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DOES THE LOGIC OF COLLECTIVE ACTION EXPLAIN THE LOGIC OF CORPORATISM?

Michael Wallerstein and Karl Ove Moene

ABSTRACT

Mancur Olson's *Logic of Collective Action* has provided the dominant framework for understanding the impact of encompassing unions and employers confederations on wage-setting in Western Europe. In particular, scholars have drawn upon Olson's writing to describe corporatism as a means for attaining the collective goods of low unemployment and low inflation in highly unionized labor markets. The strongest impact of corporatist institutions in the labor market, however, was to generate greater wage equality rather than superior macroeconomic performance. To understand the most important impact of corporatist institutions, a new framework that emphasizes the effect of wage-setting institutions on the distribution of wages and salaries is needed. In this article, we present one component of such a framework with a model that illustrates how both employers and unions might gain by central agreements that reduce wage inequality relative to the equilibrium wage distribution with decentralized wage-setting.

KEY WORDS • corporation • Mancur Olson • wage equality

1. Introduction

Perhaps the most influential application of Mancur Olson's logic of collective action in the study of West European politics has been in the literature on the institutional determinants of good (and bad) economic performance that began under the label of 'corporatism' (Schmitter and Lehmbruch, 1979) and continues to develop under the contemporary rubric of 'varieties of capitalism' (Hall and Soskice, 2001). According to mainstream opinion in political science and sociology, the essence of corporatism is the important role of encompassing organizations of unions and employers in governing the labor market. Why was governance by encompassing organizations beneficial? The answer came straight out of Mancur Olson's (1965) *The Logic of Collective Action*. Encompassing groups, when setting wages, would internalize the important ways in which wages in one firm affect wages or

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employment in other firms. The more encompassing the organizations setting wages or the more coordinated the wage-setting process, the more efficiently the labor market would operate. In particular, the literature emphasized low unemployment and/or low inflation as being important collective goods for unions (Lange, 1984). When unions set wages individually, the argument goes, union members receive the full benefit of wage increases but only pay part of the cost of the resulting unemployment or inflation. An encompassing union confederation, in contrast, would internalize most of the costs as well as the benefits.

Mancur Olson was less sure. While one can find approving remarks about the beneficial impact of encompassing organizations in Scandinavia in *The Rise and Decline of Nations* (1982), the main message goes in the opposite direction. Olson stated his policy preferences clearly in the chapter on macroeconomic problems in *The Rise and Decline of Nations*:

> The most important macroeconomic policy implication is that the best macroeconomic policy is a good microeconomic policy. There is no substitute for a more open and competitive environment. If combinations dominate markets throughout the economy and the government is always intervening on behalf of special interests, there is no macroeconomic policy that can put things right. (Olson, 1982: 233)

The existence of involuntary unemployment means that mutually desirable trades between employers and unemployed workers are not being made. What prevents wages from falling until involuntary unemployment disappears, according to Olson, is the opposition of employed workers. But employed workers can only prevent firms from hiring the unemployed at a wage below the prevailing wage rate if they control a substantial share of the relevant labor market. Olson acknowledged that the logic of encompassing groups implied that union confederations, representing a large share of the work force, would be more concerned with the well-being of society than unions representing workers in a single industry or occupation. But Olson (1986: 73–9) argued that the leadership of the union confederation would have difficulty resisting the lobbying by the leaders of individual unions for policies that advanced the interests of specific groups at the expense of workers as a whole. Decentralization, therefore, was Olson's preferred solution.[1] In Olson's (1982: 125) words, 'A monopoly over a small part of an integrated market is, of course, no monopoly at all'. If wage-setting was sufficiently decentralized, no group of insiders could prevent competitors from hiring outsiders and driving wages down. In an evaluation of Swedish economic policy, Olson (1990) downplayed the importance of centralized bargaining. Instead, Olson suggested that the avoidance of 'implicit redistri-

1. Calmfors and Driffill (1988) formalized Olson's arguments with a model in which both highly centralized and fully decentralized wage-setting generate lower levels of unemployment than intermediate levels of centralization.

butive policies', that is redistributive policies in the form of trade protection, industry subsidies and government regulations, was largely responsible for the efficiency of the Swedish economy.

Conflicting views of the efficiency and desirability of centralized versus decentralized wage-setting are at the center of current European discussions among policy-makers concerned with high and persistent unemployment. On one side, advocates of social pacts or national agreements to lower wages and expand employment draw upon Mancur Olson's arguments regarding the dilemma of collective action and the potential for bargaining among encompassing groups to achieve collectively optimal outcomes. On the other side, advocates of decentralization argue, as Olson himself argued, that no central agreement can match the efficiency of a more competitive labor market. Important policy decisions depend on policy-makers' views of the relative advantages of centralized versus decentralized wage-setting institutions.

In this article, we argue that the conventional application of Mancur Olson's model to characterize centralized wage-setting as an attempt by unions to overcome a collective action problem and achieve a collectively superior outcome is misleading in two respects. The first is the implication that the central actors in centralized systems of wage-setting are the trade unions. In the early corporatist literature, employers were viewed either as passive beneficiaries or as victims of union centralization. Today, it is more widely recognized that employers' associations often played the leading role in creating and sustaining centralized bargaining (Swenson, 1989, 1991; Thelen, 2000). The collective action problem that matters most is among employers, not among unions. Second, and more importantly, Mancur Olson's approach has led scholars to concentrate on the potential efficiency gains from centralized agreements and to pay less attention to the redistributive side of centralized wage-setting.[2] The most important impact of centralization, however, has been on the distribution of income rather than on the efficiency of the labor market. While higher profit was the aim of the architects of centralized bargaining, we argue, greater wage equality was the most significant consequence.

2. Wage-setting Institutions and Economic Performance

We begin with some evidence regarding the basic facts that a theory of the impact of different wage-setting institutions in advanced industrial societies ought to explain. Tables 1 and 2 presents a rough picture of the trends in union density, union coverage and the level of wage-setting in Western

2. Swenson (1989) and Iversen (1996) are exceptions that emphasize the redistributive aspect of centralized bargaining.

Table 1. Union Density and Coverage in Western Europe and North America

	Density 1960	Density 1973	Density 1982	Density 1995	Coverage 1990
Denmark	60.1	61.5	80.3	77.0	74
Finland	31.9	61.4	68.4	79.6	95
Norway	52.3	51.1	55.5	55.4	75
Sweden	70.7	70.5	79.3	87.5	83
Average	53.8	61.1	70.9	74.9	82
Austria	60.0	53.0	52.1	41.1	71
Belgium	41.5	48.0	51.9	53.7	90
France	19.6	22.1	17.3	9.9	92
Germany	34.7	32.4	35.0	29.1	76
Italy	24.7	43.3	46.7	38.7	83
Netherlands	41.7	36.2	32.3	24.3	60
Switzerland	37.0	29.1	29.6	23.6	43
Average	37.0	37.7	37.8	31.5	74
Canada	29.6	32.6	36.8	32.3	38
UK	44.9	50.5	54.1	36.7	47
US	31.0	28.8	20.3	14.3	18
Average	35.2	37.3	37.1	27.8	34

Notes: Density refers to active union members (excluding members who are either unemployed or retired) as a share of wage and salary earners. Coverage refers to the share of work force covered by a collective agreement.

Sources: Ebbinghaus and Visser (2000) and Golden et al. (2002) for density; Traxler (1994) for coverage.

Europe and North America. We have divided the countries into three categories. The first category consists of the four Nordic countries where most workers belong to a union and wage-setting has been highly centralized for much of the postwar period. The second category consists of continental Europe, where union membership is generally lower and wages are typically set at the industry level. The third category consists of the UK and its former colonies where wages are most often set at the level of the plant or firm.

Table 1 presents a summary of the postwar trend in union density, defined as union members who are neither unemployed nor retired divided by the total number of wage and salary workers, from 1960 to 1995.[3] During this period, union density grew steadily in the Nordic countries, with three out of four workers being union members by the 1990s. In contrast, union density is significantly lower in all non-Nordic countries, except Belgium,

3. Union membership figures that include retired members are substantially larger (Ebbinghaus and Visser, 2000).

and density has been declining since the early 1980s. In terms of union membership, the difference between continental Europe and the most decentralized group is small.

An important reason why union membership is so high in Belgium, Denmark, Sweden and Finland is that the unemployment insurance system is administered by the unions (Rothstein, 1989; Western, 1997). This is a good illustration of the role of selective incentives in maintaining high levels of membership in organizations that provide collective goods, as Olson argued in *The Logic of Collective Action* (1965). It is worth noting, however, that only the Anglo-Saxon countries have allowed compulsory union membership in the form of closed shops or union shops. In Belgium, Denmark, Sweden and Finland, workers can obtain union-administered unemployment insurance without joining a union. In this sense, unions in Western Europe are voluntary organizations, although the social pressure to join a union can be strong.

As the final column of Table 1 indicates, union coverage, defined as the share of the work force who are covered by collective agreements, is as high in continental European countries as in the Nordic countries in spite of the large difference in union density. Union coverage can exceed union density for a variety of reasons. In Austria and Germany, the terms of collective agreements extend to all employees of firms that belong to the employers' confederations, whether or not the employees are union members. In France and Belgium, the government routinely extends the terms of wage agreements to cover all workers in a given industry. As Table 1 indicates, three of four workers in Europe in 1990 were covered by collective agreements, even if only one out of three workers paid union dues.

Table 2 shows the trends in the centralization of wage-setting. The numbers reflect the average annual score within each time period of a four-category index (scaled to be between 0 and 100), where the categories are: (i) wage-setting at the level of the firm or plant, (ii) wage-setting at the industry-level, (iii) wage-setting at the national level without sanctions or controls on wage negotiations at lower levels and (iv) wage-setting at the national level with sanctions or controls on wage negotiations at lower levels. The distinction between the third and fourth category stems from the existence of multiple levels of wage-setting in centralized systems. If the signing of a central agreement does not legally restrict the ability of lower-level agents to fight for higher wages, we judged the bargaining round to be in the third category. If, however, the signing of the central agreement limits the ability of lower-level bargainers to obtain additional wage increases, for example by prohibiting industrial action for the duration of the contract, we considered the bargaining round to be in the highest category of centralization.

Table 2. Level of Wage-setting in Western Europe and North America

	1950–59	1960–72	1973–81	1982–95
Denmark	100	100	93	100
Finland	73	77	59	55
Norway	87	95	93	81
Sweden	77	100	100	67
Average	82	93	86	76
Austria	47	33	33	33
Belgium	33	33	44	67
France	33	36	33	33
Germany	33	41	33	33
Italy	67	67	67	71
Netherlands	100	82	74	50
Switzerland	33	33	33	33
Average	49	46	45	46
Canada	0	0	33	0
UK	0	44	33	0
US	0	8	11	0
Average	0	17	26	0

Notes: The level of wage-setting refers to the average annual score on a four-point scale, where 0 is wage-setting at the plant-level, 33 is wage-setting at the industry level, 67 is national-level wage-setting without controls on industry-level wage-setting and 100 is national-level wage-setting with controls on industry-level wage-setting. Data refer to private-sector workers covered by union contracts.

Source: Golden et al. (2002).

It is important to note that the scale does not distinguish between centralization in the form of government action, as in incomes policies, or centralization in the form of collective bargaining by the peak associations of unions and employers. Although government intervention in (private-sector) wage-setting is common, it is never seen as a lasting solution. The Nordic countries and The Netherlands stand out as countries in which bargaining has frequently been both voluntary and centralized. While a significant decline in the level of wage-setting has occurred since the early 1980s in several countries, most notably in Sweden and in the UK, large cross-national differences in the level of wage-setting remain.[4]

4. There is a debate regarding the extent to which the centralization of wage-setting has changed in recent years. On the one hand, Wallerstein et al. (1997) and Wallerstein and Golden (1997) argue that the level of wage-setting has changed less than is commonly thought. On the other hand, scholars such as Katz and Darbishire (1999) and Thelen (2000) argue that significant change has occurred in ways that do not appear in scales of the level of wage-setting, such as the one presented in Figure A1. See Wallerstein and Western (2000) for a review

The macroeconomic performance associated with centralized and decentralized systems of wage-setting are shown in Tables 3 and 4. As Table 3 reveals, the average level of unemployment generally rises as one moves from most to least centralized, although centralized wage-setting is no guarantee of full employment. As Table 4 shows, the average level of inflation is higher for both the Nordic countries and the English-speaking countries than for continental Europe, which is probably due to the greater independence of central banks in continental Europe. In fact, both unemployment and inflation are influenced by many factors, so not too much should be made of the difference in averages presented by Tables 3 and 4. The literature on the macroeconomic effects of centralized versus decentralized wage-setting is large and inconclusive. It is safe to say that the effect of wage-setting institutions is sufficiently subtle to leave ample room for advocates of both centralization and decentralization to point to supporting studies (Freeman, 1998; Flanagan, 1999).

There is nothing subtle, in contrast, about the impact of centralized wage-setting on the distribution of wages and salaries, as shown in the first two

Table 3. Unemployment in Western Europe and North America

	1950–59	1960–72	1973–81	1982–95
Denmark	4.5	1.4	6.0	8.2
Finland	1.3	2.0	4.3	8.1
Norway	1.0	1.6	1.8	4.1
Sweden	1.8	1.8	2.0	3.9
Average	2.2	1.7	3.5	6.1
Austria	4.4	1.8	1.8	3.6
Belgium	4.3	2.2	6.7	10.1
France	1.8	1.9	4.8	10.0
Germany	4.9	0.8	3.0	6.5
Italy	7.2	5.1	6.8	10.5
Netherlands	2.6	1.0	5.1	9.2
Switzerland	0.0	0.0	0.3	1.6
Average	3.6	1.8	4.1	7.4
Canada	4.1	5.0	7.0	9.9
UK	1.2	2.6	5.4	9.9
US	4.4	4.8	6.6	6.8
Average	3.2	4.1	6.3	8.9

Notes: Standardized unemployment rate after 1960 in all countries except Denmark: unstandardized otherwise.

Source: OECD (1997, 2000).

Table 4. Inflation in Western Europe and North America

	1951–59	1960–72	1973–81	1982–95
Denmark	3.7	5.6	10.9	4.1
Finland	5.2	5.2	12.4	4.8
Norway	5.1	4.5	9.4	5.3
Sweden	4.8	4.5	10.1	6.1
Average	3.5	5.0	10.7	5.1
Austria	5.9	3.8	6.5	3.2
Belgium	2.2	3.1	8.0	3.6
France	6.0	4.3	10.9	4.4
Germany	1.9	2.9	5.1	2.6
Italy	3.5	4.0	16.3	7.5
Netherlands	3.2	4.6	7.3	2.2
Switzerland	1.5	3.7	4.8	3.1
Average	3.5	3.8	8.4	3.8
Canada	2.4	2.8	9.5	4.2
UK	3.7	4.4	14.8	5.1
US	2.2	2.8	9.0	3.8
Average	2.8	3.3	11.1	4.4

Notes: Average annual percentage change in the CPI.

Source: IMF (1996), OECD (1997).

columns of Table 5. There is a strong association between centralized wage-setting and wage equality (Freeman, 1988; Blau and Kahn, 1996; Wallerstein, 1999; Hibbs and Locking, 2000; Rueda and Pontusson, 2000). A full-time worker at the 90th percentile of the wage and salary distribution receives, on average, a little over twice the wage of a full-time worker at the 10th percentile of the wage and salary distribution in the Nordic countries. In continental Europe, the ratio is closer to three to one. In the most decentralized countries, the ratio, by 1992, was more than four to one; more than five to one in the case of the US.

The third column of Table 5 presents the share of households whose post-tax and transfer income, after adjusting for family size and after converting to US dollars by purchasing-power parity exchange rates, would be classified as below the US poverty line in 1990. There is an increase in the average share of poor families as one moves from countries with more centralized to less centralized systems of wage determination. Such a measure of poverty, however, reflects GDP per capita as well as income inequality. Therefore, we present, in the fourth column of Table 5, an adjusted poverty measure which represents the estimated share of families who would be poor if the country's

Table 5. Inequality and Poverty in Western Europe and North America

	w_{90}/w_{10} 1980	w_{90}/w_{10} 1992	Poverty 1990	Adjusted poverty 1990
Denmark	2.14	2.17[a]	5.9	6.1
Finland	2.46	2.36	3.7	3.2
Norway	2.06	1.98[b]	1.7	1.7
Sweden	2.04	2.10	5.8	5.5
Average	2.18	2.15	4.3	4.1
Austria	3.45	3.52	n.a.	n.a.
Belgium	n.a.	2.29	6.0	5.7
France	3.26	3.23	9.8	9.3
Germany	2.69[c]	2.44	4.3	3.8
Italy	2.64	2.42[b]	14.3	13.5
Netherlands	n.a.	2.61	7.3	6.6
Switzerland	n.a.	2.67	3.8	6.0
Average	3.01	2.74	7.6	7.5
Canada	4.01[d]	4.24	6.5	6.9
UK	2.79	3.31	16.8	15.7
US	4.80	5.40	11.7	13.7
Average	3.87	4.32	11.7	12.1

Notes: w_{90}/w_{10} is the ratio of the labor income at the 90th and 10th percentiles of the distribution of wages and salaries for full-time workers: [a] 1990, [b] 1991, [c] 1983, [d] 1981. Poverty is the share of households who would be classified as poor in the US using PPP exchange rates. Adjusted poverty is poverty adjusted for differences in GDP per capita as described in the text.

Sources: Wallerstein (1999) for wage inequality; Kenworthy (1999) for poverty.

GDP per capita were equal to the average GDP per capita of the group.[5] Since the extent of poverty depends on a variety of factors, such as welfare policies and the number of single-parent households, the association of low levels of poverty with high levels of centralization is striking.[6]

In sum, the stylized facts associated with centralized wage-setting are the following:

5. To calculate the adjusted poverty measure, we first regressed poverty on GDP per capita (in thousands of US dollars) in 1990 to obtain:

$$\text{Poverty}_i = 15.4 - (.374)\,\text{GDP per capita}_i + u_i$$

where the coefficient on GDP per capita has a standard error of (.485) and $R^2 = .05$. The adjusted poverty measure is equal to average poverty plus the residual, u_i, of the regression equation.

6. In part, this is because the advanced industrial societies with more egalitarian wage distributions also spend more on social insurance policies like unemployment, disability and sickness pay (Moene and Wallerstein 2001).

1. Voluntary, centralized systems of wage-setting are in decline, on average, but the decline is slow and uneven. Centralized systems of wage-setting have proven resilient enough to last decades.
2. While unemployment is lower in countries with centralized bargaining on average, the difference in macroeconomic performance associated with centralized and decentralized systems of wage-setting is not so large as to make the macroeconomic impact of centralization in the labor market obvious.
3. Highly centralized systems of wage-setting have very egalitarian distributions of wages and salaries, while the most decentralized systems of wage-setting have the largest wage differentials.

3. A Model of Efficiency Wages with Heterogeneous Jobs

3.1. Decentralized Wage-setting

To explain the impact of centralized bargaining on wages and employment, it is necessary to start with a model that contains the key features of decentralized equilibria in the labor market that centralized wage-setters sought to improve upon: wage levels too high to maintain full employment and pay inequality perceived to be unfair. Therefore, we start with a model of a perfectly competitive labor market where both involuntary unemployment and unequal wages for equally capable workers exist in equilibrium. To construct such a model, we draw on two literatures. The first consists of models of efficiency wages due to potential shirking, developed by Shapiro and Stiglitz (1984) and Bowles (1985) and first examined in the context of centralized and decentralized wage-setting by Rødseth (1990). The second literature consists of models of pay inequality due to the matching of heterogeneous workers with each other, as in Kremer (1993), or the matching of identical workers with heterogeneous jobs, as in Moene and Wallerstein (1997).

The basic ingredients of the model consist of a continuum of workers and a continuum of potential jobs. We will assume that the number (or measure) of potential jobs equals or exceeds the number of workers, although the number of potential jobs that can be profitably turned into actual jobs will be less than the number of workers in equilibrium. Jobs are heterogeneous in the sense that different jobs are associated with different productivity levels for a given input of worker's effort and skill. We take the distribution of jobs to be exogenous.[7] Workers are assumed to be identical, in order to illustrate

7. The assumption that the distribution of jobs is exogenous can be relaxed without altering the basic results. We discuss the extension of the model to allow the distribution of jobs to be endogenous later.

the way that a decentralized labor market can result in unequal pay for equally talented and dedicated workers.

In particular, we assume that output per worker is given by the product $kq(e)$. The first term k could represent the quantity of capital, the productivity of capital or the relative price of output produced in a particular job. What is important is that k varies from job to job according to a continuous cumulative density function $F(k)$ on the interval $[0, k_{\max}]$. The term $q(e)$ represents the contribution of workers' effort. We assume that $q(e)$ is an increasing, strictly concave function or that $q'(e) > 0$ and $q''(e) < 0$, with $q(0) = 0$. That output per worker is given by the product $kq(e)$ is a simple way to capture the idea that workers' effort matters more in some jobs than others. Our assumptions regarding the function $q(e)$ state that nothing is produced without effort and that output rises with effort at a diminishing rate. An occupied job with capital k generates a profit of

$$\pi = kq(e) - w \tag{1}$$

for the employer, where w is the wage. We assume that employers set the wage to maximize profits, which implies that the wage will vary with k.

Workers are assumed to have identical preferences over the wage they receive, the effort they expend at work and the inequality of the aggregate wage distribution. The assumption that workers prefer less effort to more is a common assumption in the literature on efficiency wages derived from workers' choice of effort. The assumption that workers have preferences regarding aggregate inequality is less standard but the experimental evidence that people's behavior is often affected by notions of fairness is strong (Fehr and Schmidt, 1999; Frohlich et al., 2001).

In the decentralized equilibrium, workers' preferences over their wage and effort are all that matter, since the impact of any individual wage agreement on the inequality of the wage distribution is negligible. We write the part of workers' preferences that depend on their wage, w, and their effort at work, e, as

$$U(w, e) = w - c(e) \tag{2}$$

where $c(e)$ is the cost of effort.[8] We assume that $c(e)$ is an increasing, strictly convex function, i. e. that $c'(e) > 0$ and $c''(e) > 0$, with $c(0) = 0$. In words, we

8. The quasi-linear form of equation 2 is standard in the literature but it is restrictive. Equation 2 implies that workers' choice of effort is independent workers' views of the fairness of the wage distribution. In defense of equation 2, we would agree that effort depends on workers' views of the fairness of wages offered by their particular employer, as argued by Akerlof (1982) among others, but that is not an issue we wish to focus on in this article. Workers' views regarding the fairness of the aggregate wage distribution are less likely to influence how hard they work.

assume that the cost of minimal effort is zero but that the disutility of effort increases at an increasing rate as effort increases.

Finally, we assume that workers' spells of employment and unemployment can be described by a Markov process in which a worker's probability of losing a job depends on the worker's effort at work. According to equation 2, workers prefer to expend minimal effort at work. We assume that employers monitor workers' effort but that employers' knowledge of how hard their employees work is imperfect. In particular, we assume that employers can receive two signals. With probability $g(e)$, the employer's signal indicates the worker is shirking and the employee is laid off. With probability $1 - g(e)$, the signal indicates the employee is working diligently and no layoff occurs. The more effort workers expend at work, the lower the probability is that the employer will think they are shirking. Thus, the probability of being laid off is a declining function of e or $g'(e) < 0$. We assume, in addition, that $g''(e) > 0$ or that the impact of greater effort on the probability of keeping one's job declines as effort increases. Finally, we assume that working hard does not reduce the probability of job loss to zero or that $g(e)$ has a lower bound that is strictly positive.

Putting these assumptions together, we can write a worker's present value of being employed in a job that pays a wage of w as

$$V^{\mathrm{E}} = w - c(e) + \left(\frac{1}{1+r}\right)[g(e)V^{\mathrm{U}} + (1 - g(e))V^{\mathrm{E}}] \tag{3}$$

Equation 3 states that the value of being employed at the wage w is equal to the wage minus the disutility of effort, $c(e)$, plus expected utility one period in the future. Expected utility one period in the future is equal to the probability of losing one's job, $g(e)$, times the present value associated with being unemployed, V^{U}, plus the probability of keeping one's job, $(1 - g(e))$, times the present value of remaining in one's current position, V^{E}. The term $1/(1 + r) < 1$ is the rate at which future utility is discounted.

In a similar manner, we can write workers' outside option or the present value of the utility of unemployed workers as

$$V^{\mathrm{U}} = \left(\frac{1}{1+r}\right)[E(h(w)V^{\mathrm{E}}) + (1 - E(h(w)))V^{\mathrm{U}}] \tag{4}$$

where $h(w(k))\,\mathrm{d}F(k)$ is the probability that an unemployed worker will obtain a job that pays a wage within the small interval $\mathrm{d}w$. Equation (4) states that the unemployed have no income in the current period. In the next period, there is a probability of $h(w(k))\,\mathrm{d}F(k)$ that an unemployed worker will be hired at the wage w and receive $V^{\mathrm{E}}(w)$. We take the expectation of hV^{E} since both h and V^{E} differ in different jobs. With probability $1 - E(h(w))$, the unemployed will remain unemployed. It is common to assume the un-

employed receive a transfer payment financed by employers or by general tax revenues when unemployed but the addition of an unemployment benefit does not contribute additional insights in a model with risk-neutral workers. Therefore, we abstract from taxes and transfer payments for the sake of simplicity.

The sequence of decisions is as follows: Employers first decide what wage to offer given k. Workers then decide how much effort to expend on the job, given the wage that is offered and their outside option, V^{U}. We focus on stationary equilibria in which the rate of unemployment and the distribution of employment is constant over time. In a stationary equilibrium, the number of workers who find new employment in jobs each period with $k \in [k_0, k_1]$ must equal the number of job separations that occurred in jobs with $k \in [k_0, k_1]$. The probability that an unemployed worker obtains a job with a wage within the small interval $\mathrm{d}w$ is $h(w(k))\,\mathrm{d}F(w)$. Therefore, the share of the work force newly hired to fill a job within the small interval $\mathrm{d}k$ is $u\,h(w(k))\,\mathrm{d}F(k)$ where u is the rate of unemployment. Similarly, the share of the work force who lose jobs within the small interval $\mathrm{d}k$ is $(1-u)g(e(w(k)))\,\mathrm{d}F(k)$, since $g(e(w))$ is the probability that a worker with a job that pays w is laid off. Therefore, in the stationary equilibrium, we have

$$u\int_{k_0}^{k_1} h(w(k))\,\mathrm{d}F(k) = (1-u)\int_{k_0}^{k_1} g(e(w(k)))\,\mathrm{d}F(k) \tag{5}$$

for all $k_0 \leq k_1$.

A decentralized equilibrium is defined by the following four conditions:

1. Workers choose effort to maximize V^{E} given the wage and workers' outside option or $e = e^*(w, V^{\mathrm{U}})$.
2. Employers choose the wage to maximize profits given k and workers' choice of effort or $w = w^*(k, V^{\mathrm{U}})$.
3. Employers earn non-negative profits.
4. Workers have rational expectations or V^{U} equals the discounted value of unemployed workers' expected future utility.

In the Appendix, we prove that a stationary decentralized equilibrium exists and we derive its properties. Here we present a less formal and more intuitive explanation of basic characteristics of the competitive equilibrium. Workers face a trade-off between the disutility of effort with the desire to reduce the probability of losing their current job. How hard workers are willing to work depends on how much they value their current job compared to the alternative of being unemployed for a while and eventually finding another job. Thus, an increase in a worker's wage (holding unemployment and wages elsewhere constant) increases the worker's effort, while a reduction

in unemployment or an increase in wages elsewhere (holding a worker's current wage constant) reduces the worker's effort.

Employers, in choosing what wage to offer, face a trade-off between the cost of paying a higher wage and the higher effort that a higher wage will induce. Employers for whom effort is particularly important, that is employers with higher values of k, offer higher wages and workers in jobs with higher wages work harder. Since workers in higher paid jobs work harder, they keep their jobs for longer periods of time on average. As a consequence, the labor market generates a distribution of wages and a distribution of job separations in which low-paid jobs have a greater turnover than high-paid jobs.

A partial equilibrium corresponding to an arbitrary level of V^{U} is illustrated in Figure 1. In Figure 1, positions are arrayed along the horizontal axis from most to least productive, with output per worker, $kq(e)$, on the vertical axis.[9] For a given V^{U}, the product $kq(e)$ is a function of k alone, since $e = e^*(w^*(k, V^{U}), V^{U})$. We have also drawn the wage distribution $w = w^*(k, V^{U})$ which shows the wage offered in a job with capital k for a given V^{U}. The vertical distance between output per worker curve and the wage curve represents profits as a function of k. The value of k where profits go to zero (that is where the output per worker curve and the wage curve intersect), denoted by $k_{\min}$ in the figure, is the least productive job that it is profitable to fill, given V^{U}. The value of V^{U} is drawn as the horizontal line below the wage curve.

Figure 1 illustrates four important points. The first is that identical workers working in different jobs with different levels of k receive different wages. Second, all jobs offer wages higher than V^{U}. In fact, equation 3 implies that workers with jobs must be strictly better off than workers without jobs, since $V^{E} > V^{U}$ if $e > 0$. In addition, workers receiving a higher wage are strictly better off than workers receiving a lower wage, even though higher paid workers work harder:

$$\frac{dV^{E}}{dw} = \left(\frac{\partial V^{E}}{\partial e}\right)\left(\frac{\partial e}{\partial w}\right) + \left(\frac{\partial V^{E}}{\partial w}\right) = \left(\frac{\partial V^{E}}{\partial w}\right) > 0$$

since workers' optimal choice of effort implies that $\partial V^{E}/\partial e = 0$. Third, profits are also higher in jobs with higher k, since $\partial \pi/\partial k = q(e) > 0$. Fourth, there is some $k_{\min} > 0$ such that all positions with $k < k_{\min}$ would earn negative profits if filled, so they are left vacant even though workers employed at the wage $w(k_{\min})$ are strictly better off than workers who are unemployed.

9. Such pictures of the heterogeneity of plants are called Salter diagrams, after Salter's (1960) pioneering empirical investigations.

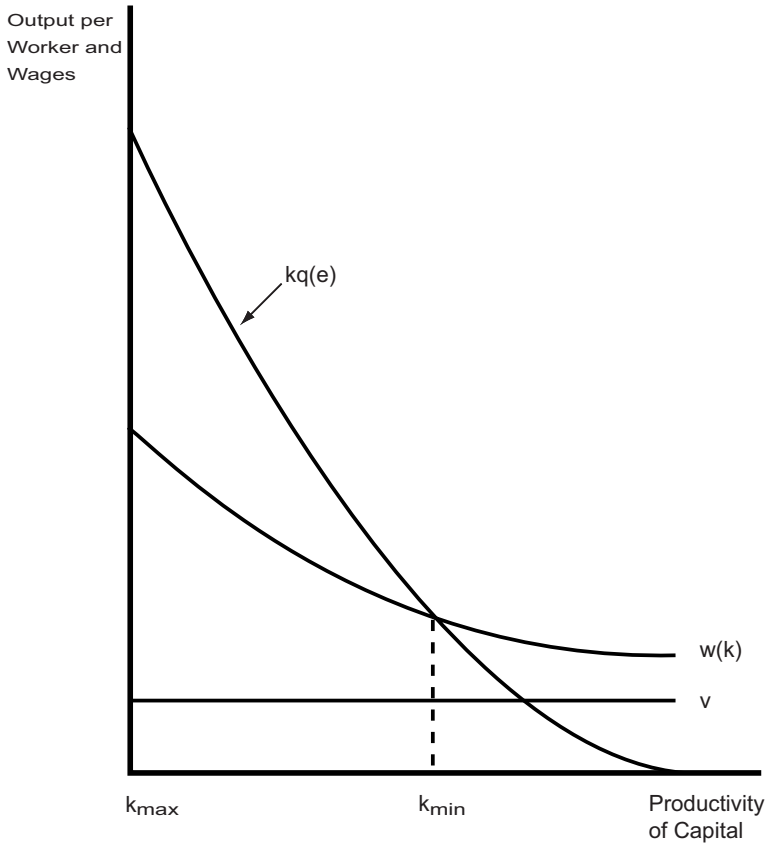

Figure 1. The Distribution of Output per Worker and Wages

The condition for a decentralized condition is that workers' outside option equals the true expected utility of the unemployed. In equilibrium, there must exist unemployed workers. Without unemployment, V^{U} would equal the average level of V^{E} which would imply that much of the work force would exert no effort. Employers would respond by raising wages or laying off workers and closing positions, thereby creating unemployment, until the equilibrium was reached. The existence of involuntary unemployment in equilibrium is the standard result of models where workers' effort is endogenous. Unemployment is involuntary in the sense that unemployed workers would prefer to trade places with any of the currently employed workers. Employers do not reduce wages, however, because of the adverse effect of a wage cut on the effort of their employees.

The second, less standard feature is the existence of unequal pay for identical workers. Some workers are lucky enough to obtain a position where effort matters a lot and pay is high. Others work in low-wage jobs where effort is less important. The inequality is involuntary in the sense that a worker in a low pay, low effort job would happily trade places with a worker in a high pay, high effort job. The inequality is unfair in the sense that, since workers are assumed to have identical preferences and identical skills, it is only luck that determines which workers have high-wage jobs, which have low-wage jobs, and which have no jobs at all.

3.2. Centralization Wage-setting

Consider the situation from the point of view of the employers' confederation. If employers' could set wages collectively, how would their preferred wage schedule differ from the competitive equilibrium? In particular, we assume that the objective of the employers' association is to maximize aggregate profits:

$$\int_{k_{\min}}^{k_{\max}} \pi(k)\,\mathrm{d}F(k) = \int_{k_{\min}}^{k_{\max}} [kq(e) - w(k)]\,\mathrm{d}F(k) \tag{6}$$

subject to the constraint that workers' effort depends on their wage and outside option and ask how employers would collectively like to alter the wage schedule associated with the decentralized equilibrium.

That employers may prefer lower wages is not surprising. In the Appendix, we show that employers may also prefer more equal wages. Wage reductions cause workers to reduce their effort but the trade-off between wages and effort is different from the point of view of the employers' confederation than from the point of view of an individual employer. Workers' effort is a function of the difference between what they are paid and their outside option or their expected future income should they lose their job. An individual employer calculates the impact of reducing the wage in a context where the outside option is fixed. An encompassing employers' association, in contrast, would include the impact of a wage reduction on workers' outside option in its calculations. Employers collectively prefer to reduce wages below the competitive equilibrium if, in doing so, they reduce workers' outside option.[10] In addition, employers collectively prefer to reduce wage

10. The result that employers collectively prefer to lower wages bears a similarity to models of monopsony power in the labor market (Manning, 2002). In the model of this article, however, employment is constrained by the demand for labor, not the supply of labor. A central difference is that a wage reduction increases employment in the model of this article but not necessarily in the monopsony labor market model.

dispersion if workers' outside option is more sensitive to the wages earned in high-wage positions than the wages earned in low-wage positions. The loss of productivity from less effort on the part of workers is more than offset by the savings of lower wages.

Of course, the employers association cannot dictate the wage schedule. With centralized bargaining, the wage schedule must be negotiated with unions and, in some countries, ratified by a vote of the union membership. While employers collectively want lower wages, unions generally want higher wages. Where employers and unions have conflicting interests, the outcome of bargaining depends on the willingness of the two sides to engage in industrial conflict and, perhaps, threats or side-payments from the government. But if workers have egalitarian preferences, such that they prefer a more equal wage distribution to a less equal wage distribution and if unions reflect their members egalitarian preferences, then both employers and the unions have a common interest in reducing wage inequality below the level of wage inequality associated with decentralized wage-setting.

It is not inconsistent to think that workers care about equality yet study their behavior in decentralized markets assuming that workers care only about their wage and their effort. In a decentralized market, workers' choices have no discernible impact on inequality. Thus, workers' preferences toward inequality have no role to play in perfectly decentralized markets. But when workers vote on a wage contract collectively, their preferences regarding inequality become important. In our model, workers are identical in every way, yet some are paid more and are better off than others. Although effort is important in production, the differences in pay are entirely due to luck by construction. It is not surprising that workers who were unlucky enough to be in poorly paid positions would be adamant in advocating greater wage equality, while workers who were lucky enough to enjoy high pay would have a harder time defending their advantage.

Employers, in sum, entered centralized negotiations seeking to reduce both the mean and the variance of the wage distribution. Unions entered centralized negotiations seeking to increase the mean but reduce the variance of wages. Whatever the outcome of bargaining with respect to the mean, it is not surprising that the resulting agreements reduced wage inequality. This, we suggest, is why centralized bargaining has had a stronger effect on wage inequality than on aggregate wage growth or macroeconomic performance. Of course, employers and unions do not necessarily share the same view of how much wage compression is optimal. In particular, unions preferred lower levels of wage inequality than employers would have chosen on their own. What began as a consensual move by employers and unions towards greater wage equality in Scandinavia in the 1950s and 1960s turned conflictual in the 1970s and 1980s when wages became so compressed that profits suffered (Iversen, 1996; Pontusson and Swenson, 1996).

A change in wage schedule that increases profits need not be a change that increases efficiency, defined as total output minus the cost of effort. Assuming a given distribution of positions or, equivalently, a fixed capital stock, the most efficient wage schedule is to make workers the full residual claimant, with $w(k) = kq(e) - \rho$, where ρ represents a fixed payment to the suppliers of capital. A change from capitalist ownership to workers' ownership would increase efficiency by allowing workers to receive the full benefit of their effort. Such a change might also increase inequality among workers. As Figure 1 illustrated, wages are less unequal than productivity differences in capitalist firms. In this sense, centralized bargaining that produces a more egalitarian wage schedule represents a move away from the efficient wage distribution. However, our model is not an appropriate vehicle for making judgements about the relative efficiency of capitalist and worker-owned firms. The central disadvantages of workers' ownership concern the ability and incentives of worker-owned firms to invest. Therefore, a comparative analysis of workers' ownership and capitalist ownership must include an analysis of the market for capital as well as the market for labor.

Including an analysis of the impact of wage compression on employers' investment in new jobs, as in Moene and Wallerstein (1997), does not alter the results of our analysis. A wage policy that results in higher profits will increase investments in new, more productive jobs. By adding job creation and job destruction to the model, one adds a channel by which wage compression might generate productivity increases due to new investment that at least partially offsets the productivity declines due to the reductions in workers' effort. Nevertheless, it is important to keep in mind that a change in the wage schedule that increases profits is not necessarily a change that increases efficiency. Employment goes up but workers' effort in existing positions goes down. Whether efficiency is increased is not clear.[11]

4. Conclusion

Our model of decentralized equilibrium illustrates two aspects of the labor market that are critical in understanding the development of wage-setting institutions. The first is the existence of involuntary unemployment. Unemployed workers would prefer to work at the going wage than remain unemployed but no employer can profitably offer them a job. The second feature is the existence of unequal pay (and unequal utility) for workers

11. In a study of productivity in Sweden, Hibbs and Locking (2000) found that reductions in wage inequality was associated with above average productivity growth in the 1950s and 1960s but with below average productivity growth in the 1970s and early 1980s when wage compression reached its peak.

who are identical *ex ante*. Lucky workers are in positions where effort is important and pay is high. Unlucky workers are in positions where effort is less important and pay is low.

The development of centralized bargaining institutions in Northern Europe, we suggest, responded to both of these features of decentralized labor markets. Employers could increase profits by reducing both wage growth and wage dispersion. Workers could satisfy their desire for greater wage equality. The result was centralized wage-setting that both held down wages overall and flattened the wage distribution. While the inefficiency of involuntary unemployment was reduced, the inefficiency of insufficient effort on the part of workers was increased. With less to lose from losing a good job, workers' effort in good jobs declined.

According to much of the literature, corporatist institutions in the labor market were established to provide the collective goods of low unemployment and low inflation for unions. Our model, in line with the historical work of Swenson (1989, 1991, 2002), emphasizes the collective good of greater profits for employers.[12] The most important collective action problem in understanding corporatism is not in preventing free-riding by unions. The union confederation can count on the employers' confederation to prevent individual unions from obtaining wages in excess of the central agreement. The most important problem is free-riding among employers. When wages are reduced below the competitive equilibrium each individual firm would like to raise wages for its workers although all firms benefit if all resist the temptation to raise pay. Keeping the employers' confederation together has proven to be harder than keeping the unions together for reasons that Mancur Olson would have understood very well (Swenson, 2002; Thelen, 2000).

The most significant impact of centralized wage-setting institutions, however, has not been on unemployment but on the distribution of wages. The most important tensions in systems of centralized bargaining are not due to free-riding by unions or even by employers. The most severe conflicts between unions and employers and among unions have been over the changes in relative wages that centralized bargaining produced. When wages are set collectively, wage-setting acquires a political dynamic. Here is where Mancur Olson's framework, which emphasizes the provision of collective goods as opposed to distributional conflict within organizations, has led scholars astray.

12. In particular, Swenson's (2002) explanation of employer support for wage compression in wartime US and postwar Sweden anticipates the central results of our model.

5. APPENDIX

5.1. The Choice of Effort

From equation 3 in the text, we write the value of a job as

$$V^{\mathrm{E}} = \frac{[w - c(e)](1 + r) + g(e)V^{\mathrm{U}}}{r + g(e)} \tag{7}$$

Workers select e to maximize V^{E}. The first-order condition for a maximum can be written as

$$w - \lambda(e) - v = 0 \tag{8}$$

where

$$\lambda(e) = c(e) - [c'(e)/g'(e)][r + g(e)]$$

and

$$v = \left(\frac{r}{1 + r}\right)V^{\mathrm{U}}$$

is workers' outside option. Note that $\lambda(e) > c(e)$ for $e > 0$, since $c'(e) > 0$ and $g'(e) < 0$. Our assumptions that $c''(e) < 0$ and $g''(e) > 0$ guarantee that the second-order condition for a maximum is satisfied or that $\lambda'(e) > 0$. Equation 8 can be re-written as

$$\left[\frac{w - c(e) - v}{r + g(e)}\right]g'(e) = c'(e)$$

a form that is easier to interpret. The term inside the brackets is the present value of the gain from having a job that pays w. Thus, the first-order condition states that the marginal increase in the probability of keeping a job multiplied by the value of the job is set equal to the marginal cost of effort.

Equation 8 implicitly defines workers' supply of effort as a function of the wage, average wages and the rate of unemployment or $e = e^*(w, v)$. Applying the second-order condition that $\lambda'(e) > 0$, it is easily seen that workers supply greater effort, the higher the wage they are offered,

$$\frac{\partial e^*}{\partial w} = \frac{1}{\lambda'(e^*)} > 0 \tag{9}$$

and the lower is their outside option,

$$\frac{\partial e^*}{\partial v} = -\frac{1}{\lambda'(e^*)} < 0$$

Even though workers work harder when they are paid more, all workers strictly prefer a higher paid job. From equation 7 we have:

$$\frac{\mathrm{d}V^{\mathrm{E}}}{\mathrm{d}w} = \frac{1 + r}{r + g(e^*)} > 0$$

The high wage paid in high-wage jobs more than compensates the workers for their greater effort.

5.2. The Choice of Wages

Employers set the wage to maximize profits given workers' response $e = e^*(w, v)$. The first-order condition for the profit-maximizing wage is

$$\frac{\mathrm{d}\pi}{\mathrm{d}w} = kq'(e)\frac{\partial e^*}{\partial w} - 1 = 0$$

which, using equation 9 can be written as

$$kq'(e) - \lambda'(e) = 0 \tag{10}$$

We assume that the second-order condition for a maximum is satisfied or that $q''(e)/q'(e) < \lambda''(e)/\lambda'(e)$.

Equation 10 implicitly defines employers demand for effort, that is the price employers are willing to pay for greater effort, as an increasing function of k or $e = e^{\mathrm{D}}(k)$ with

$$\frac{\mathrm{d}e^{\mathrm{D}}}{\mathrm{d}k} = \frac{q'(e)}{\lambda''(e) - kq''(e)} > 0$$

(The denominator is positive as a consequence of the second-order condition.) Putting the supply of effort and the demand for effort together, the optimal wage can be implicitly defined by the equation

$$e^{\mathrm{D}}(k) - e^*(w, v) = 0 \tag{11}$$

Thus, $w = w^*(k, v)$ with

$$\frac{\partial w^*}{\partial k} = \frac{q'(e^*)}{[\lambda''(e^*) - kq''(e^*)]\lambda'(e^*)} > 0$$

The profit-maximizing wage is an increasing function of the capital the worker employs. Workers' effort matters more when k is high, so employers with a higher k will induce workers to expend greater effort by paying a higher wage. In addition, we have

$$\frac{\partial w^*}{\partial v} = -\frac{\partial e^*/\partial v}{\partial e^*/\partial w} = 1$$

Wages increase one for one with workers' outside option. Profits decline as workers' outside option increases, $\partial\pi/\partial v = -1$, since an increase in the outside option forces firms to raise wages to maintain the same level of effort. However, profits increase with k, even though firms with higher levels of k pay higher wages:

$$\frac{\partial \pi}{\partial k} = q(e^*) > 0$$

5.3. Decentralized Equilibrium

Competitive equilibrium in the labor market entails the following four conditions:

1. Workers' choice of effort is given by $e = e^*(w, v)$, as defined implicitly by equation 8.
2. Employers' choice of wage is given by $w = w^*(k, v)$ as defined implicitly by equation 11.
3. The share of unemployed workers is equal to the fraction of positions that are insufficiently productive to make a profit or $u = F(k_{\min})$, where $k_{\min}$ is defined implicitly by the zero-profit condition
$$k_{\min} q(e) - w = 0 \tag{12}$$
4. The value of workers' outside option v that appears in equations 8 and 11 is consistent with the equilibrium distribution of wages and unemployment.

Equation 12 implies that the least productive position that employers seek to fill, $k_{\min}$, can be written as continuous, differentiable function of v or $k_{\min} = k_{\min}(v)$:

$$\frac{\mathrm{d}k_{\min}}{\mathrm{d}v} = \frac{1}{q(e^*)} > 0$$

In addition, equation 12 implies that $k_{\min}(v) = w/q > v/q$ since $w > v$ for all v. In particular, $k_{\min}(0) > 0$.

Now consider v as a function of $k_{\min}$. Note that if $k_{\min} = k_{\max}$, then $v = 0$, since all positions are unprofitable to fill, while $v > 0$ if $k_{\min} = 0$. Since v is a continuous function of $k_{\min}$, the curves representing the functions $v(k_{\min})$ and $k_{\min}(v)$ must intersect, as illustrated in Figure A1. At the intersection of the two curves, the four equilibrium conditions are satisfied.

5.4. Centralization Wage-setting

With centralized wage-setting, the employers' confederation chooses a wage schedule $w(k)$ and an effort schedule $e(k)$ to maximize aggregate profits:

$$\Pi = \int_{k_{\min}}^{k_{\max}} [kq(e) - w(k)]\,\mathrm{d}F(k)$$

subject to the constraint that workers in each position will choose their effort according to the condition that $w - v - \lambda(e) = 0$. The easiest way to proceed is to substitute the constraint into the employers' maximand and write the employers' problem as choosing $e(k)$ to maximize

$$\Pi = \int_{k_{\min}}^{k_{\max}} [kq(e(k)) - v - \lambda(e(k))]\,\mathrm{d}F(k)$$

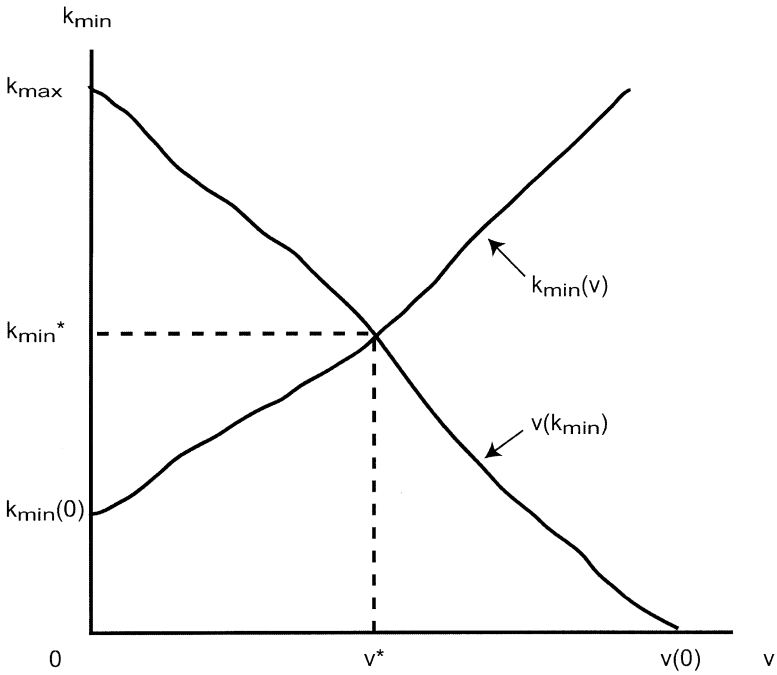

Figure A1. The Existence of an Equilibrium

The derivative of aggregate profits with respect to the effort supplied in jobs with k units of capital is

$$\frac{\partial \Pi}{\partial e(k)} = [kq'(e(k)) - \lambda'(e(k))]f(k) - \frac{\partial v}{\partial e(k)}[1 - F(k_{\min})]$$

Employers' collectively optimal wage schedule is characterized by the first-order condition $\partial \Pi / \partial e(k) = 0$ for all $k \geq k_{\min}$

If we evaluate $\partial \Pi / \partial e(k)$ at the decentralized equilibrium, that is at the level of effort, $e^*(k)$ such that $kq'(e^*(k)) - \lambda'(e^*(k)) = 0$, we have

$$\frac{\partial \Pi(e^*(k))}{\partial e(k)} = -\frac{\partial v}{\partial e(k)}[1 - F(k_{\min})] \tag{13}$$

Thus, profits can be increased by reducing $e(k)$ below the competitive level if and only if a reduction in $e(k)$ or, equivalently, a reduction in $w(k)$ reduces v, workers' outside option.

To derive an expression for v, we start with equation 4 in the text and write V^{U} as

$$V^{\mathrm{U}} = \frac{E(h)E(V^{\mathrm{E}}) + \mathrm{Cov}(h(w), V^{\mathrm{E}})}{r + E(h)} \tag{14}$$

where we used the formula that $E(xy) = E(x)E(y) + \mathrm{Cov}(x, y)$. Using equation 3 in the text, we can write $E(V^{\mathrm{E}})$ as

$$E(V^{\mathrm{E}}) = \frac{(1+r)E(w-c) + E(g)V^{\mathrm{U}} - \mathrm{Cov}(g, V^{\mathrm{E}})}{r + E(g)} \tag{15}$$

Combining equations 14 and 15 yields

$$\begin{aligned} v &= \left(\frac{E(h)}{r + E(g+h)}\right)\left[E(w-c) - \frac{\mathrm{Cov}(g, V^{\mathrm{E}})}{1+r}\right] + \left(\frac{r + E(g)}{r + E(g+h)}\right)\frac{\mathrm{Cov}(h, V^{\mathrm{E}})}{1+r} \\ &= \left(\frac{E(h)}{r + E(g+h)}\right)E(w-c) + \left(\frac{r}{r + E(g+h)}\right)\frac{\mathrm{Cov}(h, V^{\mathrm{E}})}{1+r} \end{aligned}$$

since equation 5 in the text implies that $E(h)\mathrm{Cov}(g, V^{\mathrm{E}}) = E(g)\mathrm{Cov}(h, V^{\mathrm{E}})$.

If we let r become very small, the expression for v approaches a simple form:

$$v \to (1-u)E(w-c) = \int_{k_{\min}}^{k_{\max}} (w-c)\,\mathrm{d}F(k) \tag{16}$$

(Remember that the expectation is conditional upon being employed.) Differentiating equation 16 with respect to $e(k)$ yields

$$\frac{\partial v}{\partial e(k)} = \left[\frac{\partial w(k)}{\partial e(k)} - c'(e(k))\right] f(k) = [\lambda'(e(k)) - c'(e(k))] f(k) \tag{17}$$

If $\partial v/\partial e(k) > 0$ or if $\lambda'(e(k)) - c'(e(k)) > 0$, then the collectively optimal wage schedule for employers entails reducing the wage paid in plants with k units of capital. If, in addition, $\partial^2 v/\partial e(k)^2 > 0$, or if $\lambda''(e(k)) - c''(e(k)) > 0$, then the biggest reductions would occur in the plants that pay the highest wages. Thus, if $\partial^2 v/\partial e(k)^2 > 0$, the collectively optimal wage schedule for employers entails reducing the variance of the wage distribution. While equation 16 is only an approximation for v when $r > 0$, the continuity of v as a function of r and the strict inequality in equation 17 implies that the results hold for strictly positive values of r that are close to zero.

In order to determine the signs of $\partial v/\partial e(k)$ and $\partial^2 v/\partial e(k)^2$, additional restrictions on the functions $c(e)$ and $g(e)$ are needed. Consider the special case where the function $g(e)$ is given by

$$g(e) = g_0 + (1 - g_0)\exp(-\gamma e) \tag{18}$$

with $0 < g_0 < 1$ and $\gamma > 0$ and the function $c(e)$ is given by

$$c(e) = \frac{1}{e_0 - e} - \frac{1}{e_0} \tag{19}$$

for $0 \le e < e_0$. In equation 18, $g_0 > 0$ is the lower bound on $g(e)$ while in equation 19, e_0 is the upper bound on e. It is easy to check that (18) and (19) satisfy the conditions that $g'(e) < 0$, $g''(e) > 0$, $c(0) = 0$, $c'(e) > 0$ and $c''(e) > 0$. Using $g(e)$ as defined in (18) and $c(e)$ as defined in (19), straightforward calculation yields

$$\lambda'(e) - c'(e) = [\lambda(e) - c(e)]\left[\frac{2}{e_0 - e} + \frac{\gamma g_0}{g(e)}\right] > 0$$

and

$$\lambda''(e) - c''(e) = [\lambda(e) - c(e)]\left\{\left[\frac{2}{e_0 - e} + \frac{\gamma g_0}{g(e)}\right]^2 + \frac{2}{(e_0 - e)^2} - \frac{\gamma g_0 g'(e)}{g(e)^2}\right\} > 0$$

since $\lambda(e) > c(e)$ and $g'(e) < 0$. More generally, sufficient conditions for $\partial v/\partial e(k) > 0$ and $\partial^2 v/\partial e(k)^2 > 0$ are that

$$\frac{\mathrm{d}}{\mathrm{d}e}\left(\frac{g'(e)}{g(e)}\right) > 0 \qquad \text{and} \quad \frac{\mathrm{d}}{\mathrm{d}e}\left(\frac{c''(e)}{c'(e)}\right) > 0 \tag{20}$$

If condition 20 is satisfied, employers collectively would like to reduce both the average and the variance of the wage distribution.

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MICHAEL WALLERSTEIN is professor in the Department of Political Science at Northwestern University. His current research concerns the distribution of wages and social insurance in advanced industrial societies. ADDRESS: Department of Political Science, Northwestern University, Evanston IL, USA. [email: m-wallerstein@northwestern.edu]

KARL OVE MOENE is a professor in the Department of Economics at the University of Oslo. His current research concerns comparative institutions, political conflict and economic development. ADDRESS: Department of Economics, University of Oslo, 0317, Oslo, Norway.
[email: k.o.moene@econ.uio.no]