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Unionism and the Inflationary Bias of Labor Markets

by

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Full employment seems to require high rates of wage inflation. Along the other axis of the Phillips curve diagram, the problem can be stated in an equivalent way: wage stability implies high levels of unemployment. This bias in the performance of labor markets is a problem of first-class importance in aggregate economic policy. The basic logic of Phillips curves -- that excess demand for labor drives up wages and excess supply pulls them down -- does nothing to explain the inflationary bias, yet without the bias, the existence of a tradeoff between wage inflation and unemployment would not be a matter of great concern. Indeed, if the Phillips curve passed close to the origin, we would hardly know of its existence in an economy with a sensible monetary and fiscal policy. Contemporary interest in the Phillips curve phenomonon relates to its intercept along the unemployment axis more than to its slope;

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[1]I am grateful to my colleague, Lloyd Ulman, for a series of stimulating discussions on the subject of this paper, in the course of which my thinking was changed considerably. His views on some of the topics of this paper are presented in his paper, "The Inflationary Potential of Collective Bargaining", [8]. I am also grateful to the Ford Foundation for support in the form of a Faculty Research Fellowship.

thus, the goal of labor market policy is often formulated as one of shifting the Phillips curve to the left.

It is often suggested that labor unions are to blame for the inflationary bias. By virtue of their power in the market, it is argued, unions are able to secure wage increases each year in excess of the increases that would prevail if the labor market were competitive. Union rapacity pushes up wages at an inflationary rate unless it is countered by excessive unemployment. This argument has left a few economists somewhat uneasy. If unions have the power to drive up wages, why should they fail to exercise all of their power immediately, rather than using it piecemeal over time? Unionization explains high union wages, but not rising wages, according to this counterargument.[1]

In this paper, we consider the issue from a slightly different point of view. We inquire whether the existence of unions might

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[1]Milton Friedman is probably the best-known advocate of this view: "Insofar as market power has anything to do with possible inflation, what is important is not the level of market power, but whether market power is growing or not. If there is an existing state of monopolies all over the lot, but the degree of monopoly has not been increasing, this monopoly power will not and cannot be a source of pressure for inflation." ([1], p.57. Emphases are his.) Robert Solow has taken a more cautious view: "It does not seem to me that this line of argument [that monopoly in product markets accounts for high prices but not rising prices] applies against the possibility of a continuing wage push, because there is no similar widely-accepted model of the objectives of the trade union with market power." ([7], p. 5)

explain a bias toward unemployment in the operation of labor markets.[1] As long as the Phillips curve is less than vertically-sloped, an unemployment bias will appear as an inflationary bias if the monetary and fiscal authorities pursue a policy of full employment.

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[1]There is a broader question, not considered here, whether unionism has anything at all to do with the Phillips curve phenomonon. The search theory of Stigler, Alchian, Phelps, Holt, Mortensen, and others, claims to give a full account of the behavior of labor markets in essentially competitive terms. An early draft of the present paper discussed this claim, but the discussion eventually transcended the scope of the rest of the paper, dealing by necessity with some complex empirical issues. In any case, unions are a fact of life, and we will present some empirical evidence that they have a substantial impact of the sort considered here.

1. Concentration in Labor Markets

When the counterargument is restated in unemployment terms, it becomes somewhat less convincing. It holds that there is no reason for a unionized labor market to have more unemployment than a competitive market when both have stable wage levels. Unemployment, in the sence of a failure of the labor market to clear, is ruled out by definition in competitive equilibrium. But it is exactly the purpose of a labor union to prevent competitive equilibrium in its labor market. We will argue that the outcome of union activities is to create excess supply (that is, unemployment) just as the product monopolist creates excess supply in the sense that he or any potential entrant would willingly supply more than he does at the equilibrium price. By this argument it is not unreasonable, after all, to suspect that unions shift the whole Phillips curve to the right by introducing a bias toward unemployment. The inflationary bias of the economy could then be interpreted as the outcome of the hard choice of policy makers among points on the Phillips curve away from the origin.

Most of the rest of this paper is devoted to a reconstruction of the casual argument that unions are responsible for the inflationary bias of labor markets. Our method is essentially to give a full treatment to an illustrative example, in which it is possible to be quite clear about the underlying assumptions and reasonably

confident that their implications are correctly deduced. The relevance of the example is obviously open to question; some empirical evidence is presented in the concluding section to suggest that this work is not completely divorced from reality.

The simplest argument on the role of unions in the Phillips curve phenomonon is that the purpose of a union is to restrict the benefits of employment to its own members. The unemployed consist in this simple case of all workers not fortunate enough to belong to the union. The union never has an incentive to admit new members, since this would at best leave the incomes of present members unchanged and in general would reduce them. In fact, no economy is saddled with a union with this kind of power. No single union controls employment in more than a sector of the economy. Unions are unable to prevent the development of a competitive residual labor market in certain industries.

Our attention will be devoted to the case of attenuated union power in which an organized labor market in one productive sector coexists with a competitive labor market in a second productive sector. Roughly in accord with the facts, we will identify the organized sector as the goods industry and the competitive sector as the services industry. The general thrust of our argument is that the exclusion of workers from the goods industry causes them to seek work in the services industry, where they bid down the wage

to an artificially low level. Consequently, those workers whose labor supply is positively wage-elastic withdraw partially or totally from the labor market. At least a fraction of those who withdraw report themselves as unemployed, since they would be perfectly willing to work at the union wage. The model we develop is a specialization of Eckstein's Sponge Theory[1] -- in periods of economic slack, the services industry acts as a sponge, providing employment for workers who are unable to find jobs in higher-paying industries.

We begin by stating some basic assumptions that are intended to characterize the labor market problem of immediate concern and to simplify the analysis by suppressing other problems of macroeconomics. The assumptions are:

1. The union supplies labor perfectly elastically to goods producers at a wage it dictates. The wage is chosen to give full employment to union members.

2. Nobody can be employed in the goods industry who is not a union member, and every member must receive the union wage. The union cannot engage in arbitrage between the two labor markets. This is the basic institutional constraint on union power.

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[1]Joint Economic Committee, Staff Report on Employment, Growth, and Price Levels, 1959, pp. 87-88.

3. In the static case, supply equals demand in both labor markets. Reported unemployment is the difference between the labor offered by service workers if they were paid the union wage and that offered at the actual service wage. In the dynamic case, Keynesian unemployment can exist in both markets because of the temporary fixity of the two money wages.

In addition, we will make a set of assumptions that do not affect the character of the results, but allow a substantial technical simplification in the discussion. These are:

4. Labor is homogeneous. Service workers can become workers in the goods industry if they are admitted to the union.

5. In both industries, production takes place without any inputs other than labor. Output is proportional to labor input.

6. Production is competitive.

7. Tastes are identical, and all income and price elasticities of demand are unitary.

8. There is a numeraire good, money, that is distributed equally among all workers. Nominal money holdings enter directly into the individual's preferences.

Assumption 5 allows us to escape the difficult intertemporal problems associated with durable inputs. Assumption 6 permits a very simple treatment of production and the markets for output in which each wage can stand as the corresponding output price as well. Assumption 7 gives the model a structure that is peculiarly convenient

for studying labor market anomalies. Assumption 8 is used later in the discussion to provide a good in terms of which wages are fixed.

An algebraic treatment of the model is given in a later section. In the remainder of this section we will present an informal discussion of the properties of the static version of this model. We start by defining an equilibrium as a situation in which the union wage is set at the point where the demand for union labor matches the supply of union members and the competitive wage is low enough to provide the desired level of employment for workers excluded from unions. For a fixed total number of workers, the more union members, the lower is the union wage. On the other hand, the smaller the union membership, the lower is the wage in the competitive labor market of the service industry. In the absence of union power, the wages in the two industries are identical. If the union differential is positive, union members receive pure rent as a result of the artificial restriction imposed by the union.

When the union is able to enforce the artificial scarcity of labor in the goods industry, the economy behaves in a way formally identical to that of a purely competitive economy with two primary factors, union labor and non-union labor. The economy with unionization cannot be said to be in competitive equilibrium, however, because it has, in reality, only a single labor market. Workers who are not union members are perfectly capable of satisfying the

demand for union labor. The equilibrium is always characterized by an excess supply of labor equal to the difference between the supply offered by non-union workers at their depressed wage and the supply that they would offer at the union wage. A hypothetical unemployment rate can be defined as the percentage difference between the two supplies. This unemployment rate differs from conventional rates in several ways. First, it is based on hours worked rather than employment status. In the model discussed so far, the conventional unemployment rate would always be zero, since everybody works at least a few hours. The use of hours worked has often been recommended for unemployment statistics in the U.S., which currently fail to take account of involuntary part-time employment. Second, and more important, this rate is based on a clear conception of what is meant by unemployment -- it is defined in terms of willingness to work at a wage currently received by other workers with the same skills. The conceptual basis for the unemployment rate as measured in the U.S. is far less clear. There is a strong tendency to measure unemployment in terms of search activity, although this is not the exclusive basis for the statistics in the U.S. The relation between our hypothetical measure of unemployment and search activity is problematical, and a discussion of it would again exceed the scope of this paper. The theoretical measure is the socially relevant one, although it overstates the cost of union discrimination

against non-union workers[1]. It is a fair assumption that there is some systematic relationship between this measure and the rate that would be recorded in a household survey of the kind now in use. Under that assumption, the discussion of the relationship between the theoretical unemployment rate and wage policy is relevant to contemporary problems whose diagnosis depends on conventional unemployment rates. Unfortunately, a great deal of discussion of aggregate policy is carried on without any serious consideration of what unemployment statistics are supposed to mean.

We have shown so far that union power in the goods industry generates unemployment among non-union members forced to work in the services industry. The key assumption leading to this conclusion is the positive wage-elasticity of labor supply of non-union workers. If their labor supply curves were backward-bending, the conclusion would be the opposite: unionization would reduce unemployment (in the simple case, by making it negative) in the services industry. In practice, positive wage-elasticity is the natural assumption. Non-union workers are more likely to be secondary workers whose wage sensitivity is almost sure to be high because most of their income is earned by the primary wage-earner in the family. Rather than attempt to incorporate this kind of family structure into the model,

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[1] A better wage for comparison would be the common wage that would prevail in the absence of the union. This is lower than the union wage, and therefore would induce a smaller increase in labor supply from service workers.

we assume that every worker has an unearned endowment of money that has very much the same effect on his labor supply.

2. Labor Market Dynamics

The basic restrictive force in the model just described arises from the union's ability to set the wage in the goods industry. In the static model we might just as well have supposed that unions dictated employment levels, since they were assumed to know the true demand curve for union labor. In our extended dynamic model, however, the fact that the union sets wages rather than employment is a key feature. We assume that the union knows the demand curve for union labor conditional on monetary-fiscal policy, but that it does not know exactly what that policy will be. The union may not be able to set a wage that exactly employs all of its members, for it may make errors in predicting monetary-fiscal policy. The case of unexpected expansion is of paramount importance. We assume that if the union sets a wage that turns out to be too low (that is, the demand for union labor exceeds the supply offered by current union members), then the union is powerless to prevent the filling of the excess demand from the ranks of the non-union workers. Unexpected demand is translated into increases in employment rather than increases in wages. Furthermore, the workers who take the newly-created jobs in the goods industry automatically become union members. In every subsequent period, they are included in the union's calculation of the wage that generates expected full employment for its members. Unexpected inflation is highly beneficial to the economy. The movement

of workers into the goods industry reduces the relative wage differential between the two industries, thereby reducing unemployment. Unlike other benefits attributed to unexpected inflation, this one is long-lasting; once the union is induced to offer its protection to a worker, it does so for the rest of his working life. A single burst of unexpected inflation enlarges union membership for many successive periods, during which time unemployment is always less severe than it would have been with a fully expected monetary-fiscal policy.

Our assumptions about the response to unexpected contraction are rather different. If the demand for union labor falls short of union expectations, some members will find themselves without jobs. We assume that they work for a single period in the service industry, without severing their connection with the union. Thus unexpected deflation has no prolonged effects; it only causes a further depression in the non-union labor market in the period it takes place.

Our final assumption is that there is a small rate of attrition in union size over time. The size of the working force remains constant over time, but gradual turnover in it causes the union fraction to decline, as new entrants are not automatically union members, even if their predecessors were. In the absence of a suitably ingenious monetary-fiscal policy, the economy experiences continually worsening stagnation. There is no steady state in this model; the relative

wage of union members rises without limit. This property of the model has the advantage that we cannot become obsessed with the steady-state properties of the model, a common fault of contemporary Phillips curve analysis. Our attention is always directed to the full set of problems confronting aggregate policy makers.

The model in its present form can be closed by specifying a mechanism that generates expectations of monetary-fiscal policy held by the union. The more naive the process for forming expectations, the easier it is for policy-makers to maintain full employment. For example, if expectations are completely static (the level of aggregate demand is expected to be the same as last period's), then any expansion reduces unemployment by tricking the union into admitting new members. Presumably there is a limit to the number of successive times the union will fail to anticipate inflation, and eventually it will build in a correction for inflation in its wage in the face of persistent increases in aggregate demand. If expectations are elastic with respect to recent changes, the task of formulating monetary-fiscal policy becomes more difficult.

The tradeoff between this period's unemployment and this period's monetary-fiscal expansion can be described in a diagram that looks rather like a Phillips curve. In Figure 1a we present the alternatives that might be available after a period of stagnation. The vertical axis is the change in M(t), an index of aggregate demand as controlled by monetary and fiscal policy, and the horizonal axis is

the proportionate excess supply of labor, identified as the unemployment rate. If no expansion takes place, the unemployment rate continues at its previous level, as given by the horizontal intercept of the curve. If $\Delta M(t)$ is large enough, unemployment can be eliminated altogether by moving to the vertical intercept.

In the three diagrams in Figure 1 we can trace out the response over three periods to an expansionary burst in the first period. We suppose that the burst drives the unemployment rate down to the level, u, shown in Figure 1a. The situation in the next period depends on what expectations about further inflation are induced by the initial expansion. If expectations are static, so that no additional inflation is expected, a new and more favorable Phillips curve is attained immediately. No further inflation is required to maintain the low level of unemployment, u. On the other hand, if expectations are fully elastic, and $\Delta M(t+1)$ is expected to be the same as $\Delta M(t)$, then the new Phillips curve appears to be no more favorable than the old one. Unless monetary-fiscal policy ratifies the union's inflationary expectations, union employment will fall short of union membership, and unemployment will increase again to its old level. It might appear that chronic inflation would be required to hold unemployment at its new low level. Actually, the more favorable Phillips curve of Figure 1c can be reached in period $t+2$ even in the case of perfectly elastic inflationary expectations, at the cost

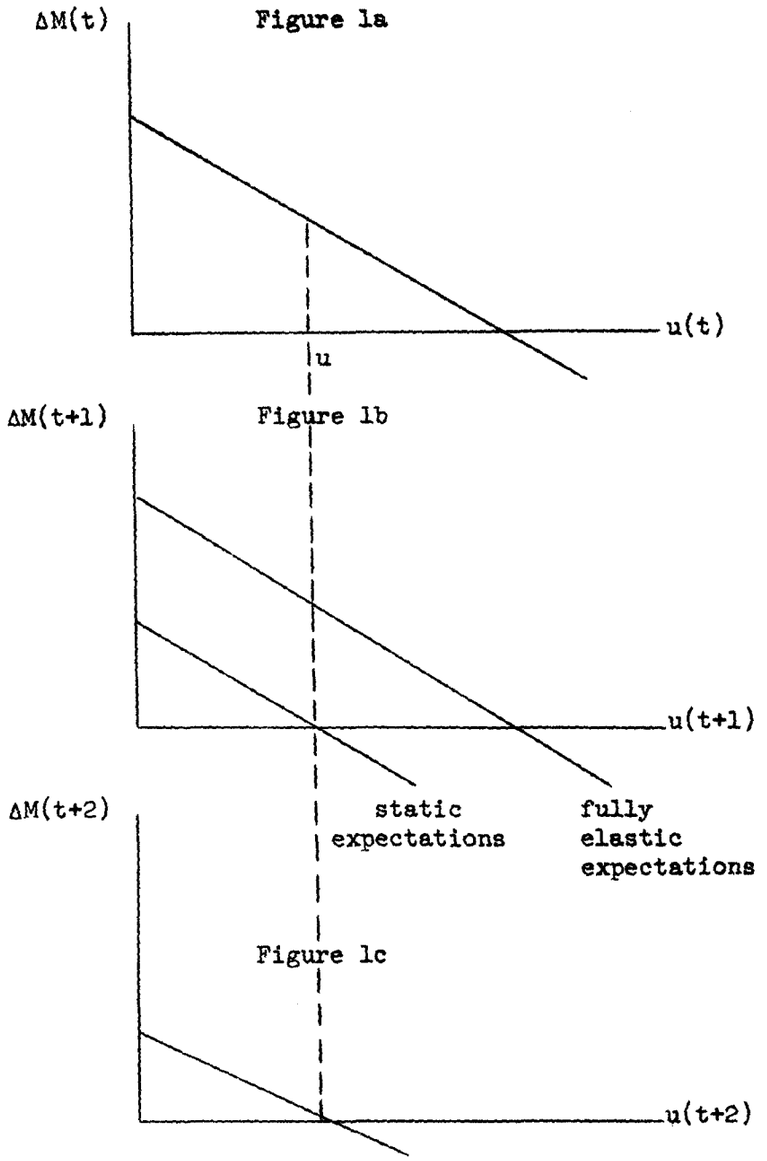

Figure 1. Phillips curves in three successive periods.

of high unemployment in period t+1. After this single period of slack, inflationary expectations are eliminated, and the economy benefits by the more-or-less permanent increment in union membership.[1]

The union may form inflationary expectations through information other than past observations of actual aggregate demand. Not every monetary-fiscal expansion need be totally unexpected at its onset; the government might well announce its policy in advance. Anticipatory announcement of an expansion would be foolish policy, of course, since the union would use the knowledge to correct the increase in demand into an increase in wages rather than an increase in its membership, thus defeating the purpose of the expansion. Intelligent policy would concentrate on prior announcement of contractions, in order to avoid driving union members temporarily into the competitive labor market and aggravating unemployment. The best policy of all, if the government has sufficient credibility, is to announce a contraction in advance, and then to fail to carry out the contraction. This causes unexpected expansion (if the announcement is believed in the first place) without any actual increase in aggregate demand. The result is that the economy attains the favorable Phillips curve of Figure 1c instantaneously without any visible effort.

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[1] In the analysis of these effects over three periods, we have neglected the small period-to-period effect of union attrition.

The discussion of this section has placed a substantial burden on rapid adjustment of the money wage in the competitive labor market. This assumption contradicts the casual impression of the operation of this market, and also contradicts the conclusion of the Search Theory, whose results are relevant in studying this market. If the competitive market equilibrates only sluggishly as employers and workers are matched through search activities, and if the natural turnover of the labor force generates a certain amount of frictional unemployment, the basic conclusions just stated need only a few amendments. First, the benefits of unexpected inflation are augmented by the fact, noted by the Search Theorists, that an increase in the money wage produces a transitory drop in frictional unemployment. At first, each unemployed worker interprets a wage increase as good luck in his wage sampling and causes him to take a job that he would not, on the average, hold if he knew that the wage increase was universal. Since he soon finds this out, the time span of the benefits from reduced frictional unemployment is far shorter than that of the benefits from expanding union membership. On the other hand, sluggish wage adjustment in the competitive market greatly increases the cost of unexpected contractions. If both wages are fixed in advance, one by the union and the other by the rigidity of adjustment in the competitive market, any decrease in the value of output (aggregate demand) must be achieved by a

reduction in employment. Again, this is a transitory departure from the behavior of the model with perfect competitive wage adjustment. Roughly speaking, the wage differential theory explains chronic unemployment, while the Search Theory explains frictional and Keynesian unemployment.

3. The Empirical Relevance of the Wage Differential Theory

The theory outlined in the previous section depends on three basic hypotheses, each susceptible to empirical test: (1) Unions are successful in maintaining differentials in wages. (2) The labor supply of at least a fraction of the labor force is positively wage-elastic. (3) Wage differentials shrink during expansions in aggregate demand. We will give a brief discussion of empirical evidence on each of these points, although it should be recognized that it is beyond the scope of the present paper to present anything more than a very cursory review.

The measurement of union wage differentials has occupied economists for many years. H.G. Lewis reviews a great deal of earlier work in Unionism and Relative Wages in the United States, [6], and concludes that the ratio of union to nonunion wages has fluctuated between 1.00 and 1.25 in the United States since 1923. His summary is reproduced in Table 1. These results tend to support the hypotheses that unions have some power to enforce an artificial scarcity of union labor and that this power is thwarted by sudden expansions in aggregate demand. The wage differential found by Lewis is, however, not very large.

A major stumbling block in measuring wage differentials is the adjustment for the quality of labor. A true union wage differential

Table 1

H.G. Lewis' Summary of Estimates of
the Ratio of Union to Nonunion Wages

Period	Average Extent of Unionism	Ratio of Wages
1923 - 29	.07 to .08	1.15 to 1.20
1931 - 33	.07 to .08	over 1.25
1939 - 41	.18 to .20	1.10 to 1.20
1945 - 49	.24 to .27	1.00 to 1.05
1957 - 58	.27	1.10 to 1.15

Source: Unionism and Relative Wages in the United States, [6], Table 50, p. 193.

cannot be said to exist if the observed higher wages of union members can be accounted for entirely by the higher efficiency of union workers. Recent progress has been achieved by using data on the wages and characteristics of individuals, which permit adjustment for age, sex, race, and years of education. A very through investigation of this kind is presented by Vector Fuchs in Chapter 6 of The Service Economy, [2]. After adjustment for quality differences, Fuchs finds that the ratio between wages in the goods and service sectors is 1.19. Since not all workers in the goods sector are union members, and some service workers are members, it is useful to reclassify Fuchs' wage data for three-digit industries by degree of unionization of the industry. The means for 9 classes of unionization are given in Table 2. The largest differential is between industries with 10 to 19 percent unionization and industries with 70 to 79 percent, with a ratio of 1.39. Again, this is not a very substantial differential. Unfortunately, Fuchs' procedure tends to overdo the adjustment for quality, since he fails to take account of the union differential in using wages to estimate the quality differences associated with age, sex, race, and education. To the extent that there is a systematic relation between quality and degree of unionization (and Fuchs' results also show this to be the case), then his procedure overstates the differential between the wages of high and low quality workers and understates the union differential. Fuchs also includes all employees

Table 2

Relative Wage by Degree of Unionization

Percent Unionization	Relative Wage (after adjustment for labor force composition)	Standard Error	Proportion of labor force
0-9	.966	.020	.264
10-19	.863	.021	.238
20-29	.881	.039	.073
30-39	1.016	.050	.044
40-49	1.089	.038	.076
50-59	1.110	.025	.187
60-69	1.099	.042	.063
70-79	1.201	.068	.023
80-89	1.152	.062	.028

Source: Calculated from Victor Fuchs, The Service Economy, [2], Table I-1, pp. 245-251, and Table I-2, pp. 252-258. The relative wage is the weighted average of Fuchs' ratio of actual to expected wage by industry. The weights are the numbers of employees.

of each industry, without regard to occupation in his calculations. The inclusion of workers in occupations that are never unionized tends to reduce the differential as measured across industries.

A recent study that avoids these difficulties has been carried out by Frank P. Stafford, [8]. Stafford's calculations are based on a body of data in which union membership is recorded directly for each individual. He estimates labor quality coefficients and union differentials at the same time in separate regressions. The results, shown in Table 3, suggest that the union differential varies substantially by occupation, and is generally higher in low-paid occupations.

All of these results, especially Stafford's, seem to suggest that union wage differentials could generate a certain amount of chronic excess supply in the U.S. labor market, provided there exist groups in the labor force with significantly positive wage elasticities of labor supply. Research on this question is less advanced than in the case of wage differentials, but a great deal of work has recently been initiated under the impetus of concern about the possible effects of negative income tax programs. Within a few years it should be possible to measure the excess demand generated by wage differentials by drawing on the results of these experimental and empirical investigations.

Table 3

Ratio of Union to Nonunion Wages
by Occupation

Occupation	Ratio of Wages
Operatives	1.32
Craftsmen	1.27
Laborers	1.64
Clerical and sales	1.19
Other	.92

Source: Calculated from Frank P. Stafford, "Concentration and Labor Earnings: Comment", [8], Table 2, p. 179.

There are good reasons to believe that male heads of families have relatively low wage elasticities. This is confirmed by a recent empirical study by Russell Hill, [4]. Full time labor force participation is the rule in this group across the whole spectrum of wage levels, in accordance with the presumption that the income effect most nearly balances the substitution effect for this group. For secondary workers and single individuals, however, there is growing evidence that their labor supply may well be sensitive to wage levels. Most of this evidence is anecdotal (see, for example, "Youth Unemployment -- a Tale of Two Ghettos" by Edwin Harwood, [3]), but this topic, too, has recently attracted the attention of empirical investigators. There is clearly a strong tendency for groups that have low wage elasticities (male heads of families) to have low recorded unemployment rates and for groups suspected of having high wage elasticities (teenagers) to have high unemployment rates. Our suggestion is that part of this tendency is caused by the desire of the latter groups to hold higher-paying jobs for which they are qualified but are indirectly excluded by the wage-setting policies of unions.

4. Details

We employ the following notation:

N_1: Number of union members

N_2: Number of non-union workers

$N=N_1+N_2$: Total population

w_1: Union wage and price of goods, in monetary terms

w_2: Competitive wage and price of services, in monetary terms

B_1: Union wage bill and value of goods output

B_2: Competitive wage bill and value of services

M: Endowment of money, per capita

α_1: Expenditure share for goods, out of whole income

α_2: Share for services

α_3: Share for leisure

α_4: Share for money $=1-\alpha_1-\alpha_2-\alpha_3$

H: Hours per person, to be divided between work and leisure

Whole income, defined as the sum of wage income, the imputed value of leisure, and the endowment of money, is

$$(1) \qquad y_i = w_i H + M \quad , \; i=1,2$$

Expenditures on leisure are the constant fraction, α_3, of whole income:

$$(2) \qquad w_i(H-x_i) = \alpha_3 y_i \qquad , i=1,2$$

where x_1 and x_2 are the hours of labor supplied by individual workers in the goods and services industries, respectively. Solving for the labor supply functions, we have

$$(3) \qquad x_i = (1-\alpha_3)H - \alpha_3 \frac{M}{w_i} \qquad , i=1,2$$

$$= \psi_i(M,w_i)$$

These are positively wage-elastic. As a consequence of the endowment of money, an increase in the wage increases the cost of leisure by a greater proportion than it increases income. The market labor supply functions are

$$(4) \qquad L_i = N_i\psi_i(M,w_i) \qquad , i=1,2$$

Now suppose that individuals are constrained to work less than they would prefer at the given wage. The constrained demand functions require that realized income be spent in proportions $\frac{\alpha_1}{1-\alpha_3}$ and $\frac{\alpha_2}{1-\alpha_3}$ on goods and services. Since these proportions are the same for both groups of consumers, there are no income distribution effects, and we can write down the market demand functions immediately:

$$(5) \qquad B_i = \frac{\alpha_i}{1-\alpha_3}(B_1+B_2+NM) \qquad , i=1,2$$

B_i on the left is total expenditure on commodity i and B_1+B_2+NM is total income. This pair of equations can be solved to get the two wage bills:

$$(6) \qquad B_i = \frac{\alpha_i}{\alpha_4} NM \qquad , i=1,2$$

Oddly enough, the wage bills can be calculated without reference to labor market conditions, as long as there is no excess demand for labor. Now since

$$(7) \qquad B_i = w_i L_i \qquad ,$$

we can calculate the conditions for equilibrium in the labor markets as follows

$$(8) \qquad \frac{\alpha_i}{\alpha_4} NM = N_i\,((1-\alpha_3)Hw_i-\alpha_3 M) \qquad , i=1,2$$

or,

$$(9) \qquad w_i = \frac{\alpha_1 N + \alpha_3\alpha_4 N_i}{\alpha_4(1-\alpha_3)} \frac{M}{N_i H}$$

$$= \phi_i(N_i,M)$$

Note that it is always costly to the union to enlarge its membership:

$$(10) \qquad \frac{\partial\phi_1(N_1,M)}{\partial N_1} < 0$$

and always costly to service workers if the union reduces its membership:

$$(11) \qquad \frac{\partial \phi_2(N_2,M)}{N_2} < 0$$

The efficient point for the economy occurs when the union has no effect, and the two wages are equal:

$$(12) \qquad \phi_1(N_1,M) = \phi_2(N_2,M)$$

The solution is

$$(13) \qquad \frac{N_1}{N_2} = \frac{\alpha_1}{\alpha_2} \quad ;$$

the distribution of employment is the same as the distribution of expenditures. If the union proportion is any smaller, the union wage will exceed the competitive service wage, and non-union workers will have an excess supply of labor,

$$(14) \qquad E_2 = N_2 \left(\psi_2(M,w_1) - \psi_2(M,w_2)\right).$$

Our unemployment rate is defined as the proportional excess supply:

$$(15) \qquad u_2 = \frac{E_2}{L_2 + E_2} = \frac{\psi_2(M,w_1) - \psi_2(M,w_2)}{\psi_2(M,w_1)}$$

Whenever the union wage, w_1, exceeds the competitive wage, w_2, unemployment exists among service workers and u_2 is positive.

In the dynamic version of the model, the union sets its wage with the same goal in mind, namely securing full employment for its members, but it acts before the monetary-fiscal policy is known, and must use an expected value for M(t):

$$(16) \qquad w_1(t) = \phi_1(\hat{N}_1(t), \hat{M}(t)) \quad .$$

$\hat{M}(t)$ is the expected monetary distribution[1] in period t and $\hat{N}_1(t)$ is the expected union membership. The latter must be distinguished from actual membership because of the possibility that unexpected expansion will draw in new members. Expected membership in period t is the membership in period t-1 less a small allowance for attrition:

$$(17) \qquad \hat{N}_1(t) = (1-\mu)N_1(t-1)$$

Actual membership is never less than expected membership, but it may be more if the wage is set too low. For that case, we can define a function $g_1(w_1,M)$ giving union membership as a function of the union wage and the actual quantity of money; it is simply the

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[1] Our treatment of monetary-fiscal policy in the dynamic model requires an apologetic explanation. To avoid deep but extraneous intertemporal problems, we assume that money is consumed and is is non-durable, and that it can be produced by the government at no cost. Its function in the present model is to provide a good in terms of which prices are quoted. Since one price is fixed in advance in the model (the union wage), the choice of numeraire is a substantive one.

inverse of the union wage function, ϕ, in w_1 and N_1:

$$(18) \qquad w_1 = \phi_1(g_1(w_1,M), M) \qquad \text{for all } w_1, M \quad .$$

Then the actual union membership in period t is:

$$(19) \qquad N_1(t) = \max (\hat{N}_1(t), g_1(w_1(t), M(t))$$

Equations 16, 17 and 19 form a logically complete description of the movement of the economy over time, provided some mechanism is specified for the formation of union expectations about monetary-fiscal policy. One simple choice is the extrapolative equation,

$$(20) \qquad \hat{M}(t) = (M(t-1))^{1+\beta}(M(t-2))^{-\beta}$$

Here a fraction β of the previous percentage change in M(t) is expected to occur again. If β is zero, all changes are unexpected, while if it is unity, the current change is expected to be the same as the most recently observed change.

Along the path traced out by equations 16, 17, 19 and 20, the values of variables in the service sector -- wages, employment and unemployment -- can be calculated from the static equations given earlier in this section.

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