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Notes on Institutional Complementarities and Organizational Forms

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Abstract - This paper analyses the concept of *organizational forms*, and derives some implications for the economics of production organization. To this end, after pointing out the role of knowledge in the organization of production, we discuss the theories based on technology (new institutional economics) and property rights (so-called radical school). When the effect of property rights is not taken into account, technology alone entails unique solution to the problem of production organization. After ruling out this technologically deterministic argument, by recourse to a simple model, we study the *complementarities* between these two domains. Finally, we derive some implications: (a) the asymmetry between the characteristics of labour and capital under the existing property relations, (b) the importance of workers' preferences for different ways of production organization. In so doing, we show that efficiency driven arguments on the relative success of different organizational forms may be misleading. Hence, we argue that, change in production organization should be described not as a linear path, but rather as a branching tree.

JEL Codes: D23, J54, L23, P14

Keywords: technology, transaction costs, property rights, institutional complementarities, organizational forms

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1. Introduction

Technology is knowledge utilized in the production of goods and services. It is central to every economic activity. This centrality, sometimes, is taken to the extreme that every major social change is solely explained by technological change. The opponents of this view, rightly, accuse technology-driven explanations as being determinist, i.e. technological determinism. Technological change does not occur in a vacuum. To put it in another way, there is technological *potentiality* not *determinism*.[1] Technological change sets the limiting conditions of what is possible. It defines the possible, and does not solely determine which choices are taken up.

Power relations and property rights are of great importance for the evolution of technology, since those who control the resources are able to choose the one most favourable to their interest from the available technologies. Yet, the evolution of technology cannot fully be shaped by the existing power relations and property rights. The prospects of advances in technological knowledge are not necessarily predictable. Hence, the opposite extreme, i.e. property rights determinism, is also flawed.

By focusing on the interplay between these two forces, we abandon the notion of production as a natural process, and place it into a framework where the organization of production is seen as a *social* phenomenon. The standard approach assumes complete contracts and zero transaction costs. As Samuelson (1957) put it, 'in a competitive economy it really does not matter who hires whom.' This framework, however, does not allow for a discussion in which technology and property rights influence each other: When it is impossible to write complete contracts, i.e. when there are positive transaction costs, the characteristics of productive forces are likely to influence the type of (control) rights that prevail and vice versa.

In the paper, we claim that whereas bounded rationality and incomplete contracts are necessary ingredients for the theory of the firm, it is the notion of institutional complementarities and multiple organizational equilibria that constitute the foundations of an approach upon which different institutional arrangements of production could be built. In doing so, we show that simple efficiency arguments on the relative success of different

[1] Stating the issue in terms of 'potentiality versus determinism' is inspired by Stephen J. Gould. In Gould, the discussion is on 'biological potentiality versus genetic (or biological) determinism' (Gould 1977, Chapter 32).

organizational forms may be misleading. Thereby, organizational evolution should be depicted as a branching tree rather than a unique linear path.

Any type of organization, including the firm, has to deal with the limits of human knowledge. The role of knowledge in production organization is discussed in Section 2. We then analyze the new institutionalist program that stresses the role of technology in determining efficient property rights regimes (Section 3). Taking into account the opposite direction of causality is the theme of Section 4. Co-determination of technology and property rights, and the *complementarities* between the two are studied in detail in Section 5.[2] Finally, in Section 6, we point out the main implications of our analysis. Section 7 concludes.

2. Knowledge and the Firm

Production is ultimately a knowledge-based activity. There is no production without technological knowledge. The study of this vital element has always been a challenging task in economic theory.[3] In this section, we study the organizational characteristics of technological knowledge, in which relations within business units are the focus of attention. In any organization, knowledge required for producing a product is not available in its totality, and is distributed across many individuals; when and how it is utilized in the production process is of great importance.

The nature of technology reflects itself on the way production is organized. As Veblen (1914) pointed out long ago, 'the life history of man is the life history of human community'. There is no technological knowledge without (industrial) community. In other words, production and technological change are group phenomena. This is so since the limitations of human capacities for receiving and processing information necessitate sharing problems that are difficult for a single person to handle (Loasby 1976). It is only because humans are limited in knowledge, skill and time that organizations are useful for the achievement of human purpose. In essence, human beings are intendedly rational but only *boundedly* so (Simon 1997). Organizations are devices which cope with the limits of man's abilities to compute in the presence of complexity (Simon 1979).

[2] This interplay constitutes the core of the Marxian theory of history. See, for example, Cohen (1978), and Brenner (1986).

[3] See Metcalfe (2010) for an overview of different approaches.

Bounded rationality implies that under complexity, decision makers look for a *satisficing* rather than an optimal solution (Simon 1955). In such an environment, habits and routines conserve scarce and costly decision making time in production. These habits and routines are based on experience and practice that are difficult to transmit in nature. In other words, technological knowledge is not totally articulated, and it is the *tacit* dimension that underlies skilful performance (Nelson and Winter 1982, 73).[4]

This unarticulated (tacit) knowledge is stored in skills and capabilities of organizations as well as individuals. For that reason, organizations' activities are likely to proceed according to established routines, and the establishment of such routines is itself a rational behaviour (Simon 1997, 89). Individuals may come and go but organizations do remain. Capabilities that enable the organization to produce are not directly accessible to any single person. In other words, the capabilities of an organization are not a mere sum of individual capabilities of its members. Thereby, possession of any technological knowledge is also an attribute of the firm as an organized entity (Nelson and Winter 1982, 63). The necessary knowledge for producing goods and services resides in organization's memory, and the way to remember it is by *doing*, i.e. routinization of productive activity in the organization (Nelson and Winter 1982).

Modern organizations with their hierarchical structures are adaptive forms for bounded rationality of agents under complexity (Simon 2002). As Simon (1962, 468) argues, administrative hierarchy is one of the most important structures that complexity uses. Yet, even though hierarchy exists both in natural and social realms, distinct from the former, in hierarchical social systems there are subordination and authority. The problem of ownership and control rights inside an organization touches upon this aspect of production organization, i.e. organizations are coalition of agents with different rights, interests and motivations. The new institutionalist approach argues that technology is paramount in determining ownership and control rights in the organization.

[4] This is the well known distinction between *know how* and *know that* (Ryle 1949). Know that corresponds to easy to codify knowledge. Know how, on the other hand, refers to skills and capabilities that are tacit in nature. Importantly, tacit knowledge is acquired experientially, and transferred by personal instruction, or by the provision of expert services (Dasgupta and David 1994, 494; Polanyi 1958, 1967). Vincenti (1990) provides an excellent historical analysis of the role of tacit knowledge in the aeronautical industry. Friedrich Hayek (1937, 1945) stressed the role of tacit knowledge in a market economy. The costly nature of acquiring and transferring tacit knowledge is related to what Pagano (2000) calls bounded communication skills.

3. Technology and the New Institutionalist Program

In the new institutionalist literature,[5] existing forms of production organization and ownership relations reflect efficient responses to the nature of assets employed, i.e. technology. The first branch of new institutionalism, i.e. the property rights approach, argues that it is the *monitoring* characteristics of the assets that determine efficient production organization. Their approach, as they claim, moves Coase towards the goal of explaining the conditions under which managing resources in the firm is less costly than allocating them through the market (Alchian and Demsetz 1972, 784).

In particular, the firm exists due to the team nature of production: It makes difficult to determine marginal contributions of each agent and the firm hierarchy (that assigns a monitoring function to an agent) is a remedy to it. Hierarchy mitigates the problem of monitoring where the monitor becomes residual claimant.[6] As such, the firm is seen as a specialized set of market contracts, in which the role of authority relations is rejected (Jensen and Meckling 1976). The centrality of saving on monitoring cost in turn determines the ownership structure of the firm. Ownership goes to difficult-to-monitor assets to save on costs associated to them. Moreover, there is no authority relation in the firm, since neither the employer nor the employee is bounded by any contractual obligation to continue their relation (Alchian and Demsetz 1972, 777).

The transaction costs approach, i.e. the second branch of new institutionalism, stresses the role of *asset specifity*. This approach mainly derives from the works of Oliver Williamson (1975, 1985). Indeed, Williamson (1985, 86-89) argues that technology is not determinative since if alternative means of contracting can be described, the same technology can feasibly be employed by these alternatives. In his approach, the effect of technology is rather indirect through its effect on determining the most transaction cost economizing organization structure (Pagano 1992).

According to Williamson, transaction cost economizing matters, since all complex contracts are unavoidably incomplete, i.e. the legal system is not functioning perfectly. This is so mainly due to *bounded rationality* (see the previous section), and *opportunism*.[7] Market

[5] This literature mainly stems from the works of Coase (1937, 1960). It has two main branches (see the text).

[6] Yet, as Putterman (1984) argues we know no real world example of worker-run firms which makes the monitor residual claimant. The argument is empirically weak.

[7] Williamson (1985, 30) defines it as 'self-interest seeking with guile.'

relations fail to support transactions of unique and imperfectly standardized goods, in which continuity of relations is important. In cases of such *asset specific* investments, contracts and governance structures are designed in such a way that they economize on bounded rationality and safeguard against opportunism (Williamson 1985).[8]

By the same token, the rationale behind the existence of the firm lies in its transaction costs economizing role. The threat of quasi rent appropriation would prevent specific investment in the absence of safeguards to which vertical integration, i.e. the firm, is the solution. In this regard, Williamson (1985, 249) argues that employment contract allows internal organization to adapt more effectively to changing market and technological conditions compared to commercial contracts in which procurement of the same good or service from autonomous suppliers requires mutual consent. The latter lacks command and control which is the decisive element of the employment contract (see below).

In the transaction costs approach, the firm with its internal hierarchy is the result of the cost economizing nature of contractual agreements in cases of asset specific investments; and in the property rights approach, it is the result of monitoring difficulties in production. Indeed, as Pagano (1993, 87) argues, the difference between these schools is more of a matter of terminology: 'Property rights, if interpreted in a general way, imply management rights and governance systems, and the latter are founded on explicit or implicit systems of rights.'

4. Inverted schema: The role of property rights and power relations

There is technological potentiality not determination. What is chosen among feasible technological alternatives, and in what directions technology develops are also a matter of power and property relations. This is tantamount to saying that technological change does not occur in an institutional vacuum. Incumbent institutions shape the evolution of technology, hence may affect the characteristics of assets employed in the production process.[9]

[8] Some authors argue that Simon's concept of satisfying is absent in Williamson, and replaced by economizing on bounded rationality (Hodgson 1993, Loasby 1999, Pagano 2000).

[9] Note that in the standard theory with zero transaction costs (no bounded rationality), perfect competition brings about the same efficient allocation of resources independently of the initial distribution of property rights (Pagano 2007, 69). In this economy, as Coase (1960) demonstrated, individuals will exchange their rights such that the final allocation of property rights will be efficient. The techniques and organization will be optimal independent of the initial distribution of property rights. In such a world who owns the firm and who hires whom are irrelevant since they will be efficiently determined by the competitive system. Alternative organizational forms acting in a competitive economy wouldn't change the results since, at equilibrium,

It is true that there is an unpredictable factor in scientific and technological progress, e.g. what Veblen (1899) calls *idle curiosity* as a driving force behind inventions and innovations. Even though imagination and curiosity play a role in technological change, too much emphasis on these factors may unduly favour explanations based on 'hero inventors' (Basalla 1988). On the contrary, the bulk of technological knowledge is created by intentional interventions of public (spending on military, education, healthcare etc.) and private actors.

Property rights determine the relationships of possession and coercion among economic agents. As Brenner (1986) put it, since property relations determine the economic actors' rule for best strategy, they affect agents' incentives for innovation, and thus provide a general pattern of development of productive forces. Incumbent power relations and property rights shape the technology used by the modern firm. Technological change is not an outcome of a socially unbiased advance of knowledge. It responds to the interests of the owners of productive forces. Therefore, certain technologies may be rejected when they threaten the existing authority relations in the modern workplace (Bowles and Gintis 1976).

In his seminal work, Marglin (1974) explores whether hierarchy and alienated work in the factory, i.e. capitalist firm, are indispensible for industrial development, or they are the result of existing social relations. He argues that the main function of the factory system is to transfer the decision making autonomy of workers on how much and how intensely work to capitalist (Marglin 1974). Moreover, scientific management assures direct control over the work through the control over the decisions that are made in the course of work: F. W. Taylor's second principle, which states that all the possible brainwork should be removed from the shop floor and concentrated in the planning department (Braverman 1974).

Scientific management, as such, has had profound effects on the production process. Detailed division of craft cheapens its individual parts; thereby converts labour into automata performing very small and repeated tasks: 'Babbage's great principle of economical production' (Braverman 1974, 80). This process, in turn, allows the extraction of useful knowledge from the shop floor, and concentrates it in the hands of managers. As Edwards (1979, 100) puts it: 'unless management knew in detail how production occurred, precise direction of worker tasks was impossible'.

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organization of production would be such that the marginal productivity of each factor is maximized (Pagano 2007, 69-70).

The separation of conception and execution in the production process completes the conversion of labour into a general purpose asset. The most institutionalized and sophisticated form of control is what Edwards calls *bureaucratic control*. It makes power appear to emanate from the formal organization itself. Rule of law replaces rule by manager and supervisor command. Overall, there is nothing intrinsic in labour that makes it a general purpose asset. Historically, it has been due to the deliberate efforts of capitalists (Braverman 1974). Therefore, they reverse the argument which is developed by the new institutionalist approach.

5. Institutional complementarities and organizational forms

Another possibility is that, as originally put by Pagano (1992, 1993) and Pagano and Rowthorn (1994), incumbent property rights could be the reason behind the adaptation of particular technology, and the characteristics of resources employed in production may be the reason behind the formation of certain system of rights. In other words, technology and property rights constitute organizational/technological equilibria in which they are optimal relative to each other: Property rights reproduce themselves via technology and technology reproduces itself via property rights.

We argue that such a framework requires two assumptions. First, agents are boundedly rational, in the sense that they have limited knowledge concerning the system. Second, there are different domains of choice, in which boundedly rational agents are not able to coordinate their choices across these domains. Importantly, it may not only be that agents are unable to coordinate their choices but also that they have conflicting interests. We argue that the second assumption is crucial, since transformation of production organization usually entails simultaneous changes in several domains.

In essence, it is the notion of institutional complementarities that constitute the foundations of an approach upon which different institutional arrangements of production could be built. Such institutional complementarities may prevent the emergence of alternative organizational forms, since the existence of complementarities implies that institutional arrangements across different domains constitute a coherent whole in which individual institutions may not easily be altered in isolation (see Milgrom and Roberts 1990a,b; Aoki 2001, 225-229).

In order to formalize such an argument, consider a population of i (employers) and j (employees) agents who are paired randomly for a single interaction. Assume that they produce a good, where property rights to the two parties are determined by i agents, whereas preference on how to produce, call it behavioural type, is chosen by j agents. For simplicity, assume that employers may offer one of the two rights: Under P, workers receive no rights and safeguards in the firm; while under R, employees have rights and safeguards in the firm such that they are willing to use their labour capacity, e.g. investing in skills. Rights and safeguards may be in the form of workplace autonomy, employment guarantees, or better work conditions.

Employees are also of two types. B type employees interpret R-rights as a sign of trust, hence reciprocate by using their labour capacity in the production process. On the other hand, when offered P type rights, they may feel distrusted, and retaliate by hiding their labour capacity. A type employees, on the other hand, irrespective of the rights offered, hide their labour capacity. In essence, we assume that non-verifiable aspects of work, such as reciprocity and work ethic in relation to the rights, are important to production (see, for example, Bowles and Belloc 2010 for such a framework).

Assume that payoffs for different types of interactions are as follows: $\pi_A^P \geq \pi_A^R$, $\pi_B^R \geq \pi_B^P$, $\pi_P^A \geq \pi_P^B$, and $\pi_R^B \geq \pi_R^A$ (see the table below). Hence, there are multiple equilibria. In this schema, we have two distinct property rights regimes, and four techniques of production. Hence, we define technology by different combinations of property rights regime and behavioural types.

j agents / **i agents**	**Behavioral type A**	**Behavioral type B**
Property rights P	π_A^P, π_P^A	π_B^P, π_P^B
Property rights R	π_A^R, π_R^A	π_B^R, π_R^B

Writing the fraction of j agents who are type A as τ, the expected payoffs to i agents offering the P and R contracts are:

$$V_P = \tau\pi_A^P + (1-\tau)\,\pi_B^P$$

$$V_R = \tau\pi_A^R + (1-\tau)\,\pi_B^R$$

Similarly, writing the fraction of the i agents offering property rights regime P as φ, the expected payoffs to the A and B behavioural types are:

$$V_A = \varphi\pi_P^A + (1-\varphi)\,\pi_R^A$$

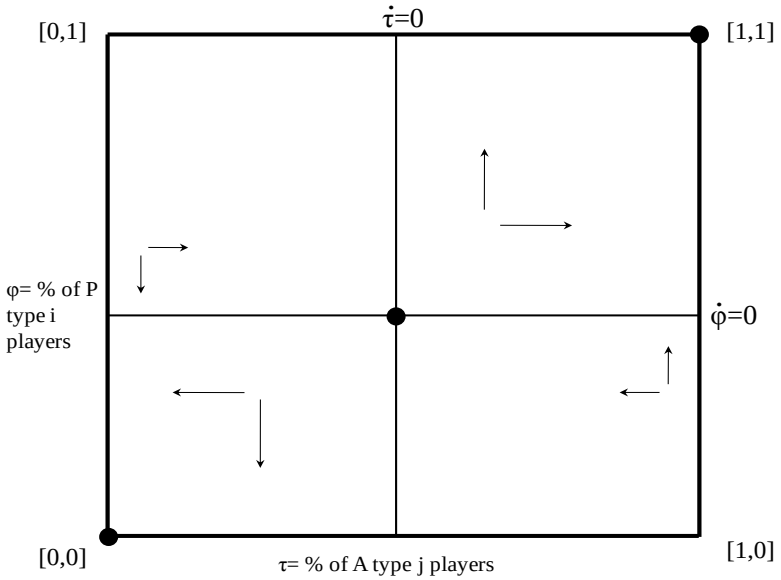
$$V_B = \varphi\,\pi_P^B + (1-\varphi)\,\pi_R^B$$

What types of rights and behaviours would we expect to observe in this population? Secondly, how could we characterize a transition from one regime to another? To answer the first question, consider the space defined by all possible combinations of rights and behavioural strategies, i.e. $\varphi \in [0,1]$, and $\tau \in [0,1]$. Then, explore the changes in both φ and τ over time. In order to do that, assume that both groups of agents periodically update their strategies by switching to strategies with higher payoffs. This process gives us the following replicator equations (Bowles 2006).

$$\dot{\varphi} = \varphi(1-\varphi)(V_P - V_R)$$

$$\dot{\tau} = \tau(1-\tau)(V_A - V_B)$$

The stationary values of φ and τ in this dynamic system are $\dot{\varphi} = 0$ for $\varphi = 0$, $\varphi = 1$, and $\dot{\varphi} = \varphi^*$, and $\dot{\tau} = 0$ for $\tau = 0$, $\tau = 1$, and $\dot{\tau} = r^*$. The resulting dynamical system is illustrated in the figure below. The point $(\varphi^*, \dot{\tau})$ is stationary, but is a saddle. Thereby, small movements away from the point are not self-correcting. The asymptotically stable states are $(\varphi, \tau) = (0,0)$ and $(\varphi, \tau) = (1,1)$. Which state occurs is determined by the initial conditions.



We see that two outcomes are likely to occur, namely high frequency of both P rights and A behavioural type, or the opposite case with R rights and B behavioural type. In order to answer the second question, let us convert the above dynamical system into an ergodic process. We could do so by introducing the possibility of intentional idiosyncratic play. Assume that in every period there is a probability $\partial \in (0,1)$ that each agent takes intentional non-best response. This process transforms our dynamical system into an ergodic process (Young 1998, Bowles 2006).

Particularly, when none of the equilibrium is Pareto superior, e.g. payoffs specified above is such an example, depending on the basin of attraction of the system, fraction of i and j agents playing idiosyncratically will have an incentive to non-best respond, because by so doing they may induce their best responding partners to change their strategy in the following periods. Yet, the introduction of idiosyncratic play does not mean that all states are equally likely, since it requires a large amount of such play to change equilibrium. Therefore, changes in individual behaviour could not amount to explain a shift in equilibrium.

An exogenous shock to the system, which could affect the basins of attraction of different systems, may lead to change. For example, Pagano (1993, 110-112) argues that the system of production in Germany and Japan with several safeguards, at the industry and firm level respectively, is due to such a shock. He claims that in the US workers were employed without any safeguards and rights (P-A equilibrium), hence they invested very little in skills. On the

other hand, German and Japanese systems of production with skilled workers (R-B equilibrium), in part, is due to a strong property rights shock that came after both countries lost the Second World War. In both countries, employers were punished for their war effort.

If institutional complementarities exist, different institutional arrangements may not be even Pareto comparable. Hence, the existence and persistence of (even inefficient) organizational equilibrium under competition are possible contrary to the well-known claims that are found in the literature, e.g. Alchian (1950). Property rights and technology at any given time have more or less a character of organic whole so that any change in one domain of the system involves a change at other domains. Incumbent set of institutions can be seen as a set of mutually supporting rocks that have come about in a process of cumulative growth (Pagano 2000).

Competition may lead to the selection of the best among similar organizational forms, yet at the same time, may prevent the development of new (potentially more efficient) forms due to the inferiority of the hybrids (Pagano 1993, 134-135). The role of power relations, hence incumbent property rights regime, is paramount since those who benefit from the incumbent arrangements may be endowed with resources and competence to perpetuate them. Overall, efficiency driven stories are not tenable in determining technology-rights equilibria (Pagano 2001). Overall, efficient change in economic organization is difficult to describe, if social and economic systems are characterized by such institutional complementarities.[10]

6. Multiplicity of Organizational Forms: Some Implications

At the dawn of the 20th century the concentration of former artisans and domestic workers under one roof, i.e. the factory, away from home was almost completed. The de-skilling of workers, mechanization of production, and the supervision of it by professional managers were the main characteristics of this new mode of production. Since then, modern business

[10] Besides, the existence of such complementarities implies that institutional evolution may have a *punctuated* character (see Eldredge and Gould 1972). Namely, there is no slow and steady transformation from one technological system to another. Continuous change in existing technology is part of a technological trajectory confined to a particular technological paradigm, whereas discontinuous and sharp changes are associated with the birth of new paradigms. As Mokyr (1990) pointed out, historically, we do not observe gradual evolution in technology, but long periods of stagnation punctuated by sudden outburst like the industrial revolution. The literature on technological paradigms (Dosi 1982) and techno-economic paradigms (Perez 1985), in which different technological trajectories are generated by alternative property rights regimes examine this fact (Pagano 1993, 90).

enterprise, i.e. capitalist firm has been an important complement to the market in coordinating economic activities and allocating resources (Chandler 1977, 1990). Claims on the efficiency of the capitalist firm rely on this historical background. We now provide a broader perspective on different institutional arrangements that have been observed in the last two centuries.

It is foremost the institution of employment contract that demarcates the *capitalist firm* from other organizational forms. Not all firms are capitalist. The defining characteristic of a capitalist firm, the dominant organizational form of the last two centuries, is the existence of employment contract that regulates the relation between employer and employee. Employment relation is one of the fundamental characteristics of modern societies, which we live in (Simon 1979).

It is different from commodity exchange and hence sales contract, since employee does not offer a specific service, but an undifferentiated time and effort (Simon 1951).[11] It assigns employer the right of decision making power over the use of employee. As Coase (1937) pointed out, when a worker moves from one department to the other he does not go because of a change in relative prices but simply because he is ordered to do so. Importantly, employment relation entails *authority* in the sense that whenever a person is subject to it, his choices are excluded from playing a role in the regulation of his actions, and are replaced by the choice of the authority (Archer 1996). Bowles and Gintis (1996a) argue that the standard argument for democratic governance in politics, i.e. it is a defense against the abuse of otherwise unaccountable power, applies to the employment relation as well.

An alternative institutional arrangement that has kept the attention of researchers as well as practitioners is *self-management* (self-managed firms or workers' control in the production process). It is different from the former because of the fact that decisions are made by workers themselves. The decision making power is distributed and profit is shared among workers. In self-managed firms, workers determine output collectively using some democratic choice mechanism in which there is no ex ante wage determination (Dow 1993). The workers of the firm, in a politically egalitarian or democratic manner, have ultimate authority over the decisions of the enterprise, including the right to delegate some or all decisions to managerial organs. Note that this is different than egalitarianism in income

[11] See Hodgson (1999) and Screpanti (2001) for contemporary accounts of the issue.

distribution, or direct democracy in decision making. Hence, some degree of hierarchy and job specialization is not ruled out in self-management (Putterman 1984). In other words, workers may appoint managers, but they have effective monitoring power over them (Screpanti 2010).[12]

In both (pure) forms, the firm does not have to belong to the insiders. What really matters to demarcate a capitalist firm from a self-managed firm is the type of contract that regulates the relations inside the firm, not the ownership of assets. Therefore, there may be private or public property rights in productive assets.[13] Alternative institutional arrangements, foremost, are about the method of coordination of the division of labour within production units, which leaves open the question of the method of coordinating the relations between production units as well as the question of property rights (Putterman 1990).

The systems of production in Germany and Japan (see the previous section) stand in the middle of the above defined (pure) forms. Even though employment contract regulates the relations between the employer and the employee, the latter is given rights and safeguards compared to the standard employment relation, i.e. classical capitalist firm. In Japan individual firms developed several safeguards, hence workers invested quite a lot in their (firm specific) skills. This happened in Germany at the industrial level with well developed occupational markets and vocational training. In essence, both types correspond to giving power and rights to workers compared to classical capitalism (or Taylorism) with no rights to workers (see also Pagano 2007, 69-70).

All these alternative organizational forms represent different ways of knowledge collection, transformation and utilization based on available technology and property rights. Importantly, social systems involve dominant structures, what Hodgson (1988) calls 'principle of dominance'. The characteristics of the system may be defined by giving reference to these dominant structures. What we have done for the employment contract is a case in point. Still, non-dominant elements are necessary parts of any system, i.e. 'principle of impurity'. No system exists in its pure form. There is institutional plurality (see Hodgson 1988 for the

[12] In self-managed firms residual claimancy may induce greater effort from partners (Bowles and Gintis 1993, 1996b). Moreover, peer-to-peer monitoring may mitigate the monitoring problem (Screpanti 2010).

[13] Economic systems could also be categorized according to asset ownership, i.e. private or public ownership of (mainly) physical assets. Yet, As Screpanti (2010) argues, there is no a priori reason to believe that authority derives from the residual right of control on wealth. There is nothing about private asset ownership that implies routine control over the ways in which assets are used. In theory, workers can lease physical assets from their owners without losing control over the production process (Dow 2003).

details of the argument). In capitalism alternative organizational forms such as workers' control as well as hybrid forms such as German and Japanese types of production co-exist with the dominant form.

What explains the dominance of employment contract in modern economies? In capitalism, labour cannot be bought and sold. This is the restriction imposed by the incumbent property rights regime. On the other hand, the treatment of the rental of labour is not substantially different from the rental of other resources in the theory. Yet, this type of analysis depends on costless definition, enforcement and transfer of private property rights. When they are costly, initial distribution of rights matters (see the formal model above). Moreover, in a world of positive transaction costs, labour cannot be treated in the same way as other non-human resources, i.e. there is no perfect symmetry between labour and capital. This asymmetry constitutes two interrelated yet distinct social conflicts: One is on the distribution of the product, and another is on the organization of the workplace.

First, capital can be pooled, whereas labour cannot. In a corporation no individual investor owns an identifiable piece of the firm's physical assets; in other words each capital supplier is not free to withdraw his or her personal machine. Hence, bargaining problem among the capitalists can be solved by not allowing each capitalist to own specific machine but to accept shares in the firm. This is a feasible solution since capital is intrinsically *mobile*, i.e. it can be separated from the capitalist. Hence, capital owners can create a cartel that bargains as a unit against workers (Leijenhufvud 1986, 219).

On the other hand, labour cannot be separated from the worker; therefore, workers cannot pool their labour power. A symmetrical solution would require a worker to sell his own person into slavery in return with an equity share in the firm (Leijonhufvud 1995, 73). In the absence of slavery, there would be a disincentive to collective investment, especially if workers had the alternative of paying themselves higher current incomes, i.e. the so-called long horizon investment problem stemming from the non-separability of labour from the worker. This is known as the problem of *alienability* (Dow and Putterman 2000, Dow 2003). It is risky for workers to make undiversified investment to their own firm. Hence, wealth inequality constraint – the riskiness of concentrating wealth in a single asset may be an important reason behind the rarity of self-managed firms (Bowles and Gintis 1996b).

Second, workers cannot be indifferent to the allocation of labour time since it is the allocation of themselves (Pagano 2007, 71). Lack of liberty in labour allocation may lead to alienated

labour, and underinvestment in skills. Thereby, de-skilling of workers may decrease worker welfare even if it increases profits of the firm.[14] We capture this fact, formally, in our model by different responses of workers to alternative property rights regimes. In the Marxist literature, for example, labour force is not regarded as a mere factor of production but as a self-conscious class actively opposing and obstructing the extraction of surplus value from it (Elster 1983). Worker does not surrender his capacity to work to capitalist. What worker sells is not a pre-agreed amount of labour but the power to labour over an agreed period of time. In return, the capitalist buys only the potential to do something. The actual outcome depends on non-verifiable aspects of work, e.g. work ethic, as well as managerial capacity. Thereby, workers, in pursuit of autonomy and better work conditions, hide their labour capacities, and employers try to overcome worker resistance by way of monitoring, incentive pay schemas etc. This is why workplace is a *contested terrain* (Bowles and Gintis 1993, Screpanti 2001).

Trade unions assume two roles in these interrelated yet distinct conflicts. First, they bargain on the method of production. Namely, they codify work rules to avoid restrictive labour withholding practices, and transform these benefits from informal methods of self-protection to contractual agreements. Therefore, unions are check on managerial discretion. Second, trade unions are workers' best strategy in the struggle for sharing joint surplus created in the firm (Leijonhufvud 1986, 220).

7. Conclusion

Technological knowledge is central to every economic activity. Yet, technological change does not occur in an institutional vacuum. To put it in another way, technological change only sets the limiting conditions of what is possible. Power relations and property rights play an important role in the evolution of technology, since those who control the resources are able to choose from the available technologies the one most favourable for their interest. By focusing on the interplay between these two forces, we are able to abandon the notion of

[14] According to Pagano (1985), in neoclassical theory workers only have preferences over their consumption decisions. Therefore, the wealth of labor is only affected via consumption. Interestingly, another implication of taking workers' preferences into account may be another reason behind the rarity of self-managed firms. Capitalists are only interested in the maximization of profits; workers may have diversified wants related to the workplace. This may lead to higher costs in reaching an agreement in worker controlled firms, i.e. collective action problem (Hansmann 1996).

production as a natural process, and place it into a framework where the organization of production is seen as a social phenomenon.

As we have seen, the interplay between technology and property rights and the existence of complementarities imply that institutional arrangements across different domains are a coherent whole in which individual domains, e.g. rights or technology, may not easily be altered in isolation. In such an environment the existence and persistence of inefficient organizational equilibrium under competition is possible. In essence, in order to explain the existence of a structure it is neither necessary nor sufficient to show that it is efficient (Hodgson 1996).

Certain institutional arrangements, i.e. capitalist firm, may seem to be the best practice under certain institutional setup, not because other forms are eliminated via competition, but because competition and selection take place with regard to an institutional setup shaped by the incumbent power relations and property rights (Hodgson 1988). Moreover, the same institutional setup may allow incumbent property rights to reproduce themselves and block the proliferation of alternative property rights regimes and associated technologies. In other words, organizational evolution does not necessarily lead to perfection (Hodgson 1996). Hence, it should be depicted not as a linear path leading to perfection, but rather as a branching tree.

Once we quit the technologically determinist explanation, and acknowledge the asymmetry between the so-called factors of production, i.e. capital and labour, we can better identify the social and historical dimension of the production organization. By doing so, for example, we can see the fictitious nature of labour as a commodity (Polanyi 1944). Subsequently, it may help us to better evaluate the problems related to this fictitious commodity, and may open the way to consider workplace democracy and collective bargaining on the side of labour without being trapped by efficiency considerations.

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