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

DAVID CARD

UC Berkeley and NBER

FRANCESCO DEVICIENTI

Università degli Studi di Torino and LABORatorio Ricardo Revelli, Collegio Carlo Alberto

and

AGATA MAIDA

Università degli Studi di Milano and LABORatorio Ricardo Revelli, Collegio Carlo Alberto

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Rent-sharing by workers can reduce the incentives for investment if some of the returns to sunk capital are captured in higher wages. We propose a simple measure of this “holdup” effect based on the size of the wage offset for firm-specific capital accumulation. Using Social Security earnings records for workers in the Veneto region of Italy linked to detailed financial data for their employers, we find strong evidence of rent-sharing, with an elasticity of wages with respect to potential rents per worker of around 4%, arising mainly at larger firms with higher price-cost margins. 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.

Key words: Rent-sharing, Hold up, Job match effects

JEL Codes: J31

1. INTRODUCTION

Do workers capture some of the rents earned by their employers? If so, does rent-sharing reduce investment by imposing a tax on sunk capital? Both questions have drawn much attention from economists.[1] Decades of research using industry and firm-level data have found a positive correlation between profitability and wages.[2] Van Reenen (1996) showed that average wages at a

1. Rent-sharing is discussed in Adam Smith (1976, Book I, Chapter 8). Simons (1944) argued that rent-sharing hurts investment, writing: “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) and Dickens and Katz (1987). Firm-levels studies include Nickell and Wadhwani (1990), Christofides and Oswald (1992), Abowd and Lemieux (1993), Blanchflower *et al.* (1996), and Hildreth and Oswald (1997).

firm rise following a successful innovation, suggesting that at least part of the correlation is causal. Recent studies that compare individual wages over time on the same job also find significant correlations with changes in profitability (*e.g.*, Guiso, *et al.* 2005; Arai and Heyman, 2009; Guertzgen, 2009; Martins, 2009). Whether rent-sharing inhibits investment, however, depends on the structure of bargaining and the irreversibility of capital. Grout (1984) showed that when long-term contracts are infeasible and capital is sunk, rent-sharing leads to under-investment. A number of analysts have argued that this "holdup" effect causes unionized firms to under-invest relative to their non-union competitors.[3]

In this article, we present new evidence on the extent of holdup in wage bargaining using matched employer–employee data from Italy. Starting from a simple model, we show that the distortionary effect of rent-sharing depends on the fraction of capital costs that a firm can recoup *before* splitting rents with its employees. With rent-sharing but no holdup, negotiated wages contain an offset for the full cost of capital. When some of the returns to sunk investments are captured by workers, however, the deduction for capital is smaller. Our empirical approach therefore focuses on the 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 holdup in this way.

We implement this approach using longitudinal Social Security earnings data for workers in the Veneto region of Italy, combined with detailed financial data for firms. Our econometric models relate the wages earned by individual workers to measures of value added and capital at their current employer and an estimate of wages that could be earned in other jobs. 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, though we also estimate specifications with only observable controls for worker productivity, and other models that include firm effects rather than job-match effects.

An important concern for our estimation strategy is the presence of transitory fluctuations in measured value added which will lead to downward bias in the estimated degree of rent-sharing, particularly in models that 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 labour supply. We validate this assumption by comparing results with and without data from specialized firms in the Industrial Districts of Veneto, where the feedback effects from industry-specific shocks are likely to be largest.

Our empirical findings point to two main conclusions. First, increases in firm-specific profitability lead to significant increases in wages for a typical firm in our sample. In cross-sectional models, the estimated elasticity of wages with respect to quasi-rents per worker is on the order of 6–10%. Within-job-spell estimates derived from our instrumental variables approach are smaller (around 4–5%) but still significant, suggesting that the simple correlation between wages and profitability reflects both ability sorting and rent-sharing. The elasticity of wages with respect to quasi-rents is bigger for larger firms, firms with greater market power, and firms with a higher likelihood of a firm-specific union contract.

Second, we find that wages are significantly *negatively* related to capital per worker. Indeed, the point estimates from a variety of alternative specifications are consistent with full offset of capital costs and a user cost of capital of around 10%—a value that is close to estimates of the

3. Studies showing a negative effect of unionization on investment include Connolly *et al.* (1986), Hirsch (2004), Denny and Nickell (1992), Bronars and Deere (1993), Odgers and Betts (1997), and Cardullo *et al.* (2013). Machin and Wadhwani (1991) find no significant effect. Likewise Addison *et al.* (2007) find no effect of works councils on investment by German firms.

user cost for firms in Italy during our sample period (*e.g.*, Gaiotti and Generale, 2001; Gennari *et al.*, 2005). These findings appear to be robust to a wide range of functional form and sample selection choices, though the precision of our estimates does not allow us to rule out some degree of holdup.

2. A SIMPLE MODEL OF RENT-SHARING AND WAGE DETERMINATION

2.1. *Model setup*

This section presents a simple two-period 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 holdup when capital accumulation takes time and investments are irreversible. We then show how holdup is reduced when in-progress investments are easier to liquidate than completed capital, and discuss other mechanisms that might mitigate holdup, including "efficient" bargaining between firms and workers (as in Crawford, 1988). Finally, we develop an empirical measure of holdup based on the relationship between wages, value added per worker, and capital per worker.

For simplicity, we assume that employment is fixed and that firms lease their capital stock period-by-period, but face a 1 period delay between the point they select the capital stock and when it is ready for use.[4] The timing is as follows: The game begins in period 1 with some 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 the parties receive their outside options.

Profits in each period depend on net revenues $R_t(K_t)$ minus the costs of labour and capital:

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

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

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

where m_t is a measure of the alternative wage in period t.[5] With these preferences, wages act as a pure transfer between the parties and the sum of their payoffs is:

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

which does not depend on w_t. Finally, we assume that the parties discount the future at a common discount factor β.

To complete the model, we need to specify the outside options of the parties. We assume that in the event of impasse the firm liquidates its existing capital and any in-progress investments. We

4. In an earlier version of this article (Card *et al.*, 2010), we present a model with variable employment and show that it yields similar predictions.

5. 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.

assume that a fraction δ of installed capital can be liquidated, yielding a payoff of $\pi_t^0 = -(1-\delta)r_t K_t$ if bargaining fails.[6] Given that K_2 is determined before 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. The liability for second period capital if the firm closes down in period 1 is therefore $\pi_2^0 = -\lambda(1-\delta)r_2K_2$. Finally, we assume that in the absence of agreement each worker earns the alternative wage m_t, implying that $u_t^0 = 0$.

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

$$[u_2(w_2) - u_2^0]^\gamma [\pi_2(w_2) - \pi_2^0]^{1-\gamma} \tag{1}$$

where $\gamma \in [0,1]$ represents the relative bargaining power of workers. The optimal wage w_2^* splits the gains from trade, implying:

$$u_2(w_2^*) - u_2^0 = \gamma Q_2 \quad \text{and}$$
$$\pi_2(w_2^*) - \pi_2^0 = (1-\gamma)\, Q_2,$$

where

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

is the "quasi-rent" associated with reaching agreement. Given our assumptions:

$$Q_2 = R_2(K_2) - m_2L - \delta r_2 K_2, \tag{2a}$$
$$w_2^* = m_2 + \gamma Q_2/L, \tag{2b}$$
$$\pi_2(w_2^*) = (1-\gamma)[R_2(K_2) - m_2L] - (1-\gamma\delta)r_2K_2. \tag{2c}$$

When capital is fully liquid, $\delta = 1$ and the quasi-rent expression in equation (2) deducts the full cost of capital (r_2K_2). When some fraction of capital is illiquid, however, the quasi rent is higher and the deduction is smaller. Differentiating π_2 with respect to K_2 yields:

$$\partial\pi_2/\partial K_2 = (1-\gamma)[\partial R_2/\partial K_2 - \theta r_2], \tag{3}$$

where

$$\theta = 1 + \gamma/(1-\gamma)\cdot(1-\delta) \geq 1$$

reflects the net cost of capital, taking account of "tax" imposed by rent-sharing. 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 on-going investments are easier to liquidate than fully installed capital, however, some of the potential holdup of the second-period capital stock can be offset by lower wages in period 1. Intuitively, the firm can use the threat of abandoning planned investment to extract wage concessions from workers. Consider the bargaining game in the first period, after K_2 has been selected by the firm. Taking account of the continuing value

6. Alternatively, the penalty for ending the capital lease early is $(1-\delta)$ per unit. A similar assumption is made by Grout (1984).

of the relationship, the payoff to workers of a 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 therefore maximizes:

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

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

$$\tilde{\pi}_1^0=\pi_1^0+\lambda\beta\pi_2^0=-(1-\delta)r_1K_1-\lambda\beta(1-\delta)r_2K_2.$$

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

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

The optimal first period wage sets:

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

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

Substituting $u_2(w_2^*)=\gamma Q_2$ and using the fact that $Q_2 = S_2-\pi_2^0$ leads to a first period wage of:

$$w_1^*=m_1+\gamma Q_1/L, \tag{5}$$

where

$$\begin{aligned}Q_1 &= S_1-\pi_1^0+(1-\lambda)\beta\pi_2^0\\ &= R_1(K_1)-m_1L-\delta r_1K_1-(1-\lambda)\beta(1-\delta)r_2K_2\end{aligned}$$

is the "effective" quasi-rent in period 1, taking account of the value of the continuing relationship. When $\lambda<1$, Q_1 contains an offset for the sunk component of K_2 that is held up in bargaining in period 2. In fact, when $\lambda=0$ the offset is just the (discounted) amount π_2^0 that is added to the quasi-rent in period 2 as a result of the irreversibility of capital.

This offset helps to re-align the firm's incentive for investment in period 2. In particular, using equation (4b) the firm's discounted profits can be written as

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

The firm chooses K_2 prior to bargaining in period 1 to maximize the sum of first- and second-period profits, leading to the first-order condition:

$$\partial[\pi_1(w_1^*)+\beta\pi_2(w_2^*)]/\partial K_2=(1-\gamma)\beta[\partial R_2/\partial K_2-\theta r_2]=0, \tag{6}$$

where

$$\theta=1+\gamma/(1-\gamma)\cdot h^*\geq 1,$$

and $h^*=\lambda(1-\delta)$ is an index of capital illiquidity. If in-progress investments are no easier to liquidate than installed capital, $\lambda=1$ and the value of θ is the same as in equation (3). When firms can more easily halt planned investments, however, $\lambda < 1$, and the degree of holdup is reduced. We suspect this mechanism may be relevant in our empirical setting, since many Veneto firms began out-sourcing production to Eastern Europe during the 1990s (see *e.g.*, Mariotti and Montagnana, 2008). Anecdotal evidence suggests that the threat of diverting new investment to offshore plants was used by firms to win wage concessions.

A number of other channels could also influence the degree of holdup (see Menezes-Filho and Van Reenen, 2003 for a related discussion). One possibility, analysed by Crawford (1988), is that w_1 and K_2 are *jointly* determined in first-period bargaining. Under this "efficient bargaining" assumption, there is no distortionary effect on investment: the wage in period 1 includes a complete offset for any holdup in period 2 regardless of the value of λ.[7] A second possibility is that firms use debt financing to mitigate holdup (*e.g.*, Baldwin, 1983; Dasgupta and Sengupta, 1993; Subramaniam, 1996). Assuming that debt holders have to be fully repaid if bargaining fails, this strategy can undo the effect of sunk capital.[8] Finally, in a richer model of product market interactions between competing firms, rent-sharing need not reduce investment. Ulph and Ulph (1989, 1994) consider a tournament style model of investment with variable employment and show that when workers bargain over employment and wages with the firm (but not investment), rent-sharing leads to an *increase* in investment.[9]

2.2. *Implications for estimating the degree of holdup*

The impact of rent-sharing on investment depends on the fraction of capital costs that are deducted prior to distributing the rents from bargaining. Specifically, equation (5) implies that in an ongoing relationship the negotiated wage in period t will depend on the alternative wage, revenues, and current and future capital costs:

$$w_t = m_t(1-\gamma) + \gamma R_t(K_t)/L - \gamma[\delta r_t K_t + \beta(1-\lambda)(1-\delta) r_{t+1} K_{t+1}]/L. \tag{5'}$$

Assume that the cost of capital is approximately constant for a given firm (though potentially different for different firms), and let $r_t = r_{t+1} = r$.[10] Assume in addition that the capital stock per worker is approximately a random walk, so we can write:

$$K_{t+1} = K_t + \nu_{t+1},$$

where ν_{t+1} represents a shock to the net capital stock. Substituting into the wage equation above and simplifying, we obtain:

$$w_t = m_t(1-\gamma) + \gamma R_t(K_t)/L - \gamma r(1-h)(K_t/L) + \varepsilon_t \tag{7}$$

where $h = \lambda(1-\delta) + (1-\beta)(1-\lambda)(1-\delta) \approx h^*$, the index of capital illiquidity from equation (6), and ε_t is a linear function of ν_{t+1}. Treating the final term as a residual component, this model has two main implications. First, controlling for net revenues per worker, higher capital per worker

7. Under joint bargaining over second period capital and the first period wage, the Nash bargain will maximize the joint surplus, leading to an efficient choice for K_2.

8. As noted by Usman (2004), the implicit assumption is that renegotiation with creditors is not possible in the event of no agreement.

9. Menezes-Filho *et al.* (1998) find empirical support for this prediction.

10. When it takes n periods to install new capital, the offset term in equation (5') will extend forward n periods, and we can think of r as the average user cost over this time horizon.

has a *negative* effect on wages. Second, the ratio of the coefficient of capital per worker to the corresponding coefficient of net revenue per worker is $r(1-h)$, where $h = 0$ if there is no holdup, and $h = 1$ if there is complete holdup. Given a value for r, we can infer the size of the holdup distortion in investment from this ratio, though we cannot separately identify λ and δ.

Importantly, equation (7) is also valid under several alternative bargaining models. For example, ignoring the potentially lower cost of liquidating in-progress investments leads to a variant of equation (5') with no future capital cost component. In this case, (7) is valid with $h = (1-\delta)$. Alternatively, if workers and firms bargain jointly over wages and future capital, or if firms *voluntarily* share rents with workers, then (7) is correctly specified with $h = 0$. Equation (7) therefore provides a convenient empirical model for assessing the degree of holdup regardless of the specific bargaining model.

For our main estimates we adopt a log-linearization of equation (7). Specifically, building on the observation that year effects and many other covariates (*e.g.*, job tenure) exert a roughly proportional effect on wages, we assume that rent-sharing results in a *proportional* premium:

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

where w_{it} is the average daily wage earned by worker i in year t, m_{it} is a measure of the opportunity wage, 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, which provides an estimate of $r(1-h)$. Comparing this ratio to a benchmark value of r provides an estimate of the illiquidity index h. We fit equation (8) using a variety of estimation strategies, and report on alternative functional forms to confirm the robustness of our findings.

Rather than attempt to derive our own estimate of the user cost of capital (r), we rely on two studies that estimate costs for a broad set of Italian firms in the 1990s: Gaiotti and Generale (2001) and Gennari *et al.* (2005). Both studies use financial information from the same underlying source as our data (described below), and both include relatively small firms (*e.g.*, the median size of firms in Gennari, Maurizi, and Staderini is 66 employees, which is comparable to the firms in our sample). Gennari *et al.* (2005) estimate that the user cost varied from 6.5% to 12% during our sample period (1995–2001), while Gaiotti and Generale (2001) present slightly higher estimates (9%–14%) for the period from 1995 to 1999.[11] Based on this evidence we conclude that a reasonable value for r is in the range of 10%–12%.

3. INSTITUTIONAL BACKGROUND, DATA SOURCES, AND DESCRIPTIVE OVERVIEW

3.1. *Institutional background*

Wage setting in Italy is governed by a "two-level" bargaining system (see Casadio, 2003, and Dell'Aringa and Lucifora, 1994). Sectoral agreements (typically negotiated every two years) establish contractual minimum wages for different occupation classes that are automatically extended to all employees in the industry. Unions can also negotiate firm-specific contracts that provide additional wage premiums. During the mid-1990s, about 40% of private sector employees were covered by firm-level contracts (ISTAT, 2000). In addition, individual employees receive premiums and bonuses that add to the minimum contractual wage covering their job.

11. Other studies that estimate the user cost of capital include Arachi and Biagi (2005), who report estimates in the range from 12.5% to 14.5% for manufacturing firms during 1995–1997, and Elston and Rondi (2006), who study listed firms and report a median user cost of 11% for 1995–2002.

As described below, our data allow us to identify the appropriate contract and occupation category for most workers, so we know the sectoral minimum wage that applies to their jobs. In our estimation sample, nearly all employees earn some premium above this level. (The 5th percentile of the percentage premium is 2.5% while the median is 24%). Unfortunately, we do not know whether a worker is covered by a firm-specific union agreement. We therefore interpret our empirical models as measuring the sum of the wage premiums received by an individual worker, including those due to firm-level union agreements. In Section 4.5, we use information on the propensity for firm-level unionization (by sector and firm size) to classify firms into those that are more or less likely to be covered by a firm agreement, and compare results for the two subsamples.

3.2. *Primary data sources*

Our data set combines three types of information: individual earnings records, firm financial data, and contractual minimum wage rates. The earnings data are derived from the Veneto Workers History (VWH) dataset, which is based on Social Security earnings records for private sector employees in the Veneto region over the period from 1975 to 2001 (see Tattara and Valentini, 2007). The VWH includes total earnings during the calendar year for each job, the number of days worked during the year, indicators 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. For firms the VWH includes industry (classified by five-digit ATECO 91), the dates of "birth" and closure of the firm (if applicable), detailed geographic information, and the firm's national tax number (*codice fiscale*).

Our balance sheet data are derived from standardized reports that firms are required to file annually with the Chamber of Commerce.[12] These data are distributed as the "AIDA" database by Bureau van Djik, and are available from 1995 onward for firms with annual sales above 500,000 euros. In principal, all (non-financial) incorporated firms with annual sales above this threshold are included in the database. The available 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 five-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 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 large 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-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.

3.3. *Matching employee data to the financial data*

We use fiscal 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 for the larger firms that are contained in AIDA, but is relatively low for very small firms that are either unincorporated or fall below the 500,000 Euro annual sales threshold for inclusion in

12. These data are known as the Company Register database (*Registro delle Imprese*). Law 580 of 1993 established the Chamber of Commerce as the depository for standardized financial and balance sheet data for all incorporated firms in Italy.

AIDA. Appendix Table A1 shows that for firm/year observations in the VWH with 50 or more employees, 90% or more can be matched to AIDA. The match rate falls to 48% for firm-year observations with 15–49 employees in the VWH, and to only 5% for firm-year observations with under 15 employees in VWH.

We evaluated the quality of our matching procedure 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, we eliminated a small number of matches for which the absolute difference between the number of employees reported in AIDA and the number found in the VWH exceeded 100. Removing these 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. The correlation between total wages and salaries for the calendar year reported in AIDA and total wage payments reported for employees in the VWH is also very high (0.98).

Column 1 of Table 1 provides some descriptive information on the set of workers aged 16–64 years who appear at least once in the VWH data between 1995 and 2001. This sample includes nearly 2 million individuals who were observed in 3.11 million job spells at 191,000 firms. About 40% of the workers are female, while just under one-half are younger than the age of 30 years and about one-sixth are aged 45 years or older. The mean daily wage (for jobs observed in 2000) was 65 Euros.

Column 2 of Table 1 shows the characteristics of the job-year observations we successfully matched to AIDA. (We exclude the small number of publicly traded firms prior to matching, since most of these firms have multiple branches in many sectors.) About one-half of all workers observed between 1995 and 2001 in the VWH can be matched to an AIDA firm: nearly all the non-matches are employees of very small firms that are absent from AIDA. Overall 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 derive our final estimation sample. First, to ensure that we capture any irregular bonus or salary payments, we eliminated job-year observations for jobs that lasted only part of a year. We also eliminated apprentices (whose wages are typically very low), managers (who may receive significant non-wage compensation), and part-time workers (to reduce measurement error due to lack of information on hours of work). Second, we eliminated employees in the construction industry, since our instrumental variables strategy relies on sales shocks in the same sector in other regions of Italy, and such shocks are arguably less relevant for firms in construction.[13] Third, we eliminated firms with fewer than 15 employees. These firms are exempt from many labour regulations (see *e.g.*, Schivardi and Torrini, 2008).[14] Moreover, we suspect that the degree of rent-sharing at these firms is limited. Indeed, as discussed below, we find that rent-sharing in Veneto is mainly confined to firms with 100 or more employees.

13. 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. Elimination of these sectors does not change the basic OLS rent-sharing models (in Table 2).

14. 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).

TABLE 1

Descriptive statistics for workers, firms, and job matches

	Universe of job-year observations	Matched job-year observations	Full sample	Estimation sample: Subset matched to sectoral minimum wage	Estimation sample: Subset matched to weighted average of sectoral minimum wages
	(1)	(2)	(3)	(4)	(5)
Characteristics of workers					
1. Number of individual workers	1,990,751	985,160	416,587	305,364	395,149
2. Per cent female	42.3	34.4	27.3	26.8	29.9
3. Per cent age 30 or less	45.6	39.8	41.3	42.5	41.2
4. Per cent age 45 or more	17.1	19.8	18.1	17.4	18.2
5. Per cent white collar	29.6	29.8	31.3	32.9	29.9
6. Mean daily wage (real Euros)	64.8	74.2	68.9	68.4	68.7
7. Mean drift component of daily wage (real Euros)	–	–	–	21.2	21.1
Characteristics of firms					
8. Number of individual firms	191,205	18,312	7,283	5,677	6,864
9. Firm size (number of employees)[a]	7.0	36.0	54.4	54.8	58.2
10. Value added/worker (1000's real Euros)	–	59.2	44.6	44.5	44.3
11. Valued added/worker less industry mean wage (1000's of real Euros)	–	33.1	24.4	24.3	24.1
12. Valued added/worker less sectoral min. wage (1000's of real Euros)	–	–	–	30.2	30.2
13. Quasi-rent/worker, using industry mean wage (1000's of real Euros)	–	23.3	20.0	20.1	19.7
14. Quasi-rent/worker, using sectoral min. wage (1000's of real Euros)	–	–	–	26.2	25.8
Characteristics of job match					
15. Number of job matches	3,111,061	1,223,889	452,136	328,824	427,322
16. Mean duration of job (years)	2.1	2.5	3.5	3.5	3.1

Notes: Sample in column 1 includes observed jobs for individuals between the ages of 16 and 64 years 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. Sample in column 5 includes job-year observations that can be matched to a weighted average of local sectoral minimum wages.
[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.

Finally, to reduce the influence of outliers, we delete firm-year observations with unusually high or low values of value added per worker and capital per worker (outside the 1%–99% range) of these key variables. As an alternative, we Winsorized the data at the 1% and 2% levels and obtained very similar results—see Section 4.2. 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.[15] As shown in Appendix Table A1, the estimation sample has about the same distribution across firm size categories as the overall matched VHW-AIDA sample, apart from the exclusion of firms with under 15 workers.

15. The largest reduction in sample size comes from the year-round job requirement. As discussed below, we find that adding in part-year workers has little effect on our main estimation results.

We were able to match information on the sectoral minimum wage for about 73% of the observations in the overall estimation sample. The resulting subsample 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 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, or about 25% of average total compensation.

Our bargaining model emphasizes the importance of the alternative wage that workers can earn in lieu of their current job. While the sectoral minimum wage or an industry average wage are potential choices for this variable, we also constructed a third potential alternative wage based on local mobility patterns and contractual minimums in each sectors.[16] Specifically, we began by assigning each firm to one of the 40 local labour markets (*Sistemi Locali del Lavoro, or SSL)* identified by ISTAT for the Veneto region based on home-to-work commuting patterns in the 2001 Census. Within each SSL, we then used our VWH sample to estimate average transition probabilities between two-digit industries for job-changers in the 1995–2001 period. (We do this separately for blue-collar and white-collar workers.) Finally, for each sector of origin × blue-collar/white-collar occupation group we calculate the alternative wage as a transition-probability-weighted average of the lowest sectoral minimum wage in each potential destination sector (ignoring any sectors for which we have no contract data).

Column 5 of Table 1 shows the characteristics of the subsample of workers in our main estimation sample that can be assigned this "weighted average of sectoral minimum wages". This subsample includes nearly 95% of the workers and 85% of the firms in the overall estimation sample, and is quite similar in terms of basic characteristics.

The entries in 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, 4, and 5. Row 11 shows the mean of value added per worker *minus* a crude estimate of the opportunity cost of labour based on the average wage in the firm's (two 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 holdup 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 minimum implies an estimate for γ of approximately 0.25.[17] We suspect that this estimate of workers' bargaining power is upward-biased, since it assumes that 100% of the markup over the sectoral minimum wage is a rent premium, whereas some fraction is probably due to skill differences that are rewarded in all jobs. Indeed, as discussed in Section 4.7 our estimates of the relationship between wages and quasi-rents suggest an estimate of γ in the range of 5–10%.

16. We are grateful to an anonymous referee for suggesting this wage measure.

17. 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).

TABLE 2
OLS estimates of rent sharing model

	Using industry mean as alternative wage		Using sectoral minimum as alternative wage		Using weighted average of sectoral minimums as alternative wage	
	(1)	(2)	(3)	(4)	(5)	(6)
1. Value added per worker	0.294	0.275	0.254	0.247	0.388	0.311
	(0.027)	(0.026)	(0.029)	(0.028)	(0.041)	(0.032)
2. Capital stock per worker	0.000	0.004	−0.033	−0.028	−0.009	0.004
	(0.010)	(0.010)	(0.013)	(0.012)	(0.013)	(0.012)
3. Alternative wage	0.629	0.374	1.757	1.467	1.185	0.305
	(0.038)	(0.048)	(0.072)	(0.081)	(0.206)	(0.107)
4. Additional controls	No	Yes	No	Yes	No	Yes
5. Number of person-year observations	1,395,031	1,395,031	984,329	984,329	1,327,493	1,327,493
Addendum						
Elasticity of wages w.r.t. rents	0.073	0.068	0.078	0.076	0.120	0.096
Ratio of estimated coefficients—	0.000	−0.016	0.132	0.114	0.024	−0.012
row 2 ÷ row 1 (abs. value)	(0.035)	(0.038)	(0.050)	(0.048)	(0.033)	(0.016)

Notes: Dependent variable in all models is log of average daily wage. All models include year dummies. Controls added in columns 2, 4, and 6 are as follows: quadratic in age, quadratic in job tenure, dummy for white-collar occupation, quadratic in firm age, quadratic in log of number of workers at firm. Standard errors clustered by four-digit industry in parentheses.

4. ESTIMATION RESULTS

4.1. *Basic results*

As a point of reference, Table 2 presents a set of simple OLS models which relate the average wage earned by an individual to the components of observed quasi-rent at his or her employer and a measure of the alternative wage. We present specifications with only year effects and the three covariates shown in the table, and models with a richer set of controls (including age and tenure, firm size, and firm age) for three choices of the alternative wage: the (two-digit) industry-wide average wage (columns 1 and 2); the sectoral minimum wage (columns 3 and 4); and the weighted average of sectoral minimums (columns 5 and 6). For the models in this table and throughout the article, we report standard errors that are clustered at the four-digit industry level (about 480 clusters). These are slightly *larger* than standard errors clustered at the firm level, reflecting a shared industry-level component of residual variance.

The estimates in Table 2 confirm that in our sample, as in other samples analysed in the literature, wages are positively correlated with value added per worker. The magnitude of the partial correlation varies somewhat depending on the measure of outside wage opportunities, and is also slightly lower when controls for worker and firm characteristics are added, 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 are in the range of 0.07–0.12.[18]

In contrast to the uniformly positive effect of value added per worker, the estimated effect of capital per worker varies with the choice of the alternative wage. Using the industry average wage or the weighted average of sectoral minimums as the alternative wage, the estimated coefficients on the capital stock per worker are very close to 0. Using the contractual minimum wage (which

18. 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.

may do a better job of controlling for unobserved worker skills), the estimated coefficient is clearly negative. The bottom row of the table shows the implied estimates of the return to capital (which are based on the ratio of the effect of capital per worker to the effect of value added per worker), along with standard errors (obtained by the delta method). Depending on the choice of the alternative wage, these estimates suggest either complete holdup (columns 1–2 and 5–6) or an offset that is consistent with a user cost of capital of about 10% (columns 3–4).

A concern with the models in Table 2 is unobserved heterogeneity in firm profitability and worker skills. In particular, if more profitable firms tend to hire better-qualified workers (as suggested by Bartolucci and Devicienti, 2012) OLS models like those in Table 2 will tend to *overstate* the causal effect of rent-sharing on wages. Several 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; Guertzgen, 2009; Martins, 2009). This approach eliminates biases caused by permanent heterogeneity due to worker, firm, or match effects.

Table 3 presents estimation results based on this within-job approach. In all cases, we include the richer set of controls included in the even-numbered columns of Table 2. Within-job models estimated by OLS are presented in columns 1, 3, and 5. These specifications yield 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 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.

While job dummies eliminate the biases due to unobserved worker and firm characteristics, the within-job correlation between wages and profitability is largely dominated by *short-run* fluctuations in value added per worker and wages. Inspection of the data suggests that there are often large year-to-year changes in sales and materials costs that are unrelated to labour or capital

TABLE 3
OLS and IV within-spell estimates of rent sharing model

	Using industry mean as alternative wage		Using sectoral minimum as alternative wage		Using weighted average of sectoral minimums as alternative wage	
	OLS (1)	IV (2)	OLS (3)	IV (4)	OLS (5)	IV (6)
1. Value added per worker	0.032	0.117	0.030	0.146	0.030	0.142
	(0.005)	(0.062)	(0.007)	(0.071)	(0.006)	(0.061)
2. Capital stock per worker	−0.002	−0.012	−0.002	−0.015	−0.003	−0.016
	(0.003)	(0.007)	(0.003)	(0.008)	(0.003)	(0.008)
3. Alternative wage	0.011	0.010	0.801	0.800	0.090	0.098
	(0.009)	(0.007)	(0.035)	(0.029)	(0.030)	(0.026)
4. Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
5. Number of person-year observations	1,395,301	1,395,301	984,329	984,329	1,327,493	1,327,493
6. First-stage F-statistic	–	28.2	–	20.3	–	28.5
Addendum						
Elasticity of wages w.r.t. rents	0.008	0.029	0.009	0.045	0.010	0.044
Ratio of estimated coefficients—	0.074	0.107	0.058	0.105	0.093	0.116
row 2 ÷ row 1 (abs. value)	(0.098)	(0.025)	(0.111)	(0.023)	(0.100)	(0.022)

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, 4, and 6) value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. Standard errors clustered by four-digit industry in parentheses.

inputs, reflecting choices about when to book sales or take a charge for input costs.[19] We suspect that many such changes are spurious and irrelevant for rent-sharing. Indeed, in an analysis based on Social Security earnings and financial data for Italian firms, Guiso *et al.* (2005) find that wages are about 10 times more responsive to permanent shocks in value added than to transitory shocks.

A simple approach to address the problem of spurious fluctuations in value added is to use an instrumental variable that is correlated with *systematic* changes in firm-specific profitability, but uncorrelated with other unobserved determinants of wages, including supply-side shocks. Given that our sample firms are located in the Veneto region, we decided to use average revenues per worker for firms in the same four-digit industry but in other regions of Italy as an instrument. 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 also a relatively strong predictor of value added per worker (see the first stage F-statistics in row 6).

Columns 2, 4, and 6 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 in the range of 0.03–0.045—about one-half as large as the elasticities from the simple OLS models in Table 2. The IV strategy also yields estimates of the wage offset for capital per worker that are robust to the choice of the alternative wage, and in all cases about one-tenth as large in magnitude as the responses to value added per worker, consistent with the predictions of a no-holdup model and a user cost of capital of 10%. Given the imprecision of the estimates and uncertainty about the precise level of capital costs, we obviously cannot rule out a modest holdup effect. For example, if the true user cost of capital is 12% 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 0.08 (*i.e.*, 8%), a value that is only marginally significantly different from the estimate in column 6 of Table 3.

We note that other studies have also found a much larger degree of rent-sharing in IV versus OLS models. Abowd and Lemieux (1993), for example, estimate wage determination models for union contracts in Canada and find very small rent-sharing effects in OLS specifications, but much larger effects when U.S. prices are used to instrument the quasi-rent measures. Van Reenen (1996) finds that instrumenting a measure of quasi-rents with indicators for firm-specific innovations and other industry-level variables leads to a doubling of the elasticity of wages with respect to quasi-rents. Arai and Heyman (2009) compare OLS and IV estimates of rent-sharing in Sweden using worker-firm data with job-match effects and find approximately 10 times larger impacts when profits per worker are instrumented with lagged profits.[20]

4.2. *Robustness checks*

We have conducted a number of robustness checks to ensure that the IV estimates in Table 3 are not simply an artefact of our sample selection procedures or the functional form of our models. In one set of checks, we compared the impact of censoring versus dropping outlying observations. Appendix Table A2 reports the baseline IV specification from column 6 of Table 3 and two alternatives: one Winsoring the top and bottom 1% of observations, and a second Winsorizing

19. We suspect that such fluctuations are especially large in our sample of relatively small non-listed firms since there is no "market discipline" on their accounting choices.

20. Margolis and Salvanes (2001) also find that IV estimates of rent-sharing are much larger than OLS estimates for both France and Norway, though their IV estimates are relatively imprecise.

the top and bottom 2% of observations. The key coefficient estimates are very similar under the alternative choices, suggesting that the choice to trim versus Winsorize the outlying observations is inconsequential.

We also checked whether exclusion of part time or part year workers have much impact on our findings. Appendix Table A3 reports two additional IV models: one that includes part-time workers (with a dummy variable added for part-timers); and a second that includes both part-time and part-year workers (with controls for part-time and part-year status). The estimates of the key parameters are very similar to those in column 6 of Table 3.

In a third series of checks, we considered alternative functional forms for our rent-sharing model. One alternative is to relate wages to the *logarithms* of value added per worker and capital per worker, rather than the levels of these variables. Appendix Table A4 (column 2) shows the estimated coefficients from this "log-log" specification, as well as the implied estimates of the derivatives of log wages with respect to capital per worker and value added per worker. The implied derivatives and their ratio are very similar to the corresponding estimates from our baseline model, suggesting that the choice of whether to use levels or logs of value added and capital per worker has little effect.

Another specification issue is whether to include log employment and its square as additional controls in the wage model. Adding these controls eliminates endogeneity bias in the measured effect of capital per worker due to a correlation between employment and the unobserved component of wages, for example due to overtime hours.[21] (Similar concerns about the effect of value added per worker are eliminated by the IV procedure). Appendix Table A4 (column 3) shows the estimated coefficients from a specification that excludes these controls. The estimated effects of capital per worker are *more negative* than in our baseline specification, consistent with a possible correlation between hours and employment. We conclude that including these controls in our baseline models leads to a more conservative estimate of the degree of offset for capital costs.

A fourth issue is the measurement of capital. For our baseline specifications we use the book value of capital, which is relatively noisy. As a check, we constructed our own capital series for firms that are continuously observed from 1995 onward, following the approach of Benfratello *et al.* (2001).[22] Appendix Table A5 shows estimates of our baseline specification and a parallel specification estimated using this re-constructed capital series. Estimates from these two specifications are very similar. In particular, the implicit user cost of capital is 9.7% (standard error 2.6%) using the newly constructed capital series for continuously observed firms.

A fifth concern with our IV strategy is that industry-level shocks may be correlated with the unobserved determinants of wages, leading to a bias in the estimated effect of value added per worker. Such biases are most likely to arise in specialized local labour markets, where many of the alternative jobs for a given worker are in the same narrowly defined industry as his/her current employer. To investigate the likely magnitude of these biases, we obtained a list of the "Industrial Districts" in the Veneto region identified by ISTAT using 2001 Census data.[23] We then re-estimated our wage model excluding the 15% of person-year observations contributed by employees of the main (two-digit) industry in each district. The results are reported in Appendix

21. If overtime hours rise when firms hire more workers, average daily wages will be negatively correlated with capital/worker leading to an estimated offset effect that is too large.

22. See the Appendix for details of the formula, which uses observed investments, industry- specific depreciation rates and price indices for investment goods, and the book value of capital in 1995 as a starting value for the capital stock in each firm.

23. See Boari (2001) for a detailed discussion of the classification of Industrial Districts in Italy, and de Blasio and Di Addario (2005) for an analysis of the effects of these districts.

Table A4 (column 4) and are quite similar to our baseline results, yielding an estimate of the implicit cost of capital of 12.1% (standard error 2.2%).

4.3. *First differenced models*

An alternative to the within-job estimation strategy used in Table 3 is to fit models in first differences. Although a "within" specification is more efficient if the model is correctly specified, there are several reasons to consider differenced models. Differencing is arguably more flexible than fixed effects, since unobserved factors need only be constant over a two-year horizon. Moreover, any misspecification is likely to lead to different biases in the fixed effects and first differenced models, so a comparison of the estimates provides an informal specification check. Finally, a differenced framework is more easily adapted to handle endogeneity in current capital per worker, arising for example from measurement error.

Columns 1, 3, and 5 of Table 4 present first-differenced models in which we treat value added as endogenous but assume capital per worker is exogenous. Building on our IV approach in Table 3, we use the change in revenues per worker at firms in the same four-digit industry in other regions of Italy as an instrument for the change in value added per worker. A comparison of these models with the corresponding IV models in Table 3 suggests that differencing yields somewhat larger estimates of the responses to both value added per worker and capital per worker than a within-job approach. The implied user costs of capital are quite similar from the two approaches, however, and consistent with no holdup and a 10% user cost of capital.

TABLE 4
IV differenced estimates of rent sharing model

	Using industry mean as alternative wage		Using sectoral minimum as alternative wage		Using weighted average of sectoral minimums as alternative wage	
	K/L exogenous (1)	K/L endogenous (2)	K/L exogenous (3)	K/L endogenous (4)	K/L exogenous (5)	K/L endogenous (6)
1. Value added per worker (first difference)	0.239	0.286	0.236	0.340	0.236	0.316
	(0.081)	(0.135)	(0.100)	(0.190)	(0.080)	(0.150)
2. Capital stock per worker (first difference)	−0.029	−0.030	−0.028	−0.028	−0.030	−0.031
	(0.011)	(0.016)	(0.013)	(0.017)	(0.011)	(0.017)
3. Alternative wage (first difference)	−0.001	0.002	0.562	0.491	0.033	0.042
	(0.003)	(0.004)	(0.019)	(0.034)	(0.013)	(0.021)
4. Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
5. Number of person-year observations	825,357	360,037	570,986	242,504	825,357	349,827
6. First-stage F-statistic (value-added)	25.8	10.8	17.7	6.4	26.1	9.3
7. First-stage F-statistic (capital)	–	140.6	–	79.0	–	170.4
Addendum						
Elasticity of wages w.r.t. rents	0.074	0.090	0.072	0.107	0.073	0.098
Ratio of estimated coefficients—	0.125	0.106	0.117	0.083	0.125	0.098
row 2 ÷ row 1 (abs. value)	(0.020)	(0.034)	(0.024)	(0.030)	(0.020)	(0.032)

Notes: Dependent variable in all models is first difference of log of average daily wage. All models include year effects and the covariates described in Table 2 that vary within-job spells (in first difference form). Models in columns 1, 3, and 5 treat capital per worker as exogenous and are estimated over the period from 1996 to 2001. Models in columns 2, 4, and 6 treat capital per worker as endogenous and are estimated over the period from 1997 to 2000. Instrument for change in value added per worker is change in revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. Instrument for change in capital per worker is difference between capital per worker between t – 2 and t + 1. Standard errors clustered by four-digit industry in parentheses.

While reassuring, this similarity does not address possible correlations between capital per worker and the error component in the wage equation. We suspect that the most likely source of such endogeneity is measurement error in the capital stock. A standard approach to endogeneity in panel data models is to use KL_{t-2} (the second lag of capital per worker) as an instrument for $\Delta KL_t = KL_t - KL_{t-1}$. Unfortunately, in our data the correlation between ΔKL_t and KL_{t-2} is weak (since capital per worker is close to a random walk) so this strategy will not work. Provided that the *only* source of endogeneity is serially uncorrelated measurement errors, however, we can use the longer difference $KL_{t+1} - KL_{t-2}$ as an instrument for ΔKL_t (see *e.g.*, Wooldridge, 2002, pp. 311–315).

Columns 2, 4, and 6 of Table 4 present the resulting IV estimation results, treating both value added per worker and capital per worker as endogenous. The effects of value added per worker and capital per worker are somewhat larger in magnitude than from the specifications in columns 1, 3, and 5, but less precisely estimated. Importantly, however, the *relative* size of the capital offset is similar whether we treat capital as exogenous or endogenous, and consistent with a user cost of capital of about 10%. Overall, we conclude that the size of the capital offset effect is robust to using fixed effects or first differences, and is also robust to a long-differences IV strategy that deals with serially uncorrelated measurement error in capital. We caution, however, that we have only limited ability to address the most general endogeneity concerns.

4.4. *Allowing for different forms of capital*

The balance sheets reported in AIDA include information on three broad categories of capital: tangible fixed assets (buildings and machinery); intangible fixed assets (intellectual property, 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 for each type of capital. The results are presented in Table 5. We find negative coefficients for all three types of capital, with the largest offset effect for intangible fixed assets, an intermediate offset for tangible fixed assets, and the smallest offset 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 relatively high implicit returns for fixed assets and relatively low implicit returns for current assets.

The finding of a larger offset effect for fixed assets is the opposite of what might be expected under a holdup story, since fixed assets are more vulnerable to holdup. Instead, the point estimates are consistent with full offset of capital costs and a lower user cost for working capital than fixed assets.

4.5. *Heterogeneity in rent-sharing and holdup*

The models presented so far ignore any heterogeneity across firms or workers in the degree of rent-sharing or holdup (apart from differences due to the structure of capital). In this section, we present estimates of our basic specification (from column 6 of Table 3) for different subgroups. Given the limited precision of our pooled estimates, we focus on pair-wise comparisons between relatively large subgroups of employers or workers. We also limit attention to our preferred alternative wage measure, the weighted average of sectoral minimums.

We begin in Table 6 by examining differences across firms that are likely to be correlated with the underlying level of rents per worker. Columns 1 and 2 of the table show results fit separately for larger firms (100 or more workers) and smaller firms (under 100 workers). A comparison of these models suggests that rent-sharing is important for larger firms. For smaller firms, however,

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	Using weighted average of sectoral minimums as alternative wage
	(1)	(2)	(3)
1. Value added per worker	0.120	0.154	0.148
	(0.074)	(0.080)	(0.074)
2. Tangible fixed assets per worker (plant and equipment)	−0.011	−0.013	−0.015
	(0.007)	(0.007)	(0.007)
3. Intangible Fixed Assets per Worker (intellectual property, R&D, goodwill)	−0.027	−0.033	−0.031
	(0.013)	(0.017)	(0.013)
4. Current assets per worker (inventories, receiveables, liquid funds)	−0.003	−0.005	−0.005
	(0.007)	(0.008)	(0.007)
5. Alternative wage	0.010	0.801	0.063
	(0.006)	(0.029)	(0.016)
6. Additional controls	Yes	Yes	Yes
7. Number of person-year observations	1,395,301	984,329	1,327,493
8. First-stage F-statistic	22.8	17.0	22.9
Addendum			
Elasticity of wages w.r.t. rents	0.030	0.047	0.046
Ratio of estimated coefficients (abs. value):			
Tangible fixed assets (row 2 ÷ row 1)	0.092	0.087	0.098
	(0.025)	(0.024)	(0.023)
Intangible fixed assets (row 3 ÷ row 1)	0.225	0.217	0.210
	(0.134)	(0.114)	(0.110)
Current assets (row 4 ÷ row 1)	0.021	0.035	0.035
	(0.047)	(0.032)	(0.034)

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 four-digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. Standard errors clustered by four-digit industry in parentheses.

there is no evidence that fluctuations in value added or capital have any significant effects on wages. Among larger firms the implied return on capital is 15.7% (standard error = 3.7%)—a value that does not suggest significant holdup problems, particularly since these firms may have somewhat lower capital costs than the overall sample of firms.

As noted earlier, we lack information on firm-level union contracts, which may be an important channel for rent-sharing in Italy. As an alternative we used a relatively recent firm survey—the 2005 Survey of Enterprises and Employment (*Rilevazione Imprese e Lavoro*), conducted by ISFOL, the Institute for Development of Vocational Training—to estimate a probit model for union coverage and impute the probability of coverage for firms in our sample. The model included 49 industry dummies and five firm-size dummies, as well as province dummies. Using the predicted coverage probabilities for Veneto region, we then divided firms in our sample into higher and lower predicted unionization groups, and fit the models reported in columns 3 and 4 of Table 6. As expected given the firm-size results in columns 1 and 2, and the strong connection between union coverage and firm size in the 2005 survey, we find that degree of rent-sharing is higher for the firms that are more likely to be covered by a union contract. For these firms the implied return on capital is 13.9% (standard error = 3.5%), providing little evidence of a holdup problem for firms that directly bargain with unions.

A third interesting way to classify firms is by their degree of market power. We use the Lerner index (*i.e.*, the price-cost margin) to classify firms as having above average or below average

TABLE 6
Differences in rent sharing and holdup by selected firm characteristics (IV within-spell estimates)

	By firm size		By probability that firm is covered by union contract		By firm-specific Lerner index (price-cost markup)	
	100+ workers (1)	< 100 workers (2)	Higher probability (3)	Lower probability (4)	Higher markup (5)	Lower markup (6)
1. Value added per worker	0.202	0.068	0.155	0.129	0.167	0.088
	(0.079)	(0.091)	(0.067)	(0.141)	(0.072)	(0.100)
2. Capital stock per worker	−0.032	−0.003	−0.022	−0.012	−0.024	−0.007
	(0.012)	(0.010)	(0.010)	(0.015)	(0.010)	(0.011)
3. Alternative wage	0.072	0.060	0.100	0.094	0.099	0.096
	(0.023)	(0.024)	(0.033)	(0.038)	(0.024)	(0.037)
4. Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
5. Number of person-year observations	575,418	752,075	663,098	664,367	616,151	711,342
6. First-stage F-statistic	19.0	12.9	24.5	8.7	24.1	15.3
Addendum						
Elasticity of wages w.r.t. rents	0.062	0.021	0.053	0.035	0.059	0.024
Ratio of estimated coefficients—	0.157	0.046	0.139	0.089	0.145	0.081
row 2 ÷ row 1 (abs. value)	(0.037)	(0.089)	(0.035)	(0.038)	(0.029)	(0.045)

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. Alternative wage is weighted average of sectoral minimum wages. Value added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. Standard errors clustered by four-digit industry in parentheses.

market power. Estimates for the two groups of firms, shown in the final two columns of Table 6, suggest that rent-sharing is mainly confined to firms with higher market power. (We obtain very similar results when we classify firms based on the Herfindahl index for their four-digit industry.) Among high-margin firms, the estimated wage effects of value added and capital are both highly significant. The elasticity of wages with respect to quasi-rents is about 0.06, while the implied return on capital is 14.5% (standard error = 2.9%), similar to the values for larger firms, and those with higher predicted union coverage rates. Among low-margin firms, value added and capital have relatively small and statistically insignificant effects on wages, suggesting little or no rent-sharing.

We have also examined differences along several other dimensions, including broad industry category (manufacturing versus other sectors) and, within manufacturing, by whether the firm has relatively high or low capital per worker. These results are summarized in Appendix Table A6. In brief, results for the manufacturing sector (which accounts for 75% of our observations) are quite similar to the results for the overall sample. Within manufacturing, we find that rent sharing is mainly confined to firms with higher capital per worker. For the non-manufacturing sector, the degree of rent sharing is imprecisely estimated, but we find a similar relative offset for capital as in the overall sample.

The degree of rent-sharing may also differ between groups of workers. We examined several different dimensions of employee heterogeneity, including men versus women and blue-collar versus white-collar. As reported in Appendix Table A7, we find small differences by gender but a bigger gap by occupation group. Specifically, the point estimates suggest a higher degree of rent-sharing for blue-collar workers than white-collar workers, though the standard errors of the estimates are large enough that the gaps are not significant. Interestingly, however, the implied returns on capital costs are very similar across occupation groups, suggesting no differences in the extent of holdup. We also examined differences by age and employee tenure, but found relatively small gaps. Overall, our analysis suggests that the heterogeneity in rent-sharing across different types of workers is less systematic than the heterogeneity across firms.

4.6. *Debt versus equity financing*

In our theoretical and empirical discussions so far we have made no distinction between different sources of capital financing. As we noted in Section 2, however, several analysts have argued that the use of debt financing may mitigate holdup problems. This suggests that an alternative explanation for the limited evidence of holdup in our main specifications is that firms with more rent sharing use more debt financing. 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 to the two sets of firms separately.

The results, reported in Appendix Table A8, show that the estimated coefficients of our model vary somewhat between subsamples, with stronger evidence of rent-sharing at low-debt firms, though the differences in coefficients between the two subsamples are not significant. Among both groups of firms, the estimated offset effect of capital is consistent with no holdup and a 10–12% user cost of capital. Overall, we conclude that the limited magnitude of the estimated holdup effect in our overall sample is not driven by high-debt firms.

4.7. *Comparisons with the literature*

A final issue we address is how our estimates of rent-sharing compare with the existing literature. Since many previous studies look at firm-level data (*e.g.*, Van Reenen, 1996), or use individual wage data with worker effects or firm effects rather than job match effects (*e.g.*, Martins, 2009), we begin by examining the sensitivity of our rent-sharing models to these choices. Table 7 shows estimates of our basic IV specification estimated in four ways: with job effects (column 1), with firm effects (column 2), with worker effects (column 3), and finally with firm effects but using the log of the average wage at the firm level as the dependent variable (column 4).

A comparison of columns 1–3 suggests that the use of firm effects leads to a slightly larger estimate of the sensitivity of wages to profitability, whereas the use of worker effects leads to a slightly smaller estimate. The use of firm-aggregated wage data (column 4) leads to point estimates that are close to our main specification but somewhat noisier. Despite these (relatively small) differences, the estimates from all four approaches support our two main conclusions: (1) wages contain an offset for capital costs consistent with a 10–12% user cost of capital; (2) the elasticity of wages with respect to quasi-rents per worker is on the order of 0.04–0.05 for employees at a typical firm in our sample.

Previous studies have not tried to estimate the offset for capital costs, but provide a range of estimates of the elasticity of wages with respect to quasi-rents. Two benchmark studies from the 1990s, Abowd and Lemieux (1993) and Van Reenen (1996), estimate relatively large elasticities (in the range of 0.25) from their preferred IV specifications. Abowd and Lemieux focus on unionized firms from the manufacturing sector in Canada, while Van Reenen studies listed manufacturing firms in the U.K. Both papers use average wage data, with no controls for worker quality. We suspect that the relatively large size of the firms and the absence of worker controls contribute to the relatively larger size of their estimated wage elasticities.

The more recent literature based on individual-level wage data tends to find much smaller elasticities of wages with respect to rents.[24] Margolis and Salvanes (2001) find only weak

24. As pointed out by Van Reenen (1996, pp. 214–215) many of the earlier firm-level studies including Christofides and Oswald (1992), Blanchflower *et al.* (1996), and Hildreth and Oswald (1997) also estimate rent-sharing elasticities in the range of 0.04.

TABLE 7
Comparisons of IV rent sharing model with job, firm, and worker effects

	Job spell effects (1)	Firm effects (2)	Worker effects (3)	Firm averaged wages with firm effects (4)
1. Value added per worker	0.142	0.174	0.119	0.125
	(0.061)	(0.062)	(0.053)	(0.070)
2. Capital stock per worker	−0.016	−0.018	−0.021	−0.010
	(0.008)	(0.008)	(0.008)	(0.009)
3. Alternative wage	0.098	0.023	0.105	0.110
	(0.026)	(0.054)	(0.028)	(0.039)
4. Additional controls	Yes	Yes	Yes	Yes
5. Number of observations	1,327,493	1,327,493	1,327,493	28,998
6. First-stage F-statistic	28.5	27.3	38.1	24.7
Addendum				
Elasticity of wages w.r.t. rents	0.044	0.063	0.043	0.045
Ratio of estimated coefficients—	0.116	0.101	0.175	0.081
row 2 ÷ row 1 (abs. value)	(0.022)	(0.022)	(0.025)	(0.033)

Notes: Dependent variable in columns 1–3 is log of individual-level average daily wage during the calendar year. Dependent variable in column 4 is log of average daily wage for all workers at firm. Model in column 1 include job-spell dummies. Models in column 2 and 4 include firm dummies. Model in column 3 includes worker dummies. All models include year effects and the covariates described in Table 2 that vary within-job spells (averaged to the firm level in the case of column 4). Alternative wage is weighted average of sectoral minimum wages. Value added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. Standard errors clustered by four-digit industry in parentheses.

evidence of rent-sharing for workers in France or Norway, with quasi-rent elasticities in the range of 0–0.03 from their IV specifications. Arai (2003) studies a small sample of Swedish workers observed in 1981 and 1991. His estimates of the elasticity of wages with respect to quasi-rents are in the range of 0.01–0.02. Arai and Heyman (2009) implement an IV estimation strategy using a much-expanded version of the data used in Arai (2003) and obtain quasi-rent elasticities in the range of 0.02–0.06. Martins (2009) uses longitudinal data for Portuguese workers employed at large firms over a three-year period. His IV estimates imply an elasticity of wages with respect to quasi-rents of 0.025–0.035. Guertzen (2009) studies a large sample of German workers employed at large manufacturing and mining companies in the 1995–2001 period. She estimates quasi-rent elasticities in the range of 0.01–0.06, with larger effects for employees at firms with firm-specific union contracts or no contracts. Finally, Guiso, Pistaferri, and Schivardi (2005) find an elasticity of wages with respect to permanent shocks in value added of 0.07 for a large sample of Italian workers and firms, implying a quasi-rent elasticity of about 0.035.

Overall, our estimates of the elasticity of wages with respect to quasi-rents are quite similar to estimates in other recent studies that use matched worker-firm data and a strategy to address measurement errors and/or transitory fluctuations in value added or profits. An estimated quasi-rent elasticity of 0.04–0.05 implies that the relative bargaining power of workers (γ) is low—in the range of 0.03–0.04.[25] With such a low level of bargaining power the distortion created by holdup is small, even in the worst-case scenario where all past investments are held up. Specifically, as shown in equation (6), the worst-case "tax" on investment caused by rent sharing is $\gamma/(1-\gamma)\approx\gamma$ when γ is small. Given that we also find a significant wage

25. The parameter γ gives the derivative of wages (in levels) with respect to quasi-rents per worker (in levels). Thus $\gamma = R\varepsilon_{WQ}$ where ε_{WQ} is the elasticity of wages with respect to quasi-rents and R is the ratio of the mean wage to mean quasi-rents per worker, which is about 0.83 in our data.

offset for capital, the distortionary effects of rent sharing on investment in our sample are small.

5. CONCLUSIONS

A growing literature in many different areas of economics has emphasized the potential importance of holdup 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 may be captured by the other, lowering the return to investment and causing inefficiency. The empirical significance of holdup effects in the labour market is unclear. Existing studies from several different countries suggests that wages respond to employer-specific gains in productivity (*e.g.*, van Reenan, 1996; Guiso *et al.*, 2005; Guertzgen, 2009; Martins, 2009). Whether there is holdup 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 4%–5%, mainly arising from larger firms with higher price-cost margins. The relative size of the deduction for capital is consistent with efficient investment (*i.e.*, no holdup) 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 holdup.

Our results suggest the need for caution in making inferences about holdup 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. 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 it 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.

APPENDIX: RECOMPUTING CAPITAL STOCK

In the AIDA dataset, capital is measured at the book-value (historical costs), and net of accumulated depreciation. To reconstruct the capital series at replacement cost, we adopted the procedures of Benfratello *et al.* (2001). Specifically, define:

K_t° = net fixed assets (net of accumulated depreciation),
K_t^{new} = net fixed assets, reconstructed at the replacement cost,
d = depreciation rate,
P_t^I = price index of investment goods,
A_t = amortization from the profit and lose accounts,
I_t = gross investment, where $I_t = K_t^{\circ} - K_{t-1}^{\circ} + A_t$.

A base year t_0 is selected ($t_0 = 1995$ in our case), and the following recursive formula is applied:

$$K_{t+1}^{new} = (1-d)(P_t^I/P_{t-1}^I)K_t^{new} + I_t,$$

where the value for the base year is set at the net book value of fixed assets in that period. We use sector-specific depreciation rates and price indices for investment goods, based on series reported by ISTAT for the calculation of aggregate capital stock in Italy.

TABLE A1
Number of firms and number of jobs in VWH, matched VWH-AIDA data, and estimation sample

	Universe of firm-year observations in VWH *N* (%) (1)	Firm-year observations in matched VWH-AIDA *N* (%) (2)	Column 2 ÷ Column 1 (3)	Job-year observations in matched VWH-AIDA *N* (%) (4)	Job-year observations in estimation sample *N* (%) (5)	Column 5 ÷ Column 4 (6)
Number of employees						
< 15	675,430 (88.6)	31,356 (38.7)	0.05	385,426 (12.8)	0 (–)	–
15–50	68,570 (9.0)	32,977 (40.7)	0.48	908,722 (30.1)	412,911 (31.1)	0.45
50–100	10,990 (1.4)	9,934 (12.3)	0.90	641,921 (21.2)	333,202 (25.1)	0.52
100–250	5013 (0.7)	4987 (6.2)	0.99	582,489 (19.3)	317,114 (23.9)	0.54
> 250	2028 (0.3)	1767 (2.2)	0.87	504,643 (16.7)	264,266 (19.9)	0.52
All	765,431 (100)	81,021 (100)	0.11	3,023,201 (100)	1,327,493 (100)	0.44

Notes: The universe in column (1) consists of all non-financial firm-year observations in the VWH data, including incorporated and non-incorporated businesses. The matched VWH-AIDA dataset of column (2) includes firm-year observations for incorporated businesses with an annual turnover larger than 500,000 euros that have financial information in AIDA. Firms owned by holding companies are excluded from matched VWH-AIDA data.

TABLE A2
Effect of alternative treatment of outliers

	Baseline model: trim top/bottom 1% (1)	Winsorize top/bottom 1% (2)	Winsorize top/bottom 2% (3)
1. Value added per worker	0.142	0.130	0.131
	(0.061)	(0.053)	(0.054)
2. Capital stock per worker	−0.016	−0.015	−0.015
	(0.008)	(0.007)	(0.007)
3. Alternative wage	0.098	0.015	0.018
	(0.026)	(0.022)	(0.021)
4. Additional controls	Yes	Yes	Yes
5. Number of observations	1,327,493	1,349,358	1,349,358
6. First-stage F-statistic	28.5	39.1	41.0
Addendum			
Elasticity of wages w.r.t. rents	0.044	0.041	0.042
Ratio of estimated coefficients—	0.116	0.116	0.114
row 2 ÷ row 1 (abs. value)	(0.022)	(0.021)	(0.021)

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 four-digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. Standard errors clustered by four-digit industry in parentheses.

TABLE A3

Effects of including part-time and part-year workers

	Include part-time workers (1)	Include part-time and part-year workers (2)
1. Value added per worker	0.170	0.187
	(0.069)	(0.077)
2. Capital stock per worker	−0.017	−0.017
	(0.009)	(0.009)
3. Alternative wage	0.058	0.063
	(0.018)	(0.026)
4. Additional controls	Yes	Yes
5. Number of observations	1,410,740	1,652,653
6. First-stage F-statistic	28.6	26.3
Addendum		
Elasticity of wages w.r.t. rents	0.051	0.056
Ratio of estimated coefficients—	0.099	0.093
row 2 ÷ row 1 (abs. value)	(0.021)	(0.020)

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. Value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. Model in column 1 includes dummy for part-time workers. Model in column 2 include dummies for part-time and part-year workers. Standard errors clustered by four-digit industry in parentheses.

TABLE A4

Effects of alternative functional form and controls for firm size

	Baseline model: VA/L and K/L linear; controls for firm size (1)	Alternative: use log(VA/L) and log(K/L) (2)	Baseline model but drop controls for firm size (3)	Baseline model but drop cluster firms in industrial districts (4)
1. Value added per worker	0.142	–	0.135	0.135
	(0.061)		(0.070)	(0.066)
2. Log (value added per worker) (coefficient × 10)	–	0.884	–	–
		(0.352)		
3. Capital stock per worker	−0.016	–	−0.036	−0.016
	(0.008)		(0.012)	(0.008)
4. Log (capital per worker) (coefficient × 10)	–	−0.087	–	–
		(0.039)		
5. Alternative wage	0.098	0.053	0.099	0.063
	(0.026)	(0.017)	(0.027)	(0.016)
6. Additional controls	Yes	Yes	Yes	Yes
7. Number of person-year observations	1,327,493	1,291,009	1,327,493	1,161,897
8. First-stage F-statistic	28.5	30.5	24.7	24.0
Addendum				
Elasticity of wages w.r.t. rents	0.044	0.045	0.042	0.042
Average derivative of log wage w.r.t. value added per worker	0.142	0.179	0.135	0.135
Average derivative of log wage w.r.t. capital per worker	−0.016	−0.019	−0.036	−0.016
Ratio of estimated derivatives—	0.116	0.109	0.264	0.121
capital per worker/value added per worker	(0.022)	(0.019)	(0.056)	(0.022)

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 (except in column 3, controls for log firm size and its square are dropped). Value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. In column 4, observations for firms in the most prevalent industry in industrial districts are dropped. Standard errors clustered by four-digit industry in parentheses.

TABLE A5
Effects of using perpetual-inventory-based capital stock

	Baseline model: book value of capital (1)	Estimated capital stock using investment and depreciation (2)
1. Value added per worker	0.142	0.145
	(0.061)	(0.062)
2. Capital stock per worker	−0.016	−0.014
	(0.008)	(0.007)
3. Alternative wage	0.098	0.113
	(0.026)	(0.040)
4. Additional controls	Yes	Yes
5. Number of observations	1,327,493	967,739
6. First-stage F-statistic	28.5	25.3
Addendum		
Elasticity of wages w.r.t. rents	0.044	0.047
Ratio of estimated coefficients—	0.116	0.097
row 2 ÷ row 1 (abs. value)	(0.022)	(0.027)

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. Value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. In column 2, capital stock is calculated by authors using perpetual inventory method for firms observed continuously from 1995 to 2001 only. Alternative wage is weighted average of sectoral minimum wages. Standard errors clustered by four-digit industry in parentheses.

TABLE A6
IV within-spell estimates of rent sharing model for different sectors

	Manufacturing versus other industries			
	Manufacturing			
	All (1)	Higher K/L (2)	Lower K/L (3)	Non-manufacturing (4)
1. Value added per worker	0.132	0.148	0.076	0.209
	(0.063)	(0.070)	(0.120)	(0.156)
2. Capital stock per worker	−0.014	−0.016	0.005	−0.027
	(0.008)	(0.008)	(0.020)	(0.018)
3. Alternative wage (sectoral minimum)	0.085	0.066	0.198	0.046
	(0.043)	(0.042)	(0.056)	(0.021)
4. Additional controls	Yes	Yes	Yes	Yes
5. Number of person-year observations	1,006,743	755,077	251,666	320,750
6. First-stage F-statistic value added per worker	30.2	23.0	24.1	8.6
Addendum				
Elasticity of wages w.r.t. rents	0.041	0.049	0.019	0.065
Ratio of estimated coefficients—	0.106	0.110	−0.072	0.131
row 2 ÷ row 1 (abs. value)	(0.030)	(0.028)	(0.363)	(0.029)

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 four-digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. 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 25th percentile for all manufacturing firms. Standard errors clustered by four-digit industry in parentheses.

TABLE A7

Estimated rent sharing models by gender and occupation group

	By gender		By major occupation group	
	Males (1)	Females (2)	Blue collar (3)	White collar (4)
1. Value added per worker	0.121	0.167	0.194	0.118
	(0.055)	(0.106)	(0.082)	(0.055)
2. Capital stock per worker	−0.014	−0.020	−0.021	−0.013
	(0.007)	(0.013)	(0.010)	(0.008)
3. Alternative wage	0.054	0.098	0.058	0.003
	(0.016)	(0.021)	(0.014)	(0.023)
4. Additional controls	Yes	Yes	Yes	Yes
5. Number of person-year observations	997,364	330,129	924,301	403,192
6. First-stage F-statistic	25.6	31.8	29.3	18.5
Addendum				
Elasticity of wages w.r.t. rents	0.037	0.052	0.060	0.037
Ratio of estimated coefficients—	0.114	0.119	0.110	0.111
row 2 ÷ row 1 (abs. value)	(0.027)	(0.021)	(0.019)	(0.034)

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 four digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. Standard errors clustered by four-digit industry in parentheses.

TABLE A8

Estimated rent sharing models for high and low debt firms

	Overall sample (1)	Lower-debt firms (2)	Higher-debt firms (3)
1. Value added per worker	0.142	0.171	0.105
	(0.061)	(0.075)	(0.083)
2. Capital stock per worker	−0.016	−0.018	−0.013
	(0.008)	(0.008)	(0.012)
3. Alternative wage	0.098	0.064	0.069
	(0.026)	(0.018)	(0.022)
4. Additional controls	Yes	Yes	Yes
5. Number of observations	1,327,493	659,930	667,563
6. First-stage F-statistic	28.5	22.0	11.1
Addendum			
Elasticity of wages w.r.t. rents	0.044	0.053	0.033
Ratio of estimated coefficients—	0.116	0.103	0.130
row 2 ÷ row 1 (abs. value)	(0.022)	(0.027)	(0.035)

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. Value-added per worker is treated as endogenous. Instrument is revenue per worker for firms in the same four-digit industry in the same year in other regions of Italy. Alternative wage is weighted average of sectoral minimum wages. Standard errors clustered by four-digit industry in parentheses.

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Supplementary Data

Supplementary data are available at *Review of Economic Studies* online.

REFERENCES

ABOWD, J.M. and LEMIEUX, T. (1993), "The Effects of Product Market Competition on Collective Bargaining Agreements: The Case of Foreign Competition in Canada", *Quarterly Journal of Economics*, **108**, 983–1014.

ADDISON, J.T., SCHANK, T., SCHNABEL, C. and WAGNER. J. (2007), "Do Works Councils Inhibit Investment?" *Industrial and Labor Relations Review*, **60**, 187–203.

ARACHI, G. and BIAGI, F. (2005), "Taxation, Cost of Capital, and Investment: Do Tax Asymmetries Matter?" *Giornale degli Economisti e Annali di Economia*, **64**, 295–322.

ARAI, M. (2003), "Wages, Profitability and Capital Intensity: Evidence from Matched Worker-Firm Data", *Journal of Labor Economics*, **21**, 593–618.

ARAI, M. and HEYMAN, F. (2009), "Microdata Evidence on Rent-Sharing", *Applied Economics*, **41**, 2965–2976.

BALDWIN, C. (1983), "Productivity and Labor Unions: An Application of the Theory of Self-Enforcing Contracts", *Journal of Business*, **56**, 155–186.

BARTOLUCCI, C. and DEVICIENTI, F. (2012), "Better Workers Move to Better Firms: A Simple Test to Identify Sorting", *Carlo Alberto Notebooks Number*, 259.

BENFRATELLO L., MARGON, D., RONDI, L., SEMBENELLI, A., VANNONI, D., ZELLI, S. and ZITTINO, M. (2001), "The New Ceris Panel On Italian Firms 1977–1997" (CERIS-CNR Working Paper Number 5–2001).

BLANCHFLOWER, D.G., OSWALD, A.J. and SANFEY, P. (1996), "Wages, Profits and Rent-sharing", *Quarterly Journal of Economics*, **111**, 227–251.

DE BLASIO, G. and DI ADDARIO, S. (2005), "Do Workers Benefit from Industrial Agglomeration?" *Journal of Regional Science*, **45**, 797–827.

BOARI, C. (2001), *Industrial Clusters, Focal Firms, and Economic Dynamism: A Perspective from Italy* (Washington DC: World Bank).

BRONARS, S.G. and DEERE, D.R. (1993), "Unionization, Incomplete Contracting, and Capital Investment", *Journal of Business*, **66**, 117–32.

CARD, D., DEVICIENTI, F. and MAIDA, A. (2010), "Rent-sharing, Holdup and Wages: Evidence from Matched Panel Data" (National Bureau of Economic Research Working Paper Number 16192).

CARDULLO, G., CONTI, M. and SULIS, G. (2013), "Sunk Capital, Unions and the Holdup Problem: Theory and Evidence from Sectoral Data" (Unpublished Working Paper, Department of Economics University of Genova).

CASADIO P. (2003), "Wage Formation in the Italian Private Sector After the 1992–93 Income Policy Agreements", in G. Fagan, Mongelli, F.P. and Morgan, J. (eds), *Institutions and Wage Formation in the New Europe* (Cheltenham, UK: Edward Elgar) 112–33.

CELLA, G.P. and TREU, T. (2009), *Relazioni Industriali e Contrattazione Collettiva* (Bologna: Il Mulino).

CHE, Y.-K. and SAKOVICS, J. (2008), "Holdup Problem", in Durlauf, S.N. and Blume, L.E. (eds), *The New Palgrave Dictionary of Economics*, 2nd edn. (New York: Palgrave Macmillan).

CHRISTOFIDES, L.N. and OSWALD, A.J. (1992), "Real Wage Determination and Rent-sharing in Collective Bargaining Agreements", *Quarterly Journal of Economics*, **107**, 985–1002.

CONNOLLY, R.A., HIRSCH, B.T. and HIRSCHEY, M. (1986), "Union Rent Seeking, Intangible Capital, and Market Value of the Firm", *Review of Economics and Statistics*, **68**, 567–577.

CRAWFORD, V.F. (1988), "Long-Term Relationships Governed by Short-Term Contracts", *American Economic Review*, **78**, 485–499.

DASGUPTA, S. and SENGUPTA, K. (1993), "Sunk Investment, Bargaining, and the Choice of Capital Structure", *International Economic Review*, **34**, 203–220.

DELL'ARINGA, C. and LUCIFORA, C. (1994), "Collective Bargaining and Relative Earnings in Italy", *European Journal of Political Economy*, **10**, 727–47.

DENNY, K. and NICKELL, S.J. (1992), "Unions and Investment in British Manufacturing Industry", *British Journal of Industrial Relations*, **29**, 113–121.

DICKENS, W.T. and KATZ, L.F. (1987), "Inter-Industry Wage Differences and Theories of Wage Determination" National Bureau of Economic Research Working Paper Number 2014.

ELSTON, J.A. and RONDI, L. (2006), "Shareholder Protection and the Cost of Capital: Empirical Evidence from German and Italian Firms", (CERIS-CNR Working Paper No. 8). (Moncalieri (Italy): CERIS-CNR).

FARBER, H. (1986), "The Analysis of Union Behavior", in Ashenfelter, O. and Layard, R. (eds), *Handbook of Labor Economics*, Vol. 2. (Amsterdam: North Holland).

FRANZOSI, A.M. (2008), "Costo del Capitale e Struttura Finanziaria: Valutazione degli effetti di IRAP e DIT" (Istituto per la Ricerca Sociale (Milano) Unpublished Working Paper).

GAIOTTI E. and GENERALE, A. (2001), "Does Monetary Policy Have Symmetric Effects? A Look at the Investment Decisions of Italian Firms" (Temi di Discussione No. 429). (Roma: Bank of Italy).

GENNARI, E., MAURIZI, G. and STADERINI, A. (2005), "Estimating the Reactivity of Investment to Tax Changes: The Case of Italy in the Nineties", *Politica Economica*, **3**, 435–460.

GROUT, P.A. (1984), "Investment and Wages in the Absence of Binding Contracts: A Nash Bargaining Approach", *Econometrica*, **52**, 449–460.

GUISO, L., PISTAFERRI, L. and SCHIVARDI, F. (2005), "Insurance within the Firm", *Journal of Political Economy*, **113**, 1054–1087.

GUERTZGEN, N. (2009), "Rent-Sharing and Collective Bargaining Coverage: Evidence from Linked Employer-Employee Data", *Scandinavian Journal of Economics*, **111**, 323–349.

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

HIRSCH, B.T. (2004), "What Do Unions Do For Economic Performance?", *Journal of Labor Research*, **25**, 417–455.

ISTAT (2000), "La Flessibilità del Mercato del Lavoro nel Periodo 1995–96", *Informazioni*, 34.

MACHIN, S. and WADHWANI, S. (1991). "The Effects of Unions on Investment and Innovation: Evidence From WIRS", *Economic Journal*, **101**, 324–330.

MACLEOD, W.B. (2010), "Great Expectations: Law, Employment Contracts, and Labor Market Performance", in Ashenfelter, O. and Card, D. (eds), *Handbook of Labor Economics*, Vol. 4. (New York: Elsevier).

MARGOLIS, D.N. and SALVANES, K.G. (2001), "Do Firms Really Share Rents with Their Workers?" (IZA Discussion Paper No. 330). (Bonn: IZA).

MARIOTTI, I. and MONTAGNANA, S. (2008), "Italian Investments in the Agglomeration of Timisoara in Romania: Threat or Opportunity for Economic Development?", *Romanian Journal of Regional Science*, **2**, 33–52.

MARTINS, P. (2009), "Rent-sharing Before and After the Wage Bill", *Applied Economics*, **41**, 2133–2151.

MENEZES-FILHO, N.A. and VAN REENEN, J. (2003), "Unions and Innovation: A Survey of the Theory and Empirical Evidence", (Center for Economic Policy Research Working Paper No. 3792). (London: CEPR).

MENEZES-FILHO, N.A., ULPH, D.T. and VAN REENEN, J. (1998), "The Impact of Unions on R&D: Empirical Evidence", *European Economic Review*, **42**, 919–930.

NICKELL, S.J. and WADHWANI, S. (1990), "Insider Forces and Wage Determination", *Economic Journal*, **100**, 496–509.

ODGERS, C.W. and BETTS, J.R. (1997), "Do Unions Reduce Investment? Evidence from Canada", *Industrial and Labor Relations Review*, **51**, 18–36.

SIMONS, H. (1944), "Some Reflections on Syndicalism", *Journal of Political Economy*, **52**, 1–25.

SCHIVARDI, F. and TORRINI, R. (2008), "Identifying the Effects of Firing Restrictions through Size-contingent Differences in Regulation", *Labor Economics*, **15**, 482–511.

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

SMITH, A. (1976), *An Enquiry into the Nature and Causes of the Wealth of Nations* (Oxford: Clarendon Press).

SUBRAMANIAM, V. (1996), "Underinvestment, Debt Financing, and Long-Term Supplier Relations", *Journal of Law, Economics and Organizations*, **12**, 461–475.

TATTARA, G. and VALENTINI, M. (2007). "The Cyclical Behavior of Job and Worker Flows" (Working Paper No. 16. Department of Economics Ca' Foscari University of Venice).

ULPH, A.M. and ULPH, D.T. (1989). "Labor Markets and Innovation", *Journal of Japanese and International Economics*, **3**, 403–423.

ULPH, A.M. and ULPH, D.T. (1994), "Labor Markets and Innovation: Ex-post Bargaining", *European Economic Review*, **38**, 195–210.

USMAN, M. (2004), "Optimal Debt Contracts with Renegotiation", *Journal of Economics and Management Strategy*, **13**, 755–776.

VAN REENEN, J. (1996), "The Creation and Capture of Economic Rents: Wages and Innovation in a Panel of UK Companies", *Quarterly Journal of Economics*, **111**, 195–226.

WOOLDRIDGE, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data* (Cambridge MA: MIT Press).