Appendix A: Determinants of Work Organization

The profitability of a marginal reallocation of the workers' time across tasks is

$$\frac{\partial \pi}{\partial \tau} = f_1 \cdot \left(1+\eta_1^s+\eta_1^c\right)\cdot\left(s_1\cdot c_1\cdot n\right) - f_2\cdot\left(1+\eta_2^s+\eta_2^c\right)\cdot\left(s_2\cdot c_2\cdot n\right) \tag{A1}$$

and the rate of increasing or decreasing returns to the marginal time reallocation is

$$\begin{aligned}\frac{\partial^2 \pi}{\partial \tau^2} =& \left(1+\eta_1^s+\eta_1^c\right)\cdot\left(s_1\cdot c_1\cdot n\right)\cdot\left[\frac{f_1}{\tau}\left[\varepsilon_{11}\left(1+\eta_1^s+\eta_1^c\right)+\left(\eta_1^s+\eta_1^c\right)\right]-\varepsilon_{12}\frac{f_1}{1-\tau}\left(1+\eta_2^s+\eta_2^c\right)\right] \\ &+\left(1+\eta_2^s+\eta_2^c\right)\cdot\left(s_2\cdot c_2\cdot n\right)\cdot\left[\frac{f_2}{1-\tau}\left[\varepsilon_{22}\left(1+\eta_2^s+\eta_2^c\right)+\left(\eta_2^s+\eta_2^c\right)\right]-\varepsilon_{21}\frac{f_2}{\tau}\left(1+\eta_1^s+\eta_1^c\right)\right]\end{aligned} \tag{A2}$$

When workers are completely versatile condition (A2) reduces to

$$\frac{\partial^2 \pi}{\partial \tau^2} = 4\left(1+\eta^s+\eta^c\right)\cdot\left(s\cdot c\cdot n\right)\cdot\left[f'\cdot\left[\varepsilon_{ii}\left(1+\eta^s+\eta^c\right)+\left(\eta^s+\eta^c\right)\right]-\varepsilon_{ij}\cdot f'\left(1+\eta^s+\eta^c\right)\right] \tag{A3}$$

When the marginal products of labor are constant ($\varepsilon_{ij}=0$ for i, j = 1,2), condition (A3) becomes

$$\frac{\partial^2 \pi}{\partial \tau^2} = 4\left(1+\eta^s+\eta^c\right)\cdot\left(s\cdot c\cdot n\right)\cdot\left[f'\cdot\left[\varepsilon_{ii}\left(1+\eta^s+\eta^c\right)+\left(\eta^s+\eta^c\right)\right]-\varepsilon_{ij}\cdot f'\left(1+\eta^s+\eta^c\right)\right]$$

Appendix B: The Labor Market

For algebraic simplicity, but without loss of generality, we assume constant returns to labor ($f_1 = \overline{f}_1$ and $f_2 = \overline{f}_2$ are constants) and suppose that each firm faces a resource cost $\psi_i\left(n_i\right)$ in conjunction with type-1 labor and $\Psi_i\left(N_i\right)$ in conjunction with type-2 labor (e.g. capital services, training), where $\psi_i', \Psi_i' > 0$, and $\psi_i'', \Psi_i'' > 0$, so that as employment rises, increasingly costly resources are brought into use. Maximizing the profit function (4) with respect to the time allocation τ, we obtain the time allocation decision $\tau_H = \tau_H^*$ for holistic organizations and $\tau_T^* = 1$ for Tayloristic organizations. Maximizing the profit function with respect to employment n yields the number of people employed in the Tayloristic and holistic organizations:[1]

$n_i = g_i\left(a_i - w_i\right)$, where $a_i = \overline{f}_1\cdot s_1\left(\tau_i^*\right)\cdot c_1\left(1-\tau_i^*\right)\cdot\tau_i^* + \overline{f}_2\cdot s_2\left(1-\tau_i^*\right)\cdot c_2\left(\tau_i^*\right)\cdot\left(1-\tau_i^*\right)$

and $g = \left(\psi'\right)^{-1}$.

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[1] Since non-versatile type-*i* workers (*i*=1,2) are equally productive as type-*i* versatile workers who specialize at task *i*, the Tayloristic organization's labor demand function for these two types of workers is the same. The second-order conditions for profit maximization are guaranteed by ψ_j'', Ψ_j''.

The Holistic Market

The nature of the equilibrium in the holistic market depends on the demand for versatile workers (given by the labor demand function g_H) relative to the supply of them ($L_H^S = \alpha \cdot \beta$). There are two equilibrium scenarios, the first of which is illustrated by point *H* in Figure 2:

- If the demand for versatile workers is "small" relative to the supply, the equilibrium is given by the intersection between the labor demand curve and the wage setting curve: [2]

$$\begin{aligned} L_H^D &= F_H \cdot 2 \cdot g_H\left(a_H - w_H\right) \\ w_H^o &= w_H^o\left(\frac{N_H^D}{\alpha \cdot \beta}, r^-\right) \\ w_H &= w_H^o \end{aligned} \qquad \text{(S1H)}$$

  (where the first argument of the wage setting function is the unemployment rate of versatile workers, $\left(1-\left(L_H^D / L_H^S\right)\right)$ and $L_H^S = \alpha \cdot \beta$).

- If the demand for versatile workers is "large" relative to the supply, the equilibrium is given by the intersection between the labor demand curve and the labor supply curve:

$$\begin{aligned} L_H^D &= F_H \cdot 2 \cdot g_H\left(a_H - w_H\right) \\ L_H^S &= \alpha \cdot \beta \\ L_H^D &= L_H^S \end{aligned} \qquad \text{(S2H)}$$

The Tayloristic Market

There are three possible equilibrium scenarios for the Tayloristic labor market, depending on the Tayloristic labor demand relative to the supply of non-versatile workers relative to versatile ones. The first of these scenarios is illustrated by point *T* in Figure 2:

- If the demand for non-versatile workers is "small" relative to the supply, the Tayloristic organizations do not need to hire versatile workers (who demand a higher wage than the non-versatile workers since their reservation wage is higher), and thus only the supply of non-versatile workers, $L_T^S = 1 - \alpha \cdot \beta$, is relevant to

Tayloristic wage determination. Then the labor market equilibrium is given by the intersection of the Tayloristic labor demand curve and the lower segment of the wage setting curve (where workers have the reservation wage r^-):

$$L_T^D = F_T \cdot 2 \cdot g_T\left(a_T - w_T\right)$$
$$w_T^o = w_T^o\left(\frac{L_T^D}{1-\alpha\cdot\beta}, r^-\right) \qquad \text{(S1T)}$$
$$w_T = w_T^o$$

- If the demand for non-versatile workers relative to the supply is in the "intermediate" range, the Tayloristic organizations hire some, but not all, of the available versatile workers. Thus the labor supply that is relevant to wage determination in the Tayloristic market is $L_T^S = 1 - L_H^*$, and the equilibrium is given by the intersection between the labor demand curve and the upper segment of the wage setting curve (where the marginal worker has the reservation wage r^+):

$$L_T^D = F_T \cdot 2 \cdot g_T\left(a_T - w_T\right)$$
$$w_T^o = w_T^o\left(\frac{L_T^D}{1-L_H^*}, r^+\right) \qquad \text{(S2T)}$$

- If the demand is "large" relative to the supply, the Tayloristic organizations hire all the available non-versatile and versatile workers. Then the equilibrium is given by the intersection between the labor demand curve and the labor supply curve:

$$L_T^D = F_T \cdot 2 \cdot g_T\left(a_T - w_T\right)$$
$$L_T^S = \left(1 - L_H^*\right) \qquad \text{(S3T)}$$
$$L_T^D = L_T^S$$

The Labor Market Equilibrium and Labor Market Segmentation

A simple explicit solution for the labor market equilibrium may be obtained if we linearize the labor demand and wage setting curves at the labor market equilibrium point. (None of our qualitative conclusions depend on this linearization, however.) Specifically, for positive constants γ_H and γ_T, let the aggregate holistic and Tayloristic labor demands[3] be $L_H^D = F_H \cdot 2 \cdot \gamma_H \cdot \left(a_H - w_H\right)$ and $L_T^D = F_T \cdot 2 \cdot \gamma_T \cdot \left(a_T - w_T\right)$. Regarding the scenarios in which the wage setting curves help determine the labor

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[2] The equation number (S1H) represents "scenario 1 for the holistic market. By symmetry, the sum of the aggregate labor demands for the type-1 and type-2 workers is equal to twice the aggregate demand for the type-1 worker.

market equilibrium, let the holistic wage setting curve (when the labor demand is "small" relative to the supply) be $w_H^o = \left(\delta L_H^D / \alpha \cdot \beta\right) + r^-$, for a positive constant δ, and let the Tayloristic wage setting curve be $w_T^o = \left(\delta L_T^D / \left(1 - \alpha \cdot \beta\right)\right) + r^-$ when the demand is "small" relative to the supply, and $w_T^o = \left(\delta L_T^D / \left(1 - L_H^*\right)\right) + r^+$ when there is an "intermediate" demand.

Then, in the holistic Scenario 1H (a "small" holistic demand), the equilibrium employment-wage combination is

$$L_H^* = \frac{F_H \cdot 2 \cdot \gamma_H \cdot \left(a_H - r^-\right) \cdot \alpha \cdot \beta}{\alpha \cdot \beta + F_H \cdot 2 \cdot \gamma_H \cdot \delta}, \quad w_H^* = \delta \cdot \frac{F_H \cdot 2 \cdot \gamma_H \cdot \left(a_H - r^-\right)}{\alpha \cdot \beta + F_H \cdot \gamma_H \cdot 2 \cdot \delta} + r^-$$

(S1H')

and in the holistic Scenario 2H (a "large" holistic demand), it is

$$L_H^* = \alpha \cdot \beta, \quad w_H^* = a_H - \frac{\alpha \cdot \beta}{F_H \cdot 2 \cdot \gamma_H} \qquad \text{(S2H')}$$

Given these two alternative equilibria, the Tayloristic equilibrium employment-wage combination in Scenario 1T (a "small" Tayloristic demand) is

$$L_T^* = \frac{F_T \cdot 2 \cdot \gamma_T \cdot \left(a_T - r^-\right) \cdot \left(1 - \alpha \cdot \beta\right)}{\left(1 - \alpha \cdot \beta\right) + F_T \cdot 2 \cdot \gamma_T \cdot \delta}, \quad w_T^* = \delta \cdot \frac{F_T \cdot 2 \cdot \gamma_T \cdot \left(a_T - r^-\right)}{\left(1 - \alpha \cdot \beta\right) + F_T \cdot 2 \cdot \gamma_T \cdot \delta} + r^-$$

(S1T')

in Scenario 2T (an "intermediate" Tayloristic demand), it is

$$L_T^* = \frac{F_T \cdot 2 \cdot \gamma_T \cdot \left(a_T - r^+\right) \cdot \left(1 - L_H^*\right)}{\left(1 - L_H^*\right) + F_T \cdot 2 \cdot \gamma_T \cdot \delta}, \quad w_T^* = \delta \cdot \frac{F_T \cdot 2 \cdot \gamma_T \cdot \left(a_T - r^+\right)}{\left(1 - L_H^*\right) + F_T \cdot 2 \cdot \gamma_T \cdot \delta} + r^+$$

(S2T')

and in Scenario 3T (a "large" Tayloristic demand) it is

$$L_T^* = 1 - L_H^*, \quad w_T^* = a_T - \frac{1 - L_H^*}{F_H \cdot 2 \cdot \gamma_H} \qquad \text{(S3T')}$$

The $M^* = 1 - L_H^* - L_T^*$ workers who do not find employment in the holistic or Tayloristic organizations remain unemployed and receive their reservation wage *r* = *r*.

In short, the labor market is segmented into a holistic sector, a Tayloristic sector, and unemployment. It is on this account that the process whereby Tayloristic

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[3]Linearizing these labor demand implies holding constant the second partial derivatives of the output function. Clearly, this still permits the existence of technological task complementarities.

firms are restructured into holistic ones has profound effects on labor market segmentation.

For the linearized labor demand and wage setting equations, the zero profit condition is

$$2\cdot\left[\left(\bar{f}'-w_H^*\right)\cdot\gamma_H\cdot\left(a_H-w_H^*\right)-\psi_H\left(\gamma_H\cdot\left(a_H-w_H^*\right)\right)\right]-\phi_H-\theta_H=0 \qquad \text{(20Ha)}$$

where

$$w_H^*=\left(\delta\cdot\frac{2\cdot\gamma_H\cdot\left(a_H-r^-\right)}{\frac{\alpha\cdot\beta}{F_H}+\gamma_H\cdot 2\cdot\delta}+r^-,\quad a_H-\frac{\alpha\cdot\beta}{F_H\cdot 2\cdot\gamma_H}\right) \qquad \text{(20Hb)}$$

in the Scenario 1H and 2H, respectively.

The reorganization condition is

$$\begin{aligned}&2\cdot\left[\left(\bar{f}'-w_T^*\right)\cdot\gamma_T\cdot\left(a_T-w_T^*\right)-\psi_T\left(\gamma_T\cdot\left(a_T-w_T^*\right)\right)\right]\\&\quad=2\cdot\left[\left(\bar{f}'-w_H^*\right)\cdot\gamma_H\cdot\left(a_H-w_H^*\right)-\psi_H\left(\gamma_H\cdot\left(a_H-w_H^*\right)\right)\right]-\phi_H-\rho_{TH}\end{aligned} \qquad \text{(21Ta)}$$

where w_H^* in Scenarios 1H and 2H is given by (20Hb), and

$$w_T^*=\left(\delta\cdot\frac{2\cdot\gamma_T\cdot\left(a_T-r^-\right)}{\frac{1-\alpha\cdot\beta}{F_T}+2\cdot\gamma_T\cdot\delta}+r^-,\quad \delta\cdot\frac{2\cdot\gamma_T\cdot\left(a_T-r^+\right)}{\frac{1-L_H^*}{F_T}+2\cdot\gamma_T\cdot\delta}+r^+,\quad a_T-\frac{1-L_H^*}{F_H\cdot 2\cdot\gamma_H}\right)$$

(21Tb)

in Scenarios 1T, 2T, and 3T, respectively.

A fall in the holistic fixed cost ϕ_H and advances in the holistic production and information technologies - represented by increases in a_H - raise the profit from restructuring into a holistic organization,

$\Pi_{TH}^*=2\cdot\left[\left(\bar{f}'-w_H^*\right)\cdot\gamma_H\cdot\left(a_H-w_H^*\right)-\psi_H\left(\gamma_H\cdot\left(a_H-w_H^*\right)\right)\right]-\phi_H-\rho_{TH}$, relative to the profit from remaining a Tayloristic organization,

$\Pi_T^*=2\cdot\left[\left(\bar{f}'-w_T^*\right)\cdot\gamma_T\cdot\left(a_T-w_T^*\right)-\psi_T\left(\gamma_T\cdot\left(a_T-w_T^*\right)\right)\right]$, from equation (21Ta).