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Interlocking complementarities and institutional change

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Abstract: In biology, the laws that regulate the structuring and change of complex organisms, characterised by interlocking complementarities, are different from those that shape the evolution of simple organisms. Only the latter share mechanisms of competitive selection of the fittest analogous to those envisaged by the standard neoclassical model in economics. The biological counterparts of protectionism, subsidies and conflicts enable complex organisms to exit from long periods of stasis and to increase their capacity to adapt efficiently to the environment. Because of their interlocking complementarities, most institutions share the laws governing the structure and change of complex organisms. We concentrate on the complementarities between technology and property rights and consider historical cases in which organisational stasis has been overcome by mechanisms different from (and sometimes acting in spite of) competitive pressure. The evolution of institutions cannot be taken for granted; but even when institutions seem frozen forever by their interlocking complementarities, their potential for change can be discovered by analysis of those interactions.

1. Introduction

Exchanges of analogies between economics and evolutionary biology are hardly surprising. In both the natural and the social world, competitive struggles have an important role and the analytical tools developed in one area can help our understanding in the other field of inquiry.

However, these analogies can be misleading. For instance, as Winter[1] has observed, biological analogies have often been used to justify the efficiency claims

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1 'Under competitive conditions a business firm must maximise profit if it is to survive – or so it is often claimed. This purported analogue of biological natural selection has had substantial influence in economic thinking, and the proposition remains influential today. In general, its role has been to serve as informal auxiliary defence, or crutch, for standard theoretical approaches based on optimisation and equilibrium.' (Winter, 1987: 545).

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of neoclassical economics: similarly to selfish genes, only the fittest efficient institutions would survive. Among some social scientists, these types of analogies have discredited the application of the evolutionary approach to the analysis of institutional change: its complexity is clearly at odds with a simplistic version of the Darwinian theory.

In this paper we take a different view. Complexity is an important issue in both the natural and the social realms. Also in the case of complex organisms, the simplistic version of the Darwinian theory fails and, unsurprisingly, suggests misleading analogies with complex human institutions. For complex organisms, natural selection can have an 'inefficient' stabilising role and can freeze the genotypes of natural species that are not adapting to a changing environment. In this case, forms of 'protectionism' (due to geographical barriers) and 'subsidies' (coming from different forms of selection such as sexual selection) can favour changes. Fruitful analogies must take into account the interlocking complementarities which characterise both complex organisms and complex institutions.

North pointed out in his Nobel Prize lecture:

> Institutions are the humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions, self-imposed codes of conduct) and their enforcement characteristics. Together they define the incentive structure of societies and specifically economies (North, 1993).

However, *humanly devised* should not be confused with *consciously created*. At the dawn of human history we were primates that followed fairly stable rules that did not change greatly through time or among geographical locations. Only at a certain stage of human history did social rules of behaviour begin to be mainly culturally transmitted and to evolve along different paths. Only in this sense were they *humanly devised* (even, in most cases, *non-consciously created*). At that point, according to North's definition, they became institutions. However, the starting point of this evolutionary process was not devised by the human species. As in the case of other species, human nature evolved through a process of natural selection, and it continues to set limits on and provide opportunities for our evolution. Even if human natural constraints have become much looser than those existing for all the other species, they still empower and restrict our evolutionary possibilities.[2] The relationship between the evolution of institutions and the evolution of human nature goes well beyond their analogies and makes it impossible to erect a Berlin Wall between biology and social sciences (Hodgson, 2004).

2 In a limited number of cases, our genetic heritage can co-evolve with cultures. However, even if human nature has a certain degree of flexibility, it still sets limits to the possible cultural and institutional evolutionary paths. In this case, the epistatic interactions, which characterise the relationship among a certain number of genes in complex organisms, have an analogous, formally equivalent, counterpart in the gene-cultural-traits relations (Feldman and Cavalli Sforza, 1984). As Francisco Ciarrapico has pointed out to me, since co-evolution occurs also when there are symbiotic relations among different organisms, symbiosis (instead of epistasis) could offer an alternative route for the arguments developed in this paper.

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More importantly, in both the natural and social domains, evolutionary change is constrained by the degree of complexity of the evolving units. The constraints are different but they are ever present. Simple units are flexible and can easily mutate, but simplicity itself constrains evolutionary possibilities. Complexity has evolutionary advantages because more complex organisms and organisations can do more things and achieve fitter outcomes. However, this comes at the cost of increased evolutionary rigidity. Most of the patterns and features of a complex natural or social body must be adjusted to each other. Once this adjustment has been made, evolutionary change becomes very difficult, and it is usually blocked by natural selection. Its pressure eliminates those hybrid combinations whose evolutionary fitness would require other complementary evolutionary changes. Thus, long periods of stasis characterise complex evolutionary units. For both complex natural and social organisms, an interesting question is under what conditions major rearrangements of their interlocking characteristics are feasible.

The following section of this paper considers how, for complex organisms in the realm of biology, there are mechanisms analogous to protectionism and subsidies which play an important role in major evolutionary changes. The third section extends the argument to the realm of social evolution and, in particular, to changes in the modes of organising production. The fourth and fifth sections consider the role performed by protectionism from pre-existing institutions and political subsidies for new institutions. Each of these sections focuses on a particular historical case and on a particular analogy with the evolution of complex organisms. The fourth section considers the comparative failure of Britain to mutate its organisational form into managerial capitalism at the time of the second industrial revolution: institutional change took place in countries where the new species of capitalism was less exposed to the competition of the species which had emerged from the first industrial revolution. The fifth section considers the comparative success of Japan in achieving major institutional mutations in the period following the Second World War: the political process, which characterised the American occupation, offered an unintended subsidy to the emergence of the new variety of Japanese capitalism. The concluding section argues that it is fruitful to use analogies when they fit the characteristics of the objects of our inquiry or, in a single word, their ontology.

2. Protectionism and subsidies in evolutionary biology

In her book *The Ant and the Peacock*, Helena Cronin observes:

> The two fundamental problems that Darwin's theory was designed to solve were adaptation and diversity. The riddle of adaptation he solved superbly. As for diversity, on certain aspects he was equally successful. The patterns of geographical distribution, the fossil record, the taxonomic hierarchy, and comparative embryology all fell into place under his incisive analysis. But in the mist of such success, there was one problem that remained just outside his

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> grasp. It was poignantly the problem of the origin of species (Cronin, 1991: 430).

Chapter nine of Darwin's (1859) *Origin of Species* was 'On the Imperfection of the Geological Record'. Ever since Darwin, this 'imperfection' has been used to reconcile the missing steps in phylogeny with the gradual nature of the adaptation predicted by the Darwinian theory. The fundamental riddle in the Darwinian theory seemed to be that evolution should be continuous and related to the intensity of natural selection. Unlike the smooth changes of simple bacteria evolving in a laboratory, fossils of complex organisms provided increasingly compelling evidence of long periods of stasis and phases of rapid evolutionary change. In the case of complex organisms, missing evolutionary links seemed to pose a major problem for Darwinian theory.

However, recent research has shown that, for complex organisms, the puzzle may have been rather different and, indeed, of almost opposite nature. Even when 'complementary' mutations could improve the fitness of the genotype, the epistatic interactions among the gene loci imply that the genotype is characterised by a built-in inertia.[3] If the blind nature of evolution involves a succession of single mutations, natural selection would eliminate those genotypes that undergo only one of the complementary changes required for the adaptation of the species.

If natural selection has operated for a sufficient length of time, each evolutionary unit is likely to be optimally adjusted to the other complementary units. In these conditions, single mutations are likely to be less fit and be eliminated by 'normalising' selection. Natural selection would stabilise the species and keep it at a 'local' fitness peak (even when higher peaks exist). Because of epistatic interactions (or, in the economist's language, complementarities), long periods of stasis may characterise the evolution of complex organisms.

In the case of complex organisms, what must be explained is how the stabilising force of natural selection can be, eventually, overcome. There are two main routes through which major evolutionary change may take place. The first route is *allopatric speciation*, which is analogous to a form of unintended economic *protectionism*. The second is *selection complementarity*, which finds

3 Comparing the genotype to a team of rowers, Dawkins claims that 'It is the "team" that evolves.' (Dawkins, 1988: 171–172). Sober (1984) explicitly introduces the role of epistatic reactions into Dawkins' rowing example and observes that they occur when a rower's superiority in a certain position depends on which rower is occupying another position. However, it is important to point our that, in natural selection, genes can also compete against themselves in different combinations because the object of selections is gene-kinds, not gene-instances. In natural selection the coach is like 'a made scientist who clones his favourite rowers and makes them race against each other in all combinations' (1984: 307). For the definition and role of epistatic relations, see the classic synthesis of Mayr (1988). The number of epistatic relations determines the shape of the evolutionary landscape (Kauffman, 1993). The higher the frequency of these relations, the higher the number of local optima and the higher the possibility of being locked in one of them.

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its counterpart in the economist's language as *unintended subsidies* coming from different selection domains.

Protectionism

The *allopatric* (in Greek 'allopatric' means 'other place') theory of speciation involves that new species originate far away from the locations where many members of the species exist. It has the virtue of being able to explain the incompleteness of the fossil records. What seems in the most populated territories of the ancestral species to be an incompleteness of the fossil record should not be interpreted as a *saltation* of intermediate evolutionary events. It may instead be due to the fact that the evolutionary process leading to speciation (formation of the new species) has occurred far away in some isolated periphery (or, in other words, it has been a form of *allopatric speciation*). The new species has only later penetrated the territories crowded by the ancestral species. For this reason, one may gain the misleading impression that there has been a *saltation* of evolutionary events.

The theory of allopatric speciation provides an explanation for the long period of stasis and the 'apparent jumps' – or the 'punctuated equilibria' (Eldredge and Gould, 1972) – that characterise natural history.

Allopatric conditions sterilise the forces of natural selection that, together with gene flow, act to maintain the *integrity* of the species (Pagano, 2001). In allopatric theory, speciation occurs in small isolated populations[4] where the changed genes of isolated founders are not promptly eliminated by natural selection. Thus, the 'exploration' of a new fitness peak, characterised by different epistatic interactions, becomes possible: the *founder effect*, which is typical of isolated peripheries, may break previously existing interlocking complementarities and allow the formation of a new population. When (and if) the two populations meet again, reproductive isolation may result from the fact that hybrids are inferior to both the ancestral and the new species, which may then co-exist with the ancestral population. Alternatively, if the new species occupies the same ecological niche, the new species may displace and replace its ancestor. In both cases, the fossil record, taken in the areas intensively populated by both species, would give the misleading impression of a jump of intermediate evolutionary events.

4 According to the Nobel Laureate John C. Eccles, an important episode of our own pre-human 'recent' natural history can be characterised in terms of allopatric speciation and punctuated equilibria. 'Despite the very extensive distribution of *Dryopithecus* – Hungary, Greece, Turkey, India, Kenya – the next stages of hominid evolution were restricted to Africa, both the Australopithecines and *Homo habilis*. It can be asked why only the African Dryopithecines participated in the evolutionary line to *Homo*. I believe that the origin of Australopithecines represented a unique evolutionary transformation such as it is postulated by Eldredge and Gould (1972) in their punctuated equilibria. It was likely therefore to be unique to a small isolated population. The reminder of the Dryopithecines went on to eventual extinction.' (Eccles, 1989: 12).

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Subsidies

In nature, tax and subsidies can be given by the interactions of different selection mechanisms. Besides natural selection, Darwin considered two other selection mechanisms: artificial and sexual selection. While what matters is overall fitness, the different forms of selection can still be distinguished in terms of the different selective agents. These agents are the forces active in the environment in the case of *natural selection*, a mate or a rival in the case of *sexual selection*, and humans in the case of *artificial selection* (Ghiselin, 1974: 130). One mechanism may impose a tax or a subsidy on other selection mechanisms.

In some cases, like the peacock's tail, one may substitute environment-related fitness for mating success. The large (but attractive!) tail imposes taxes on fitness, impairing the capacity to escape predators. In other cases, like horns, there is some degree of complementarity between sexual and natural selection. Within certain limits, in so far as they do not impair the capacity to move, big horns are not only used to fight sexual rivals; they also provide more effective defence against predators. Thus, they have positive fitness also in terms of natural selection (1974: 135).

According to Darwin (1871), sexual selection had a major role in the evolution of language, and it is likely to have had major importance for the development of human intelligence. The 'sexual selection subsidy' may have been necessary for the early evolution of the human brain until other complementary characteristics adjusted and made its large size convenient (Battistini and Pagano, 2008). These new specific human characteristics, complementary to our large brain, are likely to have included: (i) the menopause (Diamond, 1998), which establishes an optimal cut-off time for women, given their high risk of death during delivery and the dependency of the existing children (both phenomena due to large brain size); (ii) increased length of human life, so that the huge initial cost of investment in the brain is repaid (Robson and Kaplan, 2003); (iii) cultural selection and the accumulation of culture (Boyd and Richerson, 1985); and (iv) the acquisition of the technical and scientific knowledge that evinces the enormous advantages of our brain.

Humans have a unique fertilisation system based on females' concealed ovulation and their long and selective receptivity. Because of concealed ovulation, exclusive access could only be gained by long-term relationships, which in hunting and gathering societies require the cooperation of women. With respect to female primates, because of concealed ovulation, women gained additional bargaining power, including the possibility of exchanging exclusive access for parental care or other benefits. A complex and brain-intensive game had to be played in early hunter and gatherer human societies which coupled quasi-monogamous sexual relationships with high sociability. The game favoured the individuals endowed with articulated languages, emotional and rational understanding, social and political skills, and the ability to show moral virtues such as commitment and loyalty.

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The human fertilisation system provided a subsidy to the 'infant industry of our intelligence'.[5] Because of our way of interacting and loving, we were able to overcome the numerous complementarities required by the evolution of a large brain.

Whereas the pressure of natural selection (competition) favours change in the case of simple organisms, it can block the evolution of complex species. *Allopatry* (protectionism) and *selection complementarities* (subsidies) offer the possibility to overcome the stasis of complex organisms. Most human institutions share this complexity and these problems. Unsurprisingly, also their evolution is likely to go through long periods of stasis and requires protectionism or subsidies for major evolutionary changes.

3. The emergence of new organisational species

A simple definition of an organisation of production can be based on two factors. The first is its technology and, in particular, the technological characteristics of the resources used in production. The second is the set of rights (which may be legal rights and/or customary rights supported by social norms) on the resources employed in the organisation and on the organisation itself.

The relationship between these two factors has traditionally been a controversial issue in social sciences: if causation exists, it can operate in two directions. On the one hand, property rights can be seen as factors shaping the nature and the characteristics of the resources used in production. On the other hand, the technological characteristics of resources employed in production can be considered to be the causes of changes in the system of property rights.

This two-way relationship was at the very root of Marx's theory of history and of his view of the firm. It was the source of interesting problems and contradictions within this theory. 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).[6] Moreover, as Hirschman (1981) observes, Marx 'oscillated between the grand generalisation characterising an entire epoch or process and the discriminating analysis of

5 A related hypothesis is advanced by Dunbar (1992, 1998): in his case the subsidy is provided by the social skills which are required in species living in numerous groups. The more numerous the group, the more convenient a large brain to cope with the complexities of social life. Group selection (Wilson and Sober, 1994) is another route to explain features of the species which could not fit the selfish gene hypothesis.

6 Marx envisaged both types of elements but often was not able to find the right balance between them. Marxists have given differing 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 a useful survey of both. On these two sides of Marx and their link with new institutional economics, see Pagano (2007a).

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events which made differences between countries and subperiods stand out in richly textured detail'.

In spite of these contradictions and limitations, the two-way relationship considered by Marx is still an important key for the understanding of alternative organisations, and it is difficult to disagree with John Hicks when he maintains that when we consider 'theories of history' 'there is so little in the way of an alternative vision which is available' (Hicks, 1969: 3).

The relationship between property rights and the characteristics of productive forces, which created so many interesting problems and contradictions (as well as so many wrong 'predictions') in the Marxian approach, became a non-issue in neoclassical theory. In a market economy, ownership by workers or capitalists would have had no effect on the characteristics of the resources (or of the productive forces) employed by the firm. At the same time, the characteristics of the resources employed in the firm would have no impact whatever on the form of ownership which was going to characterise the firm.

Both new institutional and radical economists have reconsidered the interaction between rights and technology. However, the relationship between rights and technology is still very controversial. In these two streams of literature the causality runs in opposite directions. In new institutional economics, rights are endogenously and efficiently determined by the characteristics of the resources employed by organisations:[7] namely their degree of specificity and their monitoring requirements. By contrast, in the radical literature the characteristics of the resources employed in the firm are in their turn determined by the rights which owners of different factors exercise on the organisation.

In spite of their differences, the lines of inquiry pursued by new institutional and radicals are not necessarily incompatible, and they can be integrated into a framework that considers the two-way relationship between property rights and technology.

The 'radical direction'[8] of causation runs from property rights to technology. It is argued that the specificity and monitoring characteristics of the resources are due to the nature of the property rights under which they are employed. For instance, individuals working in organisations where they do not have rights are likely to be characterised by a relative underinvestment in organisation-specific skills and by an unfavourable distribution of asymmetric information attributes that makes them 'easy to monitor'. Specific and difficult-to-monitor workers

7 Nelson (1994: 28) observes that new institutional economics has been characterised by 'a broad theoretical stance that somehow, institutions changed optimally (if perhaps with a lag) in response to changes in economic circumstances that called for those changes'. However, he points out that some new institutionalists have abandoned the assumption of optimality of institutional response and analysed the interest-group conflict often involved in public responses. Hodgson (1996) makes related criticisms of the new institutional approach.

8 See, for instance, Bowles (1985, 1989) and Braverman (1974).

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are high-agency-cost resources that are expensive for the present owner, who has an incentive to replace them with low-agency-cost resources. By contrast, no similar replacement occurs for the individuals with rights on the organisation: the alignment of their objectives with that of the organisation allows a considerable saving on the high agency costs that would have been paid if they were employed by other agents.

When we leave the neoclassical world with zero agency costs, the 'radical direction' of causation can be justified by using a fundamental principle of economic theory: that profit-maximising employers tend to replace high-cost factors with low-cost ones. This point becomes evident when one considers that a change in property rights from one factor to the other also changes the relative costs of employing those factors. The new owning factors will save on their own agency costs while they will pay the agency costs of employing the former owning factor (while this cost was saved in the former ownership arrangement). Thus profit-maximising entails that property rights influence the combinations of productive forces that are going to be adopted: the optimal technology is bound to change with different assignments of property rights.

Also the 'new institutionalist' direction[9] of causality, running from the nature of technology to property rights, can be easily understood by using another fundamental principle of economic theory: namely that, like other economic goods, organisations tend to be owned by those individuals in whose hands they are more valuable. This implies that, for each combination of resources employed in production, property rights should go to those individuals able to save the most on agency costs when they own the organisation: these are the high-agency-cost factors that involve higher monitoring and specificity insurance costs when they are employed by other people. Thus for each combination of resources employed by the organisation there is an optimal assignment of the ownership rights on the organisation.

Consequently, in a world of positive agency costs there is an optimal technology for given ownership rights on the organisation and an optimal set of ownership rights for a given technology that is employed by the organisation. Using biological terminology, we may say that organisations are characterised by *epistatic interactions* between rights and technology. Complementarities do not only characterise the world of nature; they also shape the world of institutions.

Like the *frozen part* of a genotype, the interactions between technology and property rights have a built-in inertia.[10]

9 Alchian and Demsetz (1972) and Williamson (1985) are, perhaps, the two canonical examples.

10 Pagano (1992) and Pagano and Rowthorn (1994) have tried to capture this point by introducing the concept of organisational equilibrium and investigating the characteristics of 'institutional stability' that characterise these equilibria in the framework of a simple two-factor model. An empirical analysis of the weight of the two directions of complementarity is carried out in Earle *et al.* (2006). On the relationship between Marxian theory and institutionalism, see Pagano (2007a), and on the relationship between the concept of complementarities and organisational equilibria, see Pagano (2007b).

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An organisational equilibrium is defined by the fact that technology is optimal relatively to property rights, and property rights are optimal given the technology that is employed. The self-sustaining nature of organisational equilibria derives from the fact that owning factors saving on their own agency costs tend to choose a technology characterised by high intensity of their own high-agency-cost factors – that is, a technology under which their ownership is optimal.

The analogy between the epistatic relations characterising natural species and the characteristics defining an organisational equilibrium must, of course, be taken with some caution. Human learning may allow patterns that are not permitted to genes. On the other hand, the concept of organisational equilibria already entails a considerable degree of rationality. The optimality of technology given property rights, and that of property rights given technology, defines a *Nash equilibrium*; this is tantamount to assuming that *financiers* are able to choose the optimal owners for each firm characterised by a certain given technology and that *production managers* are able to choose the optimal technology for a certain given ownership structure. Indeed, it is reasonable to assume that this equilibrium is achieved by an evolutionary process by which firms that have suboptimal technologies given the ownership structure, as well as those that have suboptimal ownership structures given technology, are gradually eliminated by competitive forces.

In natural selection, the pressure of competition helps select the best members of a given species; however, we have seen that the effects of natural selection on speciation are much more controversial. Our question is related to the case of speciation: we are not asking whether competition can select the best member of a given species of organisation but whether it can help the formation of a new more efficient species of organisation characterised by different *technology-property rights genotypes*.

We have seen that complementarities imply that complex species are characterised by important *development constraints*: the fitness of each mutation is constrained by the other characteristics of the species. This implies that many evolutionary paths may be blocked. Unfortunately, in the case of organisational equilibria, these obstacles may work exactly against those changes that may otherwise lead to the formation of a superior species of organisation. Suppose that there are some efficient alternative potential owners that could obtain a higher ownership rent than the present owners. These alternative owners are efficient because their employment by the present owners involves very high agency costs that could be saved if they own the organisation. For this reason, the factors of the potential alternative owners are promptly replaced by factors that are cheaper for the present owners. In other words, an *anti-speciation* mechanism is embodied in each species of organisational equilibrium and it has the unfortunate characteristic that its strength is related to the efficiency of the alternative potential species.

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However, suppose that this anti-speciation factor is overcome and one of the characteristics of the old species mutates into a new species of organisation that is potentially more efficient. For instance, some organisations are characterised by new property rights that, if they were coupled with the associated optimal new technology, could form a new more efficient organisational equilibrium. Until this new technological combination is developed and employed, we will have a situation of organisational disequilibrium or, in other words, an inferior hybrid between the new property rights and the old technology. If the pressure of competition by the members of the old species is strong, the hybrid is likely to be wiped out before it has any chance of turning into the new superior species. Or, in other words, the epistatic interactions between property rights and technology imply the existence of a rugged multi-peaked fitness landscape; in these conditions the pressure of competition will act to keep the firms at the local peaks.

However, even if speciation is successful, the survival of the new species may be put at risk by tough competition raised by the old species.

In the first place, if there are few members of the new organisational species, interbreeding with the many members of the old species will be very frequent and will produce numerous inferior hybrids. In these conditions interbreeding may lead to the extinction of both mutations. When the new technology is imitated and run under the old property rights system, it turns out to be inferior and, vice versa, when the new rights are influenced by the old technology they also turn out to be inferior.

Secondly, in nature, the efficiency of each species depends on its frequency. Also, organisations have this characteristic. For instance, network externalities in property rights and in technologies may imply that few firms characterised by different organisational equilibria are not viable: they would be outcompeted by firms that, even if inferior when they exist with the same frequency, can benefit better from network externalities because of their present large number.

Thirdly, as Darwin pointed out, more numerous species may enjoy more mutations. Also organisations that are more numerous will have this advantage for the non-frozen part of their characteristics, and this will again constrain the possibility of major evolutionary changes.

In conclusion, because of interlocking complementarities, we should expect the formation of new organisational species to require allopatric conditions or major external subsidies. Major evolutionary change requires that the members of the new species must somehow be protected against competition by the members of the incumbent species. Alternatively, institutional and technological shocks should be strong enough to overcome the inertia of complementarities and rely on some external subsidy originating from a different selection domain. In the following two sections, we will give historical examples of each of these two possible cases.

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4. The allopatric emergence of managerial capitalism

In the last half of the nineteenth century there 'came into being a new economic institution, the managerial business enterprise, and a new subspecies of economic man, the salaried manager.[11] With their coming, the world received a new type of capitalism – one in which the decisions about current operations, employment, output, and the allocation of resources for future operations were made by salaried managers who were not owners of the enterprise' (Chandler, 1990: 2).

According to Chandler, the advent of the new institutions and the 'new subspecies' of economic man were strictly related to the building and operating of rail and telegraph systems. The complexities of their operations required firm-specific organisational capabilities that could not have been developed within the members of the family owning the firm, nor efficiently monitored and controlled by them. The new firms required a managerial hierarchy whereby to a great extent salaried managers controlled other managers. In other words, the new technology required the employment of *high-agency-cost* managerial skills. In turn, this required that rights, incentives and safeguards were to be given to these managers. In particular, it was vitally important for managerial effort, as well as for the efficiency of the firm, to know that promotions from the low to the high positions in the managerial hierarchy would be related to achievements and unrelated to family and other social ties.

The new system first came into being in the rail and telegraph industry, but it exhibited greater efficiency in many of the industries characterised by economies of scale and scope that could be efficiently exploited by the use of managerial hierarchies. Indeed, the diffusion of the new organisational model characterised the advent of a new species of capitalism: *managerial capitalism*. The new species had two local varieties: *competitive managerial capitalism* in the USA and *cooperative managerial capitalism* in Germany. While in German industries family control lasted longer than in the USA, in both countries salaried managers with little or no equity in the enterprises for which they worked participated in decisions concerning current production and distribution, as well as in the planning and allocation of resources for future production. 'The greatest difference, however, came in interfirm and intrafirm relationships' (1990: 395). In the USA the new managerial firms competed aggressively for market share and profits, and the anti-monopolist legislation reflected a shared belief in the value of competition. By contrast, in Germany many firms preferred to cooperate, and trade associations played a much larger role in Germany than in the USA.

While the advent of these two subspecies of managerial capitalism made the USA and Germany the two most important actors of the second industrial revolution, Britain – the main actor of the first industrial revolution – lagged behind in many of the new industries. Britain continued to be committed to

11 This section is based on Pagano (2001).

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the species of personal capitalism that had been so successful at the time of the first industrial revolution. Whereas long-term profits based on long-term growth were a goal on which the managers and the major investors of the American and German managerial firms could agree, the families owning the British firms often preferred to pay out earnings as dividends rather than using them to make the extensive investments required to move into foreign markets or to develop new products in related industries. 'Because their firms grew slowly and because they hired only a small numbers of managers, the founders and their families remained influential in the affairs of the enterprise and so affected dividend policy.' (1990: 595). By contrast, the long-term growth of American firms helped the managers to gain strong job rights in their firms. 'Such a goal not only helped to assure tenure for the senior executives, but it also enhanced the opportunity for advancement for the more junior managers.' (ibid.).

British firms did not provide similar opportunities to non-owning managers. The key managerial positions were usually reserved for the owning family. Social and family ties were more important than competence in advancing up the managerial ladder. There were few opportunities for junior managers, while no job security similar to that in German and American firms could be given to senior executives. It is hardly surprising that organisational capabilities of such importance for the firms of the second industrial revolution stagnated. As a result, Britain lost world economic leadership to the countries that had *speciated* the new form of managerial capitalism.

Using the terminology of the preceding sections, the advent of competitive and cooperative managerial capitalism can be seen as a form of *allopatric speciation*: some form of protectionism helped the *infant industry* of managerial capitalism. The speciation did not occur in Britain, where the competitive strength of personal capitalism was the strongest, but in countries that had not participated in the first industrial revolution. In the USA and Germany the nature of the productive forces required by railways and the telegraph industry first changed the structure of rights that characterised these sectors and then, after a few years, that of the other industries where the growth of productive forces could benefit from the change. Soon, the new rights favoured the employment of specific and difficult-to-monitor (and, therefore, *high-agency-cost*) managers, while their employment had a self-reinforcement feedback that made the new rights of managerial capitalism an irreversible choice.

Thus, the speciation of new organisational equilibria occurred in the USA and Germany where managerial rights and managerial skills were fundamental characteristics of new epistatic interactions between production relations and productive forces. On the one hand, given tenure rights for senior executives and fair promotion opportunities for junior managers, productive forces were best characterised by a relative high intensity of high-agency-cost managerial skills. On the other hand, given the employment of these skills, only a system of strong managerial rights could ensure the commitment of managers to the organisations

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and save the high agency costs that should have otherwise been paid in case of pronounced incongruence between their goals and those of the organisation.

In Britain, by contrast, the second industrial revolution was unable to break the complementarities between the structure of rights and the nature of productive forces. By that time, the managerial skills accumulated by the British families had already made some of their members high-agency-cost factors. This reinforced the stability of their ownership rights: their ownership saved on their own high agency and had a feedback effect on technology involving the continuation of the intensive employment of the *high-agency-cost skills* of the owning family members.

The vicious circle between managerial skills and rights mirrored the self-reinforcing interactions that we have just considered. Since managers were not involved in the organisation, their agency costs could not be saved like those of the committed family members. For this reason, the former were often replaced by the latter; but this caused even further damage to managers' commitment to the organisation and their accumulation of organisational skills. At the same time, the low intensity of high-agency-cost managerial skills implied that the (partial) saving of these agency costs (that would have occurred under managerial capitalism) could not favourably compare with the saving of agency costs of family members (that characterised British personal capitalism).

Thus, in spite of the technological shocks induced by the second industrial revolution, the *frozen part* of the genotype of the British firms did not melt. The fairly strong competition which characterised the British environment favoured the organisational 'stasis' of British capitalism. The emergence of managerial capitalism required *allopatric* conditions or some protection against the competitive pressure of family capitalism. The major role of Britain in the first industrial revolution became a paradoxical disadvantage in the environment of the second industrial revolution.

5. Post-war Japan and Italy: the role of unintended subsidies

In pre-war Japan, large firms were organised in *zaibatsu* such as Mitsubishi, Mitsui, Sumitomo and Yasuda. The *zaibatsu* were mostly family controlled and originated from a family firm. For instance, the Mitsui and the Sumitomo were two of the most powerful merchant families in Tokugawa Japan. However, in the tradition of the Japanese family system, the entire emphasis was placed on perpetuation of the family 'name' (*kamei*) rather than on continuity of the blood lineage. Good managers could be adopted by means of arranged marriages and given the family name.

After the end of the Second World War, the Americans interpreted faithfulness to the family name as a feudal relationship that formed the basis of Japanese militarism. They expropriated the *zaibatsu* families, nationalised their property and tried to sell all the stock to small shareholders. Concentrations of ownership

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and power were considered to be dangerous. Bank ownership and cross-shareholding were forbidden. By contrast, union activities were (initially) encouraged.

The war period and expropriation of the *zaibatsu* families reinforced insiders' feelings of job security together with their specific investments in companies. The contradiction between these conditions and the system that the Americans intended to create became evident with the 1949 stock market crash. This made take-overs very easy: new owners, unconstrained by implicit contracts, could jeopardise workers' job security and their firm-specific investments. As a result, cross-shareholding and bank ownership of stock were tacitly allowed, creating the conditions for delivery of the *keiretsu* system based on main banking, cross-shareholding and job security.

It is useful to compare the Japanese and Italian experiences in the years following the defeat.[12] The comparison enables some sort of natural experiment to be conducted on the role of *political subsidies* in shaping new organisational structures.

The crisis of the 1930s was particularly severe in Italy. In order to save banks, the fascist regime had to buy out their industrial holdings and transfer them to a new agency created specifically for this purpose in 1933, known as the Istituto per la Ricostruzione Industriale ('Institute for Industrial Reconstruction') (Pagano and Trento, 2003). Many large companies were owned by the state. Under the Banking Law of 1936, banks were prohibited from holding equity in industrial companies. No liquid stock exchange had been developed. Those firms that were not controlled by the state were family-owned. However, unlike the case of the Japanese *zaibatsu*, Italian family membership was a matter of blood, not the sharing of a *kamei*.

In Italy, it would have been much easier to introduce the American model based on separation of ownership and control. Many assets were already owned by the state. Moreover, banks and industry had been separated since 1936. But the political situation was different. Italy had not suddenly collapsed; rather, the liberation from German occupation had taken two years. In the meantime, the Italian counterpart of the *zaibatsu* families had all the time necessary to make deals with the Anglo-American forces. In the end, the Italian corporate governance system was not changed by the Anglo-American occupation.

The comparison with Italy confirms the role that political subsidies can perform in engendering irreversible institutional change. The main steps in the *speciation* of the post-war Japanese model can be summarised as follows:

(1) Before the war, under the *zaibatsu* system, a class of managers loyal to the firm already existed. The war enhanced the autonomy of management from the *zaibatsu* families.

12 For a more detailed analysis, refer to Barca *et al.* (1999).

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(2) During the *quasi-nationalisation* of the *zaibatsu* companies, the rights of junior managers and workers were enhanced and had time to favour the associated technology. A return to the *zaibatsu* was not politically feasible: in other words, the new rights enjoyed a political subsidy from the domain of political selection. The inferior hybrids between the new rights and the old technology could not be wiped out. By contrast, they had an opportunity to move towards the speciation of a new organisational equilibrium.

On the other hand, while the insiders were becoming *high-agency-cost* factors, the kind of privatisation promoted by the Americans was based on legislation whereby shareholders could exercise hiring and firing rights, and on the separation between commercial banking and industry. This created a situation of potential 'organisational disequilibrium' between formal rights and technology. The threat of take-overs, following the 1949 stock crash, made this disequilibrium evident and dramatic.

(3) The property rights system that emerged from the crisis was based on cross-shareholding and the main bank system. The combination of this property rights system with technology based on specific and difficult-to-monitor labour allowed the definitive speciation of the new organisational equilibrium. Observe that speciation was favoured not only by an initial protection of the new system of informal rights but also by the fact that all companies were involved in this change. Hence the network externalities among property rights standards and technology did not inhibit the change. Indeed, they even favoured it because all the firms were simultaneously involved in the process. The network externalities in property rights were particularly evident in the cases of cross-shareholding and the main bank system, whose emergence required that a plurality of companies should be involved in the institutional change.

As the comparison with the case of Italy shows, a high political subsidy was necessary for change in the Japanese system of corporate governance. In Italy, the situation was riper for change, but because no political input came from the occupying forces, no change occurred. By contrast, in Japan, the role of policies implemented by the occupying forces was analogous to that of sexual selection in the development of the human brain. It created the conditions for the emergence of a more powerful organism whose evolution was inhibited by numerous interlocking complementarities. The dramatic events in the political domain produced a decisive subsidy for the emergence of a new organisational species.

6. Conclusion

Commenting on the analogy between his panda's thumb evolutionary story and the economics of QWERTY analysed by David (1985), Gould has observed that:

> 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

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> analogy), but that both keyboards and the panda's thumb, as product 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: 66).

In a similar vein, we have considered the issue of the evolution of institutions. Institutions evolve; and they often do so in ways analogous to those of complex natural organisms undergoing a long period of stasis.[13] Evolutionary change may not be favoured, but even inhibited by natural selection (competition) so that it requires allopatric conditions (some form of protectionism) or some subsidy from some other (selection) domains. Similar mechanisms characterise the rules governing the structure and change of institutions and they should not be confused with the single-gene models, yielding an unproblematic survival of the fittest. The analogies, which we have considered, show that the evolution of complex structures cannot simply rely on competitive (natural selection) pressure. However, these analogies should not be pushed too far.

This paper began by observing that the fact that institutions are humanly devised should be not confused with the fact that they are consciously created by individuals. The speciation of managerial capitalism outside Britain, and of the *keiretsu* system in Japan, was a largely unintended consequence of human actions. We have focused on unintended design because this reinforced the analogies between evolutionary biology and human history and clarifies the similar role that the degree of complexity has in favouring or inhibiting institutional change. However, in human history, intended human actions have an important role in shaping new institutions. Indeed, many formal and informal institutions arise from a conscious attempt to improve social outcomes.

Most organisations (in particular the ones which are legal persons) spring from a deliberate endeavour to devise arrangements that can produce better outcomes. Again their complexity may make the task exceedingly difficult. It can be a cause of rigidity and evolutionary stasis (Pagano, 2010) and may involve numerous, and often undesirable, unintended consequences. Abstract theory cannot *a priori* state when and how humans are able to solve conceptual and collective action problems and consciously improve their institutions. Historical specificity matters because 'past institutional choices open up some paths and foreclose others for future institutional development' (Ostrom, 1990: 202).

13 One of the main merits of the Darwinian method was to see species as real ontological entities evolving in real time and not as mere *taxa* to be classified on the basis of some invariant properties (Ghiselin, 1969). In this sense, the Darwinian method can be extended to institutions. This requires that one should specify the laws of structure and change by which institutions come about, perpetuate themselves and eventually are replaced by other institutions.

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Intentional human rationality and the human capacity to solve collective action problems are also evolving[14] and it is impossible to assess once and for all their limits and their capabilities. However, even when institutions seem to be frozen by many interlocking complementarities, they have a potential to evolve in a certain number of directions. The understanding of these relations can, sometimes, offer keys to unlock undesirable complementarities and can contribute to open the doors to intentional policies of institutional change.

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14 'If rational behaviour is to be assumed, then its evolution has to be explained.' (Hodgson, 1998: 189). On the different types of bounded rationality, see also Pagano (2007c). Steinmo (2008) points out that the human capacity of problem solving must be seen in an historical perspective. According to him, if new ideas are generated at different points of history, the solutions that are available at a certain moment of time are different from those available in moments of histories where these ideas had not yet been produced. Institutional change cannot be understood as process separated from that of the development of new ideas and all the other capabilities required by collective action.

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