Coordination Costs and Organizational Changes in the New Economy

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1. Introduction

An important aspect, observed in the last decade with the diffusion of Information and Communication Technologies, is the adoption by many firms of new organizational practices (for instance job rotation, work teams, quality norms), characterized by a tendency towards multi-tasking. This phenomenon initially appeared in the United States, and then has expanded over to Europe. As a consequence, a consistent literature has studied the effects of these organizational changes, both on firms performance on the one hand and on working conditions (in particular occupational health and safety) on the other hand. With reference to the first aspect, most of these works show a positive impact of new work practices on productivity, and an effect represented by upskilling of workers. With reference to the second aspect, the available studies (see for instance Fairris and Brenner, 2001, Askenazy, 2001, Ramaciotti and Perriard, 1999, Askenazy, Caroli and Marcus, 2002) lead to conflicting conclusions, since some of them evidence a positive relation between new organizational practices and workers well-being (for instance quality norms reduce failures, improving occupational safety, and job rotation makes work more interesting), while others evidence opposite results (new work practices increase the pressure on workers for performance, raising the risk of injuries as well as mental strain).

It is therefore crucial to clarify these aspects, since the working conditions in the new economy are a key element that must be taken into account in the evaluation of the performance and of the long-run viability of the new productive paradigms. In particular, if the new work practices increase the risk of work injuries or illnesses we would have increase of absenteeism and of social conflicts and decrease of workers' satisfaction and of labor productivity, and this would affect the future development of the "new economy".

In such a context, this paper considers a theoretical model that tries to study some effects of multi-tasking in an economy in which individuals devote time both to production and to human capital accumulation, and in which they are involved in many tasks. In this model, the presence of multi-tasking gives rise to coordination costs for the firms (an increase in the number of tasks per worker increases output but it also reduces profits through an increase in coordination costs, due to interactions among tasks) and to disutility for the individuals (an increase in the number of tasks per worker increases work rhythms, and in this way it induces disutility). The paper considers both the decentralized economy (in which households and firms solve separately their optimization problems) and the centralized economy (in which a

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central planner acts), and it shows that the social optimum is characterized, at the steady-state, by a number of tasks per worker lower than the number obtained in the decentralized economy. Furthermore, also production and consumption are lower in correspondence of the social optimum than in the decentralized economy. The decentralized solution in this model is therefore sub-optimal, and the last part studies a policy that can be implemented in order to correct such sub-optimality.

2. The model

The model considers an economy in discrete time (from 0 to ∞) with an active population of size L (it is then possible to normalize it, i.e. to assume $L=1$). The production side is characterized by a representative firm that produces according to the technology:

$$y_t = A_t \cdot \int_0^{n_t} \left(h_t \cdot x_t(i) \cdot L_t\right)^{1-\alpha} di$$

where $0<\alpha<1$, A_t is a productivity parameter, L_t is the number of workers with human capital h_t, $x_t(i)$ is the time devoted to task *i* and n_t is the number of tasks performed per worker.
The worker's productive time is equal to T_t, hence we also have the constraint:

$$\int_0^{n_t} x_t(i)di = T_t$$

Since tasks are symmetric we then have $x_t(i)=x_t$, from the constraint this implies that $x_t = T_t / n_t$, and substituting in the first expression we obtain the production function:

$$y_t = A_t \cdot \left(h_t \cdot T_t \cdot L_t\right)^{1-\alpha} \left(n_t\right)^{\alpha}$$

The profits (assuming the price of output equal to 1) are then given by:

$$\pi_t = A_t \cdot \left(h_t \cdot T_t \cdot L_t\right)^{1-\alpha} \left(n_t\right)^{\alpha} - d \cdot \left(\frac{n_t}{n_{t-1}}\right)^{\theta} - w_t \cdot h_t \cdot T_t \cdot L_t$$

where $d, \theta > 0$, w_t is the wage rate per efficiency unit of labor and $d_t \cdot \left(n_t / n_{t-1}\right)^{\theta}$ represents coordination costs. In effect, increasing the number of tasks per worker raises coordination costs because of interactions among tasks (see Becker and Murphy, 1992), hence multi-tasking not only increases output but it also induces coordination costs which reduce profits.

The consumption side is characterized by a representative household that has a utility function given, in the general form, by:

$$u(c_t, n_t) = \frac{c_t^{1-\tau} e^{(1-\tau)\phi(n_t)} - 1}{1-\tau}$$

where $\tau > 0$, c_t is consumption and $\phi(n_t)$ represents the disutility for the individuals of multi-tasking (with $\phi'(n_t) < 0$ and $\phi''(n_t) \leq 0$), since increasing the number of tasks per worker increases work rhythms, and work intensification induces disutility (see Askenazy, 2001).
To simplify the analysis we then choose $\tau = 1$ and we assume that the disutility of multi-tasking takes the form $\phi(n_t) = -\gamma \cdot (n_t)^{1+\sigma}$ with $\gamma > 0$ and $\sigma \geq 0$ (this constant elasticity form of the disutility of multi-tasking guarantees a constant equilibrium number of tasks in the steady-state), so that the utility function becomes:

$$u(c_t, n_t) = \ln c_t - \gamma \cdot (n_t)^{1+\sigma}$$

The household holds assets a_t and is endowed with one unit of time each period, that is spent on working (the fraction T_t) or on human capital accumulation (the fraction $1 - T_t$), and the accumulation of human capital is described by the following equation:

$$h_{t+1} = E_t \cdot h_t^{\delta} \cdot (1 - T_t)^{1-\delta}$$

where $\delta > 0$ and E_t is an efficiency parameter.

It is now possible to consider first of all the decentralized economy, where the firm and the household solve their optimization problems separately, and then the centralized economy, where a central planner acts, and to analyze the steady-state solutions in these two cases.

3. The decentralized solution and the social optimum

The decentralized economy is characterized by the fact that household and firm solve separately their optimization programs. In particular, the household's intertemporal optimization problem is:

$$\max_{\{c_t, T_t, a_{t+1}, h_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[\ln c_t - \gamma (n_t)^{1+\sigma} \right]$$
$$\text{s.t. } a_{t+1} = (1 + r_t) a_t + w_t h_t T_t - c_t$$
$$h_{t+1} = E_t h_t^{\delta} (1 - T_t)^{1-\delta}$$

where β is the discount factor (with $0 < \beta < 1$) and r_t is the interest rate, and the household chooses, for each period, the level of consumption, the fraction of time spent on working, the assets held and the level of human capital.
The firm's intertemporal optimization problem is then given by:

$$\max_{\{n_t, L_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \frac{1}{(1 + r_1)(1 + r_2) \cdots (1 + r_t)} \left[A_t (h_t T_t L_t)^{1-\alpha} (n_t)^{\alpha} - d \left(\frac{n_t}{n_{t-1}} \right)^{\theta} - w_t h_t T_t L_t \right]$$

and the firm chooses, for each period, the number of tasks performed per worker and the number of workers.

On the other hand, the centralized economy is characterized by the presence of a central planner that solves the following intertemporal optimization problem:

$$\max_{\{c_t,T_t,n_t,h_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[\ln c_t - \gamma (n_t)^{1+\sigma}\right]$$

$$\text{s.t. } c_t = A_t (h_t T_t L_t)^{1-\alpha} (n_t)^{\alpha} - d\left(\frac{n_t}{n_{t-1}}\right)^{\theta}$$

$$h_{t+1} = E_t h_t^{\delta} (1 - T_t)^{1-\delta}$$

and the central planner chooses, for each period, the level of consumption, the fraction of time individuals spend on working, the level of human capital and the number of tasks per worker.

For these problems it is possible to write the equations that characterize the steady-state, and to find the corresponding values of the different variables. The main result that can be obtained is that, at the steady-state, the centralized economy is characterized by a number of tasks per worker, a level of production and a level of consumption lower than the corresponding values in the decentralized economy. This is due to the fact that in a centralized economy the central planner takes into account the disutility on individuals caused by an excessive number of tasks per worker, while in a decentralized economy this aspect is neglected by the firms that choose the number of tasks performed. The results in this latter case are therefore sub-optimal, and the fact that the number of tasks performed in a decentralized economy is too high with respect to the social optimum is consistent with the empirical findings according to which new work practices (that involve multi-tasking) have negative effects on the working conditions of the individuals. The last aspect considered, then, consists in finding a policy that can be implemented in order to correct such sub-optimality of the decentralized economy.

References

(1) Askenazy, P. (2001), "Innovative Workplace Practices and Occupational Injuries and Illnesses in the United States", *Economic and Industrial Democracy* 22 (4).

(2) Askenazy, P., E. Caroli and V. Marcus (2002), "New Organizational Practices and Working Conditions: Evidence from France in the 1990's", *Recherches Economiques de Louvain* 68 (1-2), 91-110.

(3) Becker, G. S. and K. M. Murphy (1992), "The Division of Labor, Coordination Costs, and Knowledge", *The Quarterly Journal of Economics* 107 (4), 1137-1160.

(4) Boucekkine, R. and P. Crifo (2003), "Human Capital Accumulation and the Transition from Specialization to Multi-Tasking", *Université Catholique de Louvain*, CORE Discussion Paper 2003/80.

(5) Fairris, D. and M. Brenner (2001), "Workplace Transformation and the Rise in Cumulative Trauma Disorder", *Journal of Labor Research* 22 (1), 15-28.

(6) Ramaciotti, D. and J. Perriard (1999), "Certification qualité selon ISO 9000 et fréquence des accidents du travail dans un groupe d'entreprises suisses", *Actes du XXXIVème Congrès de la SELF-CAEN*, 653-660.