_{11}) \cdot E(Z \mid Z>s_{11}) \]

\[ 115 \]
\[ \phi^2(s_{i1}) \cdot s_{i1} + \Pr(Z > s_{i1}) \cdot \int_{s_{i1}}^{\infty} z \cdot \frac{2 \cdot \phi(z) \cdot \Phi(z)}{\Pr(Z > s_{i1})} \, dz \]

\[ - \phi^2(s_{i1}) \cdot s_{i1} + \int_{s_{i1}}^{\infty} z \cdot 2 \cdot \phi(z) \cdot \Phi(z) \, dz \]

Note that \( \phi'(z) = -z \cdot \phi(z) \), so that integrating by parts gives:

\[ - \phi^2(s_{i1}) \cdot s_{i1} + 2 \cdot \phi(s_{i1}) \cdot \Phi(s_{i1}) + 2 \cdot \int_{s_{i1}}^{\infty} \phi(z) \cdot \phi(z) \, dz \]

And,

\[ 2 \cdot \int_{s_{i1}}^{\infty} \phi(z) \cdot \phi(z) \, dz = \int_{s_{i1}}^{\infty} (\pi)^{-1} \cdot \exp[-z/2] \cdot \exp[-z/2] \, dz \]

\[ = \pi^{-1/2} \cdot \int_{s_{i1}}^{\infty} \phi(z\sqrt{2}) \, d(z\sqrt{2}) \]

\[ = \pi^{-1/2} \cdot \phi(-s_{i1} \cdot \sqrt{2}) \]

So that:

\[ E\left[ \max\left(s_{i1}, s_{i2}, s_{i3}\right) \mid s_{i1} \right] \]

\[ = s_{i1} \cdot \phi^2(s_{i1}) + 2 \cdot \phi(s_{i1}) \cdot \Phi(s_{i1}) + \frac{1}{\sqrt{\pi}} \cdot \Phi(-s_{i1} \cdot \sqrt{2}) \]

Finally, the expected PDV of wages for a Personal Contact job is:

\[ V_{1}^{PC} = s_{i1} + \delta \cdot E\left[ \max\left(s_{i1}, s_{i2}\right) \mid s_{i1} \right] \]

\[ + \delta^2 \cdot E\left[ \max\left(s_{i1}, s_{i2}, s_{i3}\right) \mid s_{i1} \right] \]

\[ = s_{i1} + \delta \left[ s_{i1} \cdot \phi(s_{i1}) + \phi(s_{i1}) \right] \]

\[ + \delta^2 \left[ s_{i1} \cdot \phi^2(s_{i1}) + 2 \cdot \phi(s_{i1}) \cdot \Phi(s_{i1}) + \frac{1}{\sqrt{\pi}} \cdot \Phi(-s_{i1} \cdot \sqrt{2}) \right] \]

Q.E.D.
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<th>Full Sample</th>
<th>Job Found Through Personal Contact</th>
<th>Job Found Without Personal Contact</th>
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<td>21.8</td>
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<td>46%</td>
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<td>25%</td>
<td>25%</td>
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<tr>
<td>Education (yrs)</td>
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<td>College degree</td>
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<td>Residence in SMSA</td>
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<td>71%</td>
<td>80%</td>
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<th>Job Characteristics:</th>
<th></th>
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<td>1982 Wage ($/hr)</td>
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<td>5.55</td>
<td>5.68</td>
</tr>
<tr>
<td>Tenure (yrs)</td>
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<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Union Member</td>
<td>18%</td>
<td>19%</td>
<td>17%</td>
</tr>
<tr>
<td>Industry-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction/Manufacturing</td>
<td>25%</td>
<td>31%</td>
<td>22%</td>
</tr>
<tr>
<td>Personal and Professional Services</td>
<td>21%</td>
<td>14%</td>
<td>25%</td>
</tr>
<tr>
<td>Other</td>
<td>54%</td>
<td>55%</td>
<td>53%</td>
</tr>
</tbody>
</table>
### TABLE 1

**AVERAGE CHARACTERISTICS OF THE SAMPLE**

By Personal Contact

(continued)

<table>
<thead>
<tr>
<th>Job Characteristics (cont'd):</th>
<th>Full Sample</th>
<th>Job Found Through Personal Contact</th>
<th>Job Found Without Personal Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupation:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managerial/Technical</td>
<td>18%</td>
<td>10%</td>
<td>24%</td>
</tr>
<tr>
<td>Clerical/Sales/Service</td>
<td>47%</td>
<td>49%</td>
<td>45%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Operatives/Crafts/Agriculture)</td>
<td>35%</td>
<td>41%</td>
<td>31%</td>
</tr>
</tbody>
</table>

**Personal Contact Characteristics:**

- Contact is Male: 63%
- Contact is member of immediate family: 27%

**Number of Observations:**

- 965
- 378
- 587
### TABLE 2

**WAGE EQUATIONS CONTROLLING FOR PERSONAL CONTACTS**

**DEPENDENT VARIABLE:** $\log(1982 \text{ WAGE})$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Full Sample</th>
<th>Tenure $&lt; 1$ Year</th>
<th>Tenure $&gt; 1$ Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>4.99</td>
<td>4.81</td>
<td>5.08</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.18)</td>
<td>(0.18)</td>
</tr>
<tr>
<td>Found Job Through Personal Contact</td>
<td>0.093</td>
<td>0.156</td>
<td>-0.007</td>
</tr>
<tr>
<td>(dummy variable)</td>
<td>(0.054)</td>
<td>(0.066)</td>
<td>(0.087)</td>
</tr>
<tr>
<td>Tenure</td>
<td>0.126</td>
<td>0.265</td>
<td>0.073</td>
</tr>
<tr>
<td></td>
<td>(0.061)</td>
<td>(0.077)</td>
<td>(0.087)</td>
</tr>
<tr>
<td>Personal Contact* Tenure</td>
<td>-0.157</td>
<td>-0.255</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.091)</td>
<td>(0.121)</td>
<td>(0.045)</td>
</tr>
<tr>
<td>Tenure$^2$</td>
<td>-0.024</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Contact$^2$ Tenure$^2$</td>
<td>0.045</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>0.111</td>
<td>0.179</td>
<td>0.034</td>
</tr>
<tr>
<td></td>
<td>(0.060)</td>
<td>(0.091)</td>
<td>(0.086)</td>
</tr>
<tr>
<td>Experience$^2$</td>
<td>-0.021</td>
<td>-0.038</td>
<td>-0.004</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.028)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Education</td>
<td>0.075</td>
<td>0.073</td>
<td>0.079</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Observations</th>
<th>932</th>
<th>436</th>
<th>496</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>0.37</td>
<td>0.33</td>
<td>0.44</td>
</tr>
</tbody>
</table>

These regressions also control for union membership, number of years of experience prior to the most recent period in school, residence in an SMSA, marital status, sex, and race.
**TABLE 3**

**TURNOVER RATES FOR JOBS HELD LESS THAN 6 MONTHS IN 1982**

By Personal Contact

<table>
<thead>
<tr>
<th>Job Found Through Personal Contact</th>
<th>Job Found Without Personal Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent leaving 1982 job between 1982 and 1983 (# on job in 1982)</td>
<td>43% (172)</td>
</tr>
</tbody>
</table>
### Table 4: OLS Estimation of Wage-Growth Equations With/Without Contact Interactions

**Dependent Variable:** \( \log(1982 \text{ wage}) - \log(1981 \text{ wage}) \)

<table>
<thead>
<tr>
<th>Variable</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Only Movers</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.129</td>
<td>0.118</td>
<td>0.129</td>
<td>0.118</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.018)</td>
<td>(0.014)</td>
<td>(0.018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change job 81-82 (dummy variable)</td>
<td>0.026</td>
<td>-0.010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.030)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Quit</td>
<td></td>
<td>0.069</td>
<td>0.023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.027)</td>
<td>(0.033)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Layoff/fire</td>
<td></td>
<td>-0.102</td>
<td>-0.101</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.044)</td>
<td>(0.052)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Contact * Stay on job 81-82 (dummy)</td>
<td>0.028</td>
<td></td>
<td>0.028</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td></td>
<td>(0.028)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Contact * Change job 81-82 (dummy)</td>
<td>0.141</td>
<td></td>
<td></td>
<td>0.143</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.042)</td>
<td></td>
<td></td>
<td>(0.062)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Quit</td>
<td></td>
<td></td>
<td></td>
<td>0.161</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.048)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Layoff/fire</td>
<td></td>
<td></td>
<td></td>
<td>0.036</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.092)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regression Run with Controls for Individual Characteristics and the Industry, Occupation, and Union Status of Both the 1981 and 1982 Job.

<table>
<thead>
<tr>
<th>Number of Observations</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>630</td>
<td>630</td>
<td>627</td>
<td>627</td>
<td>199</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.002</td>
<td>0.02</td>
<td>0.02</td>
<td>0.04</td>
<td>0.25</td>
</tr>
</tbody>
</table>


TABLE 5
SIMULATION RESULTS FOR WAGES AND TURNOVER

By Personal Contact

<table>
<thead>
<tr>
<th>Experience=0:</th>
<th>WAGES</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Job Found</td>
<td>Job Found</td>
<td>Job Found</td>
<td>Job Found</td>
</tr>
<tr>
<td>Through Personal</td>
<td>0.917</td>
<td>0.008</td>
<td>22%</td>
<td>66%</td>
</tr>
<tr>
<td>Contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experience=1:</th>
<th>WAGES</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Job Found</td>
<td>Job Found</td>
<td>Job Found</td>
<td>Job Found</td>
</tr>
<tr>
<td>Through Personal</td>
<td>1.02</td>
<td>0.023</td>
<td>18%</td>
<td>65%</td>
</tr>
<tr>
<td>Contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experience=2:</th>
<th>WAGES</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Job Found</td>
<td>Job Found</td>
<td>Job Found</td>
<td>Job Found</td>
</tr>
<tr>
<td>Through Personal</td>
<td>1.13</td>
<td>0.057</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Estimates based on 5,000 simulated observations. The simulation assumes \( \delta = .95 \) and \( \sigma^2 = 1 \).

\(^1\) The wage estimates presented for this simulation have standard errors of .02-.05. Standard errors for the turnover estimates are less than 1%. 

122
TABLE 6
SIMULATION RESULTS FOR THE WAGE GROWTH OF MOVERS AND STAYERS
By Personal Contact

<table>
<thead>
<tr>
<th>Experience=0:</th>
<th></th>
<th>Experience=1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenure=0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tenure=1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

WITHIN JOB WAGE GROWTH FOR STAYERS¹
---    ---    ---    ---
Job Found | Job Found | New | New |
Through Personal Contact | Without Personal Contact |

BETWEEN JOB WAGE GROWTH FOR MOVERS¹
---    ---    ---    ---
Job Found | Job Found | New | New |
Through Personal Contact | Without Personal Contact |

Estimates based on 5,000 simulated observations. The simulation assumes δ=.95 and σ²=1.

¹The wage growth estimates presented for this simulation have standard errors of .01-.05.
TABLE 7A

SIMULATION RESULTS FOR THE WAGE GROWTH OF MOVERS AND STAYERS

By Personal Contact and Staying on Job in Next Period

<table>
<thead>
<tr>
<th>within job wage growth:</th>
<th>Stay on job next period</th>
<th>Leave job next period</th>
<th>Difference between stay and leave</th>
</tr>
</thead>
<tbody>
<tr>
<td>No personal contact</td>
<td>0.124</td>
<td>-0.212</td>
<td>0.336</td>
</tr>
<tr>
<td>Personal contact</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

| between job wage growth:         |                         |                       |                                 |
| No personal contact              | 1.24                    | 0.225                 | 1.02                            |
| Personal contact                 | 1.01                    | 0.759                 | 0.242                           |

Estimates based on 5000 simulated observations. The simulation assumes $\delta=.95$ and $\sigma^2=1$.

The wage growth estimates presented for this simulation have standard errors of .01-.05.
TABLE 7B

AVERAGE WAGE GROWTH OF MOVERS AND STAYERS IN THE SAMPLE
By Personal Contact and Staying on Job in Next Period

<table>
<thead>
<tr>
<th></th>
<th>Still on job in 1983 int. (N=460)</th>
<th>Left job by 1983 int. (N=170)</th>
<th>Difference between stay and leave</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Within job wage growth:</strong> 1981-1982</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No personal contact</td>
<td>0.125 (.015)</td>
<td>0.090 (.045)</td>
<td>0.035 (.047)</td>
</tr>
<tr>
<td>Personal contact</td>
<td>0.160 (.015)</td>
<td>0.087 (.028)</td>
<td>0.073 (.031)</td>
</tr>
<tr>
<td><strong>Between job wage growth:</strong> 1981-1982</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No personal contact</td>
<td>0.184 (.044)</td>
<td>-0.004 (.046)</td>
<td>0.188 (.063)</td>
</tr>
<tr>
<td>Personal contact</td>
<td>0.200 (.057)</td>
<td>0.317 (.085)</td>
<td>-0.117 (.100)</td>
</tr>
</tbody>
</table>

Standard errors of the estimates are given in parentheses.
TABLE 8A

SIMULATION RESULTS FOR THE VARIANCE OF WAGE GROWTH
OF MOVERS AND STAYERS

By Personal Contact

<table>
<thead>
<tr>
<th>VARIANCE OF WITHIN JOB WAGE GROWTH FOR STAYERS</th>
<th>VARIANCE OF BETWEEN JOB WAGE GROWTH FOR MOVERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Found Through Personal Contact</td>
<td>Final Job Found Through Personal Contact</td>
</tr>
<tr>
<td>Job Found Without Personal Contact</td>
<td>Final Job Found Without Personal Contact</td>
</tr>
<tr>
<td>0</td>
<td>0.698</td>
</tr>
<tr>
<td>0.406</td>
<td>0.829</td>
</tr>
<tr>
<td>Tenure=0</td>
<td></td>
</tr>
<tr>
<td>Tenure=0</td>
<td></td>
</tr>
<tr>
<td>Tenure=1</td>
<td></td>
</tr>
<tr>
<td>Tenure=1</td>
<td></td>
</tr>
<tr>
<td>Experience=0</td>
<td>Experience=1</td>
</tr>
</tbody>
</table>

Experience=0:

Tenure=0 0 0.406 0.698 0.829

Experience=1:

Tenure=0 0 0.410 0.711 0.782

Tenure=1 0 0.288 0.528 0.691

Estimates based on 5,000 simulated observations. The simulation assumes $\delta = 0.95$ and $\sigma^2 = 1$. 


**TABLE 8B**

VARIANCE OF WAGE GROWTH, 1981-1982

By Personal Contact and Tenure

<table>
<thead>
<tr>
<th></th>
<th>VARIANCE OF WITHIN JOB WAGE GROWTH FOR</th>
<th>VARIANCE OF BETWEEN JOB WAGE GROWTH FOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>STAYERS</td>
<td>MOVERS</td>
</tr>
<tr>
<td>Job Found</td>
<td>Job Found</td>
<td>Job Found</td>
</tr>
<tr>
<td>Through</td>
<td>Without</td>
<td>Personal</td>
</tr>
<tr>
<td>Personal Contact</td>
<td>Contact</td>
<td>Contact</td>
</tr>
<tr>
<td>Full sample:</td>
<td>0.0276</td>
<td>0.0559</td>
</tr>
<tr>
<td></td>
<td>(.0032)</td>
<td>(.0093)</td>
</tr>
</tbody>
</table>

By 1981 Tenure:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 9 months</td>
<td>0.0323</td>
<td>0.0556</td>
<td>0.158</td>
<td>0.152</td>
</tr>
<tr>
<td></td>
<td>(.0049)</td>
<td>(.0142)</td>
<td>(.049)</td>
<td>(.033)</td>
</tr>
<tr>
<td>&gt;= 9 months</td>
<td>0.0239</td>
<td>0.0562</td>
<td>0.117</td>
<td>0.096</td>
</tr>
<tr>
<td></td>
<td>(.0042)</td>
<td>(.0119)</td>
<td>(.028)</td>
<td>(.023)</td>
</tr>
</tbody>
</table>

Standard errors of the estimates given in parentheses.

The variances are formed using errors from wage growth regressions run separately for movers and stayers and for jobs found with and without personal contacts. The dependent variable in these regressions is the change in log wages from 1981 to 1982, and independent variables include: $\Delta$Tenure, $\Delta$Tenure$^2$, $\Delta$Experience$^2$, sex, race, residence in SMSA, education, and marital status.
<table>
<thead>
<tr>
<th></th>
<th>Period 1 Job Found Through Personal Contact</th>
<th>Period 1 Job Found Without Personal Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full Sample:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.03</td>
<td>1.37</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.07)</td>
</tr>
<tr>
<td>ln(Period 1 wage)</td>
<td>-1.62</td>
<td>-4.37</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.17)</td>
</tr>
<tr>
<td><strong>Above Average Wage in Period 1:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N=2594)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.04</td>
<td>-0.25</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>ln(period 1 wage)</td>
<td>-1.69</td>
<td>-1.55</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.30)</td>
</tr>
</tbody>
</table>

Estimates based on 5000 simulated observations. The simulation assumes \( \delta = 0.95 \) and \( \sigma_\epsilon^2 = 1 \). Standard errors of the estimates given in parentheses.
TABLE 9B
LOGIT ESTIMATION OF TURNOVER RATES FOR JOBS
HELD LESS THAN 6 MONTHS IN 1982

Dependent Variable: Left 1982 Job by 1983 Interview

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Full Sample</th>
<th>Above Average Wage in 1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.89</td>
<td>16.64</td>
</tr>
<tr>
<td>(1.32)</td>
<td>(8.34)</td>
<td></td>
</tr>
<tr>
<td>ln(1982 wage)</td>
<td>-1.88</td>
<td>-2.56</td>
</tr>
<tr>
<td>(0.586)</td>
<td>(1.33)</td>
<td></td>
</tr>
<tr>
<td>Personal Contact</td>
<td>-10.86</td>
<td>-24.24</td>
</tr>
<tr>
<td>(4.88)</td>
<td>(10.52)</td>
<td></td>
</tr>
<tr>
<td>Personal Contact* ln(1982 wage)</td>
<td>1.76</td>
<td>3.82</td>
</tr>
<tr>
<td>(0.788)</td>
<td>(1.63)</td>
<td></td>
</tr>
<tr>
<td>Number of Observations</td>
<td>259</td>
<td>118</td>
</tr>
<tr>
<td>Loglikelihood</td>
<td>-165.32</td>
<td>-69.97</td>
</tr>
</tbody>
</table>

These logits also control for experience, tenure, experience prior to the most recent period in school, residence in an SMSA, marital status, sex, and race.

Standard errors of the estimates are given in parentheses.