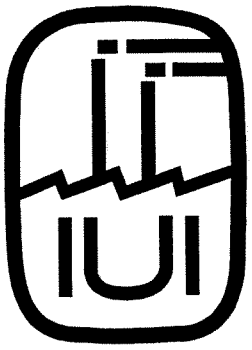

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Abstract: The paper examines the implications of an important aspect of the ongoing reorganization of work - the move from occupational specialization toward multi-tasking - for centralized wage bargaining. The analysis shows how, on account of this reorganization, centralized bargaining becomes increasingly inefficient and detrimental to firms' profit opportunities, since it prevents firms from offering their employees adequate incentives to perform the appropriate mix of tasks. The paper also shows how centralized bargaining inhibits firms from using wages to induce workers to learn how to use their experience from one set of tasks to enhance their performance at other tasks. In this way, the paper helps explain the increasing resistance to centralized bargaining in various advanced market economies.

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towards "equal pay for equal work," which means paying different employees the same (or similar) amounts for the same tasks. This practice may not be severely inefficient when different workers do different tasks, particularly if workers within an occupation have similar productivities. But once work is restructured to promote multi-tasking, the practice may become very inefficient indeed. The reason is that multi-tasking occurs when tasks are complementary. For example, insights gained on the production line may be put to use in product design, information about customer preferences gained through selling may be useful in employee training, and knowledge acquired through product repairs may be applied to product development. When different employees combine different sets of complementary tasks, there is no reason to believe that the marginal product of one employee's time at a particular task should be similar to the marginal product of another employee's time at that task, even if the two employees have the same abilities. For instance, there is no reason that time spent with customers should affect the productivity of a customer service employee in the same way as it affects the productivity of a production worker or a trainer of new recruits. The same principle holds, though to a lesser degree, even when different employees perform the same set of tasks, but in different proportions.

Consequently, the restructured firms have an incentive to offer different workers different wages at the same tasks. Beyond that, firms have an incentive to reward workers for learning how to use their experience gained at one set of tasks to enhance their performance at another set of tasks. But it is precisely these practices that centralized bargaining inhibits. Consequently, we argue, the reorganization from occupational specialization to multi-tasking raises the efficiency costs of centralized bargaining and thereby gives employers and employees growing incentives to choose decentralized bargaining arrangements instead.

Furthermore, we argue that this conclusion continues to hold even if centralized wage bargaining systems evolves in response to the changes in the organization of work. These systems could do so by ceasing to impose wage uniformity on the traditional occupational categories, and imposing it instead on the new occupational clusters that emerge under multi-tasking. But even in that event the efficiency costs of centralized wage setting are bound to rise, since such wage setting has quite different incentive effects under the traditional occupational specialization than in the multi-task setting.

Under the traditional organization, the centrally determined wages primarily affect the number of people employed; but under multi-tasking they have the dual role of influencing *both* the number of people employed *and* their time allocations across tasks. Thus even if the centrally determined wages were to induce efficient levels of employment, they will not in general ensure the time allocations across tasks are efficient as well.

Besides, we argue that the move from occupational specialization to multi-tasking is likely to be accompanied by a sharp increase in the number of occupational clusters relative to the traditional number of occupational categories. Under these circumstances it would be difficult for centralized wage bargaining systems to establish broad occupational categories within which wage uniformity can be imposed without efficiency cast. This development is likely to be magnified by increasing heterogeneity of task clusters across firms, arising from the move from standardized work in the traditional functional departments to work in small customer-oriented teams, producing highly differentiated products. The problem is magnified even further by the firms' need to assign multiple tasks not just on the basis of workers' abilities at these tasks, but also with regard to their social competence, judgment, initiative, and creativity. And insofar as workers differ in terms of these latter attributes even when they are of equal ability at particular tasks, it will be efficient to allocate different task clusters to workers of equal ability.

In these ways our analysis provides a possible rationale for the rise of decentralized wage bargaining in many OECD countries.

This trend towards decentralization in wage setting has been widely documented.[4] It has taken many different forms in different countries. For example, the UK has witnessed a marked rise in single-employer agreements at the expense of multi-employer contracts[5] and a rise in the number of agreements negotiated below the company level (e.g. the plant, division, or profit-center level) since the start of the Thatcher era.[6] The US has also experienced a drop in multi-employer agreements in favor of company- and

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[4] Katz (1993) is a excellent survey of this development.

[5] Brown (1981), Daniel and Millward (1983), Marginson et al. (1988), Millward and Stevens (1986), and Millward et al. (1992).

[6] Brown and Walsh (1991), IRRR (1989), Marginson et al. (1988), and Purcell and Ahlstand (1989).

plant-level bargaining,[7] accompanied by a decline in pattern bargaining.[8] As in other countries, the local negotiations have focused increasingly on work organization and remuneration schemes.[9]

The move towards decentralized bargaining agreements has also been pronounced in countries that previously had highly centralized bargaining. For example, over the 1980s and 1990s Sweden's bargaining arrangements became increasingly fragmented, as the country moved from a highly centralized system[10] toward industry-level bargaining. Whereas plant-level bargaining has always been important in Sweden (and was responsible for wage drift under the centralized bargaining regime), the central agreements became smaller in scope and influence with the passage of time.[11] Germany's formal bargaining structure has remained largely unchanged over the past two decades, but it has nevertheless witnessed a gradual rise in the importance of plant- and workshop-level bargaining since the beginning of the 1980s, both regarding wages and the organization of work.[12] A similar trend has been witnessed in Italy,[13] which abandoned its Scala Mobile in the 1980s. In both Germany and Italy, the scope of national bargaining agreements has shrunk, concentrating increasingly on work hour targets and general conditions of employment, while leaving wage agreements, work organization, and job classifications increasingly to local negotiations.

Needless to say, the trend towards decentralized bargaining may also be driven by phenomena other than the reorganization of firms and the rise of multi-tasking. For example, Freeman and Gibbons (1993) argue that the decentralization trend is due to rising volatility in local labor market conditions, driven by intensified product market competition, the rise of white-collar work, and widening wage differentials across skill groups. They suggest that centralized bargaining has lost influence since it has made it

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[7] Cappelli (1985), Katz and Kochan (1992), Parker and Slaughter (1988), and Turner (1991).
[8] Budd (1992), Katz and Meltz (1991).
[9] Arthur (1992), Cutcher-Gershenfeld (1991), Eaton and Voos (1992).
[10] In this centralized system the employers' confederation, SAF, and the blue-collar union confederation, LOA, negotiated wages and other issues, providing a lead for subsequent sectoral negotiations.
[11] EIRR 1992, Flanagan, Soskice, and Ulman (1983), Swenson (1989).
[12] Streek (1984), Thelen (1991), Turner (1991), Windolf (1989).
[13] EIRR (1992), Locke (1992), Windolf (1989).

difficult to adjust to this increased local variability. Furthermore, they claim that a major benefit from centralized bargaining - mitigating inflationary pressures by inducing the bargainers to internalize the inflationary consequences of wage agreements - diminished with the widespread decline in the threat of inflation during the 1980s and 90s. Beyond that, numerous observers have suggested that the decline of centralized bargaining is due to falling union density and rising management power; but this cannot be the whole story since local unions frequently support the move towards decentralization.[14] In any case, numerous case studies suggest that changes in the organization of work have played a critical role in the decline of centralized bargaining,[15] and this reorganization has been linked, in particular, to the adoption of new, flexible technologies. Thus far, however, no attempt appears to have been made to provide a theory of how this could happen. This paper seeks to do so.

Most of the existing literature on centralized bargaining assumes that workers are all alike and then examines how the degree of centralization in wage bargaining affects the real wage and employment. It has been argued, specifically, that a high degree of centralization in wage setting permits employees and employers to internalize a variety of externalities and thereby promotes wage restraint and stimulates employment.[16] On the other hand, a high degree of centralization may also raise the market power of employees and thereby raise wages and reduce employment.[17] On account of these countervailing forces, it has been suggested that the relationship between the degree of centralization and real wages is hump-shaped.[18]

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[14] See, for example, Katz (1993).

[15] For instance, Katz (1993), Locke (1992), Mathews (1989), Streek (1984), Thelen (1991), and Turner (1991).

[16] For example, an increase in the wages of one group of workers leads to an increase in the prices of consumption goods (Layard, Nickell, and Jackman, (1991, p. 132), Calmfors and Driffill (1988), Moene, Wallerstein, and Hoel (1993)) and the prices of other firms' material inputs (Layard, Nickell and Jackman (1991). It also stimulates unemployment and thereby raises expenditures on unemployment benefits that are often financed through general taxes (Blanchard and Summers (1987), Calmfors and Driffill (1988)). In efficiency wage models, a wage increase at one firm reduces effort and ability at other firms (Hoel (1989), Phelps (1994), Shapiro and Stiglitz (1984)).

[17] See, for example, Calmfors and Driffill (1988), Danthine and Hunt (1994), Driffill and van der Ploeg (1993), and Rowthorn (1992).

[18] See Calmfors and Driffill (1988) and Moene, Wallerstein, and Hoel (1993).

This literature occupies a position analogous to the early arguments (about fifty years ago) that centralized price fixing in product markets is desirable, since the central planner is able to internalize various externalities operative among firms acting in isolation.[19] Over the past four decades, however, the influence of this central planning literature has gradually waned, as economists have come to appreciate how difficult (perhaps unmanageable) central planning becomes in the presence of the product heterogeneity and imperfect information that is characteristic of advanced industrialized countries. This paper suggests that the ongoing process of restructuring work is making jobs dramatically more heterogeneous. By implication, information about workers' productivities at these jobs becomes markedly more difficult to acquire and practically impossible to centralize. Although this paper does not model the costs of information acquisition explicitly, it does show how the simple wage setting rules that characterize centralized wage bargaining become more inefficient as labor heterogeneity rises. As labor markets become more like product markets in this respect, we argue that the inefficiencies of centralized wage bargaining are becoming similar to the inefficiencies of centralized price fixing.

It is not hard to see how the restructuring process makes work more idiosyncratic. In the traditional firms, that used standardized inputs to produce standardized outputs in large quantities, work was divided into well-defined families of tasks, each performed in a different department, such as the production, marketing, sales, accounting, and product development departments. These standardized production processes demanded that workers be used in equally standardized ways. Here labor, like capital equipment, was treated as a single-purpose input; and this, in fact, is also the way labor and capital are depicted in mainstream production theory. In the restructured organizations, by contrast, production technologies are more flexible, permitting smaller production runs, smaller inventories, and quicker product development. Capital, in the form of flexible machines tools and programmable equipment, is becoming more versatile, capable of performing wider varieties of tasks. In this environment, firms have an incentive to use labor in more versatile ways as well, allowing workers to combine different tasks in wide varieties of ways to suit customers' varied needs and the workers' varied abilities. This paper

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[19]See, for example, Lange (1938).

suggests that as workers become more idiosyncratic, the costs of centralized bargaining rises relative to its benefits. Our analysis outlines several simple ways in which this can occur.

Our analysis examines the incentives for multi-tasking from a new perspective. Much of the existing economic literature on multi-tasking views this phenomenon in terms a tradeoff between the returns to specialization versus the returns from coordination across workers. For example, Becker and Murphy (1992), Bolton and Dewatripont (1994), and Yang and Borland (1991) show how the division of labor increases when the costs of communication among workers falls relative to the returns from collaboration among these workers. Whereas these various contributions deal with the *inter-personal* coordination of workers performing complementary tasks, our analysis focuses on the *intra-personal* allocation of time and effort across complementary tasks. This emphasis on task complementarities exploited by each individual worker through the learning process, rather than by different workers through the communication process, has received little, if any, attention thus far.

This is also true of the existing multi-tasking analyses that do not examine the communications problem among workers. For example, Baumgardner (1988), Kim (1989), Krugman (1987), and Stigler (1951) investigate how the degree of labor specialization depends on the size of the market: the larger the market, the greater the degree of labor specialization it will support, thereby vindicating Adam Smith's thesis. Carmichael and MacLeod (1993) analyze multi-skilling as a strategy that induces workers to cooperate with managers in promoting technological advances, since workers with multiple skills have less to lose from technologies that require new skills than do workers with single skills. Holmstrom and Milgrom (1991) analyze how the division of tasks among workers depends on the degree to which performance at these tasks is measurable; specifically, tasks whose performance is easily measured are to be assigned to one worker, while other tasks are assigned to another worker.[20] None of these contributions considers a critical determinant of multi-tasking, namely, that the

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[20] In this general context, Holmstrom and Milgrom (1994) show that the incentives offered for different tasks have complementary effects on the worker's effort at these tasks.

experience a worker accumulates at one task may improve that worker's performance at another task. This is the focus of the current paper.

The paper is organized as follows. The formal analysis begins in Section 2 with a particularly simple model of how the move from occupational specialization towards multi-tasking raises the efficiency cost of centralized bargaining. Here the multi-taskers are assumed to perform the same set of tasks, but in different proportions. This assumption gives our model a simple, transparent analytical structure; but the most serious inefficiencies of centralized bargaining are likely to occur when different workers perform different, but overlapping, sets of tasks.[21] This case, which involves a straightforward extension of the analysis in Section 2, covered in Appendix B.

In Section 2 we assume that the benefits from multi-tasking accrue inevitably: multi-taskers automatically use their experience gained at one task to enhance their productivity at another task. In practice, however, this learning process often requires effort, and workers may be unwilling to expend the requisite effort unless they receive adequate wage incentives for this purpose. Section 3 takes this aspect into account and analyzes the efficiency costs of centralized bargaining within this context.

2. Multi-Tasking with Different Task Proportions

This section examines how the move from task specialization to multi-tasking raises the efficiency cost of centralized bargaining and reduces firms' profit opportunities when different employees perform the same set of tasks, but in different proportions. Appendix B then extends the analysis to show how this damage from centralized bargaining can occur under the more prevalent form of multi-tasking, namely, when different employees perform different sets of overlapping tasks.

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[21] The reason is that the marginal products of two workers at task i are more likely to diverge when these workers differ in terms of their other tasks performed in conjunction with task i, rather than when they both perform the same set of tasks but in different proportions.

2a. Production and Labor Services

Consider a firm that produces an output q through two tasks (1 and 2), and employs two types of workers, who differ in terms of their comparative advantages at these tasks. Type-1 workers have a comparative advantage in the performance of task 1 (and, obversely, type-2 workers have a comparative advantage at task 2).[22]

Let λ_1 be the total labor services that these two types of workers provide at task 1, and λ_2 be the total labor services of these two types of workers at task 2. The production function, relating these labor services to the firm's output, is

$$q = f(\lambda_1, \lambda_2) \tag{1}$$

where $(\partial f / \partial \lambda_1), (\partial f / \partial \lambda_2) > 0$ and $\left(\partial^2 f / \partial \lambda_1^{\,2}\right), \left(\partial^2 f / \partial \lambda_2^{\,2}\right) < 0$.

The components of these labor services may be defined as follows:

- *Time spent at the two tasks:* To focus attention on the distinction between specialization of work and multi-tasking, we assume that each worker's available working time is given - and normalized to 1 - and we will examine how this time is divided between the two available tasks.[23] The fraction of each type-1 worker's available time devoted to tasks 1 and 2 is τ and τ', respectively, where $\tau + \tau' = 1$. Similarly, the allocation of the type-2 worker's available time to tasks 2 and 1 is T and T', respectively, where $T + T' = 1$.
- *Productivity at the two tasks:* Let e_1 and e_2 be the productivity of type-1 workers at tasks 1 and 2, respectively (i.e. the efficiency units of labor that a worker provides at the two tasks); and similarly let E_1 and E_2 be the productivity of type-2 workers at tasks 1 and 2. These productivities are endogenously determined below.
- *Employment:* Let n and N be the number of type-1 and type-2 workers employed, respectively.

Then the labor services provided at the two tasks may be expressed as

$$\begin{aligned} \lambda_1 &= e_1 \cdot \tau \cdot n + E_1 \cdot T' \cdot N \\ \lambda_2 &= e_2 \cdot \tau' \cdot n + E_2 \cdot T \cdot N \end{aligned} \tag{2}$$

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[22] Comparative advantage in this context is to be defined formally below.

[23] Extending our analysis to the case in which the workers' total available time is endogenously determined as well does not substantively affect our qualitative conclusions, provided that workers' utilities decline with work.

Along the lines of Lindbeck and Snower (1995), we assume that each worker's productivity at a particular task is a function of (i) the "return to specialization," whereby a worker's productivity at a task rises with experience at that task, and (ii) an "informational task complementarity," whereby the worker's productivity at a task depends on the information gained from the experience acquired at another task.[24]

Specifically, we assume that the returns to specialization at a task depend positively on the fraction of time spent at that task (*ceteris paribus*). Thus, the returns to specialization for a type-1 worker at the two tasks are

$$s_1 = s_1(\tau) \text{ and } s_2 = s_2(\tau') \tag{3a}$$

where $s_1', s_2' > 0$; and similarly for a type-2 worker at the two tasks:

$$S_1 = S_1(\mathrm{T}') \text{ and } S_2 = S_2(\mathrm{T}) \tag{3b}$$

where $S_1', S_2' > 0$.

Regarding the informational task complementarities, we assume that the greater is the fraction of time that a worker spends at one task (*ceteris paribus*), the greater will be the worker's productivity at the other task. Thus, the informational task complementarities for a worker of type 1 at the two tasks are:

$$c_1 = c_1(\tau') \text{ and } c_2 = c_2(\tau) \tag{4a}$$

where $c_1', c_2' > 0$; and similarly for a type-2 worker at the two tasks:

$$C_1 = C_1(\mathrm{T}) \text{ and } C_2 = C_2(\mathrm{T}') \tag{4b}$$

where $C_1', C_2' > 0$.

Then a type-1 worker's productivity may be expressed in terms of the returns to specialization and the informational task complementarity:

$$e_1 = e_1(s_1, c_1) \text{ and } e_2 = e_2(s_2, c_2) \tag{5a}$$

where $(\partial e_i / \partial s_i) > 0$ and $(\partial e_i / \partial c_i) > 0$, i=1,2. Along the same lines, a type-2 worker's productivity may be expressed as

$$E_1 = E_1(S_1, C_1) \text{ and } E_2 = E_2(S_2, C_2) \tag{5b}$$

where $(\partial E_i / \partial S_i) > 0$ and $(\partial E_i / \partial C_i) > 0$, i=1,2.

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[24]For example, the information about customer preferences that a worker gains at the task of marketing can generate information that is useful in product design or in the provision of ancillary services.

When type-1 and type-2 workers have different returns to specialization and informational task complementarities, they will generally have different productivities at the two tasks (for any given division of time between these tasks). Their comparative advantage at the two tasks may be defined in terms of these productivities: type-1 workers have a comparative advantage at task 1 (relative to worker 2 at task 1) in the sense that $(e_1 / e_2) > (E_1 / E_2)$, for any given $\tau = T$ and $\tau' = T'$. Furthermore, for $\tau = \tau' = a$ (a positive constant), the closer e_1/e_2 is to unity, the more "versatile" is the type-1 worker; and similarly, for $T = T' = a$, the closer E_1/E_2 is to unity, the more "versatile" is the type-2 worker.

By (2) - (5b) and recalling that $\tau + \tau' = 1$ and $T + T' = 1$, the labor services λ_1 and λ_2 may be expressed in terms of the number of workers employed and their time allocation between tasks:[25]

$$\begin{aligned} \lambda_1 &= \lambda_1(\tau, T; n, N) \\ \lambda_2 &= \lambda_2(\tau, T; n, N) \end{aligned} \qquad (2')$$

2b. Wages and Labor Costs

The trend toward greater decentralization of decision-making within firms, noted in Section 1, has an important implication for wage formation, namely, that firms need to offer incentives to induce their employees to engage in the appropriate mix of tasks. In practice, employers generally determine the range of tasks that each of their employees are to perform, while the employees often have some latitude in deciding the task mix. It is here that employers can influence their employees' decisions through wage incentives.[26] Our analysis captures this use of wage incentives quite simply as follows.

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[25] Note that the labor services (λ_i, I=1,2) depend on the time allocations (τ and T), the productivities (e_j and E_j, j=1,2), and the number of type-1 and type-2 workers employed. The productivities, in turn, depend on the time allocations (by (4a), (4b), (5a), and (5b)). Consequently, the labor services are a function simply of the time allocations and the number of workers employed.

[26] The implicit assumption is that the firm cannot perfectly monitor the employees' time allocation across tasks, but is able to predict how the employees' time allocation responds to wage incentives. Lindbeck and Snower (1996b) analyzes the organization of work when the firm determines its employees' task mix unilaterally. Alternatively, employers

Suppose that in the absence of centralized bargaining, the firm can offer (at least implicitly[27]) a different wage to each worker at each task:[28] each type-1 worker receives the real wages w_1 and w_2 at tasks 1 and 2, respectively; and each type-2 worker receives the real wages W_1 and W_2 at these tasks. Then the firm's labor costs are

$$\kappa = w_1 \cdot \tau \cdot n + w_2 \cdot \tau' \cdot n + W_1 \cdot \mathrm{T}' \cdot N + W_2 \cdot \mathrm{T} \cdot N \tag{6}$$

Given these wages, each worker decides on his time allocation between the two tasks. Let the utility function of each type-1 worker be[29]

$$u = v_1(w_1\tau + w_2\tau') - v_2(\tau, \tau') \tag{7a}$$

where $w_1\tau + w_2\tau'$ is the worker's wage income, and utility u is strictly concave in τ and τ'. The prevailing wages w_1 and w_2 are predetermined when the workers make their time allocation decisions. Maximizing the utility function u with respect to τ and τ' yields the worker's labor supply decisions:

$$\tau = h_1(w_1, w_2) \text{ and } \tau' = h_2(w_1, w_2) \tag{8a}$$

where $h_1(w_1, w_2) + h_2(w_1, w_2) = 1$.

Similarly, let the utility function of each type-2 worker be

$$U = V_1(W_1\mathrm{T} + W_2\mathrm{T}') - V_2(\mathrm{T}, \mathrm{T}') \tag{7b}$$

where utility U is strictly concave in T and T'. Maximizing the utility function U with respect to T and T', we obtain

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may determine the task mix that each employee is to perform, but the employee determines his effort level at each task, in response to wage incentives. This possibility is addressed in Section 4. Yet another possibility is that the employee is in a better position than the employer to identify the most profitable task mix (from the range of designated tasks, set by the employer) as the profit opportunities arise, while the employer evaluates the employees' performance ex post. In that event, it may be profitable for the employer to award "flexibility bonuses".

[27] Explicitly, the firm may offer each worker a single wage which depends on the task mix that worker performs. This is of course analytically equivalent to offering workers different wages for different tasks.

[28] Whereas it is natural to make this assumption in the context of our analysis, where the firm gives workers incentives to engage in multi-tasking under perfect information, other remuneration schemes are profitable under uncertainty (as in Carmichael and MacLeod (1993) and Holmstrom and Milgrom (1991), for instance).

[29] Our analysis does not require that consumption and labor be additively separable in the utility function, as in (7a), but we make this assumption to simplify the comparison with the optimal efficiency problem (11), below.

$$T_1 = H_1(W_1, W_2) \text{ and } T_2 = H_2(W_1, W_2) \tag{8b}$$

where $H_1(W_1, W_2) + H_2(W_1, W_2) = 1$.

Using the implicit function theorem, we invert equations (8a) and (8b) to obtain

$$w_1 = \zeta_1(\tau, \tau') \text{ and } w_2 = \zeta_2(\tau, \tau') \tag{8a'}$$

$$W_1 = Z_1(T, T') \text{ and } W_2 = Z_2(T, T') \tag{8b'}$$

Substituting (8a') and (8b') into (6) and recalling that $\tau + \tau' = T + T' = 1$, we may express the firm's labor costs in terms of the number of workers employed and their time allocation alone:

$$\begin{aligned} \kappa &= \left(\zeta_1(\tau, 1-\tau)\cdot\tau + \zeta_2(\tau, 1-\tau)\cdot(1-\tau)\right)\cdot n \\ &\quad + \left(Z_1(T, 1-T)\cdot(1-T) + Z_2(T, 1-T)\cdot T\right)\cdot N \\ &= \kappa(\tau, T; n, N) \end{aligned} \tag{6'}$$

2c. Profit Maximization and the Organization of Work

The firm's decision-making problem is to make the profit-maximizing employment decisions n and N, and offer the wages w_1, w_2, W_1, and W_2 that elicit the profit-maximizing time allocations[30] τ^* and T^*. By (1) and (2'), the production function (1) expressed in terms of the numbers of workers employed and their time allocations: $q = \phi(\tau, T; n, N)$. Given this production function and equation (6'), the firm's problem may be expressed as[31]

$$\underset{\tau, T, n, N}{\textit{Maximize}} \quad \pi(\tau, T; n, N) = \phi(\tau, T; n, N) - \kappa(\tau, T; n, N) \tag{9}$$

$$\textit{subject to } 0 \le \tau, T \le 1 \quad \text{and} \quad n, N \ge 0$$

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[30] By implication, the organization of work is determined on the basis of profit-maximizing principles. At the cost of some expositional simplicity, but without affecting the qualitative conclusions of our analysis, the organization of work could alternatively be portrayed as the outcome of a Nash bargain between the firm and its employees. The latter is perhaps more closely in line with the process or organizational change in various OECD countries. (On the evidence, see for example, Katz (1993).)

[31] Since the wages w_1, w_2, W_1, and W_2 are functions of the time allocations τ and T, by equations (8a') and (8b'), we can state the firm's profit-maximization problem in terms of the time allocations rather than the wages, even though the wages are actually the firm's choice variables.

To avoid trivial solutions, we assume that the profit-maximizing employment levels n and N are positive.[32] Now observe that, since worker 1 has a comparative advantage at task 1, the profit-maximizing fraction of time spent at task 1 is positive ($\tau^* > 0$). Similarly for worker 2 at task 2 ($T^* > 0$). Then the first-order conditions are[33]

$$\frac{\partial \pi}{\partial n} = 0 \quad \text{and} \quad \frac{\partial \pi}{\partial N} = 0 \tag{10a}$$

$$\frac{\partial \pi}{\partial \tau}(1-\tau^*) = 0 \quad \text{and} \quad \frac{\partial \pi}{\partial \tau} \geq 0 \tag{10b}$$

$$\frac{\partial \pi}{\partial T}(1-T^*) = 0 \quad \text{and} \quad \frac{\partial \pi}{\partial T} \geq 0 \tag{10c}$$

Equations (10a) are the standard marginal conditions to determine the profit-maximizing employment levels (given the time allocations), while equations (10b) and (10c) determine the profit-maximizing time allocations (given the employment levels).

Observe that the profit function $\pi(\tau, T; n, N)$ need not be monotonic in τ and T in the feasible range $0 < \tau, T \leq 1$. As τ rises from zero to unity, there are three sets of influences on profit:[34]

- *The return to specialization versus the informational task complementarity:* The type-1 worker's return to specialization (s) at task 1 rises, but the informational task complementarity (c) falls. The effect of τ on labor services λ_1 and λ_2 depends on the relative magnitudes of these two effects.
- *The technological task complementarity versus substitutability:* Suppose that there are diminishing returns to labor ($\partial^2 f / \partial \lambda_i^2$, i=1,2) and there is a "technological task complementarity," i.e. the two tasks are Edgeworth complements in the production function, $\partial^2 f / (\partial \lambda_1 \partial \lambda_2) > 0$. Then a rise in λ_i reduces the marginal product of task i

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[32] Since the aim of this analysis is to depict the organization of work, the focus of our analysis is on the profit-maximizing time allocations τ and T, and thus no insights are gained from taking account of the non-negativity constraints on n and N.

[33] Without any significant loss of generality, the discussion below presupposes that there is a unique local optimum. If there is more than one local optimum, then of course the question whether the global optimum is Tayloristic or holistic still depends on whether there is a corner-point solution or an interior one with respect to τ and T.

[34] Appendix A contains a specific example of the firm's profit maximization problem, in which these three sets of influences are described in terms of specific functional forms.

but raises the marginal product of task j ($i \neq j$). On the other hand, if there is a technological task substitutability ($\partial^2 f / (\partial\lambda_1 \partial\lambda_2) < 0$), then a rise in λ_i reduces the marginal products of both tasks.

- *The responsiveness of labor supplies to the wages:* Given the labor supply functions (7) and recalling that $\tau + \tau' = 1$, a rise in τ requires the wage w_1 to rise and the wage w_2 to fall. The resulting effect on labor costs depends on the relative magnitudes of these wage movements.

The relative magnitudes of these three sets of influences determine whether profit is maximized in the interior of the feasible range $0 < \tau, T \leq 1$ or at a corner point. This is of critical importance in our analysis, since it determines whether workers specialize or engage in multi-tasking. We define a "Tayloristic" organization of work as one in which workers specialize by task, and a "holistic" work organization as one in which they engage in multi-tasking. By conditions (10b) and (10c), the organization of work is Tayloristic when the firm's optimum (τ^*, T^*) is a corner point solution:

$$\tau^* = T^* = 1 \qquad (9a)$$

Thus worker 1 receives the wage $w_1 = h_1^{-1}(1)$ and worker 2 receives the wage $W_2 = H_2^{-1}(1)$. The organization is holistic when the optimum (τ^*, T^*) is an interior solution:

$$0 < \tau^*, T^* < 1 \qquad (9a)$$

so that worker 1 receives $w_1 = h_1^{-1}(\tau^*)$ for task 1 and $w_2 = h_2^{-1}(1-\tau^*)$ for task 2, while worker 2 receives $W_1 = H_1^{-1}(1-T^*)$ for task 1 and $W_2 = H_2^{-1}(T^*)$ for task 2.

Figures 1a and 1b illustrate the first order condition (10b) for worker 1 in a Tayloristic and a holistic organization, respectively.[35] Observe that in the Tayloristic organization, the marginal product $\partial f / \partial\tau$ declines slowly relative to the marginal cost $\partial\kappa / \partial\tau$, and thus the optimal organization of work involves complete specialization: $\tau^* = 1$. In the holistic organization, by contrast, the marginal product declines rapidly relative to the marginal cost, and thus the profit-maximizing time allocation τ^* lies in the interior of the feasible region[36] $0 < \tau \leq 1$.

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[35] Analogous figures could of course be drawn for worker 2.

[36] Note that $\tau > 0$, since it cannot be optimal for the type-1 worker (with a comparative advantage at task 1) to devote himself fully to task 2.

The analysis above highlights several important determinants of work organization. Specifically, *work will be organized along holistic, rather than Tayloristic, lines when:*

1) *workers are sufficiently versatile,* i.e. when they have a sufficiently small comparative advantage at their tasks. Then, as the type-1 worker allocates more time τ to task 1, the output foregone at task 2 rises sufficiently steeply and, as result, the marginal product $\partial f / \partial \tau$ falls sufficiently steeply, so that the optimal time allocation τ^* lies in the interior of the feasible region. (Similarly for the type-2 worker.)
2) *the informational task complementarities are sufficiently large relative to the returns to specialization.* Then, as the type-1 worker allocates more time τ to task 1, the output gained through specialization at task 1, is quickly dominated by the output lost through deficient experience at task 2. For this reason, too, the marginal product $\partial f / \partial \tau$ can decline steeply enough to generate an interior solution. (Similarly for the type-2 worker.)
3) *workers have a sufficiently large preference for versatile work over non-versatile work.* Then the workers' time allocated to a particular task (τ) becomes sufficiently inelastic, with respect to the wage offered for that task, as τ rises, so that their marginal disutility of work rises sufficiently steeply as they become specialized. Then the marginal cost $\partial \kappa / \partial \tau$ can rise sufficiently steeply for an interior solution to arise.

Our reading of the available literature and our observations of many firms' restructuring processes suggest that the reorganization of work from Tayloristic to holistic lines is driven, to a substantial degree, by two important forces: (i) changes in human capital that make workers more versatile and give them preferences favoring versatile work, and (ii) changes in production and information technologies that make tasks more complementary to one another. In terms of Figures 1, these developments imply that the marginal product curve $\partial f / \partial \tau$ becomes more steeply downward-sloping and the marginal cost $\partial \kappa / \partial \tau$ becomes more steeply upward-sloping with the passage of time. As result, the profit-maximizing allocation of hours between the two tasks shifts from specialization (in Figure 1a) to multi-tasking (in Figure 1b).

2d. The Influence of Centralized Bargaining

As noted, a salient characteristic of centralized wage bargaining is that it imposes some uniformity of wages across workers at given tasks. In the context of our analysis above, this uniformity[37] may be represented starkly as

$$w_1 = W_1 \text{ and } w_2 = W_2 \tag{10}$$

i.e. the wage of both workers at task 1 is the same, and similarly for task 2. We will now examine the efficiency properties of the centralized bargaining constraint (10) under Tayloristic and holistic organizations of work. We will also examine the effect of this bargaining constraint on profits under these two types of organization.

An efficient wage determination mechanism is one that permits the employer and the employees to maximize output minus the commensurate disutility of work:

$$\underset{\tau,T,n,N}{Maximize}\,\Omega = f(\tau,T;n,N) - \theta(\tau)n - \Theta(T)N \tag{11}$$

where $\theta(\tau) = v_2(\tau, 1-\tau)$ and $\Theta(T) = V_2(T, 1-T)$. Assuming that the second-order conditions are satisfied, the efficient time allocations τ^o and T^o are the solutions to the following first-order conditions:[38]

$$\frac{\partial\Omega}{\partial\tau} \geq 0 \text{ and } \frac{\partial\Omega}{\partial\tau}(1-\tau^o) = 0 \tag{12a}$$

$$\frac{\partial\Omega}{\partial T} \geq 0 \text{ and } \frac{\partial\Omega}{\partial T}(1-T^o) = 0 \tag{12b}$$

where

$$\frac{\partial\Omega}{\partial\tau} = \frac{\partial f(\tau^o, T^o)}{\partial\tau} - \theta'(\tau^o) \text{ and } \frac{\partial\Omega}{\partial T} = \frac{\partial f(\tau^o, T^o)}{\partial T} - \Theta'(T^o)$$

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[37] Alternatively, we could portray this function of centralized bargaining as setting lower and upper bounds on the dispersion of wages across workers at given tasks. Provided that these constraints are binding, this extension would not affect the qualitative conclusions of our analysis.

[38] As above, we assume that the local optimum is unique. Also, observe that since the type-1 worker has a comparative advantage at task 1 and the type-2 worker has a comparative advantage at task 2, $\tau^* > 0$ and $T^* > 0$, and thus the non-negativity constraints may be ignored.

Now observe that when work is organized along Tayloristic lines ($\tau^o = T^o = 1$), the centralized bargaining constraint (10) need not be inefficient. Specifically, if the outcome of centralized bargaining is the wage pair

$$w_1 = \zeta_1(1,0) \text{ and } W_2 = Z_2(1,0) \tag{13}$$

(by (8a') and (8b')), then the resulting allocation of workers' time across tasks will obviously be $\tau = T = \tau^o = T^o = 1$, so that the allocation of labor is efficient.[39]

The situation is quite different, however, when work is organized along holistic lines: $0 < \tau^o, T^o < 1$. Then the associated efficient wages are

$$w_1^o = \zeta_1(\tau^0, 1-\tau^o) \text{ and } w_2^o = \zeta_2(\tau^o, 1-\tau^o) \tag{14a}$$

$$W_1^o = Z_1(T^o, 1-T^o) \text{ and } W_2^o = Z_2(T^o, 1-T^o) \tag{14b}$$

where τ^o and T^o are the solutions to

$$\frac{\partial \Omega}{\partial \tau} = \frac{\partial f(\tau, T^o; n^o, N^o)}{\partial \tau} - \theta'(\tau^o) n^o = 0 \tag{15a}$$

$$\frac{\partial \Omega}{\partial T} = \frac{\partial f(\tau, T^o; n^o, N^o)}{\partial T} - \Theta'(T^o) N^o = 0 \tag{15b}$$

Here the centralized bargaining constraint (10) will in general be inefficient. The reason of course is that $w_1^o = \zeta_1(\tau^0, 1-\tau^o)$ is not necessarily equal to $W_1^o = Z_1(T^o, 1-T^o)$, and $w_2^o = \zeta_2(\tau^o, 1-\tau^o)$ is not necessarily equal to $W_2^o = Z_2(T^o, 1-T^o)$.

Observe that this is the case even if the type-1 and type-2 workers have symmetric productivities (so that for any given time allocations, a and b, $\partial f(\tau, T)/\partial \tau|_{\tau=a, T=b} = \partial f(\tau, T)/\partial T|_{\tau=b, T=a}$) and symmetric work preferences (so that $h_1^{-1}(a) = H_2^{-1}(a)$ and $h_2^{-1}(b) = H_1^{-1}(b)$), so that $\tau^0 = T^0$, $\zeta_1(a,b) = Z_2(a,b)$ and $\zeta_2(a,b) = Z_1(a,b)$. The reason

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[39]Observe that, if the bargaining outcome is given by equations (13), centralized bargaining would to an inefficient allocation of labor if type-1 workers had different marginal products or different preferences, and similarly for type-2 workers. Then the wage that induces one worker to choose the profit-maximizing allocation of time between tasks would not be the one that induces another worker to do so. Clearly, the more homogeneous workers are in terms of their marginal products and preferences, the smaller this inefficiency is.

why the centralized bargaining constraint will generally prevent the firm from choosing an efficient allocation of labor is that, even under symmetric productivities and work preferences, there is no reason for the efficient time allocation τ^o for the type-1 worker at task 1 to be equal to the time allocation $(1\text{-}T^o)$ for the type-2 worker at task 1 (in equations (14a) and (14b)). The latter is the case only when workers are *completely versatile* (i.e. able to do both tasks equally well), so that $\tau^o = T^o = 1/2$. With the exception of this special case, there is no mechanism whereby centralized bargaining can generally lead to the inefficient outcome. In this sense, the reorganization of work from Tayloristic to holistic lines raises the efficiency cost of centralized bargaining.

In the same vein, it can be shown that such reorganization of work also means that centralized bargaining comes to have an adverse effect on firms' profit opportunities. Specifically, if the bargaining outcome is (13), then centralized bargaining does not restrict the profit opportunities of a Tayloristic firm at all. But if the firm reorganizes along holistic lines, then the profit-maximizing wages are

$$w_1^* = \zeta_1(\tau^*, 1-\tau^*) \text{ and } w_2^* = \zeta_2(\tau^*, 1-\tau^*) \tag{16a}$$

$$W_1^* = Z_1(T^*, 1-T^*) \text{ and } W_2^* = Z_2(T^*, 1-T^*) \tag{16b}$$

where τ^* and T^* are the solutions to

$$\frac{\partial \pi}{\partial \tau} = \frac{\partial f(\tau, T^*; n^*, N^*)}{\partial \tau} - \frac{\partial \kappa(\tau, T^*; n^*, N^*)}{\partial \tau} = 0 \tag{17a}$$

$$\frac{\partial \pi}{\partial T} = \frac{\partial f(\tau^*, T; n^*, N^*)}{\partial T} - \frac{\partial \kappa(\tau^*, T; n^*, N^*)}{\partial T} = 0 \tag{17a}$$

Then, no matter at which levels the centrally bargained wages are set, these wages do not generally permit the firm to achieve its maximum profit. The reason is that the profit-maximizing wage for the type-1 worker at task 1, $w_1^* = \zeta_1(\tau^*, 1-\tau^*)$, is generally not equal to the profit-maximizing wage to the type-2 worker at task one, $W_1^* = Z_1(T^*, 1-T^*)$. The same holds for the wages $w_2^* = \zeta_2(\tau^*, 1-\tau^*)$ and $W_2^* = Z_2(T^*, 1-T^*)$ for these workers at task 2.[40] In this sense, the reorganization of work in favor of multi-tasking reduces the profitability of centralized bargaining.

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[40] As above, the exception to this rule is when workers are completely versatile.

2e. Centralized Bargaining Responses to Multi-tasking

However, even if we grant that existing centralized wage bargaining practices become less efficient and less profitable when firms adopt a holistic organization of work, we cannot conclude that the reorganization of work must necessarily bring centralized bargaining into greater conflict with the public interest and with firms' objectives. The reason is that the existing bargaining practices may conceivably change in response to the adoption of multi-tasking. In particular, the nature of the existing wage uniformities generated through centralized bargaining may evolve: as the traditional occupational barriers erode and new occupational clusters emerge, centralized wage bargaining systems may eventually abandon the aim of imposing some uniformity of wages within the traditional occupational categories, and start imposing such uniformity within the new occupational clusters instead. If this happens, the question to be asked is whether such new wage uniformities in holistic organizations will be comparably efficient and profitable as the current wage uniformities were in the Tayloristic organizations. In short, if the wage categories used in centralized bargaining evolve in response to the evolving organization of work, can the increasing inefficiency and unprofitability of centralized bargaining, as described in the previous section, be arrested?

The following considerations suggest that the answer is "no". We will argue that there is no change in the wage categories of centralized bargaining that can obviate the increasing inefficiency and unprofitability highlighted in our previous analysis.

To see why, let us return to the previous analytical framework and ask how the wage categories of centralized bargaining could be optimally aligned with the changing occupational categories. Observe that under the Tayloristic organization of work, the occupational categories are divided by task: the type-1 worker has occupation 1 by virtue of performing task 1, and the type-2 worker has occupation 2 by virtue of performing task 2. But as firms adopt the holistic work organization, workers start to perform two clusters of tasks: the type-1 worker performs both tasks in one specific proportion (call it "proportion 1"), while the type-2 worker performs them in another proportion (call it "proportion 2"); specifically, the type-1 worker does more of task 1 and less of task 2 than the type-2 worker. If centralized bargaining categories were to align themselves

perfectly to this change in the occupational mix, then the central bargainers would adopt proportions 1 and 2 as the new occupational categories and impose some uniformity of wages with respect to these categories. Within the framework of our analysis, this means that type-1 multi-taskers would get one wage and type-2 multi-taskers would get another. Expressed starkly, the new centralized bargaining constraint would then become

$$w_1 = w_2 \text{ and } W_1 = W_2 \qquad (10')$$

But now observe that this new centralized bargaining constraint is still inefficient. In fact, it need not even be more efficient than the constraint (10), which is aligned to the Tayloristic occupational categories! The reason is that $w_1^o = \zeta_1(\tau^0, 1-\tau^o)$ is not necessarily equal to $w_2^o = \zeta_2(\tau^o, 1-\tau^o)$, and $W_1^o = Z_1(T^o, 1-T^o)$ is not necessarily equal to $W_2^o = Z_2(T^o, 1-T^o)$, by equations (14a) and (14b).

As in the analysis of Section 2d, it is clear that even if the type-1 and type-2 workers have symmetric productivities (so that for any given time allocations, a and b, $\partial f(\tau, T)/\partial\tau\big|_{\tau=a,T=b} = \partial f(\tau, T)/\partial T\big|_{\tau=b,T=a}$) and symmetric work preferences (so that $h_1^{-1}(a) = H_2^{-1}(a)$ and $h_2^{-1}(b) = H_1^{-1}(b)$), so that $\tau^0 = T^0$, $\zeta_1(a,b) = Z_2(a,b)$ and $\zeta_2(a,b) = Z_1(a,b)$, the centralized bargaining constraint (10') would still be inefficient. The reason is that, unless the workers are *completely versatile*, the type-1 worker's efficient time allocation for task 1 will exceed his efficient time allocation for task 2: $\tau^o > (1-\tau^o)$; and similarly, for the type-2 worker, $T^o > (1-T^o)$.

Along the same lines, it is clear that the centralized bargaining constraint (10') reduces profits, since the type-1 worker's profit-maximizing wage at task 1, $w_1^* = \zeta_1(\tau^*, 1-\tau^*)$, is not equal to his profit-maximizing wage at task 2, $w_2^* = \zeta_2(\tau^*, 1-\tau^*)$. Similarly, for the type-2 worker, $W_1^* = Z_1(T^*, 1-T^*)$ is not equal to $W_2^* = Z_2(T^*, 1-T^*)$, by equations (16a) and (16b).

The intuition underlying these results is straightforward. The centralized bargaining constraint has a quite different effect on firms' labor demand under Tayloristic work organization than under holistic organization. Specifically, under Tayloristic organization, the central bargaining constraint simply determines the number of workers the firms choose to employ in each occupation: the greater the centrally bargained wage

for any given occupation, the lower the firm's demand for the services of that occupation. Here central bargaining is efficient so long as the centrally bargained wages are set efficiently (i.e. set so that the firms choose the efficient levels of employment for each occupation). *But under holistic organization, the centralized bargaining constraint determines not only the number of workers employed in each cluster of tasks, but also their time allocations across tasks within their cluster.* Thus even if the centrally bargained wages are set so that firms choose the efficient number of workers in each cluster of tasks, this wage does not in general ensure that these workers will divide their time efficiently among these tasks.

In other words, under Tayloristic organization, wages have one function in the firms' employment decision: they determine the number of people employed in each occupational category. Under holistic organization, however, they have two functions: they determine both the number of people employed and their division of time among the relevant tasks. If centralized bargaining imposes uniformity of wages within each occupational cluster, it may induce firms to employ the efficient number of people or it may induce the workers to allocate their time efficiently across their tasks, but in general it cannot do both. The same argument of course also holds with respect to the profitability of centralized bargaining under holistic organization.

However, even aside from this problem, it is worth emphasizing that there is one important respect in which our model understates the difficulty for centralized wage bargaining to adjust to the move from Tayloristic to holistic organizations of work. Since our model contains just two tasks and two types of workers, it is easy to identify the change in occupational classification required of centralized bargaining: it is a move from a classification in which occupational categories are defined by task, to one in which occupational categories are defined by task proportions. In practice, firms perform a large number of heterogeneous tasks through the services of a large number of heterogeneous workers. Under these circumstances the move from Tayloristic or holistic organizations of work may involve a vast increase in the number of occupational clusters. Specifically, under a Tayloristic organization with m tasks and n workers, there are m occupational categories; but under a holistic organization, the resulting combinations of the m tasks across the n workers may involve far more than m occupational clusters.

This problem is magnified when we consider that the efficient formation of occupational clusters within a firm depends, in practice, not only on the technological and informational task complementarities and the employees' skills at the available tasks, but also on the employees' social competence, judgment, initiative, and creativity - attributes which do not fall within the domain of any particular task. These psychological and sociological attributes naturally affect the optimal combinations of tasks for an employee to perform. And since employees of equal productive ability at a particular combination of tasks often differ in terms of these attributes, firms may find it profitable and efficient to allocate different task combinations to workers of equal productive ability.

Besides, as noted, the move from Tayloristic to holistic organizations also commonly involves the firm in switching from large functional departments (e.g. sales, production, finance, and market departments) to smaller customer-oriented teams, producing more differentiated products that are designed specifically for the firm's particular customers. Consequently, the task composition of the holistic occupational clusters are likely to vary from one firm to another.

Insofar as the restructuring of organizational along holistic lines increases the number of occupational clusters within firms and varies the composition of these clusters across firms, centralized wage bargaining will find it increasingly difficult to establish occupational categories within which wage uniformity can be imposed without threat to efficiency and profitability.

In these various ways our analysis rationalizes the growing resistance of employers to centralized bargaining in many industrialized countries.

3. Incentives to Enhance the Productivity from Multi-Tasking

Thus far we have assumed that when workers perform multiple tasks, the informational task complementarities can be reaped *automatically*. For example, in Section 2, the informational task complementarity regarding one task depends solely on the fraction of time a worker spends at the other task (as shown in equations (5a) and (5b)). In practice, of course, a worker's mere performance of multiple tasks usually does not guarantee that this worker uses the experience gained at one job to improve performance at another job. For this purpose, the worker generally needs to engage in a cognitive process that is generally (a) difficult for the employer to monitor and (b) costly to the employee in term of effort, concentration, and initiative.

The employers' motivation to provide incentives for their employees to engage in this learning process is analogous to their motivation to discourage shirking in the efficiency wage theory. In both cases there is asymmetric information about employees' productivities and employers can use remuneration as an incentive device. In the moral hazard model of Shapiro and Stiglitz (1984), for example, employers offer a wage above the market-clearing wage, and employees receive the former only if they are not caught shirking, given the firms' stochastic monitoring technology. Similarly, when workers are assigned multiple tasks, they may be offered a bonus for using their experience at one task to enhance their productivity at the other tasks. This bonus is paid only if they are not caught shirking, under the same stochastic monitoring technology. "Shirking" may now be interpreted as the mindless performance of multiple tasks that yields no informational task complementarities.

We will argue that such bonuses do not fit comfortably within centralized wage bargaining agreements, for two reasons. First, these bonuses may easily be construed as violating the rule of "equal pay for equal work". Two workers may receive different bonus payments for a particular task, provided that they use their experience from that task differently in the performance of other tasks. Second, the negotiators of the centralized bargaining agreements usually do not have enough information to set such bonuses, since informational task complementarities tend to be highly idiosyncratic across enterprises. The reason is that workers at different enterprises often perform

different combinations of tasks, and even when they perform the same sets of tasks, differences in production technologies, customer attributes, opportunities for innovation, and team dynamics would still give rise to different opportunities for the cross-task use of information.

It goes without saying that these issues are irrelevant when work is organized along Tayloristic lines, for then informational task complementarities are non-existent. Under a holistic organization of work, however, these issues are important, for if centralized bargaining prevents employers from offering bonuses to promote informational task complementarities, the efficiency of production as well as firms' profits will suffer.

To capture this idea in a simple way, let us modify the model of Section 2 so as to make informational task complementarities dependent on work effort. Specifically, given the production function (1), the labor services (2), the returns to specialization (3a) and (3b), the productivity functions (5a) and (5b), and let the informational task complementarities for a worker of type 1 be

$$c_1 = c_1(\omega \cdot \tau') \text{ and } c_2 = c_2(\omega \cdot \tau) \qquad (4a')$$

where $c_1', c_2' > 0$, ω denotes the worker's effort to use his experience at task 1 in performing task 2, and vice versa. Similarly, for a worker of type 2, let the informational task complementarities be

$$C_1 = C_1(\Omega \cdot \mathrm{T}) \text{ and } C_2 = C_2(\Omega \cdot \mathrm{T}') \qquad (4b')$$

where $C_1', C_2' > 0$, Ω is effort to use experience from task 1 in performing task 2, and vice versa.

Substituting the informational task complementarities (4a') and (4b'), along with returns to specialization (3a) and (3b) and the productivity functions (5a) and (5b), into the labor services (2), we obtain

$$\begin{aligned} \lambda_1 &= \lambda_1(\tau, \mathrm{T}; \omega, \Omega; n, N) \\ \lambda_2 &= \lambda_2(\tau, \mathrm{T}; \omega, \Omega; n, N) \end{aligned} \qquad (2'')$$

Substituting these labor services into the production function (1), we obtain

$$q = \phi(\tau, \mathrm{T}; \omega, \Omega; n, N) \qquad (1')$$

We assume that the firm is unable to observe the effort levels ω and Ω directly, but is able to manipulate these levels through bonus payments. Let b be the bonus that rewards effort ω, and B be the bonus that rewards effort Ω. Assuming for simplicity that

these effort levels generate disutility and are additively separable from the time allocations τ and T in the workers' utility functions, we may express the workers' effort supplies as follows:

$$\omega = \xi(b) \text{ and } \Omega = \Xi(B) \tag{18}$$

where $\xi(0) = \Xi(0) = 0$ and $\xi', \Xi' > 0$.

The firm's labor costs are

$$\kappa = w_1 \cdot \tau \cdot n + w_2 \cdot \tau' \cdot n + W_1 \cdot \mathrm{T}' \cdot N + W_2 \cdot \mathrm{T} \cdot N + b\omega n + B\Omega N \tag{19}$$

Inverting the effort supply functions, $b = \xi^{-1}(\omega)$ and $B = \Xi^{-1}(\Omega)$ and substituting these, along with the inverted time allocation supplies (8a') and (8b'), into the cost function (9'), we find

$$\begin{aligned} \kappa &= \left(\zeta_1(\tau, 1-\tau)\cdot\tau + \zeta_2(\tau, 1-\tau)\cdot(1-\tau) + \xi^{-1}(\omega)\right)\cdot n \\ &\quad + \left(Z_1(\mathrm{T}, 1-\mathrm{T})\cdot(1-\mathrm{T}) + Z_2(\mathrm{T}, 1-\mathrm{T})\cdot\mathrm{T} + \Xi^{-1}(\Omega)\right)\cdot N \\ &= \kappa(\tau, \mathrm{T}; \omega, \Omega; n, N) \end{aligned} \tag{19'}$$

Thus the firm's profit maximization problem becomes

$$\underset{\tau, \mathrm{T}; \omega, \Omega; n, N}{\textit{Maximize}} \quad \Pi(\tau, \mathrm{T}; \omega, \Omega; n, N) = \phi(\tau, \mathrm{T}; \omega, \Omega; n, N) - \kappa(\tau, \mathrm{T}; \omega, \Omega; n, N) \tag{20}$$

$$\textit{subject to } 0 \le \tau, \mathrm{T} \le 1,\ \omega, \Omega \ge 0, \quad n, N > 0$$

Analogously to Section 2c, we find that the first-order conditions are

$$\frac{\partial \Pi}{\partial n} = 0 \quad \text{and} \quad \frac{\partial \Pi}{\partial N} = 0 \tag{21a}$$

$$\frac{\partial \Pi}{\partial \tau}(1 - \tau^*) = 0 \quad \text{and} \quad \frac{\partial \Pi}{\partial \tau} \ge 0 \tag{21b}$$

$$\frac{\partial \Pi}{\partial \mathrm{T}}(1 - \mathrm{T}^*) = 0 \quad \text{and} \quad \frac{\partial \Pi}{\partial \mathrm{T}} \ge 0 \tag{21c}$$

$$\frac{\partial \Pi}{\partial \omega}\omega = 0 \quad \text{and} \quad \frac{\partial \Pi}{\partial \omega} \le 0 \tag{21d}$$

$$\frac{\partial \Pi}{\partial \Omega}\Omega = 0 \quad \text{and} \quad \frac{\partial \Pi}{\partial \Omega} \le 0 \tag{21e}$$

Recall that the exploitation of informational task complementarities requires positive effort $\omega, \Omega > 0$ and that this effort is not forthcoming unless the firm offers positive bonus payments for inter-task learning $b, B > 0$. Consequently, in the absence of sufficiently large technological task complementarities, the firm has no incentive to

organize work along holistic lines unless it can provide positive bonuses for inter-task learning.

Next, observe that if the centralized wage bargaining system permits wage payments only for particular tasks, not bonuses contingent on cross-task learning, then centralized bargaining may impose a Tayloristic organization of work on the firm. If the efficient organization of work is holistic, then this influence of centralized bargaining is clearly inefficient.

Along the lines of the analysis in Section 2, it is straightforward to show that the resulting efficiency costs of centralized bargaining are augmented as (a) workers become more versatile, (b) their preferences come to favor holistic work progressively more over Tayloristic work, and (c) advances in information technologies raise the informational task complementarities that can be exploited when engage in inter-task learning. In the presence of such trends and the absence of centralized bargaining constraints on wages, Tayloristic firms constraints will eventually find it profitable to restructure work along holistic lines. Centralized bargaining, however, may prevent this from happening. The resulting loss of profits and wage incomes may help explain the growing resistance to centralized bargaining among managers, and even individual workers and local unions, as documented in Section 1.

4. Concluding Remarks

Centralized bargaining has been acclaimed as a device that enables employers and employees to internalize a variety of externalities.[41] But over the 1980s and 90s, country after country relinquished these benefits as bargaining agreements were made at increasingly more local levels. This paper provides an new theoretical explanation for why this happened - one that fits well with the wide body of evidence that the decentralization wage bargaining went hand-in-hand with changes in the organization of work.

We argue that the trend away from occupational specialization toward multi-tasking has increased the efficiency cost of centralized bargaining. The underlying reason

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[41] See Bruno and Sachs (1975), Calmfors and Driffill (1988), and Layard, Nickell and Jackman (1991), just to name a few.

suggested by our analysis is that the reorganization from Tayloristic to holistic work can lead to a vast increase in the informational requirements for efficient wage setting. When workers are specialized by occupation and when the members of each occupational group have similar productivity and willingness to work, the central bargainers require little information to set wages efficiently. All that is required are estimates of productivity and the reservation wage for each occupation. But once workers engage in multi-tasking, much more information is required for efficient wage setting. In general, the efficient set of wage incentives will vary from one combination of tasks to another. They depend on the constellation of complementarities among these tasks and the effort workers must expend to exploit these complementarities. Only the employers and employees at each establishment have any hope of possessing such detailed, heterogeneous, establishment-specific pieces of information. Central bargainers simply cannot acquire and assimilate this information, much as central planners are unable to get all the relevant cost and revenue information to determine of the efficient prices of vast arrays of goods and services.

In the absence of detailed information about task complementarities, the negotiators in centralized wage bargaining have little choice but to set wages schematically, such as prescribing one wage (or a range of wages) for every broadly defined group of tasks. However multi-tasking makes this practice patently inefficient, since workers' productivities at any task can vary widely, depending on the other tasks they are performing. The traditional way for centralized bargaining to permit some local flexibility is to allow for wage drift, but once this drift becomes large, it undermines the operability of centralized bargaining. For then the central bargainers can retain their clout only if they can distinguish between "justifiable" wage drift in response to, say, genuine task complementarities, and "unjustifiable" drift resulting from local rent-seeking. But to make such a distinction, the central bargainers would need the detailed information about complementarities and effort that is beyond their reach.

Our analysis suggests that the trend toward multi-skilling may be driven by advances in information and production technologies that augments the informational and technological task complementarities, improved education that makes workers more versatile across occupational pursuits, and a swing in worker preferences away from Tayloristic jobs and towards holistic work. As such, this reorganizational trend is an

efficient response to changes in preferences, technologies, and endowments of physical and human capital. However, the "same wage for the same job" rule of centralized bargaining impedes this trend, and thereby imposes an ever larger cost on society. In this way our analysis helps explain the decline of centralized bargaining in many industrialized countries. To the extent that centralized wage bargaining has been used in many European countries to compress the wage distribution, our analysis leads us to expect that decentralization of wage decisions will lead to widening wage differentials in these countries.

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Appendix A: An Example of the Firm's Profit Maximization Problem

The following is a specific example of the firm's profit maximization problem. Suppose that the production function is

$$q = \lambda_1^{\gamma_1}\lambda_2^{\gamma_2} \tag{1'}$$

$(\gamma_1,\gamma_2 > 0, \gamma_1+\gamma_2 < 1)$. The productivity functions are

$$e_i = s_i \cdot c_i \text{ and } E_i = S_i \cdot C_i, \quad i=1,2 \tag{3'}$$

The returns to specialization are

$$s_1 = \tau^{\alpha_1},\ s_2 = \left(k_1 - \tau^{\alpha_2}\right),\ S_1 = \left(k_2 - \mathrm{T}\right)^{A_1} \text{ and } S_2 = \left(\mathrm{T}\right)^{A_2} \tag{4'}$$

where the constants satisfy $0 < \alpha_1, A_1 < 1$, $k_1, k_2 > 1$. The informational task complementarities are

$$c_1 = \left(k_3 - \tau\right)^{\beta_1},\ c_2 = \left(\tau\right)^{\beta_2},\ C_1 = \mathrm{T}^{B_1} \text{ and } C_2 = \left(k_4 - \mathrm{T}\right)^{B_2} \tag{5'}$$

where the constants satisfy $0 < \beta_1, B_1 < 1$, $k_3, k_4 > 1$. Furthermore, suppose that the workers' preferences are

$$u = w_1\tau + w_2\tau' - \frac{\mu}{2}\tau^2 - \frac{\mu'}{2}\tau'^2$$

$$U = W_1\mathrm{T}' + W_2\mathrm{T} - \frac{\mathrm{M}}{2}\mathrm{T}'^2 - \frac{\mathrm{M}'}{2}\mathrm{T}^2$$

$(\mu, \mu', \mathrm{M}, \mathrm{M}' > 0)$, so that the labor supply functions are

$$\tau = \frac{w_1}{\mu}, \tau' = \frac{w_2}{\mu'};\quad \mathrm{T}' = \frac{W_1}{\mathrm{M}}, \mathrm{T} = \frac{W_2}{\mathrm{M}'}$$

Then the firm's first-order conditions for the optimal time allocations are

$$\begin{aligned} &\frac{\partial\pi}{\partial\tau} = \gamma_1\lambda_1^{\gamma_1-1}\lambda_2^{\gamma_2}\frac{\partial\lambda_1}{\partial\tau} + \gamma_2\lambda_1^{\gamma_1}\lambda_2^{\gamma_2-1}\frac{\partial\lambda_2}{\partial\tau} - 2n\left[\tau\left(\mu-\mu'\right)+\mu'\right] \geq 0 \\ &\frac{\partial\pi}{\partial\tau}\left(1-\tau\right) = 0 \end{aligned} \tag{10b'}$$

where

$$\frac{\partial\lambda_1}{\partial\tau} = \tau^{\alpha_1}\left(1-\tau\right)^{\beta_1} n\left[\left(1+\alpha_1\right) - \beta_1\frac{\tau}{1-\tau}\right]$$

$$\frac{\partial\lambda_2}{\partial\tau} = \left(1-\tau\right)^{\alpha_2}\tau^{\beta_2} n\left[\beta_2\frac{1-\tau}{\tau} - \left(1+\alpha_2\right)\right]$$

and similarly for the time allocation of the type-2 worker.

Observe that since there are positive informational task complementarities (β_1, $\beta_2 > 0$), the marginal revenue $\partial\phi / \partial\tau$ is positive when τ is close to zero and negative when it is close to unity, so that the marginal revenue function has a maximum in the interior of the feasible range $0 \leq \tau \leq 1$. Similarly for the relation between profit and the type-2 worker's time allocation T.

The role of the three sets of influences on the firm's profit (described in the text) are straightforward to identify in this context:

- *The return to specialization versus the informational task complementarity* is given by the size of α_1 and α_2 relative to β_1 and β_2 (respectively). Observe that the greater are the former relative to the latter, the closer the firm will come to a Tayloristic organization of work.
- *The technological task complementarity* is given by the parameters γ_1 and γ_2, which however also influence the marginal products of the labor services. The degree of Edgeworth complementarity among the two labor services, deflated by the associated marginal products of labor is

  $\chi = \left(\frac{\partial^2 q}{\partial\lambda_1 \partial\lambda_2} \Big/ \frac{\partial q}{\partial\lambda_1} \frac{\partial q}{\partial\lambda_2} \right) = \frac{\gamma_1 \gamma_2}{q}$ and substituting this into the firm's first order conditions we obtain

  $$\frac{\partial\pi}{\partial\tau} = \frac{\gamma_1^2 \gamma_2}{\lambda_1 \chi} \frac{\partial\lambda_1}{\partial\tau} + \frac{\gamma_1 \gamma_2^2}{\lambda_2 \chi} \frac{\partial\lambda_2}{\partial\tau} - 2n\left[\tau(\mu - \mu') + \mu'\right] \geq 0$$

  $$\frac{\partial\pi}{\partial\tau}(1-\tau) = 0$$

  Thus, the greater is χ, the closer the firm will come to a Tayloristic work organization.
- *The responsiveness of labor supplies to the wages* is given by the parameters μ and μ'. The greater is μ relative to μ', the smaller is the wage responsiveness of τ relative to τ', and the closer the firm will come to a Tayloristic work organization.

Appendix B: Multi-Tasking with Different Task Combinations

To illustrate how the move from task specialization to multi-tasking raises the efficiency cost of centralized bargaining and reduces firms' profit opportunities when different employees perform different sets of overlapping tasks, we consider a firm in which an output q is produced through three tasks: 1, 2, and 3. Under Tayloristic organization of work, each of these tasks is done by a different worker; whereas under holistic organization, we suppose that one set of workers performs two of the tasks (say tasks 1 and 2) and another set of workers performs a partially overlapping set of tasks (say tasks 2 and 3).

Accordingly, we assume that there are three types of workers available: (i) a type-1 worker who is able to perform tasks 1 and 2 and has a comparative advantage at task 1, (ii) a type-3 worker who is able to perform tasks 1 and 3 and has a comparative advantage at task 3, and (iii) a type-2 worker who can perform only task 2. Let λ_i be the total labor services (in efficiency units) devoted to task i, τ_{ij} be the fraction of the type-j worker's available time devoted to task i, e_{ij} be the worker j's labor endowment per person per unit of time at task i, and n_j be the number of type-j workers employed by the firm.

Under a Tayloristic organization of work, the firm uses the type-1 workers exclusively for task 1, the type-2 workers for task 2, and the type-3 workers exclusively for task 3. The firm's production function may then be expressed as

$$q^T = f\left(\lambda_1^T, \lambda_2^T, \lambda_3^T\right) \tag{A1a}$$

where $\left(\partial f / \partial \lambda_i^T\right) > 0$ and $\left(\partial f^2 / \partial \lambda_i^{T2}\right) < 0$, i=1,2,3, and

$$\lambda_i^T = e_{ii} \cdot n_i, \quad i = 1,2,3 \tag{A1b}$$

and

$$e_{ii}^T = e_{ii}\left(s_{ii}(1), c_{ii}(0)\right), \quad i = 1,2,3 \tag{A1c}$$

where $\left(\partial e_{ii} / \partial s_{ii}\right) > 0$ and $\left(\partial e_{ii} / \partial c_{ii}\right) > 0$, i=1,2.

Under a Tayloristic organization of work, let the workers' labor supply decisions be given by

$$\tau_{ii} = h_{ii}^T\left(w_{ii}\right), \quad i = 1,2,3 \tag{A2}$$

(the Tayloristic analogue of (8a)). Since $\tau_{ii} = 1$ (for $i = 1,2,3$) under this work organization, the wages are

$$w_{ii} = g_{ii}^T(1), \quad i = 1,2,3 \tag{A3}$$

where $g_{ii}^T = \left(h_{ii}^T\right)^{-1}$, $i = 1,2,3$. The Tayloristic firm's labor costs are $\kappa^T = w_1^T n_1^T + w_2^T n_2^T + w_3^T n_3^T$ and, by (20), these may be expressed as

$$\kappa^T = g_{11}^T(1)n_1^T + g_{22}^T(1)n_2^T + g_{33}^T(1)n_3^T \tag{A4}$$

Thus the profits of a Tayloristic firm are the solution of the following problem

$$\underset{n_1,n_2,n_3}{Maximize} \quad \pi^T(n_1,n_2,n_3) = \phi(n_1,n_2,n_3) - \kappa(n_1,n_2,n_3) \tag{A5}$$

$$subject\ to\ n_i \geq 0, \quad i = 1,2,3$$

where $\phi(n_1,n_2,n_3)$ and $\kappa(n_1,n_2,n_3)$ are the firm's revenue and costs, both expressed in terms of the numbers of workers employed. As in the previous section, given that the profit-maximizing employment levels are positive, the profit-maximizing employment levels $\hat{n}_i^T$ satisfy $(\partial\pi^T / \partial n_i^T) = 0$, for i=1,2,3, and the maximum profit may be written as $\hat{\pi}^T = \pi^T\left(\hat{n}_1^T, \hat{n}_2^T, \hat{n}_3^T\right)$.

On the other hand, under a holistic work organization, the firm uses the type-1 workers for tasks 1 and 2 and the type-3 workers for tasks 2 and 3, and it does not employ type-2 workers at all. Then the firm's production function becomes

$$q^H = f\left(\lambda_1^H, \lambda_2^H, \lambda_3^H\right) \tag{A6a}$$

where

$$\begin{aligned} \lambda_1^H &= e_{11} \cdot \tau_{11} \cdot n_1 \\ \lambda_2^H &= e_{21} \cdot \tau_{21} \cdot n_1 + e_{23} \cdot \tau_{23} \cdot n_3 \\ \lambda_3^H &= e_{33} \cdot \tau_{33} \cdot n_3 \end{aligned} \tag{A6b}$$

and

$$e_{ij}^H = e_{ij}\left(s_i(\tau_{ij}), c_i(1-\tau_{ij})\right), \quad i = 1,2,3; j = 1,3 \tag{A6c}$$

If the firm is free to determine the wage of each worker at each task individually, the firm's labor costs are

$$\kappa = (w_{11}\tau_{11} + w_{21}\tau_{21})n_1 + (w_{33}\tau_{33} + w_{23}\tau_{23})n_3 \tag{A7}$$

The workers' labor supply decisions under this work organization may be expressed as

$$\begin{aligned}\tau_{11} &= h_{11}^{H}(w_{11}, w_{21}) \\ \tau_{21} &= h_{21}^{H}(w_{11}, w_{21}) \\ \tau_{23} &= h_{23}^{H}(w_{23}, w_{33}) \\ \tau_{33} &= h_{23}^{H}(w_{23}, w_{33})\end{aligned} \tag{A8}$$

(the holistic analogue of (8a)). As in the previous section, we assume that the relevant Jacobian determinants are non-zero, so that equations (25) can be inverted. Furthermore, since $\tau_{11} + \tau_{21} = 1$ and $\tau_{23} + \tau_{33} = 1$, we obtain the following wages:

$$\begin{aligned}w_{11} &= \zeta_{11}(\tau_{11}, 1-\tau_{11}) \quad \text{and} \quad w_{21} = \zeta_{21}(\tau_{11}, 1-\tau_{11}) \\ w_{23} &= \zeta_{23}(\tau_{33}, 1-\tau_{33}) \quad \text{and} \quad w_{33} = \zeta_{33}(\tau_{33}, 1-\tau_{33})\end{aligned} \tag{A9}$$

Substituting (26) into (24), we obtain the firm's labor costs in terms of the number of workers employed and their time allocation among the three tasks:

$$\begin{aligned}\kappa^{H} &= \left(\zeta_{11}(\tau_{11}, 1-\tau_{11})\cdot\tau_{11} + \zeta_{21}(\tau_{11}, 1-\tau_{11})\cdot(1-\tau_{11})\right)\cdot n_1 \\ &\quad + \left(\zeta_{33}(\tau_{33}, 1-\tau_{33})\cdot(1-\tau_{33}) + \zeta_{23}(\tau_{33}, 1-\tau_{33})\cdot\tau_{33}\right)\cdot n_3 \\ &= \kappa^{H}(\tau_{11}, \tau_{33}; n_1, n_3)\end{aligned} \tag{A7'}$$

Then the holistic firm's profit maximization problem may be expressed as

$$\underset{\tau, T, n, N}{\textit{Maximize}} \quad \pi^{H}(\tau_{11}, \tau_{33}; n_1, n_3) = \phi^{H}(\tau_{11}, \tau_{33}; n_1, n_3) - \kappa^{H}(\tau_{11}, \tau_{33}; n_1, n_3) \tag{A10}$$

$$\textit{subject to} \quad 0 \le \tau, T \le 1 \quad \text{and} \quad n, N \ge 0$$

where $q^{H} = \phi^{H}(\tau, T; n, N)$ is the production function (23a) expressed in terms of the numbers of workers employed and their time allocations. As in the previous section, we assume that the profit-maximizing employment levels n and N are positive. Moreover, recall that, since worker 1 has a comparative advantage at task 1, the profit-maximizing fraction of time spent at task 1 is positive ($\tau_{11} > 0$). The same holds for worker 3 at task 3 ($\tau_{33} > 0$). Then the first-order conditions are

$$\frac{\partial \pi^{H}}{\partial n_1} = 0 \quad \text{and} \quad \frac{\partial \pi^{H}}{\partial n_3} = 0 \tag{A11a}$$

$$\frac{\partial \pi^{H}}{\partial \tau_{11}}(1-\tau_{11}) = 0 \quad \text{and} \quad \frac{\partial \pi^{H}}{\partial \tau_{11}} \ge 0 \tag{A12b}$$

$$\frac{\partial \pi^{H}}{\partial \tau_{33}}(1-\tau_{33}) = 0 \quad \text{and} \quad \frac{\partial \pi^{H}}{\partial \tau_{33}} \ge 0 \tag{A13c}$$

Let the profit-maximizing employment levels be $\hat{n}_1^{H}$ and $\hat{n}_3^{H}$, the profit-maximizing time allocations be $\hat{\tau}_{11}^{H}$ and $\hat{\tau}_{33}^{H}$, and the maximum profit level be $\hat{\pi}^{H}$.

Along the same lines as in the previous section, it is easy to show that a Tayloristic organization has an incentive to restructure into a holistic organization in response to

1. a sufficiently large increase in the versatility of the type-1 and type-3 workers,
2. a sufficiently large increase in the informational complementarities between tasks 1 and 2 and between tasks 2 and 3, and
3. a sufficiently large swing in work preferences towards versatile work.

Now suppose, plausibly, that centralized bargaining imposes some uniformity of wages for task 2 across workers of type 1 and 3. In particular, let the centralized bargaining constraint be

$$w_{21} = w_{23} \tag{A14}$$

This constraint need not reduce the firm's profit opportunities under a Tayloristic organization of work. Specifically, the profit opportunities will be unaffected when the wage for the second task is set at $w_{22} = g_{22}^{T}(1)$. But under a holistic work organization, it is virtually inevitable that profits will suffer. There is no reason why, in general, the profit-maximizing wage to the type-1 worker at task 2, $w_{21} = \zeta_{21}(\hat{\tau}_{11}^{H}, 1-\hat{\tau}_{11}^{H})$, need be equal to the profit-maximizing wage to the type-3 worker at task 2, $w_{23} = \zeta_{23}(\hat{\tau}_{33}^{T}, 1-\hat{\tau}_{33}^{T})$. The reason is that, in the presence of informational and technological task complementarities, the performance of tasks 1 and 3 will, in general, have quite different influences on a worker's productivity at task 2. In that event, the imposition of the centralized bargaining constraint (29) will make the firm unable to achieve the profit $\hat{\pi}^{H}$.

To take a specific example, suppose that task 1 is the production activity of a product, task 2 is the design activity, and task 3 is the sale activity. When the productivities of workers in any particular occupational category (designers, producers, and sales people) of Tayloristic organizations are reasonably homogeneous, it is not very inefficient to pay each worker in each occupation the same wage. But once these organizations restructure along holistic lines, so that both the producers and the sales people get an input into product design, this arrangement is no longer efficient. For the marginal product of the producers' time at design is

likely to be quite different from the marginal product of the sales people's time at design.

Along the same lines, it is straightforward to show that moving from a Tayloristic to a holistic organization of work also prevents the firm and its employees from achieving an efficient allocation of employees' time across tasks.

The discussion above also indicates why the analysis of this section deals with centralized bargaining inefficiencies that are potentially much more serious than those identified in the simple, baseline model of Section 2. When workers perform the same set of tasks in different proportions (as in Section 2), the informational and technological task complementarities across these tasks are likely to be similar and consequently the wage uniformity imposed by centralized bargaining may not impose serious inefficiencies. But when workers perform different combinations of tasks, the complementarities may well be radically different from one task bundle to another and a centrally imposed wage uniformity by thus be radically inefficient.

$\frac{\partial \kappa}{\partial \tau}$

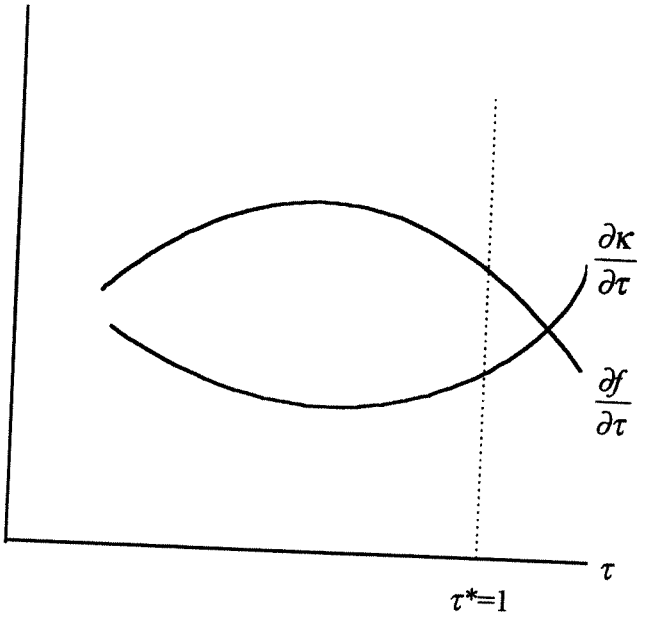

Fig. 1a

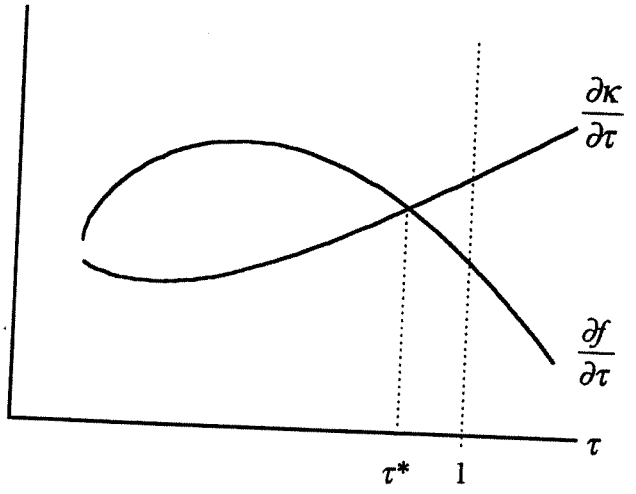

Fig. 1a

Figures 1: The Profit Maximizing Organization of Work