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# Rent-sharing, Holdup, and Wages: Evidence from Matched Panel Data

June 2009

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*ABSTRACT*

*A variety of bargaining models predict that more profitable firms pay higher wages. A closely related literature suggests that bargaining reduces the incentives to invest, since some of the return to irreversible investment is captured by workers. This "holdup" phenomenon has been blamed for the decline of unionized firms in countries with decentralized bargaining. In this paper we use rich longitudinal data from the Veneto region of Italy that combines Social Security earnings records with detailed balance sheet data to measure the degree of rent sharing and test for potential holdup. We estimate wage models with worker-firm match effects, allowing us to abstract from permanent differences in productivity across workers, firms, and job matches. We also compare OLS and instrumental variables specifications that use sales of firms in the same industry in other regions of the country to instrument value-added per worker. We find strong evidence of rent-sharing, with a "Lester range" of variation in wages between profitable and unprofitable firms of 15-20%. On the other hand we find little evidence that bargaining lowers the return to investment: firm-level bargaining in Italy appears to split the rents* <u>*after*</u> *deducting the full cost of capital. The data support a model in which current bargaining anticipates the returns to future rent-sharing, and workers pay up front for returns to capital they will capture in later periods.*

*We thank Carlo Gianelle, Alex Lefter, Ben Sand, and participants in the IRLE Lunch Seminar for comments and suggestions. We are also extremely grateful to Giuseppe Tattara for providing the Veneto Work History Data, and to Carlo Gianelle for assistance in using these data.

In the standard competitive model of the labor market wages are independent of employer profitability. A long-running strand of research, however, has argued that employees share some of the rents earned by their employers, especially when they are represented by unions.[1] Early studies of rent-sharing used data on wages and profitability at the *industry* level (e.g., Slichter, 1950; de Menil, 1971; Dickens and Katz, 1986) while later studies have employed *firm-level* data (e.g., Nickell and Wadhwani, 1990; Abowd and Lemieux, 1993; Blanchflower, Oswald and Sanfey, 1996). Both literatures have found a robust positive correlation between profitability and wages. How much of this is due to the non-random sorting of high-ability workers to high-profit firms is still unclear. The handful of recent studies that have used matched worker/firm data to control for unobserved worker abilities find smaller but typically significant effects of profitability on wages (e.g., Margolis and Salvanes, 2001; Arai, 2003; Martins, 2004; Gurtzen, 2008).

Closely related to the notion of rent-sharing is the possibility that bargaining in short term contracts leads to a holdup problem (e.g., Simons, 1944; Baldwin, 1983; Grout, 1984; Che and Sakovics, 2008). In particular, when capital is sunk, future bargaining over quasi-rents diverts some of the return on investment to employees, potentially causing firms to under-invest. Building on this insight, a number of studies have argued that holdup causes unionized firms to invest less than their non-union counterparts (e.g., Connolly et al., 1986; Denny and Nickell, 1992; Bronars and Deere, 1993), contributing to the decline in unionism in countries with

[1]The idea of rent-sharing by a cartel of workers appears in Adam Smith (1976, Book I, Chapter 8). The post-war neo-institutionalists (e.g., Lester, 1952, Reynolds, 1949, Schlicter, 1950) emphasized firm profitability (or ability to pay) as an important determinant of wages. De Menil (1971) laid out the basic model of union-firm bargaining that we use in this paper and has been adopted by many subsequent authors (e.g., Svejnar, 1986; Abowd and Lemieux, 1993; Blanchflower, Oswald and Sanfey, 1996).

decentralized bargaining (e.g., Addison and Hirsch, 1989; Hirsch, 2004).[2]

In this paper we use a matched data set that combines longitudinal earnings records for individual employees with detailed balance sheet data for their employers to measure the degree of rent sharing by firms in the Veneto region of Italy. We also test for the importance of holdup by testing whether capital costs are deducted from the quasi-rent expression that determines wages in the rent-sharing model. When capital costs are fully deducted, rent-sharing does not impose a tax on new investment and capital accumulation is potentially efficient. When some of the returns to investment are included as quasi-rent, however, firms that invest more will pay higher wages in the future, generating a holdup problem.

Our sample includes nearly one-half million workers employed at 9,000 firms, with annual wages and firm-level balance sheet data for the period from 1995 to 2001. These data enable us to estimate wage models that include worker-firm match effects (i.e., dummies for each worker-firm pair observed in the sample), as well as time-varying worker and firm variables. Match effects completely eliminate the influence of any (observed or unobserved) permanent components of worker, firm, or match-specific heterogeneity. For a majority of workers (70%) we can also identify the minimum wage specified by the sector-wide contract that covers the employment relationship.[3] Thus, we can measure the wage premium (or wage "drift" component) that arises

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[2]As shown by Crawford (1988) holdup does not necessarily arise in long term bargaining relationships. We discuss this point in the context of a standard model of worker-firm bargaining. It should also be noted that not all previous studies have found that unionized firms have lower investment rates – see e.g., Machin and Wadhwani (1991).

[3]In Italy contracts negotiated at the sector-level between national unions and employer groups are extended to cover essentially all employees. The sectoral contacts specify minimum wages by industry and occupation category (typically 5 or more categories).

through a combination of firm-level contracting and informal bargaining between workers and employers.[4] In the presence of binding sectoral contracts this premium is arguably the appropriate earnings concept for measuring firm-specific rent-sharing.[5]

We relate individual earnings to a firm-specific quasi-rent measure, defined as value added per worker net of the opportunity cost of labor and some share of the cost of capital per worker. A longstanding concern with empirical rent-sharing models is the endogeneity of observed profitability, arising through efficiency wage effects or other channels.[6] A related problem is measurement error in profitability, which is likely to be exacerbated by our within-spell estimation strategy. To address both issues, we use industry- and year-specific data for firms in other regions of Italy to construct an instrumental variable for value-added per worker for employers in Veneto. Our key identifying assumption is that (narrowly defined) industry demand shocks affect profitability but have no direct effect on local labor supply.

Our empirical findings point to three main conclusions. First, consistent with existing studies, we find that more profitable employers pay higher wages. The elasticity of wages with respect to estimated quasi-rents per worker is in the range of 0.04 to 0.10 – smaller than in some first generation studies of rent-sharing but similar to recent estimates derived from specifications

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[4]During our sample period about 40% of workers were covered by firm-level contracts that set pay scales above the sectoral minimum.

[5]Cristini and Leoni (2007) specify a two-level bargaining model that describes the determination of the sector wide minimum wages and the firm-specific wage premium. We abstract from the first and concentrate on the second.

[6]See e.g., Abowd and Lemieux (1993) and Van Reenen (1996). These authors are most concerned about the possibility that more profitable firms hire high-ability workers. As noted, by including job match dummies we control for any permanent differences in ability between employees.

that control for worker-firm fixed effects. Second, instrumental variables estimates of the degree of rent-sharing with controls for match effects are comparable to OLS estimates from models with no control for unobserved worker or firm attributes. Within-job estimates estimated by OLS are substantially smaller, but are likely attenuated by measurement error. Third, firm-level wage bargaining in Italy is driven by a quasi-rent measure that deducts the full cost of capital. We find little indication that workers appropriate some of the returns to fixed capital investments. This is consistent with a simple dynamic bargaining model in which workers pay up-front for the portion of returns to sunk investments that they will capture in future bargaining. In such a model we show that the appropriate expression for the quasi-rent contains a deduction for the cost of the non-irreversible share of the *current* capital stock, plus a deduction for future holdup of the irreversible share of *future* capital. Around a steady state the sum of these deductions equals the full cost of capital.

## II. A Model of Rent Sharing and Wage Determination

In this section we outline a simple dynamic model of wage bargaining between a firm and a collection of identical workers. We assume that wages are re-negotiated every period, and that some fraction of the current capital stock is sunk, and cannot be resold by the firm during the current period.[7] Although this is a textbook setting for holdup (e.g., Cahuc and Zylberberg, 2004, pp. 543-545) we show that holdup will not necessarily affect investment when bargaining today anticipates the possibility of rent-sharing tomorrow. Instead, as in Becker's (1962) on-the-job

[7]Thus, we are modeling a long term relationship governed by short term contracts. Our model is an adaptation of the surplus sharing model presented in Crawford (1988).

training model, workers make an up-front contribution by accepting lower wages today in return for a share of future quasi-rents, re-aligning the investment incentives for the firm.

*a. Basic Model with Fixed Employment*

For simplicity we start with the case where employment is fixed at L. We adopt a two-period model, and assume that the firm's value revenue in period t (net of raw materials costs) is $R(K_t, \theta_t)$ where $\theta_t$ is a fully anticipated revenue shock, and $K_t$ is the firm's capital stock, assumed to be determined one period in advance. The firm's profit in period t is:

$$R(K_t, \theta_t) - w_t L - r_t K_t ,$$

where $w_t$ represents the negotiated wage and $r_t$ represents the (exogenous) cost of capital. We assume that workers' preferences are represented by the excess wage bill:

$$u(w_t, L) = (w_t - m_t)L ,$$

where $m_t$ is the sectoral minimum wage in period t.[8] Finally, we assume that the parties discount the future at a common discount rate β.

In the second period the only decision variable is the wage, $w_2$. Following de Menil (1971) and many subsequent authors we assume that $w_2$ is determined by generalized Nash bargaining:

$$(1) \qquad w_2 = \underset{w}{\text{argmax}} \; [\, u(w, L) - u^0_2 \,]^{\gamma} \; [\, \pi(w, r_2; K_2, L, \theta_2) - \pi^0_2 \,]^{1-\gamma} ,$$

where $u^0_2$ and $\pi^0_2$ represent the fall-back positions of the parties if no agreement is reached, and γ

[8]We consider other definitions in our empirical work. The assumption of an excess wage bill objective means that in a setting with variable employment, the suplus-maximizing choice of employment equates the marginal product of labor to the outside wage $m_t$.

represents the relative bargaining power of workers. On the workers' side we assume that $u^0_2 = 0$. On the firm's side, we assume that a fraction $\delta$ of the capital stock can be liquidated in the event of no agreement with workers. In this case, the fallback position of the firm is a net cash flow of $-(1-\delta)r_2K_2$. Combining these assumptions with equation (1), the second period wage solves:

$$(2) \qquad \max_{w_2} \; [\,(w_2 - m_2)L\,]^{\gamma} \; [\,R(K_2, \theta_2) - w_2L - \delta r_2K_2\,]^{1-\gamma} .$$

The first order condition for $w_2$ can be re-arranged to yield:

$$(3) \qquad w_2 = m_2 + \gamma\, Q_2/L , \quad \text{where}$$

$$Q_2 \equiv R(K_2, \theta_2) - m_2 L - \delta\, r_2K_2$$

presents the quasi-rent associated with reaching agreement in period 2. Notice that when $\delta=1$, investment is fully reversible and the appropriate definition of quasi-rent is value-added minus the opportunity cost of labor, minus the full cost of capital. On the other hand, when $\delta=0$, all investment is sunk and the appropriate definition of quasi-rent is value added minus the opportunity cost of labor.

The second period profits of the firm under the optimal wage bargain are:

$$(4) \qquad \begin{aligned} \pi_2 &= (1-\gamma)Q_2 - (1-\delta)r_2K_2 , \\ &= (1-\gamma)\,[\,R(K_2, \theta_2) - m_2 L\,] - r_2(1-\gamma\delta)K_2 . \end{aligned}$$

Differentiating the second line with respect to $K_2$ yields:

$$(5) \qquad \partial\pi_2/\partial K_2 = (1-\gamma)\,[\,\partial R/\partial K_2 - r_2(1-\gamma\delta)/(1-\gamma)\,] .$$

It follows immediately that if the firm determines $K_2$ by maximizing second period profits, it will tend to under-invest whenever $\delta<1$. In particular, when a fraction $1-\delta$ of investment is sunk, the firm acts as if the price of capital is $r_2(1-\gamma\delta)/(1-\gamma) > r_2$. Building on a similar argument a number of previous studies have concluded that short term bargaining with sunk investment imposes a "tax" on capital.[9]

The simple intuition underlying equation (5) is arguably misleading, however, because it fails to recognize that the outcome of bargaining in period 1 will in general depend on the expected outcomes of bargaining in period 2.[10] Assume that the parties bargain in period 1 anticipating the returns in period 2 implied by the wage bargain of equation (3) (i.e., net utility of $(w_2 - m_2)L = \gamma Q_2$ and profits specified in equation (4)). As in period 2, assume that the fall-back position of workers in the event of no agreement in period 1 is a payoff of 0 (for one period), while the fall-back for the firm is a cash flow of $-r_1(1-\delta)K_1$. In this case, bargaining in period 1 will maximize the expression

$$(6) \qquad [\, (w_1 - m_1)L + \beta\gamma Q_2 \,]^{\gamma} \;\; [\, R(K_1,\theta_1) - w_1 L - \delta r_1 K_1 + \beta(\, (1-\gamma)Q_2 - r_2(1-\delta)K_2 \,)\, ]^{1-\gamma}.$$

As was emphasized in the "efficient contracting" literature in the 1980s, it is potentially important to consider whether $w_1$ and $K_2$ are jointly determined by the period 1 bargain, or whether the firm selects $K_2$ unilaterally.[11] For the moment, consider the case where $K_2$ is jointly determined. Then it is easily shown that the first order condition for maximization of (6) implies $\partial R(K_2, \theta_2)/\partial K_2 = r_2$, i.e., an "efficient" level of investment.[12]

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[9]For example, Cahuc and Zylberberg (2004, pp. 543-545) present a simple analysis of the sunk investment case that yields essentially the same formula as equation (5), with $\delta$=0.

[10]The same point was made by Becker (1962) in an analysis of the return to general human capital investments. See Crawford (1988) for further discussion and references to the earlier literature.

[11]For example, MacDonald and Solow (1981) and Brown and Ashenfelter (1986).

[12]For a maximand of the form $[\, a + bw + g(K) \,]^{\gamma} \;\; [\, c - bw + h(K) \,]^{1-\gamma}$, if w and K are the choice variables and there are no constraints on w the first order conditions require that

Turning to the wage, the first order condition for $w_1$ can be written as:

$$(7) \qquad w_1 - m_1 \;=\; \gamma Q_1/L, \qquad \text{where}$$

$$Q_1 \;\equiv\; R(K_1,\theta_1) - m_1 L - \delta r_1 K_1 \;-\; \beta(1-\delta) r_2 K_2 \;.$$

Note that when the bargaining relationship is expected to continue the effective quasi-rent in period 1 deducts a fraction $\delta$ of current capital costs, and a complementary fraction $1-\delta$ of future costs (discounted by $\beta$). In essence, the firm is compensated *ex ante* for the share of returns to capital it will lose due to rent sharing in the second period bargain. Note that if the return to capital is constant ($r_1$=$r_2$=r) and the capital stock is increasing at a rate $1/\beta$ then $K_2$=$K_1/\beta$ and the quasi-rent expression becomes:

$$(8) \qquad Q_1 \;=\; R(K_1\,,\,\theta_1) - m_1 L \;-\; rK_1$$

In such an environment, the appropriate expression for the quasi-rent deducts the full cost of capital even though capital is sunk.

Importantly, the expression for $w_1$ in equation (7) remains valid when $K_2$ is predetermined rather than jointly determined. Instead of bargaining with workers over investment, assume that the firm determines $K_2$ unilaterally before bargaining in period 1. Using equations (4) and (7) it is straightforward to show that:

$$(9) \qquad \pi_1 \;+\; \beta\pi_2 \;= (1-\gamma)\,[\,R(K_1,\theta_1) - m_1 L - \delta r_1 K_1\,] \;-\; \gamma(1-\delta) r_1 K_1$$
$$+\, \beta(1-\gamma)\,[\,R(K_2,\theta_2) - m_2 L - r_2 K_2\,]\,.$$

An immediate implication of (9) is that

$$\partial[\pi_1 + \beta\pi_2]/\partial K_2 \;=\; \beta(1-\gamma)\,[\,\partial R(K_2,\theta_2)/\partial K_2 \;-\; r_2\,]\,.$$

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$g'(K)+h'(K)=0$. In this setup w is an efficient transfer and any bargaining solution requires a surplus-maximizing choice of K. In applying this observation to (6) note that the sum of the second period payoffs to workers and the firm is equal to $R(K_2, L, \theta_2)-m_2L-r_2K_2$.

When first period wages are determined by (7) the firm, acting unilaterally, will set the marginal product of capital in period 2 equal to $r_2$, implementing the jointly optimal decision. Under these assumptions, ex post holdup has no distortionary effect on investment.

This conclusion depends on two critical assumptions of our model: (1) workers' preferences are linear in wages; (2) the parties share a common discount rate. These assumptions imply that the bargaining parties have identical linear preferences over wage streams, and, as shown by Crawford (1988), short-term contracting can fully internalize the impact of future bargaining over relationship-specific quasi rents.

*b. Allowing for Variable Employment*

The preceding analysis can be extended to relax the fixed employment assumption. We proceed in two steps. As a starting point we assume that employment is jointly determined by the bargaining parties, as in the "efficient contracting" models of Svejnar (1986), Brown and Ashenfelter (1986), and Card (1986). In this setting the predictions of the fixed employment model remain intact: wage-setting fully anticipates opportunistic bargaining in the future, eliminating the effect of holdup on investment. We then consider a "right to manage" model, in which the parties bargain over wages and the firm unilaterally sets employment. This creates a distortion in employment. Under reasonable assumptions, however, we show that the investment choices of firm remain approximately efficient.

Denote the revenue function for the firm in period t by $R(L_t, K_t, \theta_t)$. Following the development presented above it is straightforward to show that when wages and employment are determined jointly, the first order conditions for the optimal choices of $w_2$ and $L_2$ require:

$$w_2 = m_2 + \gamma Q_2/L_2 \quad \text{and}$$

$$\partial R(L_2, K_2, \theta_2)/\partial L_2 = m_2 \ , \text{ where}$$

$$Q_2 = R(L_2, K_2, \theta_2) - m_2 L_2 - \delta r_2 K_2 \ .$$

Likewise, the first order conditions for the optimal choices of $w_1$ and $L_1$ require

$$w_1 = m_1 + \gamma Q_1/L_1 \quad \text{and}$$

$$\partial R(L_1, K_1, \theta_1)/\partial L_1 = m_1 \ , \text{ where}$$

$$Q_1 = R(L_1, K_1, \theta_1) - m_1 L_1 - \delta r_1 K_1 - \beta(1-\delta) r_2 K_2.$$

Finally, the optimal choice for $K_2$ (which is also made in period 1) requires

$$r_2 = \partial R(L_2, K_2, \theta_2)/\partial L_2 \ .$$

The expressions for $w_1$, $w_2$ are the same as in the fixed employment case, except that L is replaced by the "efficient" level of employment that equates the marginal product of labor with the outside wage $m_t$. The expression for the firm's discounted profits also remains the same as in equation (9) (with the appropriate substitution for $L_t$), implying that the firm will unilaterally select the jointly optimal investment choice when wages and employment are jointly determined in a sequence of short-term bargains. Consequently, with jointly determined employment, holdup does not distort investment.

The case in which the firm sets employment unilaterally is more complicated because now wages have three competing roles: to split the surplus between the parties; to regulate incentives for investment; and to allocate labor within the period. The conflict between these objectives leads to some inefficiency.[13] In particular, when employment is determined unilaterally any

[13]Loosely, there are only two degrees of freedom in the negotiated wage path: the discounted present value and the fraction of wages paid in period 1 versus period 2.

bargained wage above the alternative wage will lead to a level of employment below the efficient choice that maximizes the joint surplus of the parties. To first order, however, this is the only distortion: as in the fixed employment case the negotiated wage will contain a discount for future holdup, and the level of capital selected by the firm will set the marginal product of capital equal to the interest rate.

Specifically, in Appendix A we show that when: (i) the firm sets employment taking the wage as given; (ii) wage bargaining maximizes a generalized Nash objective with a fixed weight $\gamma$ for workers; and (iii) the negotiated mark-up over the alternative wage is approximately constant over time; then the negotiated first-period wage is approximately

(10) $$w_1 = m_1 + \gamma Q_1^*/L_1^* \quad , \text{ where}$$

$$Q_1^* = R(L_1^*, K_1, \theta_1) - m_1 L_1^* - \delta r_1 K_1 - \beta(1-\delta) r_2 K_2^*$$

and

$$L_1^* = L_1(m_t, K_1, \theta_1)$$

are the "efficient" levels of quasi-rent and employment, respectively, $K_1$ is the initial capital stock, and $K_2^*$ is the "efficient" capital stock in period 2 (defined precisely in the Appendix).[14] Moreover, as in the simple case with fixed employment, the firm acting unilaterally will select the capital stock $K_2^*$.

These results imply that with unilateral investment *and* employment-setting, $w_1$ and $K_2$ will be set at (approximately) the same levels as would occur under joint employment setting.

[14]The derivation of these expressions uses a linearization of the firm's profit functions in each period around the profit associated with the outside wage ($m_1$ or $m_2$). Assuming that $\gamma$ is on the order of 10-20% and the ratio of profits to the wage bill is in the range of 0 to 1, the percentage wage markup implied by (10) is under 20% and the assumption of local linearity is reasonable.

However, the observed level of employment $L_1$ will be below the efficient level, $L_1^*$, and the observed measure of rent in period 1 will differ from the measure $Q_1^*$ that determines wages. In particular, we show in Appendix A that the observed measure of rents in period 1 is:

$$(11) \qquad Q_1 = R(L_1, K_1, \theta_1) - m_1 L_1 - \delta r_1 K_1 - \beta(1-\delta) r_2 K_2$$
$$\approx Q_1^* (1 + \epsilon\gamma g_1^*)$$

where $\epsilon$ is the elasticity of the firm's labor demand schedule, and $g_1^* \equiv (w_1 - m_1)/m_1$ is the negotiated markup of the contract wage over the outside wage. Approximating $L_1 = L_1^* (1+\epsilon g_1^*)$, the "efficient" quasi-rent per worker is

$$(12) \qquad Q_1^*/L_1^* = \lambda\, Q_1/L_1 , \quad \text{where}$$
$$\lambda \approx (1 + \epsilon g_1^*(1-\gamma)) \leq 1 .$$

Thus, observed quasi-rent per worker overstates the appropriate expression in the wage determination model. Assuming for example that $\epsilon=-1$, $\gamma=0.20$, and $g_1^*=0.15$, the bias factor is approximately $\lambda=0.88$.

*c. Empirical Implementation*

In the derivation of equation (10) we assumed that capital is homogeneous and that a fraction $\delta$ of the capital stock in each period can be readily liquidated, leading to a quasi-rent measure of the form:

$$Q_t^* = R(L_t^*, K_t, \theta_t) - m_t L_t^* - \delta r_t K_t - \beta(1-\delta) r_{t+1} K_{t+1} .$$

The fraction $\delta$ will vary across firms, depending on the age structure and types of capital at a given firm. Capital adjusts slowly (and irregularly) and is measured with some error, making it difficult to separately identify the effects of $K_t$ and $K_{t+1}$ on wages in any period. Finally, we do not have estimates of the cost of capital in different periods. In view of these limitations we make the assumptions that $r_t = r_{t+1} = r$, and that capital accumulation is close to a "steady state" trajectory with $K_{t+1} = (1/\beta)K_t$. In this case, our bargaining model predicts that the appropriate quasi-rent measure for wage determination in period t is:

$$Q_t^* \ = \ R(L_t^*, K_t, \theta_t) - m_t L_t^* \ - r K_t \ .$$

Substituting this expression into equation (10) we get

$$w_t \ = \ m_t \ + \ \gamma \ [ \ R(L_t^*, K_t, \theta_t) - m_t L_t^* \ - r K_t \ ] \ / \ L_t^*$$

and using (12) we obtain a relationship between wages and observed quasi-rents:

$$\begin{aligned} w_t \ &= \ m_t \ + \ \lambda\gamma \ [ \ R(L_t, K_t, \theta_t) \ - m_t L_t - r K_t \ ] \ / \ L_t \\ &= \ m_t (1 - \lambda\gamma) \ + \ \lambda\gamma \ R(L_t, K_t, \theta_t)/L_t \ - \lambda\gamma r \ (K_t/L_t) \ . \end{aligned}$$

Assuming that we observe a potentially noisy indicator of the alternative wage:

$$a_t \ = \alpha \ m_t \ + \ \xi_t \ ,$$

we obtain an estimating equation of the form:

(13) $$w_t \ = \ a_t \ (1 - \lambda\gamma)/\alpha \ + \ \lambda\gamma \ R(L_t, K_t, \theta_t)/L_t \ - \lambda\gamma r \ (K_t/L_t) \ - 1/\alpha \ \xi_t \ + \ u_t \ ,$$

where $u_t$ represents a combination of measurement error in $w_t$ and any other unobserved factors that affect wage determination.

Inspection of equation (13) points to two immediate predictions of our bargaining model: (1) value-added per worker affects wages with a coefficient $\lambda\gamma$ that understates the true rent-splitting parameter $\gamma$; (2) controlling for value-added per worker, capital per worker affects wages with a coefficient of $-\lambda\gamma r$. In contrast, in the presence of distortionary holdup, we would expect the coefficient of capital per worker to be smaller in absolute value than $-\lambda\gamma r$. In the limiting case of complete holdup, the quasi-rent expression makes no deduction for the cost of capital and the implied coefficient of capital per worker is 0. Thus, our main empirical focus is on comparing the estimated effects of value-added per worker and capital per worker on negotiated wages, and testing whether the ratio is consistent with existing estimates of the cost of capital.

The literature suggests that during the mid-to-late 1990s a reasonable estimate of the user cost of capital is in the range of 8-12%. Elston and Rondi (2006) report a distribution of estimates of the user cost of capital for publicly traded Italian firms in the 1995-2002 period, with a median of 0.11 (Elston and Rondi, 2006, Table A4). Arachi and Biagi (2005) calculate the user cost of capital, with special attention to the tax treatment of investment, for a panel of larger firms over the 1982-1998 period. Their estimates for 1995-1998 are in the range of 10-15% with a value of 11% in 1998 (Arachi and Biagi, 2005, Figure 2). Finally, Franzosi (2008) calculates the marginal user cost of capital taking into account the differential costs of debt and equity financing, and the effects of tax reforms in 1996 and 1997. Her calculations show that the marginal user cost of capital is declining in the fraction of debt financing, and that across all debt-equity ratios the marginal cost fell after these reforms. For a firm with all equity financing the marginal cost fell from 11.5% pre-reform to 6.5% post-reform. For a firm with 60% debt financing (roughly the average in Italian industry) the cost fell from 7.5% to 6%. Based on these estimates we conclude that an estimate in the range of 10% for the user cost of capital is reasonable.

## III. Institutional Background, Data Sources, and Descriptive Overview

### *a. Institutional Background*

Wage setting in Italy is characterized by a "two-level" bargaining system.[15] Sectoral agreements (negotiated every two years) set a series of contractual minimum wages for different occupation classes that are automatically extend to all employees in the country. Individual employers (or groups of employers) can negotiate supplemental local agreements with their workforce that provide wage premiums over and above the sectoral minimums. In the mid-1990s firm-level bargaining was in place at approximately 10% of firms with at least 10 employees, and covered about 40% of all private sector employees nationwide (ISTAT, 2000). Individual workers can also receive supplements and bonuses – including seniority adjustments – that add to the minimum contractual wage covering their job. As described below, our data allow us to identify the sectoral contract and occupation category for most workers, so we can in principle determine the sectoral minimum wage that applies to their job. We do not know whether a worker is covered by a local agreement. Conceptually, then, we think of wage bargaining as determining the sum of an individual-specific premium and any firm-wide premium paid as a result of a local contract (or for other reasons).

### *b. Data Sources*

Our data set combines three types of information: individual earnings records, firm balance sheet data, and contractual minimum wage rates. Our earnings data are taken from the

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[15]This hierarchical system was introduced in 1993, replacing an earlier system that included local and sectoral agreements and a national indexation formula (the *scala mobile*). See Casadio (2003). The Netherlands, Portugal, and Spain have similar two-level systems.

Veneto Workers History (VWH) dataset, which was constructed by a group of economists at the University of Venezia using administrative records of the Italian Social Security System.[16] The VWH contains information on private sector employees in the Veneto region over the period from 1975 to 2001 (see Tattara and Ventini, 2007). Specifically, the VWH includes register-based information on both the employee and employer for any job that lasts at least one day. Worker information includes total earnings during the calendar year of the job, the number of days worked in the year, the worker's occupation, the appropriate national contract and level within that contract (i.e., a "job ladder" code); the worker's gender, age, region and country of birth, and seniority with the firm. The employer information includes industry (classified by 5-digit ATECO 91), the dates of "birth" and closure of the firm (if applicable), the firm's location, and the firm's national tax number (*codice fiscale*).

Column 1 of Table 1 provides an overview of the sample of individual workers age 16-64 in the VWH over the 1995-2001 period (the period of overlap with the firm financial data). The sample includes just under 2 million individual workers who were observed in 3.11 million job spells at 191,000 firms. On average 42% of the sample are female, 45% are between the ages of 17 and 30, 37% are between the ages of 31 and 44, and 17% are age 45 or older. Just under 30% are white collar workers, and the mean daily wage (for jobs observed in 2000) was 68 Euros.

Firm-level balance sheet information was obtained from AIDA (*analisi informatizzata delle aziende)*, a database distributed by Bureau Van Dijk that contains annual balance sheet information for incorporated non-financial firms in Italy with annual sales of at least 500,000

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[16]We are grateful to Giuseppe Tattara for providing the dataset and to Carlo Gianelle for his help in using the data.

Euros.[17] AIDA contains the official balance sheet data for these firms, and is available starting in 1995. These balance sheets include information on sales, value added, the wage bill, capital, the total number of employees, industry (categorized by 5-digit code), and the firm's tax number. Appendix B shows an example balance sheet (as reported in AIDA) for a larger Veneto firm.

Contractual minimum wage levels were obtained from archived records of the national contracts. We were able to reconstruct contractual wage levels over our sample period for a total of 23 major nationwide contracts in construction, metal and mechanical engineering, textiles and clothing, food, furniture and wood products, trade, tourism, and services. We were unable to obtain information for one major sector – chemicals – and for several smaller sectoral contracts. For each occupation grade listed in the contract, we have information on the minimum wage, the cost-of-living allowance (a fixed amount equal to the payment set in the 1992 contract) and any special bonus amounts. Typically, the amounts are adjusted once or twice per year. Appendix Table C shows the wage information for a representative national contract.[18]

*c. Matching the Worker and Firm Data*

We match job-year observations for people age 16 to 64 in the VWH (for the period from 1995 to 2001) to employer information in AIDA for the same year using the employer tax code identifier available in both datasets. The matching rate was high: in all years except 1995 we

[17] See http://www.bvdep.com/en/aida.html

[18] Wages for other contracts (in 2003-2004) are reported at *http://usiait.it/testi/tabret.htm#*

were able to find at least one observation in the VHW for 95% of the firms in AIDA sample.[19] We investigated the quality of the matches by comparing the total number of workers in the VWH who are recorded as having a job at a given firm (in October of a given year) with the total number of employees reported in AIDA (for the same year). In general the two counts agree very closely. To reduce the influence of false matches (particularly for larger firms, where the number of affected workers would be large) we decided to eliminate the small number of matches for which the absolute difference between the number of employees reported in the balance sheet and the number found in the VWH exceeded 100.[20] Eliminating these "gross outliers" the correlation between the number of employees in the balance sheet and the number found in the VWH is 0.99. The strong correlation between the two data sources is illustrated Appendix D, which plots the employment counts in AIDA against those in the VWH (pooling all available firm-year observations). We also compared total wages and salaries for the calendar year as reported in AIDA with total wage payments reported for employees in the VWH. The two measures are very highly correlated (correlation > 0.98), and the median ratio between them is close to 1.0.

Column 2 of Table 1 shows the characteristics of the full set of job-year observations that we can match to AIDA. Just under 50% of all workers observed between 1995 and 2001 in the VWH can be matched to an AIDA firm. Non-matched observations include people working at unincorporated firms and smaller incorporated firms that are not included in AIDA. The matched observations come from roughly 18,000 firms, or only 10% of the total universe of firms

[19]In 1995, the first year covered by AIDA, there appear to be missing data for a relatively large number of firms.

[20]This eliminated fewer than 1% of firms.

contained in the VWH. Average firm size for the matched jobs sample (36.0 employees) is substantially above the average for all firms in the VWH (7.8 employees). Mean daily wages for the matched observations are also higher, whereas the fractions of female and younger workers are lower.

From the set of potential matches described in column 2 we made a series of exclusions to arrive at our estimation sample. First, we eliminated job-year observations for jobs that lasted only part of a year. Second, we eliminated apprentices, managers, and part-time employees.[21] Finally, we eliminated jobs at firms that had fewer than 10 employees or closed during the calendar year, and job-year observations with unusually high or low values for a simple estimate of quasi-rent per worker (constructed using an industry-wide mean wage as the "alternative wage"). The characteristics of the resulting sample are shown in column 3 of Table 1. This sample has only about one-half as many people, and less than half as many job spells, as the sample of all potential matches in column 2.[22]

We were able to match information on the sectoral minimum wage for about 75% of the observations in the overall estimation sample.[23] The resulting sample is summarized in column 4 of Table 1. The age, gender, and earnings distributions of workers who can be matched to a sectoral minimum wage are not too different from those in the overall estimation sample. For this

[21]Although we do not know hours worked, the VWH file includes an indicator for part-time.

[22]The largest reduction in sample size comes from the year-round job requirement, which eliminates about 33% of individuals.

[23]As noted above, we do not have sectoral contract information for firms in the chemical industry, which is a relatively large employer in the Veneto region, and for firms in industries covered by relatively narrow sectoral agreements.

group we can also construct an estimate of the "wage drift" component of salary: the gap between their average daily wage and the sectoral minimum. As shown in row 7, the average premium is 20.9 Euros per day. The average percentage premium (not reported in the table) is 26%.

Rows 10-14 of Table 1 present means of various indicators of firm profitability for the different samples. Row 10 shows mean value added per worker (in thousands of Euros per year). This is slightly higher in the overall sample of matches (column 2) but very similar between columns 3 and 4. Row 11 shows the mean of value added per worker *minus* a crude estimate of the opportunity cost of labor, based on an the average wage in the firm's industry. In the notation of our model this can be interpreted as $R(L_t, K_t, \theta_t)/L_t - a_t$, where $a_t$ is the industry mean wage. For comparison, row 12 shows an estimate of value added per worker minus the sectoral minimum wage (which is only available for the subsample that can be matched to contracts in column 4). Since the sectoral minimum is less than the industry average wage, the latter is substantially larger than the former. Finally, rows 13 and 14 show an estimate of value added per worker, minus the alternative wage, minus 10% of capital per worker, i.e., $R(L_t, K_t, \theta_t)/L_t - a_t - 0.1K_t/L_t$. Assuming there are no holdup issues, and that the return on capital is 10%, this is an estimate of quasi-rent per worker (i.e., $Q_t/L_t$, in the notation of equation 11). Again, we present two estimates, using either the industry average wage (row 13) or the minimum sectoral wage (row 14). Using the latter, the ratio of the mean quasi-rent to the wage bill (evaluated at the alternative wage) is approximately 1.83. According to equation (10), a comparison of this ratio to the average markup over the sectoral minimum wage implies that workers earn about 13% of firm-specific quasi rents.[24]

## IV. Estimation Results

### *a. Basic Results*

As a point of departure for our analysis of wage setting and profitability Table 2a presents a set of simple OLS models which relate the average yearly wage earned by an individual worker to the components of observed quasi-rent and other control variables.[25] Columns 1 and 2 show models estimated over our full estimation sample. In this sample we use the industry-wide average wage (calculated at the 4 digit level) for employees in Veneto region as our estimate of the alterative wage.[26] Columns 3 and 4 use the subsample of observations that can be matched to a minimum sectoral wage. We present models with only the three covariates shown in the table and a set of unrestricted year effects in columns 1 and 3. The richer specifications in columns 2 and 4 add controls for age and tenure of the worker, dummies for gender and foreign-born status, dummies for province and 2-digit industry, and controls for the age and total number of

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[24]The means in rows 10-14 are in thousands of Euros per year per worker. Assuming 312 paid days per year the mean contractual minimum wage is 15,600 per year (=312×67.5(1−0.26)). Ignoring the fact that the mean of a ratio is not equal to the ratio of means, the mean ratio of quasi-rents to the wage bill is 30.45/15.6 = 1.95. From equation (11), $(w\text{-}m)/m = \gamma\ Q^*/(Lm)$, implying that $\gamma = 0.26/1.95 = 0.13$. Here we are ignoring the slippage between observed quasi-rent and the "efficient" quasi-rent $Q^*$.

[25]In contrast to equation (13) our estimated models use the log of the wage as the dependent variable and include the log of the alternative wage as a control. This is similar to the procedure adapted in most of the existing literature. The use of logs changes the scale of the coefficients on value added per worker and capital per worker, but not the prediction that the latter should be equal to $-r$ times the former, where r is the annual user cost of capital.

[26]This wage is clearly "too high" since it includes the negotiated premiums earned in other sectors.

employees at the firm.

Inspection of the estimation results in Table 2a suggest that, as has been found in previous studies, wages are higher at firms with higher profitability. The effect of value added per worker on wages is somewhat smaller in magnitude when the sectoral minimum wage is used as a measure of outside wage opportunities, and when controls for worker and firm characteristics are added (as in columns 2 and 4), but in all cases the estimated effects are are precisely estimated. The implied elasticities of wages with respect to quasi-rent per worker are reported at the bottom of the table, and range from 0.05 to 0.09.[27] We also report the "Lester range" (Lester, 1952): the change in log wages associated with a 4-standard deviation shift in the value of quasi-rents per worker (i.e., from the bottom 5% to the top 5% of the profitability distribution, if quasi-rent per worker were normally distributed). This ranges from 13 to 25 percent.

A comparison of the coefficients in rows 1 and 2 of Table 2a, however, does not suggest strong support for the no-holdup prediction in equation (13). In fact, when the alternative wage is proxied by the industry average wage, the estimated effect of capital per worker on wages is insignificant but positive in sign. Using the sectoral minimum wage the estimated effect of capital per worker is negative, but the effect is too small (in magnitude) relative to the effect of value added per worker to support the no holdup prediction. Despite these findings, we fit a parallel series of models – reported in Table 2b – that impose the restriction that wage determination depends on a quasi-rent measure that deducts the 10% of the current capital stock from value

[27]We estimate the elasticity by multiplying the coefficient of value-added per worker (in row 1 of the table) by the sample average value of quasi-rent per worker, assuming no holdup issues and a 10% return to capital. This is constructed as value added per worker, minus the alternative wage, minus 0.1 times capital stock per worker.

added. Imposing this restriction, the estimated response to quasi-rents per worker is not to different from the estimated responses to value added per worker reported in Table 2a. The implied elasticities of wages with respect to quasi-rents and the estimates of the Lester range are also quite similar.

Although the models in Table 2a and 2b fit relatively well (the R-squared from the models in column 4 of these tables is a respectable 60%), and yield estimates of the elasticity of wages with respect to profitability that are comparable to those in many earlier studies, an important concern is the potential impact of unobserved heterogeneity in firm profitability and the skills of workers. In particular, if more profitable firms tend to hire better-qualified workers (as suggested by Abowd, Kramarz and Margolis, 1998, for example) OLS models will overstate the causal effect of rent-sharing on wages. An obvious solution is to use longitudinal data for workers observed in the same job over time, and relate within-job changes in the profitability of the firm to within-job wage growth (see e.g., Margolis and Salvanes, 2001; Arai, 2003; Martins, 2004; Gurtzen, 2008). A within-job approach eliminates all biases caused by permanent heterogeneity due to worker, firm, or match-specific effects.

Tables 3a and 3b present a series of estimation results from models that include unrestricted match effects. The models in Table 3a enter value added per worker and capital per worker separately, while those in Table 3b impose the no-holdup assumption that the coefficient of capital per worker is $-0.1$ times the coefficient of value added per worker. All the models include the richer set of controls included in the even-numbered columns of Tables 2a and 2b.

As shown in columns 1 and 3 of Tables 3a and 3b, OLS models with match fixed effects yield relatively small (but precisely estimated) estimates of the effect of profitability on wages.

Compared to models without match effects, the implied elasticities of wages with respect to quasi-rents, and the implied estimates of the Lester range, are reduced by a factor of 10. Taken at face value these models suggest that rent sharing is quantitatively unimportant in explaining wage variability in Italy.

We suspect that the response of wages to value added per worker is substantially attenuated by measurement errors in value added. Measured value added can vary sustantially from year to year depending on the timing of sales and payments for raw materials. We are also concerned that there may be some endogeneity in the relationship between wages and value added per worker even within a job spell. To address both concerns we constructed an instrument for value added per worker, based on average value-added per worker at firms in the AIDA data set in the same 5 digit industry but in other regions of Italy. This variable is a good proxy for industry wide demand shocks that affect the profitability of employers in our sample, but should be uncorrelated with with firm-specific measurement errors in value added, or with local labor supply conditions in the Veneto region. It is a strong predictor of value added per worker for the employers in our sample, with an F statistic of well over 500 in the first-stage equation.

Columns 2 and 4 of Table 3a report within-spell IV estimates of our wage determination model. The use of IV results in a substantial increase in the magnitude of the estimated response of wages to value added. In fact, within-job IV estimates of this response are quite similar to simple OLS estimates. The implied elasticities of wages with respect to quasi rents are also similar, as are the estimates of the Lester range.

The IV estimation strategy also yields estimates of the response of wages to capital per worker that are uniformly negative, and roughly one-tenth as large in magnitude as the responses to value added per worker. (The precise ratios of the cofficients are xxx and yyy for the models in columns 2 and 4, respectively). This pattern is consistent with the predictions of a no-holdup model with a return to capital of approximately 10%. The parallel set of models in Table 3b impose the restriction from the no-holdup specification assuming a 10% return to capital. The IV strategy is slightly different in these specifications because now value added per worker minus 0.1 times capital per worker is the endogenous varible (we continue to use value added per worker among firms in the same industry in other regions is the instrument). Nevertheless, the restricted models fit about as well as the unrestricted models, and yield essentially the same estimates of the elasticity of wages with respect to quasi rents, and of the Lester range in wages between high and low-profit firms.

*b. Long Differences*

The estimates in Table 3 are based on annual observations on wages for workers in continuing jobs. One concern with these estimates is that negotiations over the share of rents awarded to workers at more and less profitable firms occur on a lower frequency. (Most firm level contracts are renegotiated every 3 years). A second concern is that changes in average hours of work (which we cannot measure) will lead to fluctuations in average daily wages that are positively correlated with short-term industry demand shocks. As a simple robustness check, we therefore constructed a set of “long differences” estimates, based on changes over 4 years. Changes over this horizon will capture both formal and informal renegotiations, and are also less likely to be affected by temporary demand shocks that lead to overtime or short time. For workers who were observed in a job match that persisted at least 4 years we extracted one (randomly selected) change over 4 years, yielding a sample of 153,814 worker-firm observations. Of these, 105,698 can be assigned a contractual minimum wage for the start and end of the 4-year spell.

The results are presented in Tables 4a and 4b, which follow the format of Tables 3a and 3b. The estimated rent-sharing elasticities from the IV specifications are 20-30% larger using 4 year changes than using year-to-year changes but the pattern of the coefficient estimates is otherwise similar. In particular, the IV models in Table 4a suggest that capital per worker exerts a negative effect on wages, with a coefficient that is roughly 10% as large in magnitude as the effect of value-added per worker. We interpret the estimates as offering further support for the conclusion that rent sharing in Italy anticipates the returns to future holdup.

## V. Concluding Remarks

## Appendix A

This appendix derives expressions for wages and other outcomes when employment is set unilaterally by the firm. As in the simpler cases described in the text, we proceed backward from the second period. Given $K_2$ and $\theta_2$, the second period wage negotiation solves

$$\text{(A1)} \quad \max_{w} \quad [\,(w-m_2)L_2\,]^{\gamma}\ [\,R(L_2,K_2,\theta_2) - wL_2 - \delta r_2 K_2\,]^{1-\gamma}\ ,$$

where $L_2$ is endogenously determined from the labor demand schedule $L_2(w_2, K_2, \theta_2)$. Using the fact that $\partial R(L_2,K_2,\theta_2)/\partial L_2 - w_2 = 0$, the first-order condition for $w_2$ can be written as:

$$\text{(A2)} \quad (w_2 - m_2)\,L_2 \;=\; \gamma/(1-\gamma) \times \;[\,1 + \epsilon\,(w_2 - m_2)/w_2\,] \times [\,R(L_2, K_2, \theta_2) - w_2L_2 - \delta r_2 K_2\,]\ ,$$

where $\epsilon$ is the elasticity of labor demand, which we assume is constant. Since $L_2$ is endogenous, we approximate (A2) around $L_2^* = L_2(m_2, K_2, \theta_2)$, the efficient employment level in period 2. We assume that

$$\text{(A3)} \quad L_2 \;\approx\; L_2^* \;\times (\,1 + \epsilon\,(w_2 - m_2)/w_2\,)$$

and use a first order approximation of the firm's profit function around the profit associated with the wage $m_2$:

$$\text{(A4)} \quad R(L_2, K_2, \theta_2) - w_2L_2 \;\approx\; R(L_2^*, K_2, \theta_2) - m_2\,L_2^* \;-\; L_2^*\,(w_2 - m_2)\ .$$

Substituting (A3) and (A4) into (A2) we obtain:

$$\text{(A5)} \quad w_2 \;=\; m_2 \;+\; \gamma\, Q_2^*/L_2^*$$

where

$$\text{(A6)} \quad Q_2^* \;=\; R(L_2^*, K_2, \theta_2) \;-\; m_2\,L_2^* \;-\; \delta r_2\,K_2$$

is the "efficient" quasi-rent in period 2. The optimized value of the second period bargain to workers is:

(A7) $(w_2 - m_2)\, L_2 \;=\; \gamma\, Q_2^* \times L_2 / L_2^* \;=\; \gamma\, (1 + \epsilon\, g_2^*)\, Q_2^*$

where $g_2^* = (w_2 - m_2)/w_2 = \gamma\, Q_2^*/(m_2\, L_2^*)$ is the optimized proportional wage markup. Using (A4) the firm's second period profits can be written as:

$$\text{(A8)} \quad \pi_2 = R(L_2, K_2, \theta_2) - w_2 L_2 - \delta\, r_2 K_2 = Q_2^* - L_2^* (w_2 - m_2) - (1-\delta) r_2 K_2$$

$$= (1 - \gamma)\, Q_2^* - (1-\delta) r_2 K_2 .$$

Turning now to the first period, the wage $w_1$ is selected to maximize

$$\text{(A9)} \quad [\, (w_1 - m_1) L_1 + \beta\gamma (1 + \epsilon g_2^*) Q_2^* \,]^{\gamma}$$

$$\times \; [\, R(L_1, K_1, \theta_1) - w_1 L_1 - \delta r_1 K_1 + \beta(1-\gamma) Q_2^* - \beta(1-\delta) r_2 K_2 \,]^{1-\gamma}$$

subject to the condition that the firm selects $L_1$ once the wage is determined. We assume that the firm selects $K_2$ unilaterally in period 1, anticipating the choice for $w_1$ and $w_2$. The first order condition for the negotiated first period wage can be written as

$$\text{(A10)} \quad (w_1 - m_1)\, L_1 + \beta\gamma (1 + \epsilon g_2^*) Q_2^* = \gamma/(1-\gamma) \times (1 + \epsilon (w_1 - m_1)/w_1)$$

$$\times\, [\, R(L_1, K_1, \theta_1) - w L_1 - \delta r_1 K_1 - \beta(1-\delta)\, r_2 K_2 + \beta(1-\gamma) Q_2^* \,]$$

Notice that if

$$(1 + \epsilon g_2^*) = (1 + \epsilon\, (w_1 - m_1)/w_1)$$

the terms involving $Q_2^*$ cancel from the both sides of (A10). Since $g_2^* = (w_2 - m_2)/w_2$, this will be true if the markup of the wage over the outside wage is constant over time (or if $\epsilon$=0) . Assuming a constant markup, (A10) can be written as

$$\text{(A11)} \quad (w_1 - m_1)\, L_1 = \gamma/(1-\gamma) \times (1 + \epsilon\, (w_1 - m_1)/w_1)$$

$$\times\, [\, R(L_1, K_1, \theta_1) - w L_1 - \delta r_1 K_1 - \beta(1-\delta)\, r_2 K_2 \,].$$

This has exactly the same form as (A2) – the first order condition for $w_2$ – and using a similar first order expansion of the profit function we get

(A12) $w_1 = m_1 + \gamma\, Q_1^*/L_1^*$

where

(A13) $Q_1^* = R(L_1^*, K_1, \theta_1) - m_1 L_1^* - \delta\, r_1 K_1 - \beta(1-\delta)\, r_2 K_2$

and $L_1^* = L_1(m_1, K_1, \theta_1)$, the efficient employment level in period 1. Note that, as in the baseline model with fixed employment, the quasi-rent expression deducts a share $\delta$ of first period capital costs, and a (discounted) share $(1-\delta)$ of second period costs. Comparing (A12) to (A5), the markup of the negotiated wage over the outside alternative will be constant if the ratio of efficient quasi-rent to efficient employment is constant – a situation that we regard as plausible.[28]

Finally, we turn to the determination of $K_2$, which we assume is made unilaterally by the firm, anticipating wages over the next two periods. Paralleling (A8), the firm's first period profits can be written as

(A14) $\pi_1 = (1-\gamma)\, Q_1^* - (1-\delta)\, r_1 K_1 + \beta(1-\delta)\, r_2 K_2$ .

Thus,

(A15) $$\begin{aligned} \pi_1 + \beta\pi_2 &= (1-\gamma)\, Q_1^* - (1-\delta)\, r_1 K_1 + \beta(1-\delta)\, r_2 K_2 \\ &\quad + \beta(1-\gamma)\, Q_2^* - \beta(1-\delta)\, r_2 K_2 \\ &= (1-\gamma)\,[\, Q_1^* + \beta\, Q_2^* \,] - (1-\delta)\, r_1 K_1 \end{aligned}$$

which implies that the firm selects a $K_2$ that maximizes the discounted quasi-rent. Using the definitions of $Q_1^*$ and $Q_2^*$ we obtain:

[28] In a 2-period model, the quasi-rent in the second period does not include a discount for future capital costs. In a multi-period model, however, the quasi-rent in successive periods (except the last) will have the form of (A13).

$$(A16)\quad Q_1^* + \beta Q_2^* = R(L_1^*, K_1, \theta_1) - m_1 L_1^* - \delta r_1 K_1$$
$$+ \beta[R(L_2^*, K_2, \theta_2) - m_2 L_2^* - r_2 K_2] .$$

Thus, the firm's first order condition for $K_2$ sets $\partial R(L_2^*, K_2, \theta_2)/\partial K_2 = r_2$, implying an efficient capital choice.

With unilateral employment-setting, $L_1$ will differ from $L_1^*$, and the observed level of quasi-rent for a particular bargaining pair ($Q_1$) will differ from the efficient quasi-rent ($Q_1^*$) that appears in the wage determination model. In particular, the observed quasi-rent implied by the model is

$$(A17)\quad Q_1 = R(L_1, K_1, \theta_1) - m_1 L_1 - r_1 \delta K_1 - \beta(1-\delta) r_2 K_2 ,$$

and, using an first-order expansion like (A4),

$$(A18)\quad Q_1 = R(L_1^*, K_1, \theta_1) - m_1 L_1^* - r_1 \delta K_1 - \beta(1-\delta) r_2 K_2 + (L_1 - L_1^*)(w_1 - m_1)$$
$$= Q_1^* + (L_1 - L_1^*)(w_1 - m_1) .$$

Using the approximation that $L_1 = L_1^* ( 1 + \epsilon (w_1 - m_1)/m_1 )$ and equation (A12) this can be further simplified to:

$$(A19)\quad Q_1 = Q_1^* ( 1 + \epsilon\gamma g_1^* )$$

where $g_1^* = (w_1 - m_1)/m_1$ is the optimal first period markup. Finally, measured quasi-rent per employee is:

$$(A20)\quad Q_1 / L_1 = Q_1^* ( 1 + \epsilon\gamma g_1^* ) / [ L_1^* ( 1 + \epsilon g_1^* ) ]$$
$$\approx Q_1^* / L_1^* \times ( 1 - \epsilon g_1^*(1-\gamma) ) > Q_1^* / L_1^* .$$

Measured quasi-rent per worker <u>overstates</u> $Q_1^* / L_1^*$, the measure of quasi-rent per worker that drives wage determination, by approximately $|\epsilon|\, g_1^*(1-\gamma)$ percent.

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Appendix D: Plot of Number of Employees in AIDA vs. Number Found in VWH

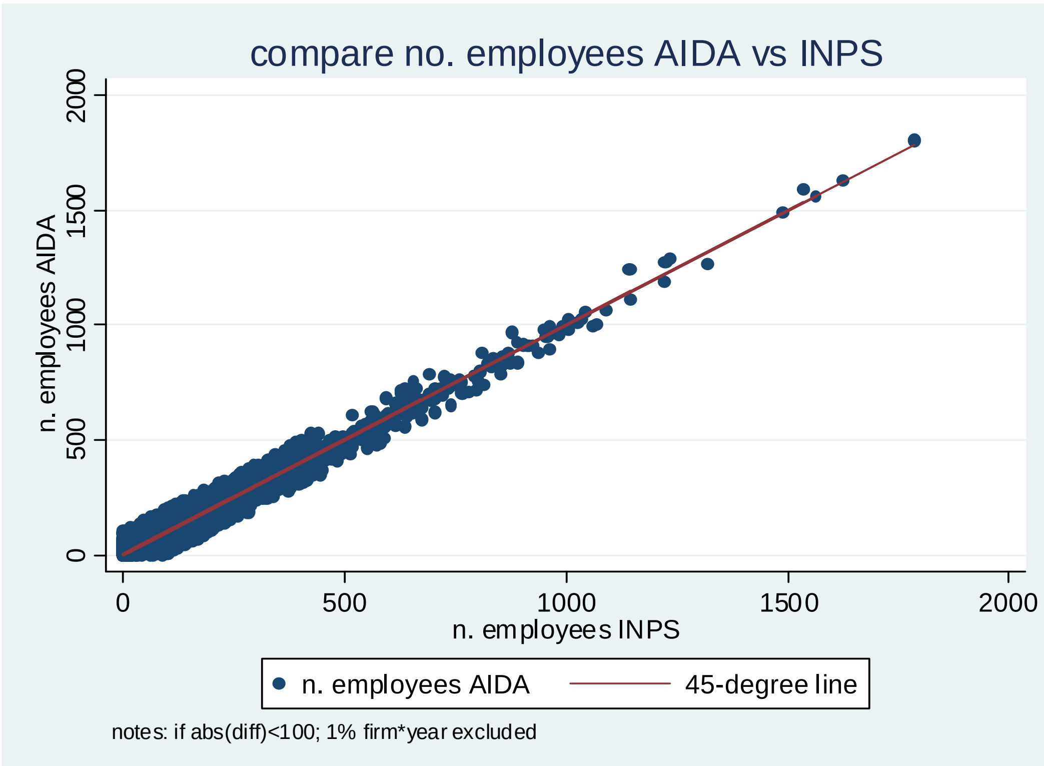

Table 1: Descriptive Statistics for Workers, Firms and Job Matches

| | Universe of Job-Year Observations (1) | Matched Job-Year Observations (2) | Estimation Sample: Full Sample (3) | Estimation Sample: Subset Matched to Sectoral Contract (4) |
|---|---|---|---|---|
| **Characteristics of Workers:** | | | | |
| 1. Number of Individual Workers | 1,990,721 | 985,159 | 495,659 | 329,379 |
| 2. Percent Female | 42.3 | 34.4 | 28.0 | 28.6 |
| 3. Percent Age 30 or Less | 45.6 | 39.8 | 31.4 | 32.6 |
| 4. Percent Age 45 or More | 17.1 | 19.8 | 23.4 | 22.5 |
| 5. Percent White Collar | 29.6 | 29.8 | 31.5 | 32.4 |
| 6. Mean Daily Wage (real Euros) | 67.8 | 74.2 | 68.2 | 67.5 |
| 7. Mean Drift Component of Daily Wage (real Euros) | – | – | – | 20.9 |
| **Characteristics of Firms:** | | | | |
| 8. Number of Individual Firms | 191,291 | 18,312 | 9,173 | 7,377 |
| 9. Firm Size (# Employees in October) | 7.8 | 36.0 | 45.8 | 46.0 |
| 10. Value Added/Worker (1000's real Euros) | – | 59.7 | 50.8 | 50.6 |
| 11. Valued Added/Worker less Industry Mean Wage (1000's of real Euros) | – | 31.5 | 28.4 | 28.4 |
| 12. Valued Added/Worker less Sectoral Min. Wage (1000's of real Euros) | – | – | – | 34.7 |
| 13. Quasi-rent/Worker, using Industry Mean Wage (1000's of real Euros) | – | 23.3 | 23.9 | 24.2 |
| 14. Quasi-rent/Worker, using Sectoral Min. Wage (1000's of real Euros) | – | – | – | 30.5 |
| **Characteristics of Job Match:** | | | | |
| 15. Number of Job Matches | 3,111,049 | 1,223,889 | 533,273 | 399,437 |
| 16. Mean Duration of Job (years) | 2.1 | 2.5 | 3.4 | 3.4 |

Notes: Sample in column 1 includes observed jobs for individuals between the ages of 16 and 64 in Veneto Worker History File during a calendar year between 1995 and 2001. Sample in column 2 includes subset of job-year observations that can be matched to AIDA balance sheet data for the firm (in the same calendar year). Estimation sample excludes part-year jobs, jobs at firms with under 10 employees, part-time jobs, and jobs held by apprentices and managers. Sample in column 4 includes job-year observations that can be matched to information on the minimum wage in the relevant sectoral contract. See text for further details.

Table 2a: OLS Estimates of Rent Sharing Model

| | Using Industry Mean As Alternative Wage | | Using Sectoral Minimum As Alternative Wage | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| 1. Value Added per Worker | 0.251<br>(0.012) | 0.184<br>(0.010) | 0.186<br>(0.010) | 0.134<br>(0.008) |
| 2. Capital Stock per Worker | 0.008<br>(0.003) | 0.007<br>(0.023) | -0.013<br>(0.004) | 0.001<br>(0.003) |
| 3. Alternative Wage | 0.633<br>(0.022) | 0.116<br>(0.012) | 1.792<br>(0.016) | 1.654<br>(0.017) |
| 4. Additional Controls | no | yes | no | yes |
| 5. R-squared | 0.214 | 0.438 | 0.045 | 0.600 |
| 6. Number of Person-Year Observations | 1,665,339 | 1,665,339 | 1,024,466 | 1,024,466 |
| <u>Addendum:</u> | | | | |
| *Elasticity of Wages w.r.t. Rents* | 0.064 | 0.047 | 0.058 | 0.042 |
| *Lester's Range* | 0.209 | 0.153 | 0.155 | 0.112 |

Notes: Dependent variable in all models is log of average daily wage. Standard errors clustered by firm and year in parentheses. All models include year dummies. Controls added in columns 2 and 4 are: quadratic in age, quadratic in job tenure, dummies for gender and foreign-born, and dummies for province (6) and 2-digit industry, firm age (in years) and number of firm's employees.

Table 2b: OLS Estimates of Rent Sharing Model − Restricted Specification

| | Using Industry Mean As Alternative Wage | | Using Sectoral Minimum As Alternative Wage | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| 1. Value Added per Worker | 0.271<br>(0.013) | 0.197<br>(0.010) | 0.213<br>(0.011) | 0.139<br>(0.008) |
| 2. Capital Stock per Worker (restricted specification) | -0.027<br>( − ) | -0.020<br>( − ) | -0.021<br>( − ) | -0.014<br>( − ) |
| 3. Alternative Wage | 0.635<br>(0.018) | 0.119<br>(0.013) | 1.810<br>(0.014) | 1.657<br>(0.017) |
| 4. Additional Controls | no | yes | no | yes |
| 5. R-squared | 0.202 | 0.437 | 0.460 | 0.600 |
| 6. Number of Person-Year Observations | 1,665,339 | 1,665,339 | 1,204,466 | 1,204,466 |
| Addendum: | | | | |
| *Elasticity of Wages w.r.t. Rents* | 0.041 | 0.050 | 0.067 | 0.043 |
| *Lester's Range* | 0.112 | 0.160 | 0.179 | 0.112 |

Notes: Dependent variable in all models is log of average daily wage. Standard errors clustered by firm and years in parentheses. See note to Table 2a for additional control variables. In the models reported in this table the coefficients in rows 1 and 2 are estimated jointly under the restriction that the return to capital is 10% and there is no holdup (see text).

Table 3a: OLS and IV Within-Spell Estimates of Rent Sharing Model

| | Using Industry Mean As Alternative Wage | | Using Sectoral Minimum As Alternative Wage | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| 1. Value Added per Worker | 0.033<br>(0.001) | 0.206<br>(0.023) | 0.029<br>(0.001) | 0.190<br>(0.002) |
| 2. Capital Stock per Worker | -0.002<br>(0.000) | -0.022<br>(0.003) | -0.009<br>(0.000) | -0.021<br>(0.003) |
| 3. Alternative Wage | 0.010<br>(0.001) | 0.009<br>(0.002) | 0.798<br>(0.005) | 0.792<br>(0.007) |
| 4. Additional Controls | yes | yes | yes | yes |
| 5. Number of Person-Year Observations | 1,665,339 | 1,484,992 | 1,204,466 | 1,071,118 |
| 6. Number of Job Spells | 533,264 | 368,015 | 397,659 | 271,323 |
| 7. First-stage F-statistic | – | 756.1 | – | 607.3 |
| Addendum: | | | | |
| *Elasticity of Wages w.r.t. Rents* | 0.008 | 0.072 | 0.009 | 0.059 |
| *Lester's Range* | 0.027 | 0.209 | 0.024 | 0.149 |

Notes: Dependent variable in all models is log of average daily wage. All models include a complete set of job-spell dummies as well as year effects and the covariates described in Table 2a that vary within job spells. In IV models (columns 2 and 4) value-added per worker minus alternative wage is treated as endogenous. Instrument is value added per worker for firms in the same 4 digit industry in the same year in other regions of Italy.

Table 3b: OLS and IV Within-Spell Estimates of Rent Sharing Model - Restricted Specification

| | Using Industry Mean As Alternative Wage | | Using Sectoral Minimum As Alternative Wage | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| 1. Value Added per Worker | 0.033 | 0.191 | 0.028 | 0.175 |
| | (0.001) | (0.027) | (0.001) | (0.022) |
| 2. Capital Stock per Worker | -0.003 | -0.019 | -0.003 | -0.018 |
| | ( − ) | ( − ) | ( − ) | ( − ) |
| 3. Alternative Wage | 0.010 | 0.009 | 0.798 | 0.792 |
| | (0.001) | (0.002) | (0.005) | (0.007) |
| 4. Additional Controls | yes | yes | yes | yes |
| 5. Number of Person-Year Observations | 1,655,339 | 1,484,992 | 1,204,466 | 1,071,118 |
| 6. Number of Job Spells | 533,264 | 368,015 | 397,569 | 271,323 |
| 7. First-stage F-statistic | − | 1617.2 | − | 869.1 |
| Addendum: | | | | |
| *Elasticity of Wages w.r.t. Rents* | 0.083 | 0.049 | 0.009 | 0.054 |
| *Lester's Range* | 0.027 | 0.149 | 0.024 | 0.137 |

Notes: Dependent variable in all models is log of average daily wage. See notes to Table 3a. In the models reported in this table the coefficients in rows 1 and 2 are estimated jointly under the restriction that the return to capital is 10% and there is no holdup (see text).

Table 4a: Long Differences (4-year) Estimates of Rent Sharing Model

| | Using Industry Mean As Alternative Wage | | Using Sectoral Minimum As Alternative Wage | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| 1. Change in Value Added per Worker | 0.055<br>(0.004) | 0.320<br>(0.046) | 0.049<br>(0.003) | 0.209<br>(0.033) |
| 2. Change in Capital Stock per Worker | -0.001<br>(0.002) | -0.030<br>(0.004) | -0.008<br>(0.001) | -0.028<br>(0.006) |
| 3. Change in Alternative Wage | 0.040<br>(0.006) | 0.024<br>(0.006) | 0.787<br>(0.010) | 0.780<br>(0.014) |
| 4. Additional Controls | yes | yes | yes | yes |
| 5. Number of Observations | 151,376 | 151,232 | 103,962 | 103,962 |
| 6. First-stage F-statistic | – | 1270.2 | – | 401.1 |
| <u>Addendum:</u> | | | | |
| *Elasticity of Wages w.r.t. Rents* | 0.014 | 0.081 | 0.014 | 0.061 |
| *Lester's Range* | 0.038 | 0.223 | 0.03 | 0.130 |

Notes: Dependent variable in all models is change in log average daily wage over 4 years. Standard errors in parentheses. All models include year effects and the covariates described in Table 2a. In IV models (columns 2 and 4) value-added per worker minus alternative wage is treated as endogenous. Instrument is revenues per worker for firms in the same 5 digit industry in the same year in other regions of Italy.

Table 4b: Long Differences (4-year) Estimates of Rent Sharing Model − Restricted Specification

| | Using Industry Mean As Alternative Wage | | Using Sectoral Minimum As Alternative Wage | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| 1. Change in Value Added per Worker | 0.054<br>(0.004) | 0.350<br>(0.060) | 0.044<br>(0.003) | 0.158<br>(0.030) |
| 2. Change in Capital Stock per Worker | -0.005<br>( − ) | -0.035<br>( − ) | -0.004<br>( − ) | -0.016<br>( − ) |
| 3. Change in Alternative Wage | 0.040<br>(0.006) | 0.027<br>(0.006) | 0.895<br>(0.010) | 0.782<br>(0.015) |
| 4. Additional Controls | yes | yes | yes | yes |
| 5. Number of Observations | 151,376 | 151,232 | 103,994 | 103,962 |
| 6. First-stage F-statistic | − | 1150.3 | − | 723.8 |
| Addendum: | | | | |
| *Elasticity of Wages w.r.t. Rents* | 0.013 | 0.086 | 0.013 | 0.046 |
| *Lester's Range* | 0.038 | 0.240 | 0.028 | 0.098 |

Notes: Dependent variable in all models is change in log average daily wage over 4 years. Standard errors in parentheses. See notes to Table 3a. In the models reported in this table the coefficients in rows 1 and 2 are estimated jointly under the restriction that the return to capital is 10% and there is no holdup (see text).