Author(s): David G. Blanchflower; Andrew J. Oswald; Peter Sanfey
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# WAGES, PROFITS, AND RENT-SHARING*

David G. Blanchflower

*Dartmouth College and NBER*

Andrew J. Oswald

*Centre for Economic Performance,*
*London School of Economics*

Peter Sanfey

*University of Kent*

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## Abstract

The paper suggests a new test for rent-sharing in the U.S. labor market. Using an unbalanced panel from the manufacturing sector, it shows that a rise in a sector's profitability leads after some years to an increase in the long-run level of wages in that sector. The paper controls for workers' characteristics, for industry fixed-effects, and for unionism. Lester's range of wages is estimated, for rent-sharing reasons alone, at approximately 24 per cent of the mean wage.

# WAGES, PROFITS, AND RENT-SHARING

## I. 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 both controversy and much research. This paper blends microeconomic data on wages with industrial data on profits. It produces a new test of the competitive market hypothesis. Contrary to the implications of textbook theory, pay determination appears to exhibit elements of rent-sharing[1].

In a prominent early attack on traditional analysis, Sumner Slichter [1950] argued that a competitive model fails to explain the empirical evidence that apparently homogeneous types of employees 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 provided *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 conclusions using better data than were available in Slichter's time.

These studies show that there are unexplained industry wage differentials and, in some cases, examine the correlation between wage levels and industry profitability. Although suggestive, the results are open to a number of criticisms. One is that the apparent pay/profit correlation may be caused by unobservable industry fixed effects. Some industries, for example, may use a technology that requires both high pay and a high rate of return on physical capital. A second is that early studies failed to control for employees' personal characteristics. An ideal data set would both have a panel element and provide controls for workers' characteristics. There are apparently no data sources of this kind.

Related work, occasionally with panel data, has been done on European labor markets. This includes research by, for example, Blanchflower *et al* [1990], Beckerman and Jenkinson [1990], Carruth and Oswald [1989], Holmlund and Zetterberg [1991], Denny and Machin [1991], Hildreth and Oswald [1992], and Nickell and Wadhwani [1990][2]. All find evidence for some kind of ability-to-pay effect upon wages. While most of these do not rest upon cross-section regressions, each draws upon data sets from highly unionized economies. Thus in such data a rejection of the competitive model might be viewed as empirically useful but theoretically unsurprising. The microeconometric work on rent-sharing of Christofides and Oswald [1992] and Abowd and Lemieux [1993] is among the first to find effects from profitability after controlling for fixed effects, but, being based upon Canadian union contracts, is open to a similar criticism. Moreover, these two studies are unable to control for employees' educational characteristics.

The primary purpose of this paper is to examine whether, in U.S. manufacturing industry, there is evidence that wages depend upon the employer's ability to pay. A second purpose of the paper is to argue that the existence of a positive correlation between wages and profitability does not automatically disprove competitive theory. The Appendix derives 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 points out that it is a long-run correlation that would shed doubt on the competive model.

Using various models, Section II discusses interactions between wages and profits. Sections III and IV contain the empirical results. U.S. manufacturing earnings equations are estimated with a data set constructed by merging CPS data from 1964-85 with information on two-digit industry profitability over the same period. This method creates a form of panel. Section V summarizes the paper's conclusions, and the Appendix describe theoretical results and the data.

## II. 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. It implies that a highly profitable company will pay the same for a given class of labor as a relatively unprofitable company.

The textbook atomistic model could, however, be a useful one for the study of the grain market while simultaneously be a misleading one for the study of the market for people's labor. There are at least three other ways to think about the theory of pay and profits. 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 supply curve of labor slopes upwards; the third is a contract model in which risk-sharing occurs. Under each of these, there may be a link from profitability to pay.

The paper's Appendix provides proofs to the following.

1. 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 equilibrium. Intuitively, the workers appropriate some of the firm's surplus.

2. In a competitive model, given demand shocks and a positively-sloped labor supply function, there may be a positive short-run correlation between wages and profits. Intuitively, this is the result of temporary frictions taking the firm up a labor supply curve. There may also be a positive correlation between 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.

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

The remainder of the paper is an attempt to confront these different theoretical hypotheses with data from the United States. It tests the competitive model's prediction that, in the long run, wages are independent of firms' profitability. Because no suitable matched microeconomic data exist -- reporting information both about U.S. employees and their employers -- the paper splices together microeconomic and industry-level data.

## III. Data and Results

The analysis draws upon information on approximately 200,000 full-time full-year workers in U.S. manufacturing industry. All part-time workers have been deleted. The data are from the March tapes of the Current Population Survey (CPS), and cover the years 1964 to 1985[3]. Means and standard deviations are given in the Appendix.

Profits are, of course, endogenous. Therefore, in estimating an equation like (7) in the Appendix, where the equilibrium wage is determined by the level of profit-per-employee, it is necessary to bear in mind the simultaneity between profitability and pay. There are two ways to try to handle the problem. First, if shocks to profits take time to be passed on in greater remuneration, it might be possible to treat the equation structure as recursive. On this view, movements in profitability in the past would be treated as pre-determined. The appropriate structure for estimation would then be to regress wages on lagged values of profits. The second possible approach is to find a good instrumental variable. If a demand shock, $\mu$, were observable to the econometrician, there would, in principle, be no difficulty. Because $\mu$ should not enter the wage equation except through its influence upon $\pi/n$, it would be a suitable instrument for profit-per-employee in a wage equation. In reality, it is difficult to find persuasive measures of the exogenous $\mu$ shocks that cause the changes in product prices, so this route cannot easily be exploited. What is feasible, however, is to gather data on cost shocks, which in the real world may be more readily observable, and to use those as an instrument. Experiments are performed here using movements in the cost of energy, which, particularly because over this period it was subject to the unpredictability of oil prices, and because it should not enter directly into a wage equation, may be a suitable instrument. These experiments produce the same general conclusion as the lags, but with less precision.

The paper employs three types of equations. First, microeconometric earnings functions are estimated. These use data on all the workers in the sample who were both full-time and worked for the full year. The equations show well-determined effects on pay from the level of profits in the industry. However, there is a difficulty when combining an independent variable that has only a few hundred observations with a dependent variable that has a quarter of a million observations. Moulton [1986] and others have pointed out that with common group errors the t-statistics in these kinds of micro-equations tend to be artificially large. Moreover, this estimation is likely to be unreliable because of so-called industry fixed effects. The second step in the paper is to compress the data into a panel of cell means (that is, average values for each industry for each year). Estimation on this sample satisfies Moulton's condition that the level of aggregation should be the same on both sides of the regression equation. It also helps guard against measurement error in individual observations. Third, the paper re-estimates using the method of papers such as Dickens and Katz [1987]. This approach takes the coefficients on industry dummies from a first-stage microeconometric wage equation and uses them to form the dependent variable in a second-stage regression. That second regression uses industry variables, such as profitability, as regressors.

Table I is a cross-section benchmark. It reports equations in which the dependent variable is the logarithm of workers' weekly and hourly earnings. For details of how these earnings variables are constructed, see the Data Appendix. Columns 1 and 2 of Table I reveal that U.S. weekly and hourly remuneration is higher in sectors where profit-per-head is higher. The estimated equations include a dummy variable for each year, to control for all economy-wide movements from 1964 to 1985. The equations also include a conventional set of demographic and educational variables for the individuals in the sample. This is to guard against the possibility that highly profitable sectors pay well merely because they employ people with unusually high levels of human capital. Because of occasional negative values, the profitability variable is not entered as a logarithm. The mean of profit-per-employee in the sample is 9.73. Given the coefficient of 0.0041 on $\pi/n$, therefore, the (simple cross-section) profit-per-head elasticity of wages is approximately 0.04. The unemployment elasticity of pay is -0.13. These estimates are only a first pass at the problem. First, they may understate the true size of profit-effects upon pay, because they ignore the possible simultaneity bias caused by the tendency for high wages to lead to low profitability. Second, they may overstate the statistical significance of profits, because it is probable that the standard errors on $\pi/n$ in such micro equations are biased downwards.

The principal result of the paper is captured in Table II. Estimation here is on industry cell means, so can be thought of as being performed on a panel of industries. The dependent variable is the logarithm of the average level of hourly earnings in each industry in the relevant year. The independent variables are the average level (in each industry in each year) of work experience, years of schooling, marital status, racial mix, proportion of employees working in the private sector, and per cent of workers who are female. These variables' values are calculated from the Uniform March CPS tapes. The regressions in Table II also include the industry unemployment rate U, lagged values of the industry profit-per-employee $\pi/n$, a lagged dependent variable, year dummies, and a set of industry dummies to capture industry-level fixed effects. Lagged unemployment contributed nothing extra. The lagged dependent variable could be instrumented here, but Nickell [1981] bias is slight with such a long panel. The reported regressions use an unbalanced panel of 16 industries by 22 years, giving approximately 300 observations in all. Details of the industries covered are given in the Appendix. The industry unemployment and profit data were merged from external sources (further explanation is in Sanfey, 1992). The estimation uses unweighted data[4].

Table II's findings are consistent with rent-sharing theory. Increases in profits feed through into permanently higher levels of pay. Various specifications are set out in columns 1 to 4 of Table II. The largest coefficient, 0.0071, is that on profits of three years earlier; columns 2 to 4 show that the size of the $\pi/n$ coefficient rises as the length of lag increases. These facts are consistent with the idea that simultaneity bias is likely to be less at comparatively long lags.

The profit-effects in Table II are large. As noted, the mean of profit-per-employee is 9.73, with a standard deviation of 7.43. The level of profit-per-employee at the 10th percentile of the profit distribution is 4.07, at the 50th percentile is 8.03, and at the 99th percentile is 44.41. The long-run impact of profit-per-employee, $\pi/n$, can be calculated from Table II column 1's general specification by summing the three profit coefficients and adjusting for the lagged dependent variable. The long-run coefficient on profit-per-employee is 0.008. The elasticity is therefore 0.08. This implies that in the long-run a doubling of profitability in a sector would be associated, after some years, with a rise in pay of approximately 8%. In the short-run, workers in a more profitable industry would have greater wage rises than employees elsewhere. The bulk of these wage rises would, according to the Table, come through by the third year after a burst of profits. The effect of profitability upon pay is approximately double that estimated from the earlier simple cross-section equation of Table I. The long-run unemployment elasticity of pay is poorly defined in Table II, which contrasts with the earlier Table I and the commonly-found elasticity of -0.1; Blanchflower and Oswald [1990, 1994] contain a summary of recent estimates.

An elasticity of 0.08 has important consequences, because profitability is one of the most volatile series studied by economists. Consider the primary metals sector, which has the data set's minimum single value of $\pi/n$, of -1.39 in 1983 (thousands of 1972 dollars). Profit-per-employee in that sector was 11.06 in 1980; it fell to 5.21 in 1982; and it rose from a negative 1983 value to reach 3.5 by 1985. The data thus show that large movements, such as a quadrupling of profitability, are not uncommon in this sector. Some industries, of course, are more stable. The food sector, for example, sees $\pi/n$ vary over the years of the data set from 11.04 to 19.76. Nevertheless, an examination of the 22-by-16 matrix of data points on industries' profits suggests, consistent with anecdotal observation, that major fluctuations in profitability are commonplace.

If the width of a distribution can be thought of as four standard deviations, the estimates make possible a calculation of the spread of pay caused by the dispersion of profits across sectors. Using Richard Lester's (1952) early terminology, the "range" of wages due to rent-sharing in U.S. manufacturing is then approximately 24 per cent of the mean wage (this number emerges from multiplying 0.08 times 4 times 7.43/9.73). It seems that a quarter of the inequality in American pay packets may be the result of rents.

Although this estimate of the size of rent-sharing is a substantial one, some recent work (reviewed in Oswald, 1995) has argued that the true effect is even greater. The first paper of this kind was Abowd and Lemieux (1993). The authors show that instrumenting a quasi-rent variable in a wage equation causes its coefficient to rise ten-fold. The result is an elasticity so large that it implies that approximately all the variation in the raw wage data is due to rents. If the authors are right, our estimates may be an understatement of the extent of rent-sharing.

The lagged dependent variable of Table II, which is in log form, has a coefficient of approximately 0.2. This is low by the standards of work on pay determination (a simple Phillips Curve might be taken to imply a coefficient of unity). It seems that, as might be hoped, most of the autoregression often found in wage equations is picked up here by the variables for workers' characteristics and by the industry-specific fixed effects. This is even more true in a fuller sample (not reported) that includes part-timers. In such a sample, the lagged dependent variable's coefficient drops below 0.1.

Table III switches to an alternative estimation method. Here the dependent variable is the industry dummy from a microeconometric earnings equation. The results are similar to those in the earlier Table, but not as well-defined. The elasticity of pay with respect to profitability is slightly smaller at approximately 0.05. Columns 5 and 6 of Table III give equations where current $\pi/n$ is, and is not, instrumented. Although instrumenting causes the coefficient to increase from 0.002 to 0.003, the precision of the estimates is low. Table IV provides another variant, using annual earnings, and reveals that again the effect of profits takes time to work through into employees' remuneration. Here the profit elasticity of pay is approximately 0.06. As with the hourly earnings equations, the third lag on profits works best.

Table V moves to sub-samples that break the data down by the proportion of unionized employees. These data were extracted from the NBER Trade and Immigration Databases (see Abowd, 1991). The motivation for this is that the results for the full sample contain some unionized sectors and it might be thought that the paper's rent-sharing finding is being driven simply by that portion of the data. Such a hypothesis can be rejected. As the four columns of Table V reveal, the evidence for rent-sharing is even stronger in low-unionism industries. Although this procedure inevitably reduces the number of observations (n=165 in the first column of Table V), the results are robust to different ways of cutting the data.

## IV. Checking Other Interpretations

It is not easy to see how the estimates of Tables I to V could be compatible with the competitive labor market framework. The main 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. But that appears to be contradicted by the finding here of a steady-state effect.

Perhaps the only other route would be to argue that the wage equation is a misspecified inverted labor demand curve. With a Cobb-Douglas production function, for example, profit maximization can generate a positive association between w and $\pi/n$. However, the significance of lagged profit levels back to t-3 is difficult to square with the idea that the wage equation might mistakenly be identifying an inverted labor demand relationship. Moreover, total profits also works as an alternative regressor (results are available from the authors), which, because a maximum profit function is declining in the wage, is a further reason to doubt the objection.

Experiments were done to check robustness. Allowing for more complex autoregressive equations -- available upon request -- using other lagged profit-per-employee terms leaves the conclusions unchanged.

The labor contract model of equations (19)-(25) in the Appendix offers an alternative interpretation of the data. It is one that falls in the gap between competitive theory and a rent-sharing model. Equation (25) is an equilibrium relation, capturing how wages vary in the contract as demand changes, and is potentially consistent with the fact that the Tables seem to 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 the predicted wage correlation is not with profit-per-employee but instead total profits, that long lags are perhaps hard to understand, and that it is not clear why wages should react to industry unemployment.

The most famous objection to the kind of rent-sharing analysis proposed in this paper is that the true model is a competitive one with slow adjustment. Reder's [1962] attack on the work of Slichter and his contemporaries helped to turn an earlier literature away from non-competitive views and back toward the competitive framework. His main point was that empirical work had failed to control for employment fluctuations, so that the tests ostensibly favoring rent-sharing might merely be revealing a temporary move up the labor supply curve in booming industries. "None of the studies to which reference has been made has attempted to control against these possibilities"

[Reder 1962, p.289]. In consequence, Reder believed, an observed correlation between wages and firms' ability-to-pay was unconvincing support for a non-competitive approach. One objection to the Reder view is that papers like Katz and Summers [1989] have shown that industry wage differentials persist over very long periods of time, so are not plausibly explained by temporary employment movements. A different test can be done by incorporating into the regression equations a set of current and lagged employment variables. If profitability is acting -- as in a competitive framework with gradual adjustment -- simply as a proxy for movements along a labor supply curve, the inclusion of employment and its rate of change should destroy the statistical significance of a variable like $\pi/n$. When this inclusion is done, however, the profit terms are unaffected.

Experiments were also performed with data on 450 4-digit industries from 1963 to 1985. These took production workers' hourly earnings as the dependent variable. They could not control for employees' characteristics, but did allow for year and industry dummies. Again there were significant positive effects from profit-per-employee (these results are available upon request).

To recapitulate, consider the textbook model after an exogenous rise in demand for the products of industry j. In a competitive labor market with frictions, profits $\pi^j$ 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 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 of the canonical model seems to be systematically violated by the data. Even within a sub-sample of industries with little unionism, there appears to be evidence of rent-sharing[5] in U.S. wage determination[6].

## V. Conclusions

This paper tests for the existence of rent-sharing in the US labor market. Controlling for industry fixed-effects, and a range of personal and compositional variables, the paper shows that changes in workers' remuneration follow 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 employees. Explaining how such sharing can happen in the absence of unions is a theoretical challenge.

The paper goes on to consider potential flaws in this kind of empirical test. The analysis 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[8].
Discriminating among these three is difficult, but the first model seems inconsistent with the paper's finding of a steady-state relationship between remuneration and profit-per-employee.

Changes in industries' levels of prosperity have large effects upon workers' remuneration. The elasticity of wages with respect to profit-per-employee is 0.08. Lester's [1952] "range" of pay is then, for rent-sharing reasons alone, approximately 24 per cent of the mean wage. According to this calculation, a quarter of the inequality[9] among the Americans in our sample is due to the existence of rents.

*Dartmouth College and National Bureau of Economic Research*

*London School of Economics*

*University of Kent*

## Endnotes

1. A paper by Steve Allen [1993] finds that, after controlling for industry fixed effects, industry price-cost margins come in negative in a log wage equation. An interesting and relatively neglected paper is Sparks and Wilton [1971], which argues, using a form of micro Phillips curve, that there are effects from the level of profits upon wage change. Hamermesh [1970] finds no robust effect from profitability. Abowd [1989] is not inconsistent with the results given here, but is concerned with a different issue, namely, the efficiency of bargaining and the consequences for profits of changes in labor costs.

2. A currently popular European approach is to think of pay as determined by a mixture of internal pressure (from profits) and external pressure (from outside unemployment). Early work includes Carruth and Oswald [1987, 1989] and Blanchflower and Oswald [1988], and the microeconometric work cited in the text.

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

4. There is support in the literature for such an approach. For example, Dickens [1990] shows that 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. Moreover, we experimented with weighted regressions, and the results were the same.

5. An earlier version of the paper established that switching to a sample with part-time workers makes no difference to this conclusion.

6. These results are consistent with some reported recently -- though without educational and similar controls -- in Hildreth and Oswald [1992] for Britain and Sanfey [1993] for the US, and also with the spirit of Holmlund and Zetterberg's [1991] conclusions for various nations including the US.

7. There are 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. Recent work by Macleod and Malcomson [1993] can also generate a wage-profit relationship.

9. Using the simplest range measure of inequality.

**TABLE I. Micro log earnings equations for U.S. manufacturing, 1964-1985.**

| | (1) Weekly earnings | (2) Hourly earnings |
|---|---|---|
| Log unemployment $U_t$ | -.1340 | -.1314 |
| | (38.35) | (36.43) |
| Profit-per-employee $(\pi/n)_t$ | .0041 | .0038 |
| | (20.89) | (18.76) |
| Year dummies | Yes | Yes |
| Personal controls | Yes | Yes |
| $R^2$ | .6294 | .5965 |
| DF | 202557 | 202343 |
| N | 202611 | 202397 |
| F | 6490 | 5647 |

Source: Current Population Surveys - Uniform March files and the NBER Productivity Database.

Note The dependent variable, w, is the natural logarithm of the employee's earnings. Industry unemployment, U, is also in natural logarithms. Profit-per-employee, $\pi/n$, is in levels. Personal control variables are as follows: 1) experience and its square 2) years of schooling 3) 4 marital status dummies 4) two race dummies 5) private sector dummy 6) gender dummy 7) 20 region dummies and 8) a constant.

The sample, here and in all later Tables, consists of full-time full-year workers only. Estimation is by OLS.

t-statistics in parentheses.

**TABLE II. Hourly log earnings equations for US manufacturing, 1964-1985, using cell means.**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log $U_t$ | -.0122 | -.0129 | -.0113 | -.0091 |
| | (0.84) | (0.92) | (0.84) | (0.68) |
| $(\pi/n)_{t-1}$ | -.0021 | .0024 | | |
| | (0.80) | (1.22) | | |
| $(\pi/n)_{t-2}$ | .0023 | | .0054 | |
| | (0.75) | | (2.77) | |
| $(\pi/n)_{t-3}$ | .0064 | | | .0071 |
| | (2.53) | | | (3.56) |
| Log $w_{t-1}$ | .2393 | .2375 | .2505 | .2402 |
| | (3.83) | (3.86) | (3.89) | (3.72) |
| Personal controls | Yes | Yes | Yes | Yes |
| Year dummies | Yes | Yes | Yes | Yes |
| Industry dummies | Yes | Yes | Yes | Yes |
| $R^2$ | .9941 | .9946 | .9943 | .9941 |
| DF | 225 | 257 | 242 | 227 |
| N | 295 | 327 | 311 | 295 |
| F | 550.80 | 889.60 | 619.35 | 570.36 |

Source: Current Population Surveys - Uniform March files and the NBER Productivity Database.

Note Personal control variables are as follows: 1) experience 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) % female and 7) a constant. All unemployment rates U and the dependent variable w (hourly earnings) are in natural logarithms. Profit-per-employee, $\pi/n$, is in levels.

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

t-statistics in parentheses.

**TABLE III. Hourly log earnings equations for US manufacturing, 1964-1985, using industry dummies from 1st stage regressions as the dependent variable.**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Log $U_t$ | -.0278 | -.0254 | -.0284 | -.0291 | -.0245 | -.0196 |
| | (2.70) | (2.51) | (2.91) | (3.16) | (2.22) | (1.77) |
| $(\pi/n)_t$ | | | | | .0020 | .0030 |
| | | | | | (1.36) | (1.60) |
| $(\pi/n)_{t-1}$ | .0005 | .0023 | | | | |
| | (0.25) | (1.68) | | | | |
| $(\pi/n)_{t-2}$ | -.0000 | | .0025 | | | |
| | (0.01) | | (1.82) | | | |
| $(\pi/n)_{t-3}$ | .0028 | | | .0030 | | |
| | (1.57) | | | (2.26) | | |
| log $w_{t-1}$ | .3557 | .4295 | .4264 | .3572 | .4411 | .4337 |
| | (6.58) | (8.56) | (7.68) | (6.66) | (8.90) | (8.45) |
| Year dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Instrumented $\pi/n$ | No | No | No | No | No | Yes |
| $R^2$ | .9200 | .9146 | .9123 | .9200 | .9143 | .9125 |
| DF | 256 | 288 | 273 | 258 | 288 | 268 |
| N | 295 | 327 | 311 | 295 | 327 | 306 |
| F | 77.51 | 81.20 | 76.80 | 82.42 | 80.91 | 75.49 |

Source: Current Population Surveys - Uniform March files and the NBER Productivity Database.

<u>Note</u> Personal control variables included in the first stage regressions for each year are as follows: 1) experience 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) % female and 7) a constant. All unemployment rates U and the dependent variable w (hourly earnings) are in natural logarithms. Profit-per-employee, $\pi/n$, is in levels. All independent variables are measured as the mean of the observations in a year/industry cell. Instruments in column 6 for $(\pi/n)_t$ were $(\pi/n)_{t-1}$ and current and one year lagged energy share of total costs.

t-statistics are in parentheses.

**TABLE IV. Annual log earnings equations for US manufacturing, 1964-1985, using cell means.**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log $U_t$ | -.0108 | -.0104 | -.0095 | -.0099 |
| | (0.90) | (0.92) | (0.86) | (0.88) |
| $(\pi/n)_{t-1}$ | -.0015 | .0020 | | |
| | (0.68) | (1.27) | | |
| $(\pi/n)_{t-2}$ | .0031 | | .0042 | |
| | (1.24) | | (2.63) | |
| $(\pi/n)_{t-3}$ | .0026 | | | .0040 |
| | (1.22) | | | (2.44) |
| Log $w_{t-1}$ | .3979 | .4005 | .4045 | .4006 |
| | (6.44) | (6.89) | (6.67) | (6.49) |
| Personal controls | Yes | Yes | Yes | Yes |
| Year dummies | Yes | Yes | Yes | Yes |
| Industry dummies | Yes | Yes | Yes | Yes |
| $R^2$ | .9960 | .9965 | .9962 | .9960 |
| DF | 225 | 257 | 242 | 227 |
| N | 295 | 327 | 311 | 295 |
| F | 820.45 | 1047.01 | 943.81 | 846.63 |

Source: Current Population Surveys - Uniform March files and the NBER Productivity Database.

Note Personal control variables are as follows: 1) experience 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) % female and 7) a constant. All unemployment rates U and the dependent variable w (annual earnings) are in natural logarithms. Profit-per-employee, $\pi/n$, is in levels.

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

t-statistics in parentheses.

**TABLE V. Hourly log earnings equations by union status, 1964-1985.**

| | (1) Low-union | (2) High-union | (3) Low-union | (4) High-union |
|---|---|---|---|---|
| | *Second-stage regressions* | | *Cell means* | |
| Log $U_t$ | .0182 | -.0503 | .0359 | -.0300 |
| | (0.96) | (5.20) | (1.44) | (2.07) |
| $(\pi/n)_{t-3}$ | .0059 | .0014 | .0084 | .0024 |
| | (2.76) | (0.90) | (2.96) | (1.03) |
| Log $w_{t-1}$ | .3710 | .3231 | .4349 | .3277 |
| | (5.29) | (3.78) | (6.03) | (3.57) |
| Year dummies | Yes | Yes | Yes | Yes |
| Personal controls | 1st stage | 1st stage | Yes | Yes |
| Industry dummies | Yes | Yes | Yes | Yes |
| $R^2$ | .9195 | .8839 | .9930 | .9932 |
| DF | 135 | 102 | 135 | 102 |
| N | 165 | 130 | 165 | 130 |
| F | 53.21 | 28.76 | 657.88 | 549.43 |

Source: a) Current Population Surveys - Uniform March tapes b) the NBER Productivity database and c) The NBER Immigration and Trade database

Note Personal control variables included in the second-stage regressions for columns 1 and 2 for each year are as follows: 1) experience 2) years of schooling 3) 4 marital status variables 4) two race variables 5) private sector variable 6) % female and 7) a constant. Personal control variables in columns 3 and 4 are averages for full-time workers 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) % female and 7) a constant. All unemployment rates U and the dependent variable w (hourly earnings) are in natural logarithms. Profit-per-employee, $\pi/n$, is in levels.

t-statistics in parentheses.

The low-union sector is defined as the 9 industries with below the average (36.7%) overall union density for the whole group of industries over the period 1964-1985. The low-union industries are as follows with average union density over the period in parentheses -- 1. Textiles (14.5%) 2. Apparel (30.5%) 3. Lumber and Wood (25.3%) 4. Furniture (25.1%) 5. Printing (22.9%) 6. Chemicals (28.4%) 7. Rubber (33.7%) 8. Machinery not Electrical (31.7%) 9. Electrical Machinery (31.3%). The high-union sector is defined as the 7 industries with above average union density -- 1. Food and Tobacco (39.0%) 2. Paper (52.3%) 3. Stone, Clay and Glass (45.7%) 4. Primary Metals (60.0%) 5. Motor Vehicles (67.8%) 6. Transport (40.5%)

<u>Theoretical Appendix</u>

*Model 1*

Consider a bargaining model in which wages are determined as if by a Nash problem in which $\varphi$ is the bargaining power of employees. Write this maximization problem as

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

where u(w) is a single 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 $\pi$ is profits. This formulation relies on the assumption that in the event of bargaining delay the firm earns zero profit and the worker receives $\overline{w}$. 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:

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

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

Rewrite the first of these as

(4) $$\frac{u(w) - u(\overline{w})}{u'(w)} = \left(\frac{\varphi}{1-\varphi}\right)\frac{\pi}{n}$$

This can be simplified by using

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

to produce

(6) $$w \approx \overline{w} + \left(\frac{\varphi}{1-\varphi}\right)\frac{\pi}{n}$$

This equation is simple but useful. It 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 exact nature of the employment function. In particular, given efficiency, it does not depend on whether employment is fixed along a labor demand curve (which would result from efficient bargaining under locally horizontal indifference curves) or an upward-sloping contract curve. Equation (6) would not, however, be generated by the Nickell and Wadhwani [1990] version of a labor-demand model.

That model relies upon an unexplained inefficiency and would include one extra term for the elasticity of labor demand.

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, the equilibrium wage is

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

In a regression equation for (7), estimated on longitudinal data, year dummies are likely to capture $w^0$ and b, leaving industry unemployment U and employer profit-per-employee $\pi/n$ as the key explanatory variables. A separate industry variable for $w^0$ is not included explicitly in the later regressions because a cell-mean industry wage is used as the dependent variable. Equation (7) corresponds to the regressions in the paper in which profits-per-employee is an independent variable.

Unlike the next model, this theoretical structure does not impose an assumption of zero profit in equilibrium. It seems natural to allow non-zero profits in a bargaining model. One weakness should be noted: why new firms fail to enter the sector then remains unexplained.

*Model 2*

At the other extreme from a bargaining model lies competitive theory. It is of interest to examine (Hildreth and Oswald [1992]) whether this can imply a positive co-movement of wages and profitability.

Imagine demand shocks hitting the economy. Because the focus is the relationship between wages and profits, it is convenient to define a maximum profit function

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

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 assumes 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 if necessary 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.

It is not sufficient, for later purposes, to appeal to a conventional demand/supply picture, because profits cannot be read from such a diagram. But a simple algebraic argument is as follows. Equilibrium in this market is given by the equation

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

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

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

so that the relationship between demand shocks and wages is

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

showing that wages rise in a boom.

Because the profit function is homogeneous of degree one, $\pi$ can be written

(12) $$\pi = \mu\pi_\mu + w\pi_w$$

Differentiating:

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

Cancelling terms and re-arranging:

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

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

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

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

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

where equation (11) and (14) have been used to substitute terms. Note that $d\mu/dw$ is simply the inverse of the derivative of wages with respect to the exogenous demand shock.

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

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

The latter follows from $l'(w) > 0$, and the fact that $\pi(\mu,w)$ is increasing in the demand shock $\mu$ and has a negative cross-partial derivative.

Equation (17) shows that wages and profits are positively correlated. A sufficient condition for wages and profit-per-employee to move together is that the elasticity of labor demand be less than unity. The algebra is omitted.

*Model 3*

The final model 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. 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:

(19) Maximise $\int v(\pi)g(\mu)d\mu$

subject to

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

(21) $\pi \equiv \mu f(n) - wn$

The solution is a wage function w(μ) 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(π). 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(μ). Firms must offer their employees the market level of expected utility.

The key first-order conditions are

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

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

where $\lambda$ is a multiplier on the integral constraint (20) and is thus independent of μ. Equation (22) defines an implicit function linking profits and wages. Differentiating:

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

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 $\Omega$. Then, combining (22) and (24),

$$\frac{dw}{d\pi}\frac{\pi}{w} = \frac{\Omega}{r} \tag{25}$$

In other 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. Wages and profits then move together.

Data Appendix

**Sample Means (and Standard Deviations) in $thousands**

Profit-per-employee

| | $\pi/n$ |
|---|---|
| Low-union sample | 9.07 (6.93) |
| High-union sample | 11.02 (8.18) |
| All | 9.73 (7.43) |

**Means in $thousands**

| | $\pi/n$ |
|---|---|
| SIC20. Food and Kindred Products | 14.99 |
| SIC22. Textile Mill Products | 4.67 |
| SIC23. Apparel and Other Textile Products | 4.40 |
| SIC24. Lumber and Wood Products | 5.41 |
| SIC25. Furniture and Fixtures | 5.70 |
| SIC26. Paper and Allied Products | 10.67 |
| SIC27. Printing and Publishing | 8.97 |
| SIC28. Chemical and Allied Products | 25.83 |
| SIC30. Rubber and Miscellaneous Plastics | 8.87 |
| SIC32. Stone, Clay and Glass Products | 9.06 |
| SIC33. Primary Metals | 7.41 |
| SIC34. Fabricated Metals | 8.11 |
| SIC35. Machinery except Electrical | 9.46 |
| SIC36. Electric and Electronic Equipment | 8.66 |
| SIC371. Motor Vehicles and Equipment | 12.76 |
| SIC37. Other Transportation Equipment (excl. SIC371) | 8.00 |

These are all for 2-digit industries. Some SIC industries were omitted from the analysis because of doubts about the consistency of their coding over the period. Means for 4-digit data are available upon request.

**Data sources and construction**

1. Uniform CPS Files

The data used here were constructed from the 1964-1986 March files of the Current Population Survey. In each year the sample was restricted to those individuals whose main activity in the previous year was as an employee in the manufacturing sector. Individuals who were self-employed and/or who worked in the service sector were deleted from our sample. We also deleted all individuals who reported that they were part-time. Where possible, we defined this as having usual hours of <30, but for the years 1964-1975, because of changes in definitions across the years, we used self-reports of part-time status in the subsequent period. As a check, some equations were run separately for the largest feasible sample of workers (full+part-time), and they were very similar to those reported here.

Three dependent variables are used in the paper. They are total earnings from wages and salaries in the year preceding interview, weekly earnings, and hourly earnings. Only usual weekly hours for the previous year are available in the CPS. Following Katz and Murphy [1992] we use hours worked during the survey week to measure weekly hours in the previous year. For individuals who did not work during the survey week, we imputed usual weekly hours using the mean of hours worked last week for individuals of the same sex and same full-time/part-time status who reported hours worked last week on that year's survey.

Prior to aggregation, the data by industry and the various control variables were made consistent across years. In calculating hourly earnings by cell mean, the earnings data were aligned with the appropriate year's hours.

2. Profit Variables

The data source for the profit data is the NBER's Productivity Database, constructed by Wayne Gray (1989). The database contains annual data for 450 4-digit manufacturing industries. It uses the 1972 SIC definitions. Data on profits are not directly available in the data set, so various definitions of real profits were constructed. To get to the profitability variable used in the paper (derived from Sanfey's thesis, and termed Profit3c there), the following three steps have to be gone through. The final variable, denoted 3c profits, is built up in stages. First, define a preliminary measure

$$\text{Profit1c} = \frac{(\text{Value Added - Payroll})}{\text{CPI}}$$

Value added is essentially equal to the value of shipments minus cost of materials, but this is adjusted by the change in inventories and the addition of value added by merchandising operations. Accordingly, this measure "avoids the duplication in the figure for value of shipments that results from the use of products of some establishments as materials of others" (Census of Manufactures, 1987, Appendix A). Measure 1c is akin to the definition of profits used in Beckerman and Jenkinson (1990) and is a useful starting point. However, two problems should be noted. First, the method of valuing inventories changed in 1982 (from any acceptable accounting method to the lower of cost or market value), so the data on Value-Added post-1982 may not be strictly comparable to pre-1982. Second, the measure of payroll excludes 'supplementary labor costs' i.e. legally required expenditures such as social security contributions and payments to voluntary programs.

The database includes data on capital stocks and investment. It is possible, therefore, to adjust the above profit measure for depreciation and the opportunity cost of capital. The data on capital are already in real (1972) dollars, but the data on investment are not, so we deflated the series by the investment deflator provided in the dataset. Investment combines spending on structures and equipment. This means we cannot calculate separate depreciation rates for these. The overall depreciation rate is given by

$$\text{Dep}_t = \text{Capital}_t - \text{Capital}_{t+1} + \text{Investment}_t$$

Thus the new measure of profits, 2c, is

$$\text{Profit2c} = \text{Profit1c} - \text{Dep}.$$

Naturally, the last year (1986) is lost when including depreciation in the calculation.

One last step is required, namely, to adjust for the opportunity cost of capital. Here we define that cost as the product of the real interest rate and the real capital stock, where the real rate of interest is defined as the difference between the one-year T-bill rate (Source: U.S. Board of Governors of the Federal Reserve: Banking and Monetary Statistics, 1941-1970, and Statistical Abstract of the United States (various issues)) and the rate of CPI inflation. This real rate of interest is often negative, particularly during the 1970s. The opportunity cost measure of capital is designated Oppc for short. Then define a variable

$$\text{Profit3c} = \text{Profit2c} - \text{Oppc}.$$

By definition, the measure of opportunity cost used here does not have any industry variation.

In summary, the total profit variable (Sanfey's variable Profit3c) used in the paper is

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

This 3c measure of total profit is divided by employment to get the $\pi/n$ used in the paper's regressions. The resulting "profit-per-employee" measure may biased upwards because, first, the employee figures do not include employees working in "auxiliary units" (e.g. headquarters and support facilities) and, second, the payroll figures exclude the wages of these workers. There is nothing that can be done about this difficulty. The fixed effect methods of the paper may help to nullify it. Further details are given in Sanfey (1992, Appendix 2) and Gray (1989).

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