

THE COMPETITIVE SELECTION OF DEMOCRATIC FIRMS IN A WORLD
OF SELF-SUSTAINING INSTITUTIONS

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Abstract

The New Institutional economists assume that technology determines property rights, whilst radical economists assume that causality runs in the opposite direction. This paper introduces the concept of “organisational equilibrium” to show how these two approaches can be combined. In such an equilibrium, existing property rights are the most efficient for utilizing the current technique of production. At the same time, this technique is also optimal from the point of view of existing property owners. The paper demonstrates that more than one organisational equilibrium may exist. To shift from one equilibrium to another will require a simultaneous change in both technology and property rights. This is likely to be difficult and may help to explain the persistence of inefficient productive arrangements. The paper concludes by comparing its analysis of multiple organisational equilibria with the biological theory of speciation.

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Introduction

It has been often been claimed that, through the use of a different technology, organisations controlled by their own workers could achieve better results than traditional capitalist firms. The normal counter-argument has been that, if such organisations were superior, they would have already been “selected” by the market economy. In the present paper we examine this issue by exploring the relations between agency costs, property rights and technologies that characterise alternative organisations.

One school of thought argues that, for a given technology, the ownership of a firm goes to the factor that can save the most on agency costs if it owns the organisation. Another school argues that the owning factor chooses a technology which economises on the agency costs arising from the employment of other factors. Thus, one side stresses that technology influences the allocation of property rights, whilst the other stresses that ownership influences the choice of technology. These approaches are often seen as mutually exclusive, but they are not, since causation may flow in both directions at once. To explore this two way causation, we introduce the concept of an “organisation equilibrium”. Such an equilibrium is any combination of property rights and technology which has the following characteristics. With the given property rights, the current technology is the most efficient available; conversely, with this technology, the current property rights are most efficient. In such an equilibrium, property rights and technology have a self-reinforcing character since changing one component at a time damages efficiency, and hence reduces the total income available for distribution between the various parties.

We argue that the “market selection” argument is subject to the following objections. First, the self-reinforcing nature of a given organisational equilibrium inhibits gradual evolution through piecemeal mutations in property rights or technology. If it occurs at all, the transition from one type of organisational equilibrium to another will be abrupt rather than gradual, and hence evolution will have a “punctuated” character. Secondly, the efficiency of each organisational equilibrium is itself dependent on the frequency of other types of organisational equilibrium. The joint consequence of these objections is that, instead of a simple efficiency story based on market “selection”, there will be a process of cumulative causation between property rights and technology which is such that alternative, and potentially more efficient combinations, may never have the chance

to develop. Although enterprise democracy is not “selected” by market competition, it may be a superior system which permits a better cumulative causation between the nature of rights, technology and the quality of human labour.

1. Some Questions on the Nature of Organisations

In recent economic theory the firm is defined as an institution where some agents exercise some governance over other agents. Governance can improve on market transactions when agency costs are high because of the existence of specific or difficult-to-monitor assets.

Three questions arise in this context:

- 1) which factors will control the organisation and will have the power to “design” the production process?
- 2) how will different factors exercise this power?
- 3) will the exercise of this power change the nature of the technology and of the factors employed in the firm?

1) The first question can be answered by observing that if governance arises to save on agency costs, organisations should be controlled by the most specific or difficult-to-monitor factors: they will be able to save the most on the risk-premium due to resource specificity or on the monitoring expenses that would have to be paid if they were employed in other people’s organisations. In other words, these agents should control the organisation so as to economise on the high agency costs which would be incurred if they were employed in organisations owned by others.

2) As to the second question, it can be argued that the exercise of power will change according to the particular factor that controls the organisation. Observe that the factor owning the organisation does not pay for its own agency costs whereas it does pay for the agency costs of the other factors. Thus each type of owner will tend to develop a technology that saves on the agency costs of employing the remaining non-owning factors.

3) Finally, an answer to the third question can be deduced from the argument outlined above. Owning factors have to pay high agency costs in order to employ difficult-to-monitor and specific factors. Thus they will try to replace these factors by easy to monitor or non-specific factors: an attempt will be made to change the nature of the non-owning factors and to make them “easy to monitor” and “general purpose”. This does not happen to the owning factors because no agency cost for their use has to be expended

by the firm. Thus, owning factors choose a technology that tends to make themselves more difficult-to-monitor and specific than would be the case if they did not own the organisation. Ownership biases the nature of the factors: owning factors tend to become more specific and more difficult to monitor (compared to the situation where they do not own the organisation); non-owning factors tend to become less specific and less difficult to monitor (compared to the situation where they do own the organisation).

Observe that the last point concerns something we assumed to be given to answer the first question: we have just argued that owning factors tend to become more specific and difficult to monitor but we also argued that ownership goes to those factors that are more specific and more difficult to monitor. If it is accepted (as we do) that both arguments are correct, then it must also be maintained that property rights and the nature of technology tend to be self-reinforcing: the nature of technology and of resources may have a tendency to re-generate itself via property rights while the latter in turn re-generate themselves via technology. Let us define such a self-sustaining construction as an “organisational equilibrium”. The following new questions then arise:

- 1) Does an organisational equilibrium exist for any pattern of agency costs?
- 2) When do multiple organisational equilibria arise? Are they the exception or the rule? Are there patterns of agency costs that always cause multiple equilibria?
- 3) How do more or less rigid technologies (or different elasticities of substitution among factors) affect the existence and the multiplicity properties of organisational equilibria?
- 4) How stable are organisational equilibria to changes in agency costs due to institutional shocks, changes of the social climate and changes of the “governance technology”?
- 5) Do inefficient organisational equilibria exist? Are they “institutionally stable”? Can we justify economic policies that aim to change organisational equilibria?

In this paper we try to answer these questions. In the following section we define more precisely the concept of organisational equilibrium and we show that it can encompass mechanisms and interpretations that are typical of the New Institutional and the Radical literature. In the third section we outline the assumptions of our model and give a formal definition of organisational equilibrium.

In the fourth section we show that for each pattern of agency costs an

organisational equilibrium always exists. We identify the conditions under which there are capitalists' or workers' unique equilibria and/or multiple equilibria; we show that for any technology there is always a pattern of agency costs for which multiple equilibria exist and that, for each pattern of agency costs, the likelihood of multiple equilibria increases with the elasticity of substitution.

The elasticity of substitution s plays an important role in our argument. We will show that a high s acts like a good "anti-virus": it favours the rejection of the non-owning factors, that, because of the increase in their agency costs, threaten to upset the health of the existing ownership regime. Unfortunately, the "anti-virus" works particularly well with the factors that are the most efficient potential alternative owners. They are efficient potential alternative owners because of the high agency costs that must otherwise be paid when they are employed by other factors. A high s causes an unfortunate "preventive treatment": these factors are promptly replaced by factors that are cheaper for the present owners. In the evolutionary interpretation of our model a high s can also be interpreted as an "anti-speciation" factor: by allowing adaptations of the present species it prevents major mutations that would bring about the emergence of new species of organisational equilibria.

In the fifth and sixth sections we consider the "institutional stability" and efficiency properties of organisational equilibria: we show that, for sufficiently high values of the elasticity of substitution between factors, inefficient but institutionally stable equilibria are likely to exist.

In the seventh section we observe that our analysis can explain institutional diversity and the "fitness" of inefficient organisations; the "complementarities" within property rights and technology within each organisation and those between rights and technology existing among different organisations may prevent "market selection" from achieving efficient organisational outcomes. This offers a possible argument in favour of policies for the extension of democracy to economic life.

Finally, in the concluding section we consider some limitations of our analysis and we indicate some consequences of factor heterogeneity and of the collective action problems.

2. The "Inverted" Arguments of New Institutionalists and Radicals

Consider a traditional capitalist firm organised on strict Tayloristic principles and suppose that a representative Radical economist and a

representative New Institutional economist agree to examine and explain the nature of this firm. They agree that two sets of facts, one concerning the property rights and the other the nature of the technology and of the resources, characterise this firm:

2.1. The rights that the owners of the resources have on the firm

They observe that the owners of capital own the organisation and they have hiring and firing rights. By contrast, workers have no rights in the organisation, they can be fired whenever the employers decide that it is convenient for the firm.

2.2. The technological nature of the resources employed in the firm

Much capital equipment is specific to the firm: many machines appear to be tailored to the production needs of that particular organisation and could not be used in other organisations. Moreover, machines are “difficult-to-monitor”: in the sense that it is not possible to infer their user-induced depreciation by simply observing their physical state before and after they have been used: the use of the machine must be directly monitored if one wants to assess user-induced depreciation. The characteristics of the workers lie at the opposite pole: they perform simple movements at the assembly line that require no firm-specific skills. It is easy for supervisors to monitor the workers who are often also “monitored” by the pace of machines themselves.

Does the consensus on these facts imply some consensus on the theory explaining them? We believe not. Each one of the two economists can claim that the correlation between these two sets of facts is not inconsistent with their own theory about the direction of causation among them.

According to the New Institutional (b) causes (a). The New Institutional Economist maintains that capital controls the organisation because it is a difficult to monitor or a specific factor. Workers lack these rights because they are general or easy to monitor factors. Thus, the nature of the resources employed in the organisation shapes “efficiently” the structure of rights: “efficiency” implies that capital should hire labour, not vice versa.

For, suppose that we change the system of property rights and assume that workers own the organisation and hire the machines. The fact that easy-to-monitor or general labour hires difficult-to-monitor or specific capital increases the agency costs in the form of monitoring or insurance against opportunistic behaviour. For example, firm-specific capital would be rented

to others without rights or safeguards only at a very high price: an insurance premium would need to be paid to cover the risks due to the absence of alternative employment for specific resources. Conversely, the owner-workers would be willing to employ these factors only if their productivity compensates for the risk that it is difficult to replace specific factors. Analogous arguments apply in the case of difficult to monitor capital.

Under some alternative sets of unforeseen circumstances, each factor could be a victim of the opportunism of the other - a circumstance that make very high the transaction costs of employing difficult-to-monitor and/or specific factors. These costs are saved in the "Tayloristic" firm, examined by our two economists. Here, following the New Institutional "predictions", difficult-to-monitor or specific capital does "efficiently" hire easy-to-monitor or general labour.

However, the Radical economist can also claim that the correlation of facts observed in the Tayloristic firm is not inconsistent with his or her theory. Indeed, according to Radical theory, (a) explains and is the cause of (b).

The Radical Economist believes that the argument of the New Institutional Economist can be turned upside down. According to such an economist the workers have become "easy-to-monitor" factors without firm-specific skills because they do not have any rights in the organisation.

This lack of rights implies that the workers do not identify themselves with the goals of the firm. As a result, monitoring workers is very expensive and capitalists have replaced difficult-to-monitor with easy-to-monitor labour. This substitution has occurred also in cases when difficult-to-monitor labour was (net of agency costs) considerably more productive than easy-to-monitor labour.

According to the Radical economist a similar explanation holds also for nature of labour-skills: the development of firm-specific skills is inhibited by the absence of rights and safeguards for these factors; this makes their employment very costly. On the one hand, the workers fear that, in unforeseen circumstances, in case of dismissal they may be lose their firm-specific investment in human capital. On the other hand, the employers fear that, in other unforeseen circumstances, the workers, lacking rights and attachment to the firm, may opportunistically exploit the fact that the specificity of their skills makes it difficult to replace them.

Thus, according to the Radical economist, under capitalist property rights

there is a strong incentive to replace difficult-to-monitor with easy-to-monitor labour and there is a similar incentive to replace specific with “general-purpose” labour. The “substitution effect”, due to “capitalist property rights”, explains the fact that the firm makes such an intensive use of assembly line unskilled worker. These workers repeat simple movements that are easy to monitor and do not require any firm-specific skill - an outcome that is perfectly consistent with the “predictions” of Radical Theory. By contrast, under this system of property rights, capital tends to become relatively difficult-to-monitor and firm-specific because, unlike the workers, no risk premium or monitoring costs have to be expended on this factor.

According to the radical approach the asymmetric information and specificity characteristics cannot be taken as given but should be endogenously explained on the basis of the system of property rights prevailing in the firm.

The Radical and the New Institutional Economist disagree also on the desirability of policies aimed at changing the situation of the firm. According to the New Institutionalist the change will “spontaneously and correctly” come about if technology requires a new set of property rights that minimises transaction costs; policies intending to change rights will be counterproductive and inefficient. By contrast, according to the Radical the existing property rights are shaping the development of the technology in a way that is undesirable: new rights are required to change the type of development which is occurring within the context of the present technological paradigm.

We have constructed our imaginary debate between a New Institutionalist and a Radical economist in such a way that their differences come out very sharply and clearly. But are the Radical and the New Institutionalist theories really incompatible?

We strongly believe that the answer to this question is no. Indeed the main thrust of this paper is that the self-sustaining nature of economic institutions can be properly understood only by unifying these two approaches. The fact that (a) causes (b) and (b) causes (a) are not mutually incompatible; rather, they imply that (a) can reinforce itself via (b) and (b) can reinforce itself via (a). When this occurs, the New Institutional and Radical mechanisms taken together imply that an institution of production such as the Tayloristic firm is self-sustaining. In this case we can say that we are in a situation of “organisational equilibrium”.

Thus an organisational equilibrium is defined by the fact that property rights “re-generate” themselves via technology and technology “re-generates” itself via property rights. An organisational equilibrium is therefore characterised by equilibrium property rights and technologies. We may interpret an organisational equilibrium as a property right or a technological equilibrium according to the nature of the initial shock: a property rights equilibrium is an organisational equilibrium when the initial shock is to the property right system whereas a technological equilibrium is an organisational equilibrium where the initial shock is a technological change such as a new invention.

In many cases it is impossible to identify a single initial shock and we cannot say whether we are in a technological equilibrium or in a property right equilibrium. However, we may still define an institution as an organisational equilibrium as long as we can identify the “New Institutional” and “Radical” mechanisms that make it self-sustaining after its establishment.

In this respect, independently of its historical origins (which may be different in different countries) the “Tayloristic firm”, visited by our two economists, defines an organisational equilibrium: the rights of management and capital on the organisation induce a Tayloristic technology (difficult-to-monitor or specific capital and easy-to-monitor general purpose labour) that can only be cheaply operated under ownership; or, alternatively, the Tayloristic technological specification of resources induces capitalist ownership under which it is optimal to choose a Tayloristic technology.

Our concept of “organisational equilibrium” is related to the Marxian notion of “mode of production” that is also based on a close interaction between property rights (relations of production) and technology (productive forces). This relation, however, is subject to two qualifications:

a) our analysis is related to what Hirschman (1981, p. 89) has aptly defined as “micro-Marxism”. Hirschman observes that Marx “oscillated between the grand generalisation with which to characterise an entire epoch or process and the discriminating analysis of events which made differences between countries and subperiods stand out in richly textured detail”. Our analysis is clearly related to the second approach. For example, we would define as alternative “organisational equilibria”, or modes of production, Fordist-type firms and Japanese-type firms.

b) Marxist analysis has often oscillated between “technological determinism” (technology invariably gives rise to a unique set of property

rights) and “property rights romanticism” (alternative property rights can invariably bring about an alternative technology). We claim that our concept of organisational equilibrium can clarify and overcome the limitations of these two extreme views.

This last point takes us to the threshold of the formal analysis of the next section. A consequence of this analysis is that “technological determinism” is untenable because, for whatever technology, there is always some combination of agency costs such that multiple organisational equilibria are possible. At the same time, we show that “property rights romanticism” is also seriously flawed because the set of agency cost combinations under which multiple property rights equilibria are possible is both bounded and conditioned by the possibilities of “technological substitution” existing in the economy. The analysis of the institutional stability and efficiency have additional consequences for these issues.

3. A Formal Definition of Organisational Equilibrium

The two fundamental assumptions of our model may be traced back to the two fundamental “Radical” and “New Institutionalist” mechanisms that we have considered in the preceding section.

The “Radical” assumption is that capitalists and workers face different costs when they own (and run) the organisation (and are therefore likely to choose different technologies). When workers own the organisation they pay an additional agency cost Z in order to employ a unit of difficult-to-monitor or specific capital K - a cost that is saved when K is employed under capitalist ownership. By contrast when the capitalists own the organisation they pay an additional agency cost H when they employ a unit of difficult-to-monitor or specific labour L - a cost that is saved when L is employed under labour ownership. No such additional costs are paid for easy-to-monitor and general purpose labour and capital k and l when they are employed by either capitalists or workers;. Thus, denoting by r and w the prices of respectively easy-to-monitor and/or general capital and labour and by R and L the prices (net of agency costs) of respectively difficult-to-monitor and/or specific capital and labour, we can formulate our “Radical” assumption as follows:

Assumption 1

Under capitalist ownership firms maximise profits equal to:

$$R^c = Q(k, K, l, L) - [rk + RK + wl + (H+W)L] \quad (1)$$

Under labour ownership firms maximise profits equal to:

$$R^L = Q(k, K, l, L) - [rk + (Z+R)K + wl + WL] \quad (2)$$

The New Institutional assumption is that the firm is owned by that factor which can earn the highest ownership rent. This rent is equal to the difference between the cost of employing the factor in a firm that is property of the owners of the factor and the cost of employing it in a firm that is property of other owners.

Assumption 2

For any given combination of factors employed in the firm, ownership of the firm will be acquired by the factor which can get the highest ownership rent. Therefore: capitalist property rights can prevail if, given the factors currently employed, $R^C \geq R^L$ or, alternatively,

$$ZK - HL \geq 0 \quad (3)$$

workers' property rights can prevail if, given the factors currently employed, $R^L \geq R^C$, or alternatively,

$$HL - ZK \geq 0 \quad (4)$$

Thus "the Radical assumption" concerns the behaviour of the firm for any *given (capitalist or workers') ownership*. By contrast the "New Institutional assumption" concerns the ownership conditions of the firm for any *given combination of factors employed in the firm*. We say that we are in an *organisational equilibrium* when both the Radical and New Institutional assumptions are simultaneously satisfied: in an organisational equilibrium the behaviour of the firm under particular ownership conditions must bring about technologies characterised by factor intensities that do not upset the initial ownership conditions. We can therefore give the following definition of an organisational equilibrium:

Definition 1

An institution of production is an organisational equilibrium when it is defined by a system of property rights P and a technology T such that T is the technology that maximises rent under the property rights system P, and P is the property rights system that maximises ownership rent with the factor intensities associated with T.

In particular, we will be in a capitalist organisational equilibrium when the capitalist rights P^c and the technology T^c are such that:

$$\longrightarrow P^c \longrightarrow T^c \longrightarrow P^c \longrightarrow$$

and we will be in a labour organisational equilibrium when the labour rights P^L and the labour technology T^L are such that:

$$\longrightarrow P^L \longrightarrow T^L \longrightarrow P^L \longrightarrow$$

In other words, there will be a capitalist organisational equilibrium (COE) if there is a technology that maximises (1) and satisfies (3) and there will be a labour organisational equilibrium (LOE) if there is a technology that maximises (2) and satisfies (4). Let:

$$(k^c, K^c, l^c, L^c) = \operatorname{argmax} R^c(k, K, l, L) \quad (5)$$

$$(k^L, K^L, l^L, L^L) = \operatorname{argmax} R^L(k, K, l, L) \quad (6)$$

Then a firm will be in a capitalist organisational equilibrium (COE) if:

$$ZK^c - HL^c \geq 0 \quad (7)$$

and in labour organisational equilibrium (LOE) if:

$$HL^L - ZK^L \geq 0 \quad (8)$$

Condition (7) has an immediate intuitive meaning. Suppose that a firm is under capitalist ownership and the technique of production is such as to maximise profits. Condition (7) implies that, with this technique, the ownership rent occurring to capitalists is at least as great as the rent which workers could obtain if they owned the firm. Hence with this technique of production, the workers would have no incentive to buy out the capitalists. This is what is meant by a capitalist organisational equilibrium. Condition (8) has an analogous intuitive meaning.

It will also be useful to write the conditions for COE and LOE in the following equivalent ways:

$$K^c/L^c \geq H/Z \quad (7')$$

$$K^L/L^L \leq H/Z \quad (8')$$

Conditions (7') and (8') have also an intuitive meaning. Observe that K/L is the ratio of high-agency-cost (H-A-C) capital to H-A-C labour or the H-A-C capital intensity; observe also that H/Z is the agency cost ratio between the capitalist's extra-cost in employing H-A-C labour and labour's extra-cost in employing H-A-C capital. Thus (7') means that a COE is feasible when the intensity of H-A-C-capital is greater than the agency cost ratio and (8') means that a LOE is feasible when the intensity of H-A-C capital is lower than the agency cost ratio. For instance, high agency costs per unit of labour could be compensated by the employment of a great amount of H-A-C capital and make it feasible a COE.

The conditions for the existence of organisational equilibria can also be interpreted as a Nash equilibrium. Organisational equilibria may be defined by the fact that "production managers" choose that technology that maximises profits given the existing property rights system and by the fact that "financiers" arrange property rights that maximise ownership rent given the existing technology. In this sense condition (7) says that capitalist property rights are the best response of "financiers" given the technology chosen by the "production managers". The same condition says also that a H-A-C capital intensive technology is the best response of the "production managers" given the capitalist property rights chosen by the "financiers". Condition (8) has an analogous interpretation¹⁰.

4. Existence and Multiplicity of Organisational Equilibria

We now establish some propositions concerning the conditions under which we have multiple and unique organisational equilibria.

We start by defining by R^0 as the profits of a traditional neo-classical firm where agency costs are equal to zero. Thus:

$$R^0 = Q(k, K, l, L) - [rk + RK + wl + WL] \quad (9)$$

and

$$(k^0, K^0, l^0, L^0) = \operatorname{argmax} R^0(k, K, l, L) \quad (10)$$

Since

$$(H+W)/R \geq W/R \geq W/(Z+R)$$

it follows under standard assumptions about technology that:

$$K^c/L^c \geq K^o/L^o \geq K^L/L^L \quad (11)$$

and therefore:

$$K^c/L^c \geq K^L/L^L \quad (12)$$

The value of H/Z either falls in the interval defined by these two values or outside it. This has the following consequences:

(A) Suppose that H/Z is such that:

$$K^c/L^c \geq H/Z \geq K^L/L^L \quad (13)$$

Then both (7') and (8') are satisfied and we have multiple (capitalist and labour) organisational equilibria.

(B1) Suppose that H/Z is such that:

$$K^c/L^c \geq K^L/L^L > H/Z \quad (14)$$

Then (7') is satisfied but (8') is not satisfied. In this case only a COE exists.

(B2) Suppose that H/Z is such that:

$$H/Z > K^c/L^c \geq K^L/L^L \quad (15)$$

Then (8') is satisfied but (7') is not satisfied. In this case only a LOE exists.

(C) Since the ratio H/Z must necessarily fall in one of the three intervals just considered, for any H/Z ratio at least one organisational equilibrium must always exist.

We can now state the following proposition:

Proposition 1

(A) multiple organisational equilibria exist if the closed interval defined by the H-A-C capital intensities under the two property rights regimes includes the agency cost ratio H/Z

(B1) a unique capitalist equilibrium exists if the agency cost ratio H/Z is smaller than the H-A-C capital intensity with the labour ownership.

(B2) a unique labour equilibrium exists if the agency cost ratio H/Z is greater than the H-A-C capital intensity with capitalist ownership.

(C) for any agency cost ratio H/Z at least one organisational equilibrium exists.

How likely is it that the ratio H/Z falls in a multiple organisational equilibria interval or in one of the two unique organisational equilibria intervals?

Given any exogenous agency costs ratio H/Z the values of the H-A-C capital intensities depend on the shape of the production function and it is impossible to say a priori whether they will define an interval including or excluding H/Z .

We can, however, show that under fairly general assumptions there is always some value of H/Z such that multiple organisational equilibria exist:

Proposition 2

For any “standard” production function and for any set of factor prices (W, W, R, R) , there exists at least one pair (H, Z) of agency costs such that multiple organisational equilibria exist.

Proof. Choose the rate H/Z such that:

$$H/Z = K^0/L^0 \tag{16}$$

It follows from (11) that

$$K^c/L^c \geq H/Z \geq K^L/L^L$$

This is identical to condition (13) for the existence of multiple organisational equilibria.

Thus, under standard assumptions about technology and factor prices, there always exists at least one agency cost ratio for which multiple organisational equilibria exist: multiple organisational equilibria are clearly something more than an intellectual curiosity! Still this does not give us much information about the “size” of the set of agency costs for which multiple organisational equilibria exist. Economic intuition suggests the “rigid” or “malleable” nature of the technology may have a lot to do with the size of this set. The more “malleable” are input ratios, the easier is it for any set of

property rights to adjust input ratios to its own needs. The set of agency costs, for which we have multiple organisational equilibria, should then be fairly wide when the inputs ratios are very “malleable”. By contrast rigid input ratios should limit the ability of property rights to shape the “technology” in such a way that they become self-sustaining institutions. Rigid input ratios should reduce the set of agency costs under which COE and LOE are feasible and therefore diminish the set of agency costs for which multiple equilibria are feasible. Consider the following proposition:

Proposition 3

If the elasticity of substitution is equal to zero, i. e. if K and L are perfect complements, there is only one H/Z agency cost ratio for which multiple equilibria are possible.

Proof. If K and L are perfect complements, then (11) become equalities:

$$K^c/L^c = K^0/L^0 = K^L/L^L \quad (11')$$

From which it follows we have multiple equilibria only when (16) is satisfied, and a unique equilibrium otherwise.

In particular:

$$H/Z < K^0/L^0$$

implies that

$$K^c/L^c = K^L/L^L > H/Z$$

and hence a unique COE.

Conversely

$$H/Z > K^0/L^0$$

implies that

$$H/Z > K^c/L^c = K^L/L^L$$

or a unique LOE.

Thus, in the case of perfect complementarity the set of agency costs for

which multiple equilibria exist shrinks to one single point. We may gain additional intuition on the influence of “malleability of technology” on organisational equilibria by considering the opposite case of perfect substitutability. We concentrate our attention on a particular case - the knife-edge in which both inputs are used when agency costs are zero, and we obtain the following proposition:

Proposition 4

Suppose that $K^0 > 0$ and $L^0 > 0$. If the elasticity of substitution is infinite, i. e. if K and L are perfect substitutes, then any positive combination of agency costs (H, Z) will imply that multiple organisational equilibria exist.

Proof: By assumption $K^0 > 0$ and $L^0 > 0$. Since these factors are perfect substitutes, any deviation in relative user prices (inclusive of agency costs) from the knife-edge situation will imply that one factor or the other is no longer employed. Under capitalist ownership $K^c > 0$ and $L^c = 0$; under labour ownership $K^L = 0$ and $L^L > 0$. These imply that:

$$K^c/L^c = \infty \text{ and } K^L/L^L = 0$$

which in turn imply that any positive combination (H,Z) will always satisfy the following conditions

$$K^c/L^c \geq H/Z \geq K^L/L^L \tag{13}$$

for which multiple equilibria exist.

Denote by σ the elasticity of substitution between K and L. Propositions 3 and 4 show that, for the two extreme values of σ , the relation between technology and organisational equilibria behaves in the way in which our economic intuition suggests. In order to explore this type of relation for other values of σ consider the following definition of “neutral” changes of σ .

Definition 2

A change in the elasticity of substitution of the factors σ is neutral if is accompanied by compensatory changes in other parameters such that the ratio K^0/L^0 remains unchanged at existing factor prices.

It can be shown that the following proposition holds for any CES production function:

Proposition 5

A “neutral” increase in σ strictly enlarges the set of (H,Z) for which:

- (i) a capitalist organisational equilibrium is feasible.
- (ii) a labour organisational equilibrium is feasible.
- (iii) multiple organisational equilibria are feasible.

Proof: see appendix.

The content of proposition 5 is clarified by the following figure (the derivation of which is explained in the appendix)

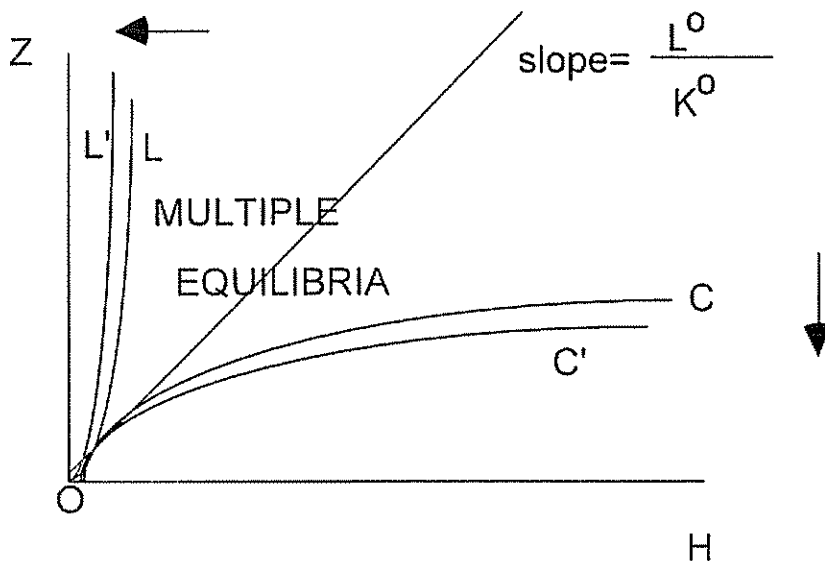


Figure 1.

The pair of (H, Z) for which a COE exists lies above the curve OC . A neutral increase of s has the effect of lowering this curve to OC' and, so, enlarging the set of points for which a COE is feasible. Similarly, the pair of (H, Z) for which a LOE exists lies to the right of the curve OL . A neutral increase in s moves the curve leftwards to OL' , so enlarging the set of points for which a LOE exists. Both movements also have the effect of enlarging the set of points for which multiple organisational equilibria are possible.

We conclude this section by observing that the notion of complete “technological determinism” is not valid because there are always combinations of agency costs for which an arbitrary organisational equilibrium may prevail. Moreover, even in the case of “rigid” technologies there are combinations of agency costs for which multiple property rights equilibria are possible. However, the degree of “rigidity” of technology has an important implications for property rights. The more rigid is the technology the smaller is the set of agency costs for which any given type of property right system can shape the technology in such a way as to become self-sustaining; consequently, the smaller is the set of agency costs for which multiple organisational equilibria exist and the less justified is “property rights romanticism”.

5. Institutional Stability

Agency costs may change for various reasons. An increase in social conflict or an innovation in the monitoring technology can cause changes in agency costs. The agency costs paid for the employment of specific resources can also be subject to shocks: specificity is not a stable natural characteristic of the resources employed in one firm but it is a measure of the difficulty of employing these resources in other organisations. Suppose that we are in a particular organisational equilibrium and agency costs change for one of the reasons that we have just considered. Will this organisational equilibrium be “institutionally stable” in the sense that the agency cost shock will not imply any change in the ownership of the organisation?

We start by observing that “institutional stability” is a matter of degree: institutions can be more or less “stable”. We try to capture this point in the following definition:

Definition 3

The institutional stability of an organisational equilibrium is the probability that an equilibrium is still feasible after a stochastic shock to agency costs.

We now consider the relation between institutional stability and the degree of “malleability” of the technology.

Suppose that agency costs (H, Z) are subject to a proportionate stochastic shock (r_h, r_z) where $r_h, r_z \in [0, \infty)$ and the density function $f(r_h, r_z) > 0$ for values in this range. For a given (H, Z) , let $P^C(H, Z)$ and $P^L(H, Z)$ be the probability that capitalist and property rights equilibria remain feasible following a stochastic shock to agency costs. We can now show the following proposition:

Proposition 6

Any neutral increase in σ will increase the probability that any given organisational equilibrium is stable with respect to a stochastic shock in agency costs.

Proof. Let A^c be the set of (H,Z) for which a COE is feasible at existing factor prices. Suppose $(H,Z) \in A^c$ and there is a stochastic shock (r_h, r_z) to (H,Z) . The new agency costs will be $(r_h H, r_z Z)$. A COE will remain feasible at the new agency costs if:

$$(r_h H, r_z Z) \in A^c.$$

Thus,

$$P^c(H,Z) = \text{Probability} \{(r_h H, r_z Z) \in A^c\}$$

From Proposition 5, for any neutral increase in σ , the set A^c is strictly enlarged. Hence $P^c(H,Z)$ is increased. Analogous arguments apply in the case of a LOE.

Social and technological changes challenge the institutional stability of organisational equilibria through agency costs shocks. Organisational equilibria absorb shocks in the following way. When agency costs change, the owning factors reduce the employment of those non-owning factors whose agency costs have increased and may, therefore, threaten to become owners of the firm; this characteristic of institutional stability is clearly related to the ability to absorb shocks by substitution and it is not surprising that P^c and P^L are increasing functions of σ . A high σ acts like a good “anti-virus”: it favours the rejection of the non-owning factors, that, because of the increase in their agency costs, threaten to upset the health of the existing ownership regime.

6. The (In)Efficiency of Organisational Equilibria

The definition of efficiency in the present context is not free from ambiguities. Some “partial” type of efficiency is built into the definition of organisational equilibria themselves: in each organisational equilibrium property rights are efficient in the sense that they give maximum ownership rent given the structure of the resources employed in the firm and technology is efficient in the sense that it maximises profits, given the ownership structure of the firm.

However, the type of “partial” efficiency considered above may be the cause of “overall” inefficiency. Alternative more efficient owners are such because they are very costly to employ for other owners; however, precisely for this reason it is not efficient for other owners to employ them. Thus, more efficient potential owners may never get employed in such quantities that the agency costs sustained to employ them become greater than the ownership rent of the present proprietors. Thus the “partial” efficiency, built into the present organisational equilibrium may prevent the achievement of “overall” efficiency which requires a change of organisational equilibrium. Observe that this inefficiency is linked to factor substitution: the most efficient potential owners are substituted for by the least efficient potential owners because, *ceteris paribus*, the latter are cheaper than the former when they do not own the firm.

In order to make these points more clear let us define what we mean by the (overall) efficiency of an organisational equilibrium. In the present context efficiency can only refer to “second best” situations because the existence of agency costs makes it impossible to achieve any first best solution. Moreover, the “agency costs” per unit of factor, which are assumed to be given in our model, should be endogenously determined in order to state general efficiency criteria. Although we are aware of these problems, we suggest two possible definitions of the (overall) efficiency of organisational equilibria.

The first definition is very simple. We can consider profits (as defined in assumption 1) as an index of efficiency. When factor prices express genuine social scarcities, there is much to be said in favour of this criterion of efficiency that may be summarised as follows:

Definition 4

A capitalist (labour) organisational equilibrium is said to be efficient if R^C is greater (smaller) than R^L .

If factor prices do not represent social opportunity costs we can use a more restrictive definition of efficiency that is based only on direct agency costs and say that overall efficiency involves minimum direct agency costs.

Definition 5

A capitalist (labour) organisational is efficient when ZK^L is greater (smaller) than HL^C .

According to both definitions, except for the particular cases in which $R^c = R^L$ or $ZK^L = HL^c$, the existence of multiple organisational equilibria implies the existence of an inefficient equilibrium. The fact that an organisational equilibrium may be inefficient means that the self-reinforcing characteristics of an institution may hold in spite of its inefficiency. We have already observed that this self-sustaining mechanism works by substituting potential efficient alternative owners (that can only be employed at high agency costs) for cheap factors (that cannot be efficient owners). Inefficiency is therefore related to the malleability of the technology. This same point may also be made by observing that inefficiency is necessarily linked to the existence of multiple equilibria and that the size of the set of agency costs for which multiple equilibria arise increases when the elasticity of substitution increases. Thus an increase of s increases the size of the set of (H,Z) for which inefficient organisational equilibria exist. We may summarise the argument considered above in the following proposition:

Proposition 7

Suppose that $R^c \neq R^L$ and $ZK^L \neq HL^c$. A neutral increase in s will strictly enlarge the set of (H,Z) for which inefficient organisational equilibria exist.

Proof: Under the conditions assumed here multiple organisational equilibria necessarily imply the existence of one inefficient equilibrium. Proposition 7 follows from proposition 5 according to which a neutral increase in σ strictly enlarges the set of (H,Z) for which multiple organisational equilibria exist.

Thus, when σ is sufficiently large there will be a fairly large set of agency costs for which inefficient equilibria exist.

Using the terminology used in definition 1, denote by (P^c, T^c) the property rights and the technology that characterise a capitalist organisational equilibrium and by (P^L, T^L) the property rights and the technology defining a labour organisation equilibrium. Moreover define by (P^c, T^L) and (P^L, T^c) the two “hybrids” obtained by mixing together the technology and the property rights of each one of the two organisational equilibria. Recall that in an organisational equilibrium the technology is optimal given the property rights and vice versa. Then, when multiple equilibria exist, efficiency will rank organisational equilibria and “hybrids” in one of the following ways:

$$(P^c, T^c) \geq (P^L, T^L) \geq (P^c, T^L), (P^L, T^c)$$

$$(P^c, T^c) \geq (P^L, T^L) \geq (P^L, T^c), (P^c, T^L)$$

$$(P^L, T^L) \geq (P^c, T^c) \geq (P^c, T^L), (P^L, T^c)$$

$$(P^L, T^L) \geq (P^c, T^c) \geq (P^L, T^c), (P^c, T^L)$$

or, in other words, organisational equilibria can be inefficient in the sense that they may be inferior to another organisational equilibrium but they are always superior to hybrids.

In the following section we are going to show that the inferiority of hybrids implies that competition may fail to help the generation and the selection of efficient organisational equilibria.

7. The Selection of Organisational Equilibria

Because of the inferiority of hybrids, organisational equilibria cannot easily evolve into superior organisational arrangements by changing gradually, one at a time, technology or property rights. The emergence of different organisational equilibria is likely to follow a pattern that is closer to the theory of “punctuated equilibria” discussed by Eldredge and Gould (1972) with reference to the evolution of new species than to any “gradualist” conception of speciation.¹¹

The analogy between the emergence of new organisational equilibria and speciation is appropriate because the emergence of new organisational equilibria must satisfy one of the typical aspects of speciation: the inferiority of the “hybrids”.¹² For instance, as in the case of natural species, any hybrid combination of property rights and technology drawn from different types of organisational equilibria, is inferior to the pure equilibria (capitalist or labour) from which its components derive.

In the case of organisational equilibria, as in the case of natural species, each part of the whole tends to become optimal given the nature of the other parts. For this reason, a substantially better arrangement cannot be approached by individual, gradual modifications. It requires simultaneous, complementary modifications. Because of the “complementarities”¹³ that are necessary for a successful change, such changes may be exceedingly uncommon and so, like species, organisations may be characterised by long periods of stasis punctuated by relatively short periods of intense

change. If we pursue the biological analogy, the elasticity of substitution s in our model may be interpreted as a measure of the degree of flexibility of the present “species” of organisations: a greater s facilitates minor mutations which are compatible with the present “gene pool” and thereby helps this species of organisation to adapt to variations in the economic environment.¹⁴ In other words, a high s can also be interpreted as a good “anti-speciation factor”.

When the pressure of the competition is strong, the inferiority of hybrids makes it difficult to change, one by one, the characteristics of each species are, for the same reason, those of organisations. Therefore, like the evolution of natural species, the history of organisation is likely to be “punctuated” by sudden complementary changes followed by a relatively short period of one-by-one adjustments and, after that, by long periods of stasis. Although many economists argue that the contrary is true, the biological analogy shows that the speciation of more efficient organisations may be made more difficult by a strong competitive pressure. In evolutionary biology, the force of competition favours the optimal adaptation of a given species but it may also inhibit the type of “macromutations” that are necessary to the formation of a different and potentially viable species.

The “punctuated” nature of evolution may help to explain some features of real life institutions and some of the obstacles to organisational change. There is a wide diversity in the institutions of production across the developed capitalist economies. This diversity may be explained by the different major institutional shocks that have characterised their history.

A major institutional shock, affecting the basic ownership and control rights, implies that, for some time at least, it is impossible to go back to the old institutions. This creates conditions analogous to those required for “allopatric” speciation in biology - where some physical barrier prevents interbreeding between two geographically separated populations. In the economic case, a major institutional shock prevents technology “interbreeding” with the old property rights, and may allow a new technology to evolve which is such that the new property rights and the new technology are mutually re-inforcing in the sense we have defined in this paper. This new organisational equilibrium may be more efficient than the old and capable of competing without continuing protection¹⁵.

If the shock is “weak” it is possible to go back soon to the old institutions and, according to the theory of organisational equilibria, this is very likely to happen: the technology inherited by the new institutions has been chosen

under the old institutions and can be better operated under them. By contrast, if the institutional shock is sufficiently strong, a new technology that maximises the surplus under new institutions is likely to be developed, and with this new technology it will be optimal to stick to the rights defined by the new institutions. For example, the institutional shocks caused by the American occupation may provide an important explanation for the different kind of “organisational equilibrium” that characterises Japanese firms where the specificity of labour, its difficult-to-monitor nature, and the strong job rights held by the workers seem to reinforce each other¹⁶.

The nature of organisation equilibria may offer a possible argument for the extension of democracy to economic life. Authoritarian institutions, where the owners of capital and a few managers control an organisation, may in principle be institutionally stable even when they are inefficient. Under these conditions, economic democracy and workers rights will be more efficient on purely economic grounds. However, the self-sustaining nature of capitalist institutions may block the establishment of this alternative organisational equilibrium: whenever technological substitution is possible, those workers, who would be the most efficient alternative owners, are replaced by other factors which cost less under traditional capitalist property rights.¹⁷

These reasons may justify an active policy in favour of economic democracy. They also imply that such a policy will meet considerable obstacles; indeed, it can only succeed if it breaks the self-sustaining interplay between property rights and technology. Action only on property rights is likely to fail: the new democratic property rights may look useless and empty if they are not supported by a technology where workers exercise skills that require those rights; without the support of the associated technology the new rights will fade away and will be eventually re-acquired by the owners of those factors which value them most. Likewise, action only on technology is also likely to fail: the skills necessary for the exercise of this technology will never be developed without the existence of democratic property rights under which these skills can be utilised and cultivated without fear.

There is some truth in the claim that, *if a more efficient organisational equilibrium happens to exist*, market selection, as well as imitation, should favour the diffusion of this equilibrium. However, as in many evolutionary processes, the efficiency of a particular organisational equilibrium may, in turn, depend on its own frequency.¹⁸ The more efficient organisations are such only in the sense that they are more profitable when their number is not (much) smaller than that of the other organisations. In these cases,

if the less efficient organisations happens to be more numerous than the more efficient organisations, then the former may prevail against the latter: market competition may end up selecting inefficient organisational equilibria.

Frequency dependent organisational equilibria, that are inefficient, are likely to arise whenever there are strong network externalities among firms. In our context network, externalities may either arise among the technological standards or among the ownership systems of the organisations. The case of technology has attracted considerable attention.¹⁹ For instance, it may be argued that network externalities can arise from the fact that imitating one particular technology involving a certain combination of inputs is cheaper than trying to develop and learn a new one; we may also observe that network externalities can also arise from the fact that common inputs, produced under a regime of economies of scale, may be used by all the firms operating under a certain property rights system.

However, the case of network externalities among ownership systems is equally important: it is far cheaper to set up organisations according to established property rights, used by other firms, than according to a new system of rights; moreover, for all the firms using the same property right system, legislation is a common input that is also produced under a system of pronounced economies of scale: the same type of legislation may be used by many firms without being destroyed.²⁰

The nature of organisational equilibria implies that the network externalities that characterise property rights and technology may reinforce each other: the need to standardise technology may cause the “homogenisation” of property rights and the need to homogenise property rights may cause the “standardisation” of technology. The uniform path taken by technological development may also be due to the homogeneity of the existing “ownership standards”; at the same time, the uniform path taken by legislation and by the other institutions that favour a certain ownership system may also be due to the homogeneity of the existing “technological standards”. Changing the property rights and the technology that are the outcome of this “homogenisation” process may not be convenient for each individual agent; however, in some cases, if the costs of co-ordinating actions could be reduced, many agents could benefit from the change.

Institutional diversity and the survival and fitness of inefficient organisations are strictly related to the nature of organisational equilibria: mutations that improve efficiency are difficult and path dependent;

moreover the environment that should select the efficient mutations is not neutral because its characteristics depend on the number and the character of these mutations. The “complementarities” existing within each organisational equilibrium may easily prevent the emergence of a better organisational outcome; economic policies that deal with these “complementaries” may in principle, achieve this result.

Conclusion

We are aware of the fact that, while our analysis of organisational equilibria may answer the “market selection” argument against enterprise democracy, it does not show that policies favouring this organisation are necessarily desirable. Our analysis is perfectly symmetrical. Even where the market does select worker-controlled organisations, it is still theoretically possible that capitalist firms could provide a better organisational arrangement.

Although our model refers explicitly to capital and labour, the analysis is more general and could, in principle, refer to any pair of distinct factors such as two different types of workers or owner of different types of capital.

From a certain point of view this “generality” is an advantage of our model: it may allow extensions of our approach to other factors. We believe that the concept of organisational equilibrium might be usefully applied to the labour market to study the relation between technology and the rights of insiders and outsiders. Likewise the same model could be used to study the relation between the financial structure of the firm and its technology. In both cases we should expect to observe the same kind of self-reinforcing relations between rights and technology.

One weakness of our model is its neglect of collective action problems. These problems are by no means symmetrical for capital and labour. In the case of capital, the collective action problem can in principle be solved by concentrating the ownership of physical capital in few hands. At the same time, the nature of capital also implies that its ownership can be highly dispersed - an outcome that aggravates the collective action problem but allows risk sharing and encourages investments.

In both respects the situation is different for workers. In modern society, each worker owns his or her own body and cannot sell their labour power permanently to another, as would be the case in a slave society. This prevents the permanent concentration of labour power in a few hands. At the same time, for the same reason, the nature of labour power also implies that its ownership cannot be very dispersed: individuals cannot own more

or less than themselves - a point that may limit the aggravation of the collective action problem but may make it more complex to organise forms of risk sharing than encourage investments in human capital.

We may conclude by suggesting that the study of the asymmetric nature of labour and capital - and the different collective action problems that they imply - would greatly improve the analysis of the self-reinforcing relations between rights and technology that we have considered in this paper.

Notes

1. Both New Institutional and Radical theories are so complex and developed that it is very difficult to make any clear-cut division between them. No economist will completely identify himself/herself with the ideal types considered above. However, we believe these ideal types to be fair representations of these alternative view points.
2. The concept of “difficult to monitor capital” is due to Alchian and Demsetz (1972). If the owners of the firm own the capital employed in the organization, then they have an incentive to take care of their capital. When user induced depreciation is difficult to monitor, the possibility of careless use makes the rental of “difficult to monitor capital” more expensive than its ownership. (Alchian and Demsetz 1972). A possible objection to this argument is that, instead of renting machines, the workers may borrow money, buy the machines and use them as collateral. Still, this objection can be answered by observing that difficult-to-monitor machines are less valuable as collateral than easy-to-monitor machines because it is more difficult to liquidate them in case of bankruptcy. In both cases it will be more expensive to rent difficult-to-monitor capital than easy-to-monitor capital. An analogous argument applies for firm-specific machines. Of course, labour can be “difficult to monitor” in many other different and more complex ways.
3. The New Institutional school stems from Coase (1937), (1960). It includes the contributions of Alchian (1987), Alchian and Demsetz (1972a) and (1972b), Jensen and Meckling (1976), Demsetz (1966), North (1981), and Williamson (1985). They see the firm and the property rights structure of the firm as an efficient answer to the cost of using the market mechanism. From this point of view also Grossman and Hart (1986), Hart and Moore (1990) can be considered part of this school even if, from other points of view there are very relevant differences (Basile, Casavola 1994). Useful readers are Putterman (1986) (that includes also “radical” contributions) and Williamson and Winter (1991). The relation between the modern

transaction cost approach and earlier approaches based on the disequilibrium costs of the market mechanism is considered in Pagano (1992a).

4. Radical contributions start with Braverman (1974) and Marglin (1974) and Rowthorn (1974). They include Bowles (1985), Bowles and Gintis (1986), Edwards (1979), Pagano (1985) and Putterman (1982). They emphasise that property rights and power relations shape technology and the organisation of labour.
5. The concepts of organisational equilibria and property rights equilibria are developed in Pagano (1991b) (1992b) and (1993).
6. Rowthorn (1974) argues that what is missing in both Neo-classical and Neo-Ricardian economics is the concept of “mode of production”.
7. Such a definition of “micro-Marxism” does not necessarily have a “left-wing” political connotation. It could include Demsetz (1966) contribution and many other so called “right-wing” analyses. The fact is that when we come to “theories of history” “there is so little in the way of an alternative vision which is available” (Hicks 1969 p. 3).
8. Marx contains both types of elements and is not often able to find the right balance between them. Marxists have given different importance to the “primacy” of the productive forces or to the influence of property rights on technology. For instance Cohen (1978) defends this “primacy” whereas Brenner (1986) criticises it. Roemer (1988) offers an useful survey of both. Observe that both New Institutionalists and Radicals could claim that Marx is one of their predecessors.
9. We concentrate our attention on a model with two types of capital and labour. Likewise we consider only the extreme cases of pure capitalist and pure labour ownership. This is done for analytical

simplicity. Observe that the symbols could stand for different factors: this allows alternative interpretations of the model that could be used to study the outsider-insider problem in labour market or the relation between financial and industrial capital.

10. Thus the concept of organisational equilibria is based on the assumption that “financiers” have perfect knowledge of the value of the company for alternative owners using the existing technology but they are ignorant of the value of the company under alternative technologies. This informational structure is based on the idea that technology is not a “menu” that is available for free to everybody but has to be created, developed and transmitted at certain costs in a given institutional framework, characterised by certain property rights. When certain property rights are missing, much of the knowledge about the associated “optimal” technology is also likely to be missing. Our point is consistent with the idea that it is very unlikely that an isoquant, describing all the production techniques, can ever be “produced” and be known to all the agents. The techniques, that are currently used, are likely to determine the “piece” of the “new” isoquant that is “produced”. Property rights act similarly to factor prices and, indeed, affect these prices (when they include also agency costs). In this way, they influence the choice of the current technique and the set of new techniques that are going to be “produced”. On the “path dependency” characteristics of technological development see David (1975, 1994), Nelson and Winter (1982), Dosi (1988), and Inkster (1991).
11. For a stimulating analysis of the analogies between economics and evolutionary biology see Hodgson (1993).
12. On the role of the inferiority of hybrids, see Ridley (1993, p. 412). We can defend this analogy with the following words used by Gould in defence of his own analogy between the QWERTY system and the evolution of the panda’s thumb: “My main point, in other words, is not that typewriters are like biological evolution (for such an argument would fall right into the nonsense of false analogy), but

that both keyboards and the panda's thumb, as products of history, must be subject to some regularities governing the nature of temporal connections. As scientists, we must believe that general principles underlie structurally related systems that proceed by different overt rules. The proper unity lies not in the false applications of these overt rules (like natural selection) to alien domains (like technological change) but in seeking the more general rules of structure and change themselves" (Gould, 1992).

13. On the concept of complementarities see Milgrom and Roberts (1992), p.108.
14. In other words, only technologies-genes that are compatible with the present team of genes are likely to be selected by a process of gradual evolution. "It is the "team" that evolves. Other teams might have done the job just as well, or even better. But once one team has started to dominate the gene pool of a species it thereby has an automatic advantage. It is difficult for a minority team to break in, even a minority team which would, in the end, have done the job more efficiently, The majority team has an automatic resistance to being displaced, simple by virtue of being the majority. This doesn't mean that the majority team can never be displaced. If it couldn't, evolution would grind to a halt. But it does mean that there is a kind of built-in inertia." (Dawkins, 1988).
15. In biology, the inferiority of hybrids implies that a gradual process, whereby only one mutation occurs at a time, is inhibited by competition from the existing species. Even if complementary mutations do occur simultaneously, there will at first be few members of the new species, and the old species will still be numerically preponderant. This implies that members of the new species will mostly mate with members of the old species, producing hybrids that are inferior to both species. Thus, in spite of the fitness of the new species, it may be eliminated through interbreeding with the more numerous old species. In the case of allopatric speciation, such interbreeding is prevented by geographical isolation of the new

species. Shielded from competition by a physical barrier, the new species may evolve to the point where it will no longer interbreed on a significant scale with the old species, even if the barrier is removed and the two populations are re-united.

16. See the concluding section of Pagano (1993)
17. In the model considered in this paper we have concentrated our attention on the extreme cases of complete “capitalist” and “labour” ownership. This has only been done for reasons of analytical simplicity. Intermediate forms of ownership such as the labour-capital partnerships advocated by James Meade (1972) and (1993) may be a more appropriate alternative when both some high-agency-cost capital and labour must both be employed. However, we claim that the self-sustaining nature of property rights and technology also holds for these more complex cases. The same argument applies for job rights and other workers rights.
18. For instance, according to Darwin more numerous species would not only show greater fitness because they were less liable to accidental extermination but also because “these from existing in greater numbers will, in the aggregate, present more variation, and thus be further improved through natural selection and gain further improved through natural selection and gain further advantages.” (Darwin 1986, p.211).
19. See Arthur (1989) and Agliardi (1991).
20. For instance, consider the case of the legislation on limited liability and its importance for the case of joint stock companies. Leijonhufvud (1986) considers the importance of the creation of these institutions to make capitalist overcome asset-specificity problems. Rowthorn (1988) and Pagano (1991a) point out the relative underdevelopment of corresponding labour institutions.

APPENDIX.

Proof of Proposition 5

Suppose the elasticity of substitution between all variables is constant in the production function:

$$y = F(x_1, x_2, \dots, x_n) \quad (A1)$$

Let

(p_1, \dots, p_n) be the vector of prices and suppose all factors receive their marginal products. Then it can be shown that for all i, j :

$$(x_i/x_j) = (p_j/p_i)^\sigma (a_j/a_i)^\sigma \quad (A2)$$

for some constants (a_1, \dots, a_n) and s is the constant elasticity of substitution. The above formula applies whether there are constant or variable returns to scale.

In the present case, our production function is $y = Q(k, l, K, L)$.

In the no-agency cost case, factor prices are (R, r, W, w) . Hence in equilibrium:

$$K^0/L^0 = (W/R)^\sigma (a_k/a_L)^\sigma \quad (A3)$$

Under capitalist property rights, factor prices are $(R, R, W, H+W)$. Hence in equilibrium:

$$K^c/L^c = (1+H/W)^\sigma (W/R)^\sigma (a_k/a_L)^\sigma = (1+H/W)^\sigma (K^0/L^0) \quad (A4)$$

For $K^0 > 0, L^0 > 0$ this implies that $K^c/L^c > K^0/L^0$.

With workers property rights factor prices are $(R, Z+R, W, W)$. Hence in equilibrium:

$$K^L/L^L = [1/(1+Z/R)^\sigma] (W/R)^\sigma (a_k/a_L)^\sigma = [1/(1+Z/R)^\sigma] (K^0/L^0) \quad (A5)$$

For $K^0 > 0, L^0 > 0$ this implies $K^L/L^L < K^0/L^0$.

Thus, for $H, Z > 0$ the following strict inequalities hold for any CES production function:

$$K^c/L^c > K^o/L^o > K^L/L^L \quad (A6)$$

The condition for capitalist organisational equilibrium (COE) is:

$$ZK^c - HL^c \geq 0$$

or:

$$Z \geq H (L^c/K^c)$$

In the CES case this condition is equivalent to:

$$Z \geq Z^c$$

where from (A4):

$$Z^c = [H / (1+H/W)^\sigma] (L^o/K^o) \quad (A7)$$

An analogous condition holds for labour organisational equilibrium (LOE).

We now investigate the conditions under which each type of equilibrium holds separately and, in particular, the conditions for a capitalist organisational equilibrium.

Differentiating Z^c with respect to H we find after manipulation that:

$$\partial Z^c / \partial H = (L^o / K^o) [(1 + (H/W))^{-(\sigma+1)} [1 + (1 - \sigma) (H/W)]] \quad (A8)$$

For a sufficiently small H the expression (A8) is approximately equal to L^o / K^o

Differentiating again:

$$\partial^2 Z^c / \partial^2 H = \{(-\sigma) / [W(1 + H/W) (\sigma+2)]\} [2 + (1 - \sigma) (H/W)] (L^o / K^o) \quad (A9)$$

For H small and $s > 0$ we have: $\partial^2 Z^c / \partial^2 H < 0$.

Thus the range of Z for which a COE is possible lies above a frontier of the type shown in Figure 2:

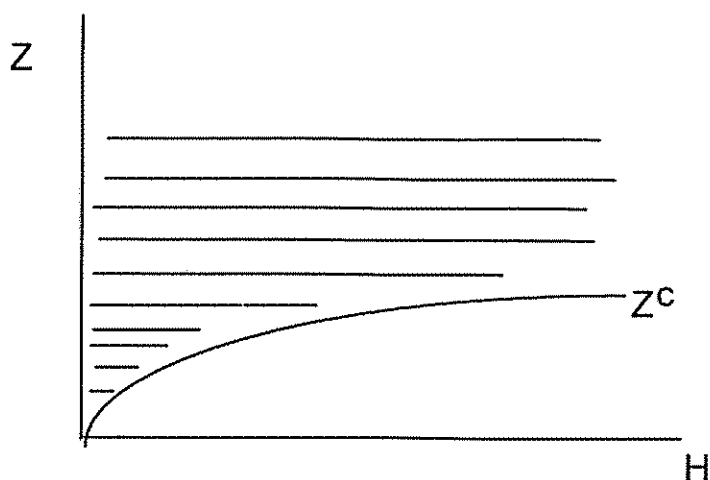


Figure 2.

Above Z^c : values of Z for which COE is possible.

Now consider the effect of “neutral” change in s . Recall that a change in s is said to be neutral if it is accompanied by changes in parameters (i. e. the ratio ak/aL) such that the ratio K_0/L_0 remain unchanged at existing factor prices.

To see the effect of a neutral increase in s write (A7) in logarithm form:

$$\log Z_c = \log H - s \log [1+(H/W)] + \log (L_0/K_0)$$

Holding H constant and differentiating with respect to s (remember (L_0/K_0) is constant):

$$(1/Z_c) (\partial Z_c / \partial s) = - \log [1+(H/W)]$$

Hence:

$$\partial Z_c / \partial s = - Z_c \log [1+(H/W)]$$

which implies that $\partial Z_c / \partial s < 0$.

Thus for any given value of H , a larger s implies a smaller value of Z_c . Diagrammatically this means the frontiers shifts downwards from Z_c to Z_c'' , as in figure 4:

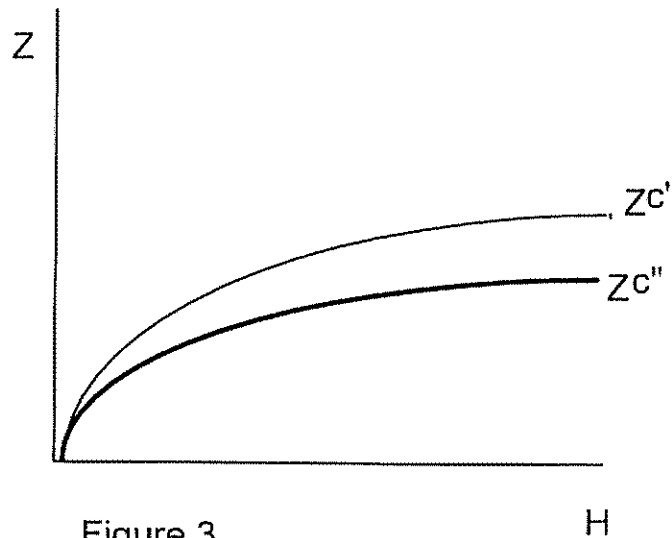


Figure 3

Thus for any neutral increase in s , the range for which a COE is possible expands.

By symmetry it follows that for any neutral increase in s , the range of H, Z for which a LOE is possible also expands.

Multiple equilibria occur for (H, Z) in the intersection of the two sets (see Figure 4).

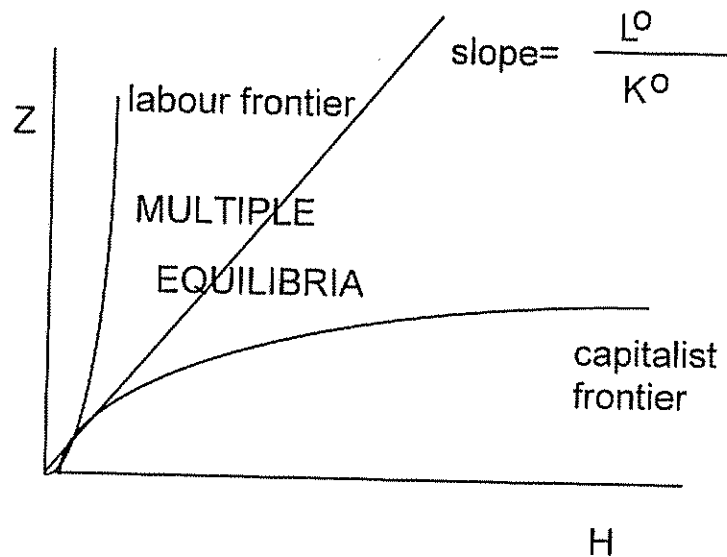


Figure 4.

The effect of a neutral increase in s (as shown Figure 1 in the text) is to enlarge the set of points in the intersection. This increases the range over which multiple organisational equilibria are possible. Q. E. D.

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