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ABSTRACT

Rent-Sharing, Hold-up, and Wages: Evidence from Matched Panel Data*

It is widely believed that rent-sharing reduces the incentives for investment when long term contracts are infeasible because some of the returns to sunk capital are captured by workers. We propose a simple test for the degree of hold-up based on the fraction of capital costs that are deducted from the quasi-rent that determines negotiated wages. We implement the test using a data set that combines Social Security earnings records for workers in the Veneto region of Italy with detailed financial information for employers. We find strong evidence of rent-sharing, with an elasticity of wages with respect to current profitability of the firm of 3-7%, arising mainly from firms in concentrated industries. On the other hand we find little evidence that bargaining lowers the return on investment. Instead, firm-level bargaining appears to split the rents after deducting the full cost of capital.

JEL Classification: J31

Keywords: rent-sharing, hold-up, employer-employee data

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Do workers capture some of the rents earned by their employers? If so, does rent-sharing reduce investment by taxing sunk capital? Both questions have drawn much attention from economists.[1] Decades of research using industry and firm-level data have shown a positive correlation between profitability and wages.[2] Although some of this could reflect the sorting of high-ability workers to more profitable firms, recent studies that compare wages over time on the same job also find a significant correlation with changes in profitability (e.g., Margolis and Salvanes, 2001; Martins, 2009; Guertzgen, 2010).[3] Focusing on a specific source of productivity growth, van Reenen (1996) showed that wages rise after firms introduce successful innovations. As a theoretical matter, whether rent-sharing reduces investment depends on the irreversibility of capital investments and the structure of wage bargaining. Grout (1984) showed that when long term contracts are infeasible and capital is sunk, rent-sharing can lead to under-investment.[4] Consistent with this insight, several studies have argued that unionized firms have lower rates of investment that their non-union competitors.[5]

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[1]Rent-sharing by a cartel of workers is discussed in Adam Smith (1976, Book I, Chapter 8). The argument that rent sharing reduces investment was made by Simons (1944), who wrote: "I can see no reason why strongly organized workers, in an industry where huge investment is already sunk in highly durable assets, should ever permit a return on investment sufficient to attract new capital."

[2]Industry-level studies include Slichter (1950) de Menil (1971) and Dickens and Katz (1986). Firm-levels studies include Nickell and Wadhwani (1990), Chistofides and Oswald (1992), Abowd and Lemieux (1993), Blanchflower, Oswald and Sanfey (1996), Hildreth and Oswald (1997) and Arai (2003).

[3]Guiso, Pistaferri, and Schivardi (2005) also find that firm-specific productivity shocks have a positive effect on wages using data for Italian firms.

[4]A similar point was made by Baldwin (1983). For general overviews hold-up-related issues see Che and Sakovics (2008) and MacLeod (2010).

[5]Studies showing a negative effect of unionization on investment include Connolly et al. (1986), Hirsch (1990, 1991, 2004), Denny and Nickell (1992), Bronars and Deere (1993), and Odgers

Despite the evidence that higher profitability leads to higher wages, the actual degree of hold-up in a labor market setting depends on whether the firm can recoup its investment costs *before* splitting the rents with employees. We propose a simple measure of hold-up based on fraction of capital costs that are deducted from the quasi-rent measure that determines observed wages. In the absence of hold-up, negotiated wages contain an offset for the full cost of the firm's capital. When some of the returns to sunk investment are captured by workers, however, the deduction for capital is smaller. Our testing procedure therefore focuses on the relative magnitude of the wage offset for firm-specific capital accumulation. To the best of knowledge, we are the first to attempt to measure the degree of hold-up in this way.

We implement this test using administrative wage data for employees in the Veneto region of Italy, combined with detailed balance sheet data for firms. Under Italian law, sectoral contracts set minimum wages for workers at various occupation levels in each industry. Firm-specific union agreements raise wages above these levels for many workers (see Cristini and Leoni, 2006). Employees also receive various supplements that can vary with profitability. Given this setting, our econometric models relate overall wages earned by individual workers to the appropriate sectoral minimum wage and measures of firm-specific "quasi-rents." Our preferred specifications include job match effects (i.e., dummies for each worker-firm pair) that control for unobserved ability differences between workers and unmeasured productivity differences among firms.

An important issue for our estimation strategy is measurement error in value-added, which will lead to downward bias in the estimated degree of rent-sharing, particularly in models that

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and Betts (1997). In contrast, Machin and Wadhwani (1991) find no significant effect. Likewise Addison et al (2007) find no effect of works councils on investment by German firms.

control for match effects. We use the revenues of firms in the same narrowly-defined industry in other regions of Italy to construct an instrumental variable for the value-added of Veneto employers. Our identifying assumption is that industry-specific demand shocks affect firm-level profitability but have no direct effect on local labor supply.

Our empirical findings point to two main conclusions. First, increases in firm-specific profitability lead to statistically significant but modestly-sized increases in wages. In cross-sectional models the estimated elasticity of wages with respect to quasi-rents per worker is on the order of 6-8%. Within-job-spell estimates derived from our instrumental variables approach are somewhat smaller but still significant, suggesting that the simple correlation between wages and profitability reflects both unobserved ability and rent-sharing. Second, we find that wages vary with a quasi-rent measure that deducts the full cost of capital. Although we cannot rule out some hold-up effect, estimates from a range of specifications are consistent with a user cost of capital of around 10% – very close to the benchmark suggested by recent studies (e.g., Arachi and Biagi, 2005; Elston and Rondi, 2006). We also find larger deductions for fixed assets (which are more vulnerable to hold-up but have a higher user cost) than current assets (which are least vulnerable to hold-up but have a lower user cost), consistent with the hypothesis that the offset reflects the cost of capital.

The next section presents a very simple model that illustrates the hold-up problem in a dynamic bargaining relationship when investment takes time and wages are renegotiated every period. We also use the model to develop a simple estimate of the degree of hold-up. We then describe the data sources used in our analysis, and turn to the main empirical results, followed by some checks and robustness tests. The final section of the paper summarizes our conclusions.

II. A Simple Model of Rent Sharing and Wage Determination

This section presents a simple bargaining model between a firm and a homogeneous group of workers. We use the model to show how bargaining in a sequence of short-term contracts can lead to hold-up when capital accumulation takes time and investments are irreversible. We then show how hold-up can be reduced when in-progress investments are easier to liquidate than completed capital. Finally, we develop a simple measure of hold-up based on the observed relationship between wages and the components of quasi-rents.

For simplicity we assume employment is fixed.[6] The timing is as follows: The game begins in period 1 with a predetermined capital stock K_1. The firm then chooses a capital stock K_2 for period 2. Following this decision the parties bargain over the wage for period 1, w_1. If no agreement is reached the game ends and each party receives their outside option. If agreement is reached, workers receive w_1, the firm earns profits $\pi_1(w_1)$, and the game proceeds to period 2. At this point the only decision variable is w_2, which is again determined by bargaining. If agreement is reached workers receive w_2 and the firm receives $\pi_2(w_2)$. If not, the game ends and parties receive their outside options.

We assume that the firm's profits in each period depend on net revenues $R_t(K_t)$ minus the costs of labor and capital:

$$\pi_t(w_t) = R_t(K_t) - w_t L - r_t K_t ,$$

where $R_t(K_t) = R(K_t, \theta_t)$ depends on a revenue shock θ_t known at least one period in advance, L is the level of employment, and r_t is the cost of capital. We assume that workers' payoffs are proportional to the excess wage bill:

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[6]In an earlier version of this paper (Card, Devicienti, Maida, 2010) we present a model with variable employment and show that it yields similar predictions.

$$u_t(w_t) \;=\; (w_t - m_t)\,L\,,$$

where m_t is the minimum sectoral wage (or, more generally, some measure of the opportunity wage) in period t.[7] With this specification of preferences, wages act as a pure transfer between the parties, and the sum of their payoffs in each period:

$$S_t \;= u(w_t) + \pi(w_t) \;=\; R_t\,(K_t) - m_t\,L - r_t\,K_t\,,$$

is independent of w_t. Finally, we assume that the parties discount the future at a common discount rate β.

To complete the model we need to specify the outside options available to each party. We assume that the outside option for the firm is to close down and liquidate its capital. We assume that a fraction δ of the installed capital stock can be resold, so in the event of no agreement in period t the firm's net income in the period is $\pi^0{}_t = -(1-\delta)r_tK_t$.[8] Given that K_2 is determined prior to wage bargaining in period 1, we also need to specify what happens to *second* period capital in the event of no agreement in the first period. We assume that a fraction $1-\lambda$ of "in-progress" investments can be costlessly abandoned, implying that the liability for second period capital if the firm closes down in period 1 is $\lambda\pi^0{}_2 = -\lambda(1-\delta)r_2K_2$. For workers we assume that the outside option in each period is a payoff of $u^0{}_t = 0$. (Equivalently, each worker earns the outside wage).

Working backward, we assume that second-period bargaining maximizes a generalized Nash objective:

(1) $$[\,u_2(w_2) - u^0{}_2\,]^{\gamma} \quad [\,\pi_2(w_2) - \pi^0{}_2\,]^{1-\gamma}$$

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[7]See Farber (1986) for a discussion of the collective preferences of workers. With fixed employment and identical workers this objective is consistent with each worker having a linear within-period utility of income.

[8]A similar assumption is made by Grout (1984) who distinguishes between the price paid for capital and its resale value.

where $\gamma \in [0,1]$ represents the relative bargaining power of workers (see de Menil, 1971 and Svejnar, 1986 for early examples of use of this objective). The optimal wage w_2^* splits the gains from trade:

$$u_2(w_2^*) - u^0_2 = \gamma Q_2 \quad \text{and}$$

$$\pi_2(w_2^*) - \pi^0_2 = (1-\gamma) Q_2 ,$$

where

$$Q_2 \equiv u_2(w_2^*) + \pi_2(w_2^*) - u^0_2 - \pi^0_2 = S_2 - u^0_2 - \pi^0_2$$

is the quasi-rent associated with reaching agreement. Given our assumptions on the outside options and worker preferences:

$$\text{(2a)} \qquad Q_2 = R_2(K_2) - m_2 L - \delta r_2 K_2 ,$$

the negotiated wage is

$$\text{(2b)} \qquad w_2^* = m_2 + \gamma Q_2/L ,$$

and second period profits are

$$\text{(2c)} \qquad \pi_2(w_2^*) = (1-\gamma) [R_2(K_2) - m_2 L] - (1-\gamma\delta) r_2 K_2 .$$

When investment is fully reversible, $\delta=1$ and equation (2a) shows that the appropriate quasi-rent deducts the full cost of capital (r_2K_2). When only a fraction of investment is reversible, however, the deduction is smaller. Differentiating (2c) with respect to K_2 yields:

$$\partial\pi_2/\partial K_2 = (1-\gamma) [\partial R_2/\partial K_2 - r_2(1-\gamma\delta)/(1-\gamma)] .$$

If the firm were to choose K_2 in period 1 to maximize second period profits, this condition would imply under-investment whenever $\delta<1$ (see Grout, 1984 for a very similar expression).

When capital accumulation takes time and investments in the "build" phase can be more easily liquidated, however, some of the potential hold-up of the second period capital stock can be offset by lower wages in period 1. Loosely speaking, the cost of liquidating second period capital is lower in the first period, leading to an offset in w_1 for capital that will be "held up" in period 2. More precisely, taking account of the continuing value of the relationship, the payoff to workers of a first period agreement at the wage w_1 is $u_1(w_1) + \beta u_2(w_2^*)$, while the payoff to the firm is $\pi_1(w_1) + \beta\pi_2(w_2^*)$. Bargaining in period 1 will therefore maximize

$$(3) \qquad [\, u_1(w_1) + \beta u_2(w_2^*) - \tilde{u}^0_1 \,]^{\gamma} \;\; [\, \pi_1(w_1) + \beta\pi_2(w_2^*) - \tilde{\pi}^0_1 \,]^{1-\gamma}.$$

where $\tilde{u}^0_1$ and $\tilde{\pi}^0_1$ represent the outside options of the parties if there is no agreement in period 1. Given our assumptions, $\tilde{u}^0_1 = 0$ and

$$\tilde{\pi}^0_1 = \pi^0_1 + \lambda\,\beta\pi^0_2 = -(1-\delta)r_1K_1 - \lambda(1-\delta)r_2K_2\,.$$

The total quasi-rent $\tilde{Q}_1$ associated with reaching an agreement in period 1 is therefore

$$\begin{aligned}\tilde{Q}_1 &= u_1(w_1^*) + \pi_1(w_1^*) - \pi^0_1 + \beta(\, u_2(w_2^*) + \pi_2(w_2^*) - \lambda\pi^0_2\,) \\ &= S_1 - \pi^0_1 + \beta\,(\, S_2 - \lambda\pi^0_2\,).\end{aligned}$$

The optimal first period wage will set

$$(4a) \quad u_1(w_1^*) + \beta u_2(w_2^*) = \gamma\,\tilde{Q}_1$$

$$(4b) \quad \pi_1(w_1^*) + \beta\pi_2(w_2^*) = (1-\gamma)\,\tilde{Q}_1 + \tilde{\pi}^0_1\,.$$

Substituting $u_2(w_2^*) = \gamma Q_2$ and using the fact that $Q_2 = S_2 - \pi^0_2$ (see equation (1a)), equation (4a) implies that

$$u_1(w_1^*) = \gamma S_1 - \gamma\pi^0_1 + (1-\lambda)\gamma\beta\pi^0_2\,,$$

leading to a first period wage of

$$(5) \qquad w_1^* = m_1 + \gamma\, Q_1/L\,,$$

where
$$\begin{aligned}Q_1 &= S_1 - \pi^0_1 + (1-\lambda)\beta\pi^0_2 \\ &= R_1(K_1) - m_1L - \delta r_1K_1 - (1-\lambda)\beta(1-\delta)r_2K_2\end{aligned}$$

is the quasi-rent to be distributed in period 1 when the relationship is expected to continue. When $\lambda<1$, equation (5) implies that Q_1 contains an offset for the sunk component of K_2 that is "held up" in bargaining in period 2. In fact when λ=0 the offset is just the (discounted) amount π^0_2 that is added to the quasi-rent in period 2 as a result of the irreversibility of capital.

The offset in w_1 helps to re-align the firm's incentive for investment in period 2. In particular, using equation (3b) the firm's discounted profits can be written as

$$\pi_1(w_1^*) + \beta\pi_2(w_2^*) = (1 - \gamma)(S_1 + \beta S_2) + \gamma\pi^0_1 + \gamma\beta\lambda\pi^0_2 .$$

Assuming that K_2 is determined prior to wage bargaining in period 1, the optimal choice for K_2 solves the first-order condition:

$$\partial[\pi_1(w_1^*)+\beta\pi_2(w_2^*)] / \partial K_2 = (1-\gamma)\beta \; [\partial R_2/\partial K_2 - \theta r_2] , \tag{6}$$

where

$$\theta = [1-\gamma+\gamma\lambda(1-\delta)] / (1-\gamma) \in [1, 1/(1-\gamma)]$$

measures the distortionary effect of hold-up on the cost of capital. When capital is fully liquid δ=1 and there is no hold-up effect, implying that θ =1. When completed capital is sunk but in-progress investments are fully reversible, δ<1 but λ=0, again implying no hold-up effect. More generally, with 0<λ<1 there is still some inefficiency caused by hold-up in the second period (i.e., θ >1), but the distortion is smaller than would arise if first period wages did not respond to the (credible) threat of reduced investment by the firm.[9]

Empirical Implementation

This simple model points to two main conclusions. The first is that the magnitude of the

[9]An alternative to the assumption that the firm unilaterally chooses investment prior to wage bargaining is that the parties jointly set w_1 and K_2 in the first period bargain. Under this assumption, Crawford (1986) shows that investment will be efficient and the first-period wage will fully offset any hold-up that arises in the second period. This result is easily seen from (3) by noting that with joint determination of K_2, the firm's fall-back position in period 1 is $\tilde{\pi}^0_1 = \pi^0_1$, which is equivalent to setting λ=0.

distortion to investment caused by rent sharing depends not only on the fraction of existing capital that can be resold in the event of a failure of agreement, but also on the reversibility of in-progress investments. If firms can easily halt planned investments, the degree of hold-up may be relatively small. This mechanism may be particularly relevant in our empirical setting since during the 1990s many Veneto firms established branch operations – or began out-sourcing production – in the former Eastern Europe.[10] Anecdotal evidence suggests that the threat of diverting new investments to offshore plants was used by firms to argue for wage moderation.

A second insight from the model is that one can potentially measure the importance of hold-up in a bargaining relationship by examining the effect of capital costs on wages. Specifically, in an ongoing relationship wages in period t will depend on a quasi-rent measure of the form specified by equation (5):

$$Q_t = R_t(K_t) - m_t L - \delta r_t K_t - \beta(1-\lambda)(1-\delta) r_{t+1} K_{t+1}$$

which includes an offset for the fraction of the current capital stock that can be readily liquidated, and another offset for the fraction of the future capital stock that will be "held up" in period t+1 but can be costlessly liquidated today. In particular, the degree of hold-up depends on the sum of the coefficients on current and future capital costs. When this sum is approximately 1, $\lambda(1-\delta)$ is approximately 0 and there is no distortion in the firm's cost of capital (i.e., $\theta = 1$ in equation 6).

In principle we could estimate δ and λ by relating observed wages to a measure of quasi-rents based on this expression (or a generalization of (5) with longer lags in the time to complete investments). Unfortunately, we do not have direct information on the cost of capital for firms in our sample. Morever, we lack instruments for K_{t+1} that would be needed to address any concerns

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[10] Veneto firms producing clothing and footwear have been particularly active in the region around Timisoara Romania – see Mariotti and Montagnana (2008).

over potential endogeneity between current wages and *future* capital. Given these data limitations we make the assumptions that $r_t = r_{t+1} = r$, and that capital per worker is approximately constant. In this case, with $\beta \approx 1$ equation (5) implies a relationship between observed wages, value-added per worker, and capital per worker of the form:

$$(7) \qquad w_t = m_t(1-\gamma) + \gamma R_t(K_t)/L - \gamma r[1 - \lambda(1-\delta)](K_t/L) .$$

Note that the ratio of the coefficients of capital per worker and value-added per worker in equation (7) is $- r \times [1 - \lambda(1-\delta)]$. Given a value for r we can therefore infer the degree of hold-up. Specifically, when the ratio is 0 (i.e., the measured offset effect of capital per worker is 0), we can infer that $\lambda(1-\delta)=1$, implying that the distortionary effect on the firm's cost of capital is $\theta = 1/(1-\gamma)$. At the opposite extreme, if the ratio is equal to the value of r, then $\lambda(1-\delta)=0$ and $\theta = 1$. Thus we can estimate the degree of hold-up by comparing the relative size of the coefficients on capital per worker and value-added per worker with an estimate of the user cost of capital.

The literature on capital investment in Italy suggests that during our sample period (the mid-to-late 1990s) the user cost of capital was 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 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).[11]

In our estimation we adopt a log-linearization of equation (7). Specifically, building on

[11]Franzoni (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 suggest that the marginal user cost of capital was about 7.5% pre-1996 for a firm with 60% debt financing, and fell to 6% after 1997.

the observation that covariates like job tenure exert a proportional effect on wages, we assume that rent sharing with heterogeneous workers results in a *proportional* rent premium:

$$(8) \qquad \log(w_{it}) = \log(m_{it})\, b_1 + X_{it} b_2 + VA_{j(i,t),t}\, b_3 + KL_{j(i,t),t}\, b_4 + \xi_{it} ,$$

where w_{it} is the average daily wage earned by worker i in year t, m_{it} is a (potentially noisy) measure of the opportunity wage for the worker in that year, X_{it} represents a vector of measured characteristics of the worker, $VA_{j(i,t),t}$ represents measured value-added per worker at the firm j(i,t) that employed worker i in period t, $KL_{j(i,t),t}$ is measured capital per worker at the firm, and ξ_{it} is an error term. Our focus is on the ratio b_4/b_3. In the absence of hold-up, $b_4/b_3 = -r$, while full hold-up implies $b_4/b_3 = 0$. We fit this model using a variety of estimation strategies, including OLS, OLS with firm-worker-match fixed effects, and instrumental variables (IV) with match fixed effects, treating value added per worker (and in some cases capital per worker) as endogenous.

III. Institutional Background, Data Sources, and Descriptive Overview

a. Institutional Background

Wage setting in Italy is governed by a "two-level" bargaining system.[12] Sectoral agreements (typically negotiated every two years) establish contractual minimum wages for different occupation classes that are automatically extended to all employees in the sector. Unions can also negotiate firm-specific contracts that provide wage premiums over and above the sectoral minimums. During the mid-1990s such firm-level bargains covered about 40% of private sector employees nationwide (ISTAT, 2000). In addition, individual employees receive premiums and bonuses that add to the minimum contractual wage covering their job.

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[12]This system was introduced in 1993, replacing an earlier system that included local and sectoral agreements and a national indexation formula. See Casadio (2003) and Dell'Aringa and Lucifora (1994). The Netherlands, Spain, and Portugal have similar two-level systems.

As described below, our data allow us to identify the sectoral contract and occupation category for most workers, so in principle we know the sectoral minimum wage that applies to their jobs. Unfortunately we do not know whether a worker is covered by a firm-specific supplementary agreement. Conceptually, then, we think of wage bargaining as determining the average value of the individual-specific premiums at a firm, including any premium established by a firm-wide agreement. In our estimation sample nearly all employees earn at least some premium: the 5th percentile of the percentage premium is 2.5%, while the median is 24%.

b. Data Sources

Our data set combines three types of information: individual earnings records, firm balance sheet data, and contractual minimum wage rates. The earnings data are derived from the Veneto Workers History (VWH) dataset, which was constructed by Giuseppe Tattara and colleagues at the University of Venezia using administrative records of the Italian Social Security System.[13] The VWH contains information on private sector employees in the Veneto region over the period from 1975 to 2001 (see Tattara and Valentini, 2007).[14] Specifically, it includes register-based information for any job that lasts at least one day.

On the employee side the VWH includes total earnings during the calendar year for each job, the number of days worked during the year, a code for the appropriate sectoral contract and occupation level within that contract (i.e., a "job ladder" code), and the worker's gender, age, region (or country) of birth, and seniority with the firm. On the employer side the VWH includes

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[13]We are extremely grateful to Giuseppe Tattara for making available the dataset and to Marco Valentini and Carlo Gianelle for their advice in using the data.

[14]Veneto region has a population of about 4.6 million – approximately 8% of the total population of Italy.

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 individuals who were observed in 3.11 million job spells at 191,000 firms. On average 42% of the workers are female, 45% are under the age of 30, 37% are between the ages of 31 and 44, and 17% are age 45 or older. The mean daily wage (for jobs observed in 2000) was 65 Euros.

Firm-level balance sheet information was obtained from AIDA (*analisi informatizzata delle aziende),* a database distributed by Bureau Van Dijk that includes information for incorporated non-financial firms in Italy with annual sales of at least 500,000 Euros.[15] AIDA contains the official balance sheet data for these firms, and is available starting in 1995. The AIDA data include sales, value added, total wage bill, the book value of capital (broken into a number of subcategories), the total number of employees, industry (categorized by 5-digit code), and the firm's tax number.

Contractual minimum wage levels were obtained from records of the national contracts. We were able to reconstruct the minimum wages over our sample period for a total of 23 major national 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 many other small sectoral contracts. For each occupation grade listed in the contract, we have information on the minimum wage, the cost-of-

[15]See http://www.bvdep.com/en/aida.html. Only a tiny fraction of firms in AIDA are publicly traded. We exclude these firms and those with consolidated balance sheets (i.e., holding companies).

living allowance, and other special allowances. Typically, the contractual minimum wage levels are updated once or twice per year to adjust for changes in the cost of living allowance.

c. Matching the Worker and Firm Data

We use tax code identifiers to match job-year observations for employees in the VWH to employer information in AIDA for the period from 1995 to 2001. The match rate is relatively high: we were able to find at least one worker in the VHW for over 95% of the firms in AIDA sample. We evaluated 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) we decided to eliminate a 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. Removing these "gross outliers" (less than 1% of all firms) the correlation between the number of employees in the balance sheet and the number found in the VWH is 0.99. (A plot of the two measures against each other shows that most of the points lie very close to the 45 degree line). 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 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 job-year observations we successfully matched to AIDA. About one-half of all workers observed between 1995 and 2001 in the VWH can be matched to an AIDA firm. Most of the non-matches are employees of small firms that are excluded from AIDA. In all we have matched data for about 18,000 firms, or about

10% of the total universe 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 (7.0 employees). Mean daily wages for the matched observations are also higher, while 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, as well as employees in construction.[16] Finally, we eliminated jobs at firms that had fewer than 15 employees[17] or closed during the calendar year, and job-year observations with unusually high or low values of value added per worker and capital per worker. (We trim observations outside the 1% - 99% range). The characteristics of the resulting sample are shown in column 3 of Table 1. The estimation sample includes about 40% of the individuals and firms in the overall sample of potential matches in column 2.[18]

We were able to match information on the sectoral minimum wage for about 73% of the observations in the overall estimation sample.[19] The resulting subsample is summarized in column

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[16]We also eliminated workers in one small textile industry (furs), and several other industries with a relatively small number of firms outside the Veneto area. These exclusions were adopted to improve the power of our instrumental variables strategy, which relies on revenue shocks at firms outside Veneto. Elimination of these sectors does not change the basic OLS rent sharing models (in Table 2).

[17]Firms with under 15 employees are exempted from many regulations in Italy: workers at these firms are also excluded from the key rights of worker representation under the Statuto dei Lavoratori of 1970 – see Cella and Treu (2009).

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

[19]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

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 group we can also construct an estimate of the "wage drift" component of salary: the gap between the average daily wage and the sectoral minimum. As shown in row 7, mean drift is 21 Euros per day – the mean percentage premium (not reported) is about 25%.

Rows 10-14 of Table 1 show the mean values of various indicators of firm profitability. Mean value added per worker (in thousands of Euros per year) is reported in row 10. 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 the average wage in the firm's (2 digit) industry. In the notation of our model this is $R(K_t, \theta_t)/L - m_t$, where m_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 industry average wage is above the sectoral minimum 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., $R(K_t, \theta_t)/L - m_t - 0.1K_t/L$. Assuming there are no hold-up issues, and that the user cost of capital is 10%, this is an estimate of quasi-rent per worker. Again, we present two estimates, using either the industry average wage (row 13) or the minimum sectoral wage (row 14). A comparison of average quasi-rent per worker (using the sectoral minimum wage) to the average markup of wages over the sectoral

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covered by relatively narrow sectoral agreements.

minimum implies an estimate for γ of approximately 0.25.[20] This estimate of workers' bargaining power is arguably upward-biased to the extent that firms pay higher wages for more skilled workers in a given occupation class (i.e., to the extent that wage drift includes both skill premiums and bargaining rents).

IV. Estimation Results

a. Basic Results

As a point of departure for our analysis Table 2 presents a set of simple OLS models which relate the average wage earned by an individual worker to the components of observed quasi-rent at his or her employer and other control variables. 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 2 digit level) for employees in Veneto region as our estimate of the alterative wage. Columns 3 and 4 use the subsample of observations that can be matched to a minimum sectoral wage. The baseline models in columns 1 and 3 include only the three covariates shown in the table and a set of year effects. The richer specifications in columns 2 and 4 add controls for age and tenure (quadratics), white collar vs. blue collar occupation, firm size and firm age. In these models (and all other specifications in the paper) we report clustered standard errors, allowing a common component of variance at the four digit industry level (about 480 clusters).

The estimation results in Table 2 confirm that in our sample, as in other samples analyzed in the literature, wages are higher at more profitable firms. The effect of value added per worker

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[20]From equation (2b), $(w-m) = \gamma\ Q^*/L$, implying that a rough estimate of γ is the ratio of the average markup of the wage over the contractual minimum wage, divided by quasi-rent per worker. To construct the ratio we multiply the mean drift in row 7 (21.2 Euros per day) times 312 working days per year and divide by quasi-rent per worker in row 14 (which is in 1000s).

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 precisely estimated. The implied elasticities of wages with respect to quasi-rent per worker are reported at the bottom of the table, and center around 0.07.[21] 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 18 to 22 percent.

When the sectoral average wage is used as a measure of the alternative wage, the estimated coefficients on the capital stock per worker are very close to 0. In contrast, when we use the contractual minimum wage as the alternative wage, the estimated coefficients are negative, and around 10% as large (in magnitude) as the corresponding coefficients on value added per worker. The ratio of the effects of capital per worker and value added per worker is presented in the bottom row of the table, along with estimated standard errors (obtained by the delta method). Depending on the choice of the alternative wage, these simple OLS models suggest either complete hold-up (columns 1-2) or roughly full offset of the cost of capital in the appropriate quasi-rent expression assuming the user cost of capital is 10% (columns 3-4).

We are uncertain of the reasons for the discrepancy, though we believe the sectoral minimum wage is a conceptually better measure of the outside wage in the Italian setting.[22] As we

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[21]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 hold-up 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.

[22] The difference is not due to the different samples used in columns 1-2 and 3-4: when we fit the model using the industry-average wage to the subsample for which we can match a sectoral

show below, in models that include job-match effects, the estimated wage offset for capital is very similar whether we control for the sectoral minimum, the industry average wage, or neither.

Following the discussed in Section II, the specifications in Table 2 assume that the firm's capital-labor ratio is approximately constant so we can estimate the full wage offset effect by including only the current capital stock per worker in our estimating models. As a check we estimated a parallel set of models that include both the current and future capital stocks per worker. In the absence of endogeneity problems equation (5) suggests that the respective coefficients provide estimates of $-\gamma\delta r$ and $-\gamma(1-\lambda)(1-\delta)\beta r$, with a sum that is (approximately) the same as the coefficient of capital per worker in our main specifications. In a model with the same controls as in column 3 of Table 2, for example, the estimated effect of current capital per worker is -0.016 (standard error =0.017), the effect of future capital per worker is -0.023 (0.012) and the sum of the coefficients is -0.039 (0.015), which is 15% as big as the estimated coefficient for value added per worker.. In a model parallel to the one in column (4), the estimated effect of current capital per worker is -0.022 (standard error =0.016), the effect of future capital per worker is -0.010 (0.011) and the sum of the coefficients is -0.032 (0.013), which is 12% as big as the estimated effect of value added per worker. Despite the potential for endogeneity bias in the measured effect of future capital per worker, these results are quite supportive of the conclusions from our baseline model, and suggest that the sum of the offset effects is approximately 10% as large as the effect of value added per work.

Although the models in Table 2 fit relatively well (the R-squared from the model in column 4, for example, is close to 50%), and yield profit-sharing effects that are comparable to those in many earlier studies, an important concern is the potential impact of unobserved

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minimum wage, we get results similar to those in columns 1-2.

heterogeneity in firm profitability and workers' skills. In particular, if more profitable firms tend to hire better-qualified workers (as suggested by Abowd, Kramarz and Margolis, 1999, for example) OLS models like those in Table 2 will overstate the causal effect of rent-sharing on wages. A number of recent studies have used matched worker-firm data to relate within-job changes in the profitability of the firm to within-job wage growth (see e.g., Margolis and Salvanes, 2001; Martins, 2009; Guertzgen, 2010). This approach eliminates biases caused by permanent heterogeneity due to worker, firm, or match-specific effects.

Table 3 presents estimation results from models that include unrestricted match effects. All the models in the table also include the richer set of controls included in the even-numbered columns of Table 2. OLS models are presented in columns 1 and 3. These specifications yield relatively small (but precisely estimated) estimates of the effect of profitability on wages. Compared to models without match effects (e.g., in Table 2), the implied elasticities of wages with respect to quasi-rents, and the implied estimates of the Lester range, are reduced by a factor of 8-10. Taken at face value these models suggest that rent sharing is statistically significant but quantitatively unimportant in explaining wage variability in Italy.

Nevertheless, a problem with including match effects is that these controls substantially reduce the variance in value-added per worker, potentially magnifying the attenuation effect of any measurement errors in value-added.[23] Causal inspection of the data suggests that there are often large fluctuations in firm-specific value added that are unrelated to labor or capital inputs and seem instead to reflect measurement errors or other types of transitory fluctuations. To address the

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[23]A similar problem has been widely noted in studies of the effects of union status and industry on individual worker data (Krueger and Summers, 1988; Card, 1996). In cross-sectional models the effect of measurement errors in union status and industry are negligible. In panel data models, however, the effects are substantial.

potential effects of such errors and fluctuations we constructed an instrument for value added per worker, based on average revenues per worker for firms in the AIDA data set in the same 4 digit industry but in other regions of Italy. This variable provides a proxy for industry-wide demand shocks that affect the profitability of employers in our sample, but should be uncorrelated with measurement errors or transitory fluctuations in value added. It is a relatively strong predictor of value added per worker for the employers in our sample (see the first stage F-statistics in row 7).

Columns 2 and 4 of Table 3 report within-spell IV estimates of our wage determination model. The IV strategy leads to a substantial increase in the magnitude of the estimated response of wages to value added: the implied elasticities of wages with respect to quasi rents are about one-half as large as the elasticities from the simple OLS models – in the range of 0.03 to 0.045. The IV strategy also yields estimates of the wage offset for capital per worker that are roughly one-tenth as large in magnitude as the responses to value added per worker. (See the bottom row of the table). This pattern is consistent with the predictions of a no-hold-up model and a user cost of capital of 10%. It is worth emphasizing, however, that we cannot rule out a modest hold-up effect. For example, if the true user cost of capital is 10% and one-quarter of capital investments are "held up" (i.e., $\lambda(1-\delta)$=0.25) we would expect the ratio of the effect of capital per worker and value added to worker to be 0.075 (i.e., 7.5%) a value that falls just outside an 80% confidence interval for the point estimate from the specification in column 4.

The large increases in the estimated coefficient of value-added per worker between the OLS and IV specifications in Table 3 suggest that the causal effect of this variable is substantially downward-biased in the OLS models with job match dummies. Very similar findings are reported by Abowd and Lemieux (1993) who estimate OLS and IV models of rent sharing using union contract data from Canada, and by Arai and Heyman (2004), who compare OLS and IV estimates of rent-sharing in Sweden, using worker-firm data with job-match effects. A related finding is reported by Guiso, Pistaferri, and Schivardi (2005), who use Social Security earnings and balance sheet data from Italy to analyze the responses of wages to permanent and transitory value-added shocks. They find that the response to permanent shocks is about 10 times larger than the response to transitory shocks. We believe that the permanent-transitory distinction in their results is very similar to our IV-OLS distinction, since our IV strategy identifies the response to industry-wide demand shocks, which are likely to be more persistent than firm-specific deviations from the industry means.

b. Instrumenting Capital per Worker

Although the IV estimates in Table 3 address the problem of measurement error in value added per worker, they (implicitly) assume that capital per worker is measured without error. Arguably, capital is also mis-measured, leading to potential attenuation bias in the offset effect of capital per worker on wages. In the AIDA data, capital is measured as the book value of past investments. Such a measure tends to evolve relatively smoothly but may nevertheless provide a noisy measure of the true capital stock. As a check we re-estimated the models, treating both value added and capital per worker as endogenous and using revenues per worker for firms outside Veneto and lagged capital per worker as instruments. The need for data on lagged capital leads to some reduction in our sample size because we lose all observations from 1995 (the first year of the AIDA data). The estimation results, presented in Table 4, suggest that allowing for potential measurement errors in current capital leads to an increase in the offset effect of capital, although the estimates are relatively imprecise and we cannot reject that the ratio of the coefficients of capital per worker and value added per worker is 10%. We conclude that specifications that ignore measurement problems in current capital provide, if anything, somewhat "conservative" estimates of the offset effect of capital costs in the wage determination model.

We also tried estimating specifications with match effects that include current and future capital per worker. Lacking credible instruments for current *and* future capital, we estimated these models assuming both were exogenous (but instrumenting value added per worker). The results showed significant negative effects of the current capital per worker, and very small but positive (and statistically insignificant) effects of future capital per worker, with sums very close to the coefficients on capital per worker reported for the baseline models in Table 3.[24] A concern with these estimates is that the measured effect of future capital may be upward-biased by firm-specific productivity shocks that cause increased investment and higher wages. In view of this issue we prefer to focus on specifications that include only the current capital stock, though it appears that the estimated degree of holdup – which depends on the sum of the capital per worker terms – is quite robust.

c. Allowing for Different Forms of Capital

The AIDA balance sheets include information on three broad categories of capital: tangible fixed assets (buildings and machinery); intangible fixed assets (intellectual property, accumulated research and development investments, goodwill); and current assets or "working capital" (inventories, receivables, and liquid financial assets). To investigate the effects of different types of capital, we re-estimated the IV models in Table 3, allowing separate coefficients

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[24]For a specification similar to the one in column 4 of Table 3 the estimated effect of value added per worker of 0.177 (standard error=0.076), the estimated effect of current capital per worker is −0.023 (0.008) and the effect of future capital per worker is +0.005 (0.003). The sum of the capital coefficients is 0.0181, which is 10.2% of the size of the value-added effect.

for measures of the amount of each type of capital per worker. The results are presented in Table 5. We find negative coefficients for all three types of capital, with the largest estimated offset effect for intangible fixed assets, an intermediate magnitude for tangible fixed assets, and the smallest magnitude for working capital. The ratios of the estimated offset coefficients to the coefficient of value added per worker are shown in the bottom rows of Table 5, and show a relatively low implicit return for current assets and a higher return for fixed assets.

The finding of a larger offset effect for fixed assets than working capital is the opposite of what might be expected if hold-up is more of a problem for sunk investments than relatively liquid forms of capital. Instead, the point estimates are consistent with the idea that the user cost of working capital is relatively low, whereas the user cost for fixed investments (which are arguably riskier, and require a higher return) is higher.

d. Differences by Sector

There are a number of reasons to expect that the parameters of our wage setting model may vary across industries. For example, the extent of firm-level bargaining varies by sector. To the extent that formal firm-wide contracting leads to more rent-sharing than informal person-level bargaining, the response of individual wages to firm-specific rents will vary accordingly. The types of capital and the riskiness of investment also vary by sector, leading to potential variation in the relevant user cost. To explore the heterogeneity by sector we fit a series of models similar to the IV specification in Table 3, using a number of alternative classifications of industries.

As an illustration, columns 1-4 of Table 6 present a simple 3-way classification that divides workers into three (roughly equal) groups: employees at manufacturing firms with high capital-intensity; employees at low capital-intensity manufacturing firms; and employees in non-manufacturing.[25] For simplicity we only show models that use the sectoral minimum wage as the measure of the alternative wage. The results for employees in manufacturing as a whole (column 1) are quite similar to our overall results (compare the estimates to those in column 4 of Table 3). Interestingly, the results for high capital intensity manufacturing (column 2) and low capital intensity manufacturing (column 3) are also quite similar, and close to the pooled results. By contrast, the results for non-manufacturing industries (column 4) suggest a smaller degree of rent-sharing in this sector. Nevertheless in all three sectors the ratio of the coefficient on capital per worker to the coefficient on value added per worker is close to -0.1, consistent with no holdup and a user cost of capital of around 10%. We conclude that there is some heterogeneity in the degree of rent sharing across industrial sectors but no strong evidence of differential hold-up.

As an alternative we used the Herfindahl index (estimated by four-digit industry in each year, using AIDA data on shipments for all firms in Italy) to classify job matches as belonging to more concentrated industries (Herfindahl above the median value) or less concentrated industries (Herfindahl below the median value). We then fit versions of the IV models in Table 3 to the two subgroups. The estimates, reported in columns 5 and 6 of Table 6, suggest that rent sharing is mainly limited to firms in high-concentration industries. In the high-concentration subsample the elasticity of wages with respect to quasi-rents is 0.07 – roughly 50% larger than in the sample as a whole. The ratio of the capital offset effect to the effect of value added per worker is relatively precisely estimated at just over 10%. In contrast, in the low-concentration sector there is no evidence of rent-sharing, and the measured wage offset for capital is extremely imprecise.

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[25]We construct an estimate of average capital per worker for each firm, and classify firms depending on whether the average is above or below the median for all firms in manufacturing.

e. Debt versus Equity Financing

In our theoretical and empirical discussions so far we have made no distinction between different sources of capital financing. A number of authors have pointed out that the use of debt financing is one way to mitigate the hold-up problems that arise between workers and firms (e.g., Baldwin, 1983; Dasgupta and Sengupta 1993; Subramaniam 1996). In the simplest version of this hypothesis it is assumed that debt holders have to be repaid before workers and owners receive any payments, implying that debt-financed capital costs are fully deducted from the quasi-rent before any rent-splitting.[26] This argument suggests that an alternative explanation for our "no hold-up" finding is the use of debt financing, particularly by firms that are most vulnerable to hold-up.[27]

To test this explanation we stratified the firms in our sample into two groups: those with an above-median ratio of debt to debt-plus-equity, and those with a below-median ratio. We then fit our basic IV specification (with match-specific fixed effects) to the two sets of firms separately. We found that the estimated coefficients of our model vary between subsamples, but that the no-hold-up finding is present for both types of firms. For example, using the sectoral minimum wage as a reference wage, for low-debt firms the estimated coefficient of value added per worker is 0.199 (standard error=0.104, and the estimated coefficient of capital per worker is −0.018 (standard error 0.011). By comparison, for high-debt firms the estimated coefficient of value added per worker is 0.089 (standard error=0.077), and the estimated coefficient of capital per worker is −0.012 (standard error 0.010). Although the estimates are relatively imprecise, in both

[26]As noted by Usman (2004), an implicit assumption is that renegotiation with creditors is costly in the event of no agreement. We are grateful to Bentley MacLeod for helpful discussions on the potential importance of debt in avoiding hold-up.

[27]Debt financing requires costly monitoring by lenders and may introduce its own moral hazard problems between managers and debt holders (Myers, 1977; Dasgupta and Sengupta, 1993). Thus, one would not expect debt financing to fully mitigate hold-up.

subsamples the ratio of the capital coefficient to the value-added coefficient is very close to 10% (8.8% with a standard error of 3.0% for low-debt firms; 13.4% with a standard error of 4.0% for high-debt firms). Based on these results, and other specifications that include interactions between the two main coefficients and the relative share of debt in the firm's financial structure, we conclude that the absence of hold-up in our sample does not does depend on the use of debt. If anything, in fact, the finding is slightly stronger for firms with relatively low levels of debt.

V. Conclusions

A growing literature in many different areas of economics has emphasized the potential importance of hold-up in long term relationships where binding contracts are unenforceable (see e.g., Che and Sakovics, 2008; MacLeod, 2010). Once a sunk investment is made by one party, some of the returns can be captured by the other, lowering the return to investment and causing inefficiency. The empirical significance of hold-up effects in the labor market is unclear. Existing studies from several different countries suggests that wages respond to employer-specific gains in productivity (e.g., van Reenan, 1996; Margolis and Salvanes, 2001; Martins, 2009; Guertzgen, 2010). Whether there is hold-up or not, however, depends on whether the wage bargaining process allows the firm to recoup its investment costs *before* splitting the rents with employees, and not on rent-sharing per se.

We use a large matched employer-employee data set from the Veneto region of Italy to estimate wage determination models that include separate effects for value-added per worker and capital per worker. We find systematic evidence of rent sharing, with an average elasticity of wages with respect to profits on the order of 3-5%, mainly arising from firms in more concentrated industries. We also find that firms with higher capital per worker pay lower wages, holding constant value-added per worker. The relative size of the deduction for capital is consistent with efficient investment (i.e., no hold-up) assuming an average user cost of capital of around 10%, though given the precision of the estimates we cannot rule out a modest degree of hold-up. For example, an 80% confidence interval around our baseline estimate of the ratio of the capital offset effect to the effect of value added per worker includes up to a 25% capture rate of past investments. We also find a larger wage offset for tangible assets than working capital – a pattern that is consistent with the higher user cost of tangible assets and supportive of the no hold-up hypothesis.

Our results suggest the need for caution in making inferences about the presence of hold-up from evidence on rent-sharing alone. In our setting it appears that workers receive a share of the rents that remain ***after*** the costs of capital are fully deducted. A similar conclusion is reached by Addison et al. (2007), who find no effect of gaining or losing coverage by a works council on plant-level investment rates in Germany. Of course different results could arise in other institutional settings, where workers may have less concern about the ability of firms to divert new investments. In any case, we believe that is important to carefully consider the measure of rents that is distributed in wage bargaining before reaching any conclusions about the impact of rent sharing on the efficiency of investment.

References

Abowd, John M. and Thomas Lemieux (1993). “The Effects of Product Market Competition on Collective Bargaining Agreements: The Case of Foreign Competition in Canada.” *Quarterly Journal of Economics* 108, pp. 983–1014.

Abowd, John M., Francis Kramarz, and David N. Margolis. (1999) “High-Wage Workers and High-Wage Firms.” *Econometrica*, 67(2), pp. 251-333.

Addison, John T. and Barry T. Hirsch (1989) “Union Effects on Productivity, Profits, and Growth: Has the Long Run Arrived?" *Journal of Labor Economics* 7, pp. 72-105.

Addison John T., Thorsten Schank, Claus Schnabel, and Joachim Wagner. (2007). “Do Works Councils Inhibit Investment?” *Industrial and Labor Relations Review* 60, pp. 187-203.

Arachi, Giampaolo and Federico Biagi (2005). “Taxation, Cost of Capital, and Investment: Do Tax Asymmetries Matter? *Gionale degli Economisti e Annali di Economia* 64 (2/3), pp. 295-322.

Arai, Mahmood. (2003) “Wages, Profitability and Capital Intensity: Evidence from Matched Worker-Firm Data.” *Journal of Labor Economics* 21 (3), pp. 593-618.

Arai, Mahmood, and Fredrik Heyman. (2004). “Microdata Evidence on Rent-Sharing.” FIEF Working Paper No. 198. Stockholm: Trade Union Institute for Economic Research (FIEF).

Baldwin, Carliss (1983). “Productivity and Labor Unions: An Application of the Theory of Self-Enforcing Contracts.” *Journal of Business* 56, pp. 155-186.

Becker, Gary S. (1962). “Investment in Human Capital: A Theoretical Analysis.” *Journal of Political Economy* 70 (Supplement), pp. 9-49.

Blanchflower, David G., Andrew J. Oswald, and Peter Sanfey (1996). “Wages, Profits and Rent-sharing.” *Quarterly Journal of Economics* 111 , pp. 227–251.

Bronars, Stephen G. and Donald R. Deere (1993) “Unionization, Incomplete Contracting, and Capital Investment.” *Journal of Business*; 66(1), pp. 117-32.

Card, David (1996). “The Effect of Unions on the Structure of Wages: A Longitudinal Analysis.” *Econometrica* 64, pp. 957-979.

Card, David, Francesco Devicienti and Agata Maida (2010). “Rent Sharing, Hold-up and Wages: Evidence from Matched Panel Data.” National Bureau of Economic Research Working Paper Number 16192, July.

Casadio Piero (2003), “Wage Formation in the Italian Private Sector After the 1992–93 Income Policy Agreements.” In G. Fagan, F.P. Mongelli and J. Morgan, editors, *Institutions and Wage Formation in the New Europe*, Cheltenham, UK: Edward Elgar, pp. 112–33.

Cella, G. P. and T. Treu (2009) *Relazioni Industriali e Contrattazione Colletiva*. Bologna: Il Mulino.

Che, Yeon-Koo and Jozsef Sakovics (2008). "Hold-up Problem." In Steven N. Durlauf and Lawrence E. Blume, editors, *The New Palgrave Dictionary of Economics,* Second Edition. New York: Palgrave Macmillan.

Cristini, Annalisa and Riccardo Leoni (2006). “The 93 July Agreement in Italy: Bargaining Power, Efficiency Wages, or Both?” In Nicola Acocella and Riccardo Leoni, editors, *Social Pacts, Employment and Growth: A Reappraisal of Ezio Tarantelli’s Thought.* Heidelberg: Physica-Verlag. pp. 97-122.

Christofides, Louis N. and Andrew J. Oswald (1992). “Real Wage Determination and Rent-sharing in Collective Bargaining Agreements.” *Quarterly Journal of Economics* 107, pp. 985–1002.

Connolly, Robert A., Barry T. Hirsch, and Mark Hirschey (1986). “Union Rent Seeking, Intangible Capital, and Market Value of the Firm." *Review of Economics and Statistics* 68 (4) pp. 567-577.

Crawford, Vincent F. (1988). "Long-Term Relationships Governed by Short-Term Contracts." *American Economic Review* 78 (3), pp. 485-499.

Dasgupta, Sudipto and Kunal Sengupta (1993). "Sunk Investment, Bargaining, and the Choice of Capital Structure." *International Economic Review* 34 (1), pp. 203-220.

Dell'Aringa, Carlo, and Claudio Lucifora. (1994). "Collective Bargaining and Relative Earnings in Italy." *European Journal of Political Economy,* Vol. 10, pp. 727–47.

de Menil, George (1971). *Bargaining: Monopoly Power versus Union Power*. Cambridge, MA: MIT Press

Denny, Kevin and Stephen J. Nickell (1992). "Unions and Investment in British Manufacturing Industry." *British Journal of Industrial Relations* 29 (1), pp. 113-121.

Dickens, William T. and Lawrence F. Katz (1986) "Industry Wage Patterns and Theories of Wage Determination." Unpublished Manuscript, University of California at Berkeley.

Elston, Julie Ann and Laura Rondi (2006). "Shareholder Protection and the Cost of Capital: Empirical Evidence from German and Italian Firms." CERIS-CNR Working Paper No. 8. Montcalieri (Italy): CERIS-CNR.

Farber, Henry (1986). "The Analysis of Union Behavior." In Orley Ashenfelter and Richard Layard, editors, *Handbook of Labor Economics* Volume 2. Amsterdam: North Holland.

Franzosi, Alessandra M. (2008). "Costo del Capitale e Struttura Finanziaria: Valutazione degli Effecti di IRAP e DIT." Instituto per la Ricerca Sociale (Milano) Unpublished Working Paper.

Grout, Paul A. (1984). "Investment and Wages in the Absence of Binding Contracts: A

Nash Bargaining Approach." *Econometrica* 52 (2), pp. 449-460.

Guiso, Luigi, Luigi Pistaferri and Fabiano Schivardi (2005). "Insurance within the Firm." *Journal of Political Economy* 113 (5), pp. 1054-1087.

Guertzgen, N. (2010). "Rent-Sharing and Collective Wage Contracts - Evidence from German Establishment-Level Data." *Applied Economics* 42 (22), pp. 2835- 2854.

Hildreth, A.K.G. and Andrew J. Oswald (1997). "Rent-sharing and Wages: Evidence from Company and Establishment Panels." *Journal of Labor Economics* 15, pp. 318–337.

Hirsch, Barry T. (2004). "What Do Unions Do For Economic Performance?" *Journal of Labor Research* 25, pp. 417-455.

ISTAT (2000). "La Flessibilità del Mercato del Lavoro nel Periodo 1995-96." *Informazioni* 34 Roma: ISTAT.

Krueger, Alan B. and Lawrence H. Summers (1988). "Efficiency Wages and the Inter-Industry Wage Structure." *Econometrica* 56, pp. 259-293

Lester, Richard A. (1952). "A Range Theory of Wage Differentials." *Industrial and Labor Relations Review* 5, pp. 483-500.

Machin, Stephen and Sushil Wadhwani (1991). "The Effects of Unions on Investment and Innovation: Evidence From WIRS." *Economic Journal* 101 (405), pp. 324-330.

MacLeod, W. Bentley (2010). "Great Expectations: Law, Employment Contracts, and Labor Market Performance." In Orley Ashenfelter and David Card, editors, *Handbook of Labor Economics* Volume 4. New York: Elsevier, forthcoming 2010.

Manning, Alan (1987). "An Integration of Trade Union Models in a Sequential Bargaining Framework." *Economic Journal* 97 (385), pp. 121-139.

Margolis, David N. and Kjell G. Salvanes. (2001). "Do Firms Really Share Rents with

Their Workers?" IZA Discussion Paper No. 330. Bonn: IZA.

Mariotti, Ilaria and Simona Montagnana (2008). "Italian Investments in the Agglomeration of Timisoara in Romania: Threat or Opportunity for Economic Development?" *Romanian Journal of Regional Science* 2, pp. 33-52.

Martins, Pedro (2009) "Rent Sharing Before and After the Wage Bill." *Applied Economics* 41 (17), pp. 2133-2151.

McDonald, Ian M., and Robert Solow (1981). "Wage Bargaining and Employment." *American Economic Review* 71, pp. 896-908.

Myers, Stewart (1977). "The Determinants of Corporate Borrowing." *Journal of Financial Economics* 4, pp. 147-175.

Nickell, Stephen J. and Sushil Wadhwani (1990). "Insider Forces and Wage Determination." *Economic Journal* 100(401), pp. 496-509.

Odgers, Cameron W. and Julian R. Betts. (1997). "Do Unions Reduce Investment? Evidence from Canada." *Industrial and Labor Relations Review* 51 (1), pp. 18-36.

Simons, Henry (1944). "Some Reflections on Syndicalism." *Journal of Political Economy* 52, pp. 1-25.

Slichter, Sumner. (1950). "Notes on the Structure of Wages. *Review of Economics and Statistics* 32, pp. 80–91.

Smith, Adam. (1976). *An Enquiry into the Nature and Causes of the Wealth of Nations*, Clarendon Press, Oxford.

Subramaniam, Venkat (1996). "Underinvestment, Debt Financing, and Long-Term Supplier Relations." *Journal of Law, Economics and Organizations* 12 (2), pp. 461-475.

Svejnar, Jan. (1986). "Bargaining Power, Fear of Disagreement, and Wage Settlements:

Theory and Evidence from U.S. Industry." *Econometrica* 54 (5), pp. 1055-1078.

Tattara, Giuseppe and Marco Valentini (2007). "The Cyclical Behavior of Job and Worker Flows." Working Paper No. 16. Department of Economics Ca' Foscari University of Venice.

Usman, Murat. (2004). "Optimal Debt Contracts with Renegotiation." *Journal of Economics and Management Strategy* 13 (4), pp. 755-776.

Van Reenen, John. (1996). "The Creation and Capture of Economic Rents: Wages and Innovation in a Panel of UK Companies" *Quarterly Journal of Economics* 111 (443), pp. 195-226.

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	1,990,751	985,160	416,587	305,364
2. Percent Female	42.3	34.4	27.3	26.8
3. Percent Age 30 or Less	45.6	39.8	41.3	42.5
4. Percent Age 45 or More	17.1	19.8	18.1	17.4
5. Percent White Collar	29.6	29.8	31.3	32.9
6. Mean Daily Wage (real Euros)	64.8	74.2	68.9	68.37
7. Mean Drift Component of Daily Wage (real Euros)	–	–	–	21.2
Characteristics of Firms:				
8. Number of Individual Firms	191,202	18,312	7,283	5,677
9. Firm Size [a]	7.0	36.0	54.4	54.8
10. Value Added/Worker (1000's real Euros)	–	59.7	44.6	44.5
11. Valued Added/Worker less Industry Mean Wage (1000's of real Euros)	–	31.5	24.4	20.1
12. Valued Added/Worker less Sectoral Min. Wage (1000's of real Euros)	–	–	–	30.2
13. Quasi-rent/Worker, using Industry Mean Wage (1000's of real Euros)	–	23.3	20.0	20.1
14. Quasi-rent/Worker, using Sectoral Min. Wage (1000's of real Euros)	–	–	–	26.2
Characteristics of Job Match:				
15. Number of Job Matches	3,111,990	1,223,889	452,136	328,824
16. Mean Duration of Job (years)	2.1	2.5	3.5	3.5

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 15 employees, part-time jobs, jobs held by apprentices and managers, and jobs in construction and sectors with a relatively small number of AIDA firms outside Veneto. 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.

[a]In column 1 firm size is based on number of employees as of October in VWH data. In other columns firm size is from AIDA data.

Table 2: 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	0.294 (0.027)	0.275 (0.026)	0.254 (0.029)	0.247 (0.028)
2. Capital Stock per Worker	0.000 (0.010)	0.004 (0.010)	-0.033 (0.013)	-0.028 (0.012)
3. Alternative Wage	0.629 (0.038)	0.374 (0.048)	1.757 (0.072)	1.467 (0.081)
4. Additional Controls	no	yes	no	yes
5. R-squared	0.223	0.353	0.445	0.494
6. Number of Person-Year Observations	1,395,031	1,395,031	984,329	984,329
Addendum:				
Elasticity of Wages w.r.t. Rents	0.073	0.068	0.078	0.076
Lester's Range	0.219	0.206	0.187	0.182
Ratio of Estimated Coefficients - row 2 ÷ row 1 (abs. value)	0.000 (0.035)	-0.016 (0.038)	0.132 (0.050)	0.114 (0.048)

Notes: Dependent variable in all models is log of average daily wage. Standard errors clustered by four-digit industry in parentheses. All models include year dummies. Controls added in columns 2 and 4 are: quadratic in age, quadratic in job tenure, dummy for white collar occupation, quadratic in firm age, quadratic in firm size.

Table 3: 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	0.032	0.117	0.030	0.146
	(0.005)	(0.062)	(0.007)	(0.071)
2. Capital Stock per Worker	-0.002	-0.012	-0.002	-0.015
	(0.003)	(0.007)	(0.003)	(0.008)
3. Alternative Wage	0.011	0.010	0.801	0.800
	(0.009)	(0.007)	(0.035)	(0.029)
4. Additional Controls	yes	yes	yes	yes
5. Number of Person-Year Observations	1,395,301	1,395,301	984,329	984,329
6. First-stage F-statistic	–	28.2	–	20.3
Addendum:				
Elasticity of Wages w.r.t. Rents	0.008	0.029	0.009	0.045
Lester's Range	0.024	0.087	0.022	0.108
Ratio of Estimated Coefficients - row 2 ÷ row 1 (abs. value)	0.074	0.107	0.058	0.105
	(0.098)	(0.025)	(0.111)	(0.023)

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 2 that vary within job spells. In IV models (columns 2 and 4) value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same 4 digit industry in the same year in other regions of Italy. Standard errors clustered by four digit industry in parentheses.

Table 4: IV Within-Spell Estimates of Rent Sharing Model, Treating Capital as Endogenous

	Using Industry Mean As Alternative Wage (1)	Using Sectoral Minimum As Alternative Wage (2)
1. Value Added per Worker	0.153	0.147
	(0.081)	(0.105)
2. Capital Stock per Worker	-0.038	-0.030
	(0.009)	(0.012)
3. Alternative Wage	0.009	0.790
	(0.008)	(0.034)
4. Additional Controls	yes	yes
5. Number of Person-Year Observations	1,127,153	806,348
6. First-stage F-statistic for Value added per Worker	13.9	10.4
7. First-stage F-statistic for Capital Stock per Worker	77.5	64.7
Addendum:		
Elasticity of Wages w.r.t. Rents	0.038	0.045
Lester's Range	0.111	0.105
Ratio of Estimated Coefficients - row 2 ÷ row 1 (abs. value)	0.251	0.203
	(0.122)	(0.119)

Notes: Dependent variable in both models is log of average daily wage. Models include a complete set of job-spell dummies as well as year effects and the covariates described in Table 2 that vary within job spells. Value-added per worker and capital per worker are treated as endogenous. Instruments are revenue per worker for firms in the same 4 digit industry in the same year in other regions of Italy, and lagged capital per worker at the firm. Standard errors clustered by four-digit industry in parentheses.

Table 5: IV Within-Spell Estimates of Rent Sharing Model, Distinguishing Three Types of Capital

	Using Industry Mean As Alternative Wage	Using Sectoral Minimum As Alternative Wage
	(1)	(2)
1. Value Added per Worker	0.120 (0.074)	0.154 (0.080)
2. Tangible Fixed Assets per Worker (plant and equipment)	-0.011 (0.007)	-0.013 (0.007)
3. Intangible Fixed Assets per Worker (intellectual property, R&D, goodwill)	-0.027 (0.013)	-0.033 (0.017)
4. Current Assets per Worker (inventories, receiveables, non-fixed financial assets, liquid funds)	-0.003 (0.007)	-0.005 (0.008)
5. Alternative Wage	0.010 (0.006)	0.801 (0.029)
6. Additional Controls	yes	yes
7. Number of Person-Year Observations	1,395,301	984,329
8. First-stage F-statistic Value added per worker	22.8	17.0
<u>Addendum:</u>		
Elasticity of Wages w.r.t. Rents	0.030	0.047
Lester's Range	0.090	0.113
Ratio of Estimated Coefficients (abs. value)		
Tangible Fixed Assets (row 2 ÷ row 1)	0.092 (0.025)	0.087 (0.024)
Intangible Fixed Assets (row 2 ÷ row 1)	0.225 (0.134)	0.217 (0.114)
Current Assets (row 4 ÷ row 1)	0.021 (0.047)	0.035 (0.032)

Notes: Dependent variable in both models is log of average daily wage. Models include a complete set of job-spell dummies as well as year effects and the covariates described in Table 2 that vary within job spells. Value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same 4 digit industry in the same year in other regions of Italy. Standard errors clustered by four-digit industry in parentheses.

Table 6: IV Within-Spell Estimates of Rent Sharing Model for Different Sectors

	Manufacturing versus Other Industries:				By Industry Herfindahl:	
	Manufacturing			Non	High	Low
	All	High K/L	Low K/L	Manufacturing	Concentration	Concentration
	(1)	(2)	(3)	(4)	(5)	(6)
1. Value Added per Worker	0.207	0.259	0.254	0.084	0.233	0.012
	(0.097)	(0.164)	(0.121)	(0.079)	(0.111)	(0.085)
2. Capital Stock per Worker	-0.021	-0.028	-0.024	-0.010	-0.024	-0.001
	(0.011)	(0.018)	(0.015)	(0.010)	(0.012)	(0.011)
3. Alternative Wage	0.789	0.761	0.811	0.814	0.776	0.816
(Sectoral Minimum)	(0.036)	(0.058)	(0.041)	(0.052)	(0.042)	(0.036)
4. Additional Controls	yes	yes	yes	yes	yes	yes
5. Number of Person-Year Observations	717,674	328,731	388,943	266,655	481,752	502,577
6. First-stage F-statistic Value added per worker	14.2	5.2	10.7	10.8	10.9	17.6
Addendum:						
Elasticity of Wages w.r.t. Rents	0.063	0.079	0.078	0.026	0.071	0.004
Lester's Range	0.152	0.191	0.187	0.062	0.171	0.009
Ratio of Estimated Coefficients - row 2 ÷ row 1 (abs. value)	0.102	0.108	0.093	0.123	0.104	0.120
	(0.027)	(0.033)	(0.034)	(0.047)	(0.026)	(0.331)

Notes: Dependent variable in all models is log of average daily wage. Models include a complete set of job-spell dummies as well as year effects and the covariates described in Table 2 that vary within job spells. Value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same 4 digit industry in the same year in other regions of Italy. Manufacturing firms are classified as having high or low capital per worker (K/L) if their ratio of capital per worker is above or below the median for all manufacturing firms. High/low concentration classification in columns 5-6 is based on Herfindahl index of sales for 4-digit industry in all of Italy. Standard errors clustered by four-digit industry in parentheses.