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WAGES, PROFITS AND RENT-SHARING

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ABSTRACT

The paper uses CPS data from 1964 to 1985 to test for the existence of rent-sharing in US labor markets. Using an unbalanced panel from the manufacturing sector, and random-effects and fixed-effects specifications, the paper finds that changes in wages are explained by movements in lagged levels of profitability and unemployment. The results appear to be consistent with rent-sharing theory (or a labor contract framework with risk-averse firms) and to be inconsistent with the competitive labor market model. The paper estimates the unemployment elasticity of pay at approximately - 0.03, and the profit elasticity of pay at between 0.02 and 0.05.

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1. Introduction

One of the oldest questions in economics is that of whether the market for labor can be represented satisfactorily by a standard competitive model. The importance of this question, which has implications for macroeconomics as well as labor economics, has stimulated much earlier research and more than a little controversy. The purpose of this paper is to blend microeconomic data on wages with industrial data on profits to produce a new test of the competitive market hypothesis. The results of the study suggest that, contrary to the implications of competitive theory, US pay determination exhibits elements of rent-sharing.

In a prominent early attack on traditional analysis, Sumner Slichter (1950) argued that a competitive model fails to explain the empirical evidence that apparently homogenous types of employee earn significantly different amounts in different industries. His data, drawn from the US manufacturing sector, showed that wages appeared to be positively correlated with various measures of the employer's 'ability to pay'. Slichter concluded that this correlation provides *prima facie* evidence against a conventional competitive model. Recent research into this issue by Dickens and Katz (1987), Krueger and Summers (1987, 1988) and Katz and Summers (1989) has reached the same conclusion using better data than were available in Slichter's time. Equivalent findings emerge from new work on European labor markets by, for example, Blanchflower *et al* (1990), Beckerman and Jenkinson (1990), Carruth and Oswald (1989), Holmlund and Zetterberg (1991), Denny and Machin (1991), and Nickell and Wadhwani (1990). The Canadian results of Christofides and Oswald (1992) point to the same conclusion.

Almost all of these studies estimate microeconometric wage equations and examine whether variables such as profitability enter positively and significantly in those equations. Such results, it is argued, imply that a competitive version of labor market theory is rejected because, in an atomistic wage-taking environment, high profits in a firm or industry should not affect the competitive requirement that employers pay neither more nor less than the going wage in the external labor market. An employer who offered epsilon above that market rate should -- whether or not high profits make such a wage feasible -- be flooded with job applicants from other sectors. In a competitive framework, an employer's ability to pay ought to have no effect upon the earnings of its workers. There ought to be no rent-sharing.

The primary purpose of this paper is to examine whether, in US manufacturing industry, there is evidence that wages depend upon the employer's ability to pay. It appears to be the first US study to do so in a way that can control for industry fixed effects[(1)]. A second purpose of the paper is to argue that, contrary to what has sometimes been asserted, the existence of some forms of positive correlation between wages and profitability would not automatically disprove competitive theory. Later sections derive three models in which a positive wage-profit correlation is to be expected; two of these models do not have non-competitive or rent-sharing features. The paper attempts to discuss the kind of wage-profit correlations that could be used to throw light on the usefulness of the competive model.

Section 2 studies the interactions between wages and profits in three different models. Section 3 contains the empirical results: it estimates US manufacturing earnings equations. Section 4 summarizes the paper's conclusions, and the Appendix describes the data.

2. Models of the Wage-Profit Correlation

The textbook model of a competitive labor market implies that firms are wage-takers whose profitability will not affect the wage that they offer to homogeneous employees. This is the assumption of an infinitely elastic supply of labor.

By contrast, the paper proves the following analytical results.

1. In a competitive model, given an upward-sloping labor supply curve, there is a positive short-run correlation between wages and profits. There may also be a positive correlation between

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[1]. An exception is the new paper by Steve Allen (1992), which we saw after this project had been largely completed. He finds that price-cost margins come in negative in a log wage equation. However, he does not look explicitly at the role of total profits or profits per worker. An interesting and relatively neglected paper that is close to being a further exception is Sparks and Wilton (1971), which finds profit effects in a form of micro Phillips curve.

wages and profit per employee: a sufficient condition for this is that the elasticity of labor demand be less than unity. There is no long-run relation between wages and profit variables.

2. In a labor contract model (with symmetric information) in which both workers and the firm are risk-averse, profits and wages are positively correlated. The elasticity of wages with respect to profits equals the ratio of the parties' relative risk-aversion parameters.

3. In a bargaining model with rent-sharing, there is a positive partial correlation between wages and profit per employee, and a negative partial correlation between wages and unemployment. These are long-run correlations in the sense that they exist in steady-state equilibrium.

The theoretical results establish that evidence of co-movement between pay and profitability is not, in itself, proof of the existence of rent-sharing. The remainder of this section sets out the proofs of the propositions stated above. Three models of wage determination are considered. The first is a bargaining framework in which rents are divided between the firm and its employees; the second is a competitive model in which the short run industry supply curve of labor slopes up; the third is an optimal labor contract model under which risk-sharing occurs.

Three Models

Consider a bargaining model in which rents exist and are divided between workers and the employer. Assume that wages are determined as if by a Nash problem in which ϕ is the bargaining power of employees. Write this maximization problem as

$$\text{Maximise } \phi \log\left\{\left[u(w) - u(\overline{w})\right]n\right\} + (1-\phi)\log\pi \tag{1}$$

where u(w) is the worker's utility from wage w, $\overline{w}$ is the wage available from temporary work in the event of a breakdown in bargaining, n is employment, and π is profits. This formulation relies on the assumption that in the event of bargaining delay the firm earns zero profit and the worker wage $\overline{w}$, and by the choice of units the variable n is also the probability of employment. Define profits as f(n)-wn, where f is a concave revenue function. The maximization's solution must be such that each side earn at least what is available as an outside option.

At an interior optimum, the following first order conditions hold:

$$w: \quad \frac{\phi u'(w)}{\left[u(w)-u(\overline{w})\right]n} - \frac{1-\phi}{\pi} = 0 \tag{2}$$

$$n: \quad \frac{\phi}{n} + \frac{(1-\phi)\left[f'(n)-w\right]}{\pi} = 0 \tag{3}$$

Rewrite the first of these as

$$w: \quad \frac{u(w)-u(\overline{w})}{u'(w)} = \left(\frac{\phi}{1-\phi}\right)\frac{\pi}{n} \tag{4}$$

This can be simplified using the first-order Taylor approximation

$$u(\overline{w}) \cong u(w) + (\overline{w} - w)u'(w) \tag{5}$$

Combining (4) and (5):

$$w \cong \overline{w} + \left(\frac{\phi}{1-\phi}\right)\frac{\pi}{n} \tag{6}$$

This equation shows that, to a first-order approximation, the equilibrium wage is determined by the outside wage available in the event of a temporary dispute in bargaining, the relative bargaining strength of the two sides, and the level of profit-per-employee.

Equation (6) is more general than might at first be apparent. Because it stems only from the first of the two first-order conditions, equation (6) is true independently of the nature of the employment function. In particular, it does not depend on whether employment is fixed along a labor demand curve or an efficient-bargaining locus.

A conventional assumption about the underlying determinants of $\overline{w}$, the outside temporary wage, is that it can be described by the function $c(w^0, b, U)$, where w^0 is the going wage in other sectors of the economy, b is the level of income when unemployed, and U is the unemployment rate among workers of the type employed by the firm. A natural interpretation of the algebra is that $\overline{w}$ is expected income and U determines the probability of receiving b rather than w^0. Written in full, therefore,

$$w \cong c\left(w^0, b, U\right) + \left(\frac{\phi}{1-\phi}\right)\frac{\pi}{n} \qquad (7)$$

In a regression equation for (7), estimated on longitudinal data, year dummies are likely to capture w^0 and b, leaving unemployment U and profit-per-employee π/n as the key explanatory variables.

At the other extreme from a bargaining model lies competitive theory. It is of interest to examine whether this, too, can imply a positive co-movement of wages and profitability[2]. Because the focus is the relationship between wages and profits, it is convenient to define a maximum profit function

$$\pi(\mu, w) = \max[\mu f(n) - wn] \qquad (8)$$

where employment, n, is chosen to maximize the difference between revenue and labor costs, and f(n) is a concave production function, μ is a demand shock (or output price) variable, and w is the wage. The function $\pi(\mu,w)$ is convex and homogenous of degree one in the prices μ and w. The later analysis will assume that the function is twice differentiable.

Assume that $\pi(\mu,w)$ represents the profit of the representative firm within an industry. By an appropriate choice of units, the long-run equilibrium level of profits can be set as $\pi(\mu,w) = 0$. This is the usual convention that profits be written net of some required return to the entrepreneur who runs the firm.

In this framework there is a labor demand curve defined by the derivative of the maximum profit function with respect to wages. Assume that there is also a labor supply function l(w) which may be upward-sloping in the short-run but which is horizontal in the long-run. This captures the competitive notion that, although in the long-run there should be free entry along a perfectly elastic labor supply curve, in the short-run there may be frictions that cause wages to be bid up by a demand shock.

Equilibrium in this market is given by the equation

2. This follows the method developed in Hildreth and Oswald (1992).

$$-\pi_w(\mu, w) = l(w) \tag{9}$$

where the function on the left is the demand curve for labor, and the function on the right is the supply curve of labor. The differential of equation (9) is

$$-\pi_{ww}dw - \pi_{w\mu}d\mu = l'(w)dw \tag{10}$$

so that the relationship between demand shocks and wages is

$$\frac{dw}{d\mu} = -\frac{\pi_{w\mu}}{l'(w) + \pi_{ww}} \geq 0 \tag{11}$$

showing that wages rise in a boom.

Because the profit function is homogeneous of degree one, π can be written

$$\pi = \mu\pi_\mu + w\pi_w \tag{12}$$

Differentiating this partially with respect to the wage:

$$\pi_w = \mu\pi_{\mu w} + w\pi_{ww} + \pi_w \tag{13}$$

Cancelling terms and re-arranging:

$$\frac{\pi_{ww}}{\pi_{w\mu}} = -\frac{\mu}{w} < 0 \tag{14}$$

To establish the reduced-form relationship between wages and profits, differentiate throughout the profit function $\pi(\mu, w)$ to give

$$\frac{d\pi}{dw} = \pi_\mu \frac{d\mu}{dw} + \pi_w \tag{15}$$

$$= -\pi_\mu[l'(w) + \pi_{ww}] / \pi_{w\mu} + \pi_w \tag{16}$$

$$= -\frac{\pi_\mu l'(w)}{\pi_{w\mu}} + \frac{\mu\pi_\mu}{w} + \pi_w \tag{17}$$

where equation (11) and (14) have been used to substitute terms.

The right hand side of equation (17) is non-negative. It is strictly positive if either supernormal profits are being made ($\pi > 0$), or the labor supply curve is strictly increasing. To check the former, note that, by homogeneity, $\pi > 0$ implies and is implied by

$$\frac{\mu\pi_\mu}{w}+\pi_w>0 \tag{18}$$

The latter follows from $l'(w) > 0$, and the fact that $\pi(\mu,w)$ is increasing in the demand shock μ and has a negative cross-partial derivative. Equation (17) shows that wages and profits are positively correlated.

A natural question to ask is that of whether there is also, within the competitive framework, a positive correlation between profit-per-employee and the wage. The answer is that there may be such a relationship.

Profit per employee is given by the ratio of profit to the wage-derivative of the profit function. Where n is employment, then,

$$\frac{\pi}{n}\equiv\frac{\pi}{-\pi_w} \tag{19}$$

so that

$$\frac{d}{dw}\left(\frac{\pi}{n}\right)=\frac{d}{dw}\left(\frac{\pi}{-\pi_w}\right) \tag{20}$$

Consider the derivative

$$\frac{d}{dw}(\pi_w)=\pi_{ww}+\pi_{w\mu}\frac{d\mu}{dw} \tag{21}$$

$$= - l'(w), \tag{22}$$

which uses equation (11) to cancel terms. Hence, the right hand-side of equation (20) can be written out in full, substituting from equations (12), (17) and (22), as

$$\frac{d}{dw}\left(-\frac{\pi}{\pi_w}\right)=-\frac{1}{\pi_w}\left[\frac{\mu\pi_\mu}{w}+\pi_w-\frac{\pi_\mu l'(w)}{\pi_{w\mu}}+\frac{\pi}{\pi_w}l'(w)\right] \tag{23}$$

$$=-\frac{1}{\pi_w}\left[\frac{\mu\pi_\mu}{w}+\pi_w-\frac{\pi_\mu l'(w)}{\pi_{w\mu}}+\frac{\mu\pi_\mu l'(w)}{\pi_w}+wl'(w)\right] \tag{24}$$

By earlier assumptions of an upward-sloping labor supply curve and non-negative profit

$$\frac{\mu\pi_\mu}{w}+\pi_w\geq 0 \tag{25}$$

$$wl'(w)\geq 0 \tag{26}$$

Then a sufficient condition for profit per capita and the wage to be positively correlated is:

$$-\frac{\pi_\mu l'(w)}{\pi_{w\mu}}+\frac{\mu\pi_\mu l'(w)}{\pi_w}\geq 0 \qquad (27)$$

Using the definition of the elasticity of labor demand, combined with equation (13), the inequality in (27) is guaranteed to hold if the labor demand elasticty is below unity. Hence, a sufficient condition for the term in square brackets in equation (24) to be positive is that the elasticity of labor demand be less than unity[3].

The final model to be considered is a generalization of the Baily (1974) and Azariadis (1975) optimal contract framework. In this the firm and workers are assumed to reach an implicit contract in which wages are set to provide efficient 'insurance' against random demand shocks.

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3. There is, in fact, a generalization of this result.
Equation (24), above is

$$\frac{d}{dw}\left(-\frac{\pi}{\pi_w}\right)=\frac{-1}{\pi_w}\left[\frac{\mu\pi_\mu}{w}+\pi_w-\frac{\pi_\mu l'(w)}{\pi_{w\mu}}+\frac{\mu\pi_\mu l'(w)}{\pi_w}+wl'(w)\right]$$

There are five terms in the square brackets. The sum of the first two is non-negative (equation (25)). Taking the other three terms, dividing by l' (w) and multiplying by $\pi_w\pi_{w\mu}$, we get

$$w\pi_w\pi_{w\mu}-\pi_\mu(\pi_w-\mu\pi_{w\mu}) \qquad (1')$$

We now examine when this is greater than zero. Using equation (14) to eliminate $\pi_{w\mu}$,

$$(\frac{-1}{\mu})w^2\pi_w\pi_{ww}-w\pi_{ww}\pi_\mu-\pi_w\pi_\mu \qquad (2')$$

or

$$-(\frac{w\pi_{ww}}{\mu})(w\pi_w+\mu\pi_\mu)-\pi_w\pi_\mu \qquad (3')$$

Recalling, first, that the absolute value of the elasticity of labour demand ε, equals $(\frac{w}{n})\pi_{ww}$, second, that the term in the second brackets in (3') equals π (equation (12)), the third, that $n = -\pi_w$, (3') becomes,

$$-\varepsilon n(\frac{\pi}{\mu})+n\pi_\mu \qquad (4')$$

For this to be greater than zero (dividing through by n) we need,

$$\varepsilon<\mu\frac{\pi_\mu}{\pi}=\frac{R}{\pi} \qquad (5')$$

where R is the firm's revenue. The modified sufficient condition for a positive correlation between wages and profits-per-employee, in words, is that the elasticity of labour demand is less than the ratio of revenues to profits. Note that in the special case of $f(n) = n^\alpha$, the elasticity of demand is equal to R/n but in this case the sum of the first two terms in equation (24) is unambiguously greater than zero (provided $\alpha < 1$). In this case, $d(\pi/n)/dw = (1/\alpha)(1 - \alpha)$.

Although the original articles assumed that firms are risk-neutral, and thus obtained the result that wages should be rigid, that assumption can be generalized to allow the firm to be averse to risk. The model then predicts a positive correlation between pay and profitability.

A labor contract model can be represented as the following maximization problem:

$$\text{Maximise} \int v(\pi)g(\mu)d\mu \tag{29}$$

subject to

$$\int [nu(w) + (1-n)u(b)]g(\mu)d\mu \geq \bar{u} \tag{30}$$

$$\pi \equiv \mu f(n) - wn \tag{31}$$

The solution is a wage function $w(\mu)$ defined on demand shocks. Implicit in the above formulation are the following assumptions. First, the firm's utility depends upon profits and can be represented by a concave function $v(\pi)$. Second, the worker receives utility $u(w)$ when employed and $u(b)$ when unemployed. Normalizing the size of the labor pool to unity, the probability of employment is n and of unemployment 1-n. Assume that there is no private unemployment insurance and that b is exogenously given (in line with the US data reported in Oswald (1986)). Demand shocks here follow a probability density function $g(\mu)$. Firms must offer their employees the market level of expected utility.

The key first-order conditions are

$$w(\mu):\ -v'(\pi) + \lambda u'(w) = 0 \tag{32}$$

$$n(\mu):\ v'(\pi)[\mu f'(n) - w] + \lambda[u(w) - u(b)] = 0 \tag{33}$$

where λ is a multiplier on the integral constraint (30) and is thus independent of μ. Equation (32) defines an implicit function linking profits and wages. Differentiating:

$$\frac{dw}{d\pi} = \frac{v''(\pi)}{\lambda u''(w)} \tag{34}$$

which is strictly positive if both parties are strictly risk-averse, is undefined if workers are risk-neutral, and is zero if firms are risk-neutral. The latter is the well-known case studied by Baily (1974) and Azariadis (1975).

Assume that workers' relative risk-aversion is r and the firm's relative risk-aversion is Ω. Then, combining (32) and (34),

$$\frac{dw}{d\pi}\frac{\pi}{w}=\frac{\Omega}{r} \qquad (35)$$

In words, the elasticity of wages with respect to profits is equal to the ratio of the firm's relative risk-aversion to the workers' relative risk-aversion. Here the firm and its employees choose to share the risk of demand fluctuations, so that wages and profits move together.

To summarize, the extreme competitive model, with instantaneous entry and exit of workers, implies that firms' wages will be unaffected by profit shocks. Intuition suggests that this result will disappear when frictions are introduced into the competitive framework, and this section formalizes that intuition. The testable characteristic of a competitive theory therefore becomes the hypothesis that long-run wage levels do not respond to profit movements. By contrast, there is a long-run relationship between pay and profits in either a rent-sharing model or a labor contract framework with risk-averse firms.

The remainder of the paper is an attempt to confront these theoretical hypotheses with data from the United States. Because no suitable matched microeconomic data exist -- reporting information both about employees and their employers -- it is necessary to splice together microeconomic data on individuals with industry-level profits data.

3. Results

This paper uses data on approximately 400,000 workers in US manufacturing industry. The data are drawn from the March tapes of the Current Population Survey (CPS), and cover the years 1964 to 1985(4). Although micro earnings equations at the level of the individual can be

4. The earnings data are taken from the 1965 to 1986 Current Population Surveys. Individuals are asked to report their earnings in the previous year. Thus, for example, 1964 earnings are derived

estimated directly on this sample (see Blanchflower and Oswald, 1992), the focus of interest is the impact of profitability, and this makes it necessary to take a different approach. To avoid the aggregation problems identified by Moulton (1986), which result in the standard errors in these kinds of micro-equations being artificially small, and to exploit the availability of industrial profit statistics, the data were converted into a panel of cell means. This satisfies Moulton's condition that the level of aggregation should be the same on both sides of the regression equation. The reported regressions, therefore, use an unbalanced panel of 19 industries by 22 years, giving 394 observations in all. Details of the industries covered are outlined in the Appendix. The dependent variable and all of the independent variables with the exception of the the year dummies are the calculated year/industry cell means from the underlying CPS data. The industry unemployment and profit data were merged from external sources and are also described in the Appendix (see also Sanfey, 1992). In our estimation we use unweighted data(5).

An application of the rent-sharing bargaining model is estimated in Table 1. This is a version of equation (7). The Table includes a set of individual control variables. These variables, which are traditionally incorporated in earnings equations, are assumed here to capture compositional effects of a kind omitted from the theoretical model based on a single kind of worker. The control variables are all measured as the proportion present in an industry/year cell and include average years of experience (the square was never significant), average number of years of schooling, percentage female, a set of variables distinguishing marital status and racial mix, the proportion of individuals employed in the private sector, the proportion part-time, and a full set of year dummies.

from the 1965 CPS. The use of an unbalanced panel was necessitated because of coding differences across the years in the industry variables.

5. There is some support in the literature for such an approach. For example, Dickens (1990) shows that it is inappropriate to weight because individual error terms are likely to be correlated due to group-specific error components, which means that weighting by say, the square root of group size is inappropriate.

Table 1 takes as the dependent variable the logarithm of workers' income in each industry by calendar year calculated from the aggregated CPS March files. Earnings equations for US manufacturing industry are estimated from 1964-1985. The dependent variable is entered in nominal terms; the price level, and other aggregate effects, are effectively subsumed into the year dummies. The first three columns of the Table are estimated by Ordinary Least Squares; the fourth is estimated by a one-way fixed-effects model while the fifth column is estimated using a one-way random effects panel estimator(6). The models estimated are of the general form

$$y_{it} = \mu_i + \beta' \mathbf{x}_{it} + \varepsilon_{it} \tag{36}$$

where $E[\varepsilon_{it}] = 0$ and $Var[\varepsilon_{it}] = \sigma_\varepsilon^2$. In the fixed effects model μ_i is a separate constant term for each unit. This model may be written

$$y_{it} = \alpha_1 d_{1it} + \alpha_2 d_{2it} + \ldots + \beta' \mathbf{x}_{it} + \varepsilon_{it} \tag{37}$$

$$= \alpha_i + \beta' \mathbf{x}_{it} + \varepsilon_{it} \tag{38}$$

where the α_i's are industry-specific constants and the dj's are dummy variables which are 1 only when j=1. In the random effects model (REM) μ_i is an industry specific disturbance. This model is as follows

$$y_{it} = \alpha + \beta' \mathbf{x}_{it} + \varepsilon_{it} + \mu_i \tag{39}$$

where E[ui] = 0, Var[ui] = σ_u^2, Cov[ε_{it}, u_i] = 0. All disturbances have variance

$$Var[\varepsilon_{it} + u_i] = \sigma^2 = \sigma_\varepsilon^2 + \sigma_u^2 \tag{40}$$

but for a given i, the disturbances are correlated,

$$Corr[\varepsilon_{it} + u_i, \varepsilon_{is} + u_i] = \rho = \sigma_u^2 / \sigma^2 \tag{41}$$

The efficient estimator is GLS. The variance components are first estimated with LIMDEP using the residuals from an OLS regression. Then feasible GLS estimates are computed using the estimated variances (see Green, 1990, chapter 16 and Hsiao, 1990, chapter 6).

Each of the earnings equations in Table 1 includes explanatory variables for profits per employee, industry unemployment and lagged earnings. The last of these is a conventional lagged

6. We also estimated using a two-way random effects estimator, but this was always rejected against both the fixed effects and one-way random effects models.

dependent variable. Unemployment is entered at the industry level and as a logarithm. In column 1 of Table 1 lagged earnings and profits are included in an OLS regression along with only a set of 21 year dummies. In column 2 the unemployment rate is added, followed by a series of worker characteristics variables in column 3. Column 4 includes the group fixed effects and column 5 is the random-effects model. Both Hausman's Chi-square and the Breusch-Pagan Lagrange multiplier statistics provide tests between the specifications and favor the random effects model. In what follows all estimation uses the REM model.

The lagged dependent variable, which is also in log form, falls in size from around 0.8 in the first two columns to only 0.14 in column 3 and then to below 0.07 in columns 5 and 6. This suggests that most of the auto-regression often found in wage equations is being picked up here by the worker characteristics variables plus the industry-specific fixed effects. Because of the smallness of the estimated coefficient on the lagged dependent variable in what follows, the long-run elasticities are only (approximately) one tenth larger than the short-run elasticities. The long-run unemployment elasticity, for example, is in absolute value no larger than 0.03, which suggests that a *ceteris paribus* doubling of an industry's unemployment rate would be associated with a three or four per cent drop in earnings. This is a little below the commonly-found elasticity of -0.1. Blanchflower and Oswald (1990) contains a summary of recent estimates. The negativity of the unemployment rate conforms to the prediction of the rent-sharing bargaining model. This effect appears to be robust across many specifications. If there is any simultaneity bias, it should act to make the coefficient smaller in absolute terms (that is, closer to a positive value).

Profit per employee is denoted by the symbol π/n. When entered contemporaneously in the full specifications of columns 4 and 5 of Table 1, profit per employee has a coefficient of 0.0022 with a t-statistic of approximately 2.3. The variable π/n is not entered as a log (because it takes the occasional negative value). To convert to an elasticity in this semi-log equation, therefore, it is necessary to multiply by the mean of the independent variable. The mean of π/n over the period is approximately 10, so this implies that the short-run profit elasticity of earnings is approximately 0.02, and the long-run elasticity is approximately 0.025.

Although later Tables discuss variants on these results, Table 1 conveys the main findings of the paper. As predicted by the rent-sharing model of equation (7), wages are positively correlated with profitability per employee and negatively correlated with the unemployment rate in the relevant industry. While this result comes through in an OLS specification without any controls, such as column 2 of Table 1, the parameter estimates generated in that way appear to be too large. The favored specification, the random effects model of column 5, has a much smaller coefficient on lagged wages, and coefficients on unemployment and profits-per-employee that are less than half those in the OLS specification of column 2.

It is not easy to see how these estimates could be compatible with the competitive labor market framework. The only possibility appears to be the one discussed earlier in the paper, namely, that temporary frictions could induce a short-term positive correlation between profits and pay. To investigate this issue it is necessary to examine the autoregressive structure of profits within wage equations.

Columns 1, 2, and 3 of Table 2 keep current profit per employee as a regressor, and add respectively profit per employee lagged one year, two years and three years. These maintain the random-effects specification. In each case the contemporaneous profit variable is statistically weak whilst the lagged value is precisely estimated. The sum of the profit coefficients is approximately 0.0035 in each of the equations 1 and 2 in Table 2. In column 3 it exceeds 0.0045. Columns 4-6 conduct the further experiment of removing the current profit variable, and the results are similar. The large coefficient on profits three years ago seems to be noteworthy; it is both larger and more precisely estimated than the more recent profit variables. At the mean, the long-run unemployment elasticity of profits-per-employee in column 6 is approximately -0.04. In column 7 all three lags are included, with the first and third positive and significant.

Table 3 keeps the same general form but allows for more complex lagged profit-per-employee terms. Columns 1 and 2 show profit terms going insignificant -- presumably because of collinearity -- although in each case the coefficients continue to sum to approximately 0.003. This is not, however, the natural or robust specification. Specifications 3-7 reveal the robustness of the profit term three years earlier. There is some indication that a change in profits (between t-1 and t-2) enters positively. However, the main result here appears to be that the sum of the profit coefficients is reliably close to 0.004. Again this implies that, at the mean, a doubling of profit per employee increases earnings by approximately five per cent. Because of the volatility of the π/n variable, this is quantitatively important.

Total industry profits, π, are used as an independent variable in Table 4. It can be seen that statistically this is nearly as well-defined as per capita profit (Table 1), and the direction of the effects is the same. The first three columns of the Table omit personal control variables, and the final three include them. There is little to choose between the results obtained using the fixed effects or the random effects model (columns 5 and 6 respectively). As found in Table 1, however, the REM model is preferred statistically on the basis of the Breusch-Pagan and Hausman tests. Consequently, the REM model is used in Tables 5 and 6.

Table 5 switches exclusively to a specification with total profits and no unemployment variable. The thrust of the results is the same as in the earlier tables, but some of the details differ. Lagged profits have consistently small coefficients when entered simultaneously with current profit. Total profit in the current period has a coefficient of approximately 0.00004 to 0.00005, and is well-defined. As the mean of industry profit is \$500m. approximately, the short-run profit elasticity of earnings is approximately 0.02. The lagged dependent variable continues to be small, so the long-run elasticity is only slighter larger than its short-run value. Table 6 sets out more complex dynamic forms in a format symmetric to Table 3.

Tables 4-6 correspond to the competitive and labor contract equation given as (17) and (34). They use total profitability, in other words, rather than profit-per-head as an independent variable.

Imagine an exogenous rise in demand for the products of industry j. Under the assumption of a competitive labor market with frictions, profits π^j and wages w^j will at first rise together. The correlation is induced by the outward shift in the demand curve for labor in industry j. However, workers of a given skill are then being rewarded more highly in industry j than in other sectors of the economy. The resulting inward migration of workers must, by competitive logic, eventually eliminate the wage gain. A blip in profits, therefore, can have no long-run effect on pay.

This prediction appears to be systematically violated by the data. Of the thirty-nine estimated equations in Tables 1-6, only four give any support to the view that profitability variables have no long run effect, and these four are statistically dominated by the other specifications.

The labor contract model of equations (29)-(35) offers an alternative interpretation of the data, and one that falls in the gap between competitive theory and the rent-sharing model. Equation (35) is a steady-state relation, capturing how wages vary in the contract as demand changes, and thus is immune to the criticism that the Tables reveal long-run effects from profit shocks. This model has no supernormal expected returns, so differs from the rent-sharing framework. Potential disadvantages are that it requires us to believe that individuals are between 20 and 50 times more risk-averse than firms (to be consistent with profit elasticities of pay of 0.02 - 0.05) and that it fails to explain why wages should react to industry unemployment.

One further check was done. It could be that the statistical significance of profitability in the wage equation stems merely from the existence of rent-sharing in certain high-wage heavily unionized parts of US manufacturing. Table 7, however, appears to cast doubt on that interpretation. It re-estimates the equations of Table 1 using a sub-sample of industries with low wages. These are the eight industries -- their identities are listed below Table 7 -- that pay below the mean level of earnings in the overall sample. Although this procedure inevitably reduces the number of observations (n=164), Table 7 continues to show evidence of the influence of profit-per-employee upon workers' remuneration. The coefficient on the profit variable in Table 7 varies from 0.0029 with a t-statistic of 2.8 to 0.0112 with a t-statistic of 3.47. Unemployment remains negative but is not well-determined.

Table 7 thus confirms the paper's main finding. Even within a subsample of industries with low levels of pay, there appears to be evidence of rent-sharing in US wage determination.

4. Conclusions

The principal finding of this paper is that wage determination in United States manufacturing industry appears to be better explained by a rent-sharing model than by a competitive framework. Controlling for industry fixed effects, and a range of personal and compositional variables, the paper shows that changes in workers' remuneration occur, in part, in response to earlier movements in profitability[7]. When firms become more prosperous, workers eventually receive some of the gains. This is the central prediction of non-competitive theories in which rents are divided between firms and workers.

The paper considers potential flaws in this kind of empirical test. It shows that wages and profits may exhibit co-movement in a variety of circumstances:

(i) in a modified competitive model where, because of frictions, labor supply temporarily slopes upwards;

(ii) in an optimal contract model in which workers and the employer are risk-averse;

(iii) in a bargaining framework in which there are non-competitive rents.

The first of these, however, is not compatible with the existence of a long-run association between earnings and profitability. It is this property that is the ultimate reason for the paper's rejection of competitive theory. There is evidence in these data of a long-run or steady-state relationship between remuneration and industrial profitability, and of fairly long lags on the key profit variables. These facts suggest that model (iii) fits the data most naturally[8].

The paper also discusses the properties of model (ii) in which there is an optimal implicit contract between risk-averse employees and a risk-averse employer. Taken literally, the empirical estimates suggest that the ratio of the parties' relative rates of risk-aversion is between 0.02 and

7. There are, of course, other sources of information on a wage-profit correlation, and some industrial relations researchers are likely to see these results as establishing statistically a relationship that they have observed many times in actual wage-setting. Blanchflower and Oswald (1988) documents direct questionnaire evidence of this type. Field experiments like those in Bazerman (1985) point in the same direction. For a recent survey of explanations for industry wage differentials, see Groshen (1991).

8. As this paper was being completed Jim Malcolmson convinced us that his new paper Macleod and Malcolmson (1993) may also generate a wage-profit relationship.

0.05, which implies that US workers are twenty to fifty times as risk-averse as the firms for which they work. A criticism of this interpretation of the estimated wage equations is that it fails to explain why the rent-sharing specification (model (iii)) does so well. Nevertheless, the labor contract model appears to be broadly consistent with the data, out-performs a standard competitive framework, and seems to deserve attention in future research.

Table 1. Earnings Equations for US Manufacturing, 1964-1985

	(1)	(2)	(3)	(4)	(5)
U_t		-.0716	-.0159	-.0239	-.0306
		(3.86)	(1.61)	(2.79)	(2.47)
$(\pi/n)_t$	.0060	.0060	-.0014	.0022	.0022
	(6.25)	(6.27)	(2.40)	(2.33)	(2.34)
w_{t-1}	.8217	.7896	.1396	.0654	.0672
	(34.71)	(31.97)	(5.95)	(2.73)	(2.83)
Year dummies	Yes	Yes	Yes	Yes	Yes
Personal controls	No	No	Yes	Yes	Yes
Fixed Effects	No	No	No	Yes	No
Random effects	No	No	No	No	Yes
R^2	.9559	.9576	.9905	.9946	.9864
Log likelihood	132.26	140.052	434.18	545.41	n/a
Autocorrelation e(i,t)	n/a	n/a	n/a	.3218	.0009
Lagrange multiplier test	n/a	n/a	n/a	n/a	343.85
Hausman test	n/a	n/a	n/a	n/a	2.6916
N	394	394	394	394	394

Source: Current Population Surveys - March tapes.

Note: personal control variables are averages across industry/year cells and are as follows 1) experience 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) part-time status variable 7) % female and 8) a constant. All unemployment rates U and the dependent variable w (annual income) are in natural logarithms.

T-statistics in parentheses.

Table 2. Earnings Equations for US Manufacturing, 1964-1985

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
U_t	-.0258	-.0269	-.0336	-.0257	-.0322	-.0289	-.0272
	(2.11)	(3.13)	(2.75)	(3.06)	(2.65)	(3.47)	(3.25)
$(\pi/n)_t$	-.0012	.0006	.0010	-	-		
	(0.73)	(0.54)	(1.01)				
$(\pi/n)_{t-1}$	.0042	-	-	.0032	-	-	.0032
	(2.61)			(3.44)			(1.97)
$(\pi/n)_{t-2}$	-	.0028	-	-	.0035	-	-.0035
		(2.39)			(3.51)		(1.51)
$(\pi/n)_{t-3}$	-	-	.0036	-	-	.0039	.0049
			(3.62)			(4.21)	(2.97)
w_{t-1}	.0624	.0594	.0531	.0627	.0592	.0535	.0541
	(2.64)	(2.50)	(2.25)	(2.66)	(2.49)	(2.26)	(2.29)
R^2	.9862	.9860	.9854	.9862	.9861	.9858	.9855
Autocorrelation e(i,t)	.0009	.0008	.0008	.0009	.0009	.0009	.0009
Lagrange multiplier test	348.34	334.31	339.26	345.18	333.15	337.80	338.88
Hausman test	2.7838	2.9063	3.1050	2.7982	2.8898	2.9887	3.1069
N	394	394	394	394	394	394	394

Source: Current Population Surveys - March tapes.

Note: all equations include full sets of year dummies (21), plus controls for 1) experience and its square 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) part-time status variable 7) % female and 8) a constant. All unemployment rates U and the dependent variable w (annual income) are in natural logarithms.

All variables including the dependent variable are measured as the mean of all observations in a year/industry cell.

T-statistics in parentheses.

Table 3. Earnings Equations for US Manufacturing, 1964-1985

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
U_t	-.0273	-.0266	-.0268	-.0289	-.0280	-.0272	-.0273
	(3.18)	(3.14)	(3.16)	(3.46)	(3.35)	(3.25)	(3.22)
$(\pi/n)_t$	-.0009	-	.0015	-	-	-	-.0002
	(0.53)		(1.28)				(0.12)
$(\pi/n)_{t-1}$	.0029	.0020	-	-	.0014	.0032	.0034
	(1.27)	(1.27)			(1.27)	(1.97)	(1.49)
$(\pi/n)_{t-2}$	.0012	.0015	-.0015	-.0002	-	-.0035	-.0035
	(0.74)	(0.89)	(0.80)	(0.11)		(1.51)	(1.51)
$(\pi/n)_{t-3}$	-	-	.0047	.0041	.0031	.0049	.0049
			(2.81)	(2.55)	(2.71)	(2.97)	(2.91)
w_{t-1}	.0604	.0602	.0532	.0535	.0534	.0540	.0541
	(2.54)	(2.54)	(2.25)	(2.26)	(2.26)	(2.29)	(2.29)
R^2	.9861	.9860	.9855	.9858	.9855	.9855	.9856
Autocorrelation e(i,t)	.0009	.0009	.0009	.0009	.0009	.0009	.0009
Lagrange multiplier test	334.10	331.97	339.50	339.06	338.16	338.88	340.57
Hausman test	2.9047	2.9043	3.1126	2.9965	3.0942	3.1069	3.1064
N	394	394	394	394	394	394	394

Source: Current Population Surveys - March tapes.

Note: all equations include full sets of year dummies (21), plus controls for 1) experience and its square 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) part-time status variable 7) % female and 8) a constant. All unemployment rates U and the dependent variable w (annual income) are in natural logarithms.

All variables including the dependent variable are measured as the mean of all observations in a year/industry cell.

T-statistics in parentheses.

Table 4. Earnings Equations for US Manufacturing, 1964-1985
(π = gross profits * 10^4)

	(1)	(2)	(3)	(4)	(5)	(6)
U_t	-	-	-.0217	-	-.0215	-.0213
			(1.57)		(2.53)	(2.52)
π_t	.5670	.5525	.5025	.4623	.4172	.4202
	(5.16)	(3.12)	(2.80)	(4.26)	(3.82)	(3.93)
w_{t-1}	.8401	.2619	.2557	.0683	.0645	.0655
	(35.83)	(7.06)	(6.94)	(2.88)	(2.73)	(2.80)
Personal controls	No	No	No	Yes	Yes	Yes
Fixed effects	No	Yes	Yes	Yes	Yes	No
Random effects	No	No	No	No	No	Yes
R^2	.9545	.9843	.9844	.9946	.9947	.9886
Autocorrelation e(i,t)						.0009
Lagrange multiplier test						349.48
Hausman test						2.3168
N	394	394	394	394	394	394

Source: Current Population Surveys - March tapes.

Note: all equations also include year dummies (22) plus a constant. All unemployment rates U and the dependent variable w (annual income) are in natural logarithms.

All variables including the dependent variable are measured as the mean of all observations in a year/industry cell.

T-statistics in parentheses.

Table 5. Earnings Equations for US Manufacturing, 1964-1985
(π= gross profits * 10^4)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
π_t	.3865	.4952	.4597	.4601	-	-	-
	(7.23)	(3.50)	(4.15)	(4.35)			
π_{t-1}	-	.1655	-	-	.3835	-	-
		(1.19)			(3.50)		
π_{t-2}	-	-	.0146	-	-	.1444	-
			(0.13)			(1.28)	
π_{t-3}	-	-	-	.2325	-	-	.2398
				(2.16)			(2.18)
w_{t-1}	.0695	.0674	.0693	.0664	.0685	.0751	.0745
	(2.96)	(2.86)	(2.94)	(2.83)	(2.88)	(3.12)	(3.11)
R^2	.9887	.9887	.9887	.9884	.9884	.9873	.9878
Autocorrelation e(i,t)	.0009	.0010	.0009	.0009	.0010	.0010	.0010
Lagrange multiplier test	336.06	337.61	333.46	340.64	325.84	311.13	315.59
Hausman test	2.1610	2.2739	4.2509	1.0070	2.3285	2.5826	2.4089
N	394	394	394	394	394	394	394

Source: Current Population Surveys - March tapes.

Note: all equations include full sets of year dummies (21), plus controls for 1) experience and its square 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) part-time status variable 7) % female and 8) a constant. All unemployment rates U and the dependent variable w (annual income) are in natural logarithms.

All variables including the dependent variable are measured as the mean of all observations in a year/industry cell.

T-statistics in parentheses.

Table 6. Earnings Equations for US Manufacturing, 1964-1985
(π = gross profits*10^4)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
π_t	.3573	-	.5233	-	-	-	.4145
	(2.65)		(4.67)				(3.07)
π_{t-1}	.2231	.4777	-	-	.3422	.5253	.2396
	(1.33)	(3.44)			(2.99)	(3.76)	(1.44)
π_{t-2}	-.0967	-.1559	-.2515	-.0165	-	-.3967	-.3760
	(0.68)	(1.10)	(1.68)	(0.11)		(2.27)	(2.18)
π_{t-3}	-	-	.3856	.2500	.1384	.3274	.3928
			(2.74)	(1.76)	(1.21)	(2.33)	(2.80)
w_{t-1}	.0679	.0691	.0679	.0747	.0675	.0680	.0663
	(2.88)	(2.91)	(2.91)	(3.11)	(2.84)	(2.88)	(2.84)
R^2	.9887	.9883	.9885	.9878	.9885	.9885	.9884
Autocorrelation e(i,t)	.0010	.0010	.0009	.0010	.0010	.0009	.0010
Lagrange multiplier test	333.63	322.83	340.19	316.00	329.09	329.15	340.43
Hausman test	2.1919	2.3221	2.6001	2.3017	0.0000	0.0000	2.3431
N	394	394	394	394	394	394	394

Source: Current Population Surveys - March tapes.

Note: all equations include full sets of year dummies (21), plus controls for 1) experience and its square 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) part-time status variable 7) % female and 8) a constant. All unemployment rates U and the dependent variable w (annual income) are in natural logarithms.

All variables including the dependent variable are measured as the mean of all observations in a year/industry cell.

T-statistics in parentheses.

Table 7. Earnings Equations for Low Wage Sectors, 1964-1985

	(1)	(2)	(3)	(4)	(5)
U_t		-.0680	-.0271	-.0071	-.0112
		(1.78)	(1.52)	(0.47)	(0.75)
$(\pi/n)_t$	.0103	.0109	.0029	.0112	.0091
	(5.00)	(5.29)	(2.83)	(3.47)	(3.70)
w_{t-1}	.5577	.5396	.0184	.0184	.0137
	(12.81)	(12.15)	(0.66)	(0.66)	(0.52)
Year dummies	Yes	Yes	Yes	Yes	Yes
Personal controls	No	No	Yes	Yes	Yes
Fixed Effects	No	No	No	Yes	No
Random effects	No	No	No	No	Yes
R^2	.9364	.9378	.9955	.9955	.9864
Log likelihood	125.87	127.72	215.28	261.35	n/a
Autocorrelation e(i,t)	n/a	n/a	n/a	.0684	.0009
Lagrange multiplier test	n/a	n/a	n/a	n/a	29.41
Hausman test	n/a	n/a	n/a	n/a	8.9378
N	164	164	164	164	164

Source: Current Population Surveys - March tapes.

Note: personal control variables are averages across industry/year cells and are as follows 1) experience 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) part-time status variable 7) % female and 8) a constant. All unemployment rates U and the dependent variable w (annual income) are in natural logarithms.

T-statistics in parentheses.

Low wage sector includes 8 industries with a mean wage for the period 1964-1985 below the mean level of $9561.50. The mean wage for this group is $7620.50 compared with $11240.75 for the 'high wage' sector. The 8 industries are as follows, with their average wage in parentheses 1. Lumber and Wood ($7591) 2. Furniture ($7268) 3. Stone, Clay and Glass ($9970) 4. Miscellaneous Manufacturing ($8513) 5. Food ($6986) 6. Textile Mills ($5401) 7. Paper ($9567) 8. Rubber ($6875)

Appendix. Description of Profit Variables

The profit variable (Sanfey's variable Profit3c) is derived as follows

$$\pi = \frac{\text{value added - payroll}}{\text{CPI}} \text{ - real depreciation - (real interest rate*real capital stock)}$$

For a detailed explanation of how these variables are derived see Sanfey (1992, Appendix 2) and Gray (1989). Our sample is restricted to individuals employed in manufacturing for the period 1963-1985. Average real profits and per capita real profits for the longer period 1958-1985 are available at the 4-digit level for each of these years, in 1972 dollars (deflator =CPI). We aggregated these profit data to the two digit level for each year and them mapped them onto our CPS data files. Below we report the average level of profits and the average per capita profits for the longer period 1958-1985 in constant 1972 dollars.

		Profits $million	Profits/head $thousands
SIC20.	Food and Kindred Products	426.04	17.85
SIC22.	Textile Mill Products	127.23	5.05
SIC23.	Apparel and Other Textile Products	164.09	4.38
SIC24.	Lumber and Wood Products	186.26	4.91
SIC25.	Furniture and Fixtures	176.39	5.75
SIC26.	Paper and Allied Products	355.47	9.18
SIC27.	Printing and Publishing	550.39	7.61
SIC28.	Chemical and Allied Products	719.07	21.91
SIC29.	Petroleum and Coal Products	892.59	22.95
SIC30.	Rubber and Miscellaneous Plastics	802.18	7.34
SIC31.	Leather and Leather Products	106.25	4.24
SIC32.	Stone, Clay and Glass Products	193.62	8.31
SIC33.	Primary Metals	312.53	8.76
SIC34.	Fabricated Metals	307.35	7.82
SIC35.	Machinery except Electrical	383.35	8.51
SIC36.	Electric and Electronic Equipment	357.16	8.81
SIC371.	Motor Vehicles and Equipment	2357.52	9.70
SIC37.	Other Transportation Equipment (excl. SIC371)	556.94	6.83
SIC39.	Miscellaneous Manufacturing	143.20	7.40

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