



UNIVERSITÀ
DI SIENA
1240

**QUADERNI DEL DIPARTIMENTO
DI ECONOMIA POLITICA E STATISTICA**

**Fabio Landini
Ugo Pagano**

Synergy, Conflict and Institutional Complementarities

n. 686 – Settembre 2013



Abstract - In biology, the evolution of species is influenced by two types of complementarities. One type is mostly related to the synergies among and within organisms, while the other is the outcome of conflicts among different species and among members of the same species. In both conflictual and synergetic complementarities, the traits selected in one domain affect the traits selected in the other domain, and both complementarities involve the co-evolution of certain traits. However, synergies and conflicts involve different mechanisms and interact with each other to generate complex dynamics. Social and economic systems are characterized by a similar range of interacting complementarities. Whereas technology and property rights tend to have synergistic complementarities, workers' and capitalists' organizations are mostly characterized by conflictual complementarities. The evolution of the different varieties of capitalism, as well as of different patterns of technological specialization across countries, can be better understood in terms of both types of complementarities and by their interactions. The comparative history of the American and the European economies is used to illustrate how models of capitalism can diverge, building different types of institutional complementarities over time. Economic policies can have different, and sometimes opposite consequences, in these different contexts.

Keywords: complementarities, complexity, corporate governance, European and American institutions.

JEL Classifications: P5, P1, B41, B52

Fabio Landini, MEDAlics and CRIOS – Bocconi University
email: fabio.landini@medalics.org

Ugo Pagano, University of Siena and Central European University, Budapest
email: pagano@unisi.it

1. Introduction

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 aid understanding in the other field of inquiry. However, in some cases, these analogies have been used in a misleading way to justify naive claims about the efficiency and uniformity of prevailing institutions (Winter, 1987). Among some social scientists, these claims have discredited the application of the evolutionary approach to the study of institutional change: its complexity is clearly at odds with a simplistic version of Darwinian theory.

In this paper we take a different view. We start by recognizing that 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 lead to divergent speciation patterns. Fruitful analogies must take account of the different types of complementarities that characterize both complex organisms and complex institutions.

In this paper we argue that in biology two main typologies of complementarities affect the evolution of complex species, namely synergetic and conflictual complementarities. The former is related to the synergies among and within organisms, while the latter is the outcome of the conflicts among different species and among members of the same species. We argue that, similarly to biological systems, the same types of complementarities also affect the evolution of complex social and economic systems, such as capitalism. In a capitalist system, workers' and capitalists' organizations tend to have conflictual complementarities. At the same time technology and organizational rights are mostly characterized by synergistic complementarities. The evolution of the different varieties of capitalism, as well as of different patterns of technological specialization across countries, can be better understood in terms of both types of complementarities and by their interactions.

The paper relates to two main streams in the literature. The first one consists of the literature on institutional complementarities (Aoki, 1994, 2000, 2001; Amable, 2000, 2003; Boyer, 2000, 2001). According to Aoki (2001), institutional complementarities are situations of synchronic interdependence across distinct institutional domains. This concept has been employed in several contexts to study the evolution of institutional forms, including the emergence of distinct ways to organize production (Pagano and Rowthorn 1994; Landini, 2012, 2013) and the evolution of varieties of capitalism (Hall

and Soskice, 2001). With respect to this literature, the present paper offers two main contributions. First it shows the existence of different types of institutional complementarities, both conflictual and synergetic. Second, it investigates how these two types of complementarities can explain the emergence of distinct patterns of institutional speciation across countries.

The second stream of literature related to our work is concerned with corporate governance models. For a long time, at least until the recent economic crisis, several authors advocated the merit of the Anglo-American system of corporate governance, which is characterized by a relatively weak role of block holding. Independently of the presumed origin of that system, whether legal (La Porta et al., 1998, 1999), electoral (Pagano and Volpin, 2005) or political (Roe, 2003), this literature encouraged the change of what was once an American exception into the general rule to be followed by all countries. Recently, however, the economic crisis and corporate failures have called the presumed validity of the Anglo-American model into question, while at the same time highlighting its drawbacks. Starting from this evidence, some authors¹ have suggested that better understanding of the diversity of corporate governance models across countries could be gained from focusing on the interdependences among distinct institutional domains and the consequent impossibility of adequately ranking different systems of corporate governance. With respect to this literature, the main contribution of our paper is its provision of a theoretical micro-foundation including both conflictual and synergetic complementarities. These micro-foundations provide another route to understand the complex relations between politics, law and the economy, characterising the different systems, which involve that the same policies can have sometimes beneficial and sometimes deleterious consequences in different contexts (Acemoglou and Robinson 2013, Milhaupt, Pistor 2008).

The rest of the paper is organized as follows. The following section discusses the role of synergetic and conflictual complementarities in constraining the evolution of complex organisms, making particular reference to our closest relatives: chimps and gorillas. Section 3 draws on the notion of conflictual complementarities to model class struggle among three different social groups: workers, owners and managers. Section 4 exploits the conflict equilibria identified in Section 3 to model the synergetic adaptation of technology and organizational rights. Section 5 uses the comparative history of the American and the European economies to illustrate how, similarly to complex natural species, models of capitalism can diverge. The treatment builds on the combination of both conflictual and synergetic complementarities. Finally, the last section concludes by discussing the consequences of the complex interactions among the different domains characterising most evolving systems.

¹ See, for instance, Millhaupt and Pistor (2008) and Belloc and Pagano (2009, 2013).

2. Types of selection complementarities in evolutionary biology.

The success of the members of natural species stems from two factors: (i) their relative capacity to deal with the environment and to obtain food and other resources; (ii) their relative mating success. The concept of natural fitness can thus be split into two components: environmental and sexual. The two selection domains are not independent. In the well-known case of the peacock tail, environmental fitness, related to the rapid motility necessary to escape from predators, must be sacrificed to the sexual fitness acquired from the large tail, which is much appreciated by female peacocks. The peacock tail story links the domains of environmental and sexual selection in terms of fitness substitution. However, the two domains are also linked by forms of fitness complementarity: the fitness of a trait in one domain may increase when some other trait is selected in another domain.

Fitness complementarities between the sexual and environmental domains, which are absent in the peacock case, are quite common in nature, and most herbivores are characterized by a complex substitution and complementarity relationship between these two domains. Herbivores are endowed with capacities for both combat and motility, and they can undergo evolutionary trade-offs between these traits. Unlike peacock tails (which are only useful for sexual selection), big horns are useful in sexual combat and in defence against predators, but they may be a disadvantage because they cause reduced motility. High motility traits can greatly help successful mating and the escape from predators, but they may be disadvantageous in terms of reduced body size and, in particular, horn ramifications. Whilst motility and horns can be useful in both domains, it is likely that motility traits are mainly selected in a process of environmental selection when herbivores must flee from their predators. By contrast, horns are likely to be selected in a process of sexual selection, since their shape and position are usually most suited to combat against mating rivals and large horn ramifications are a specific male attribute. Thus, in the sexual and the environmental selection domains, individuals are selected according to two different rules corresponding to selective agents of different types: in the case of sexual selection, a mate or a rival are the selective agents, while forces like predators active in the environment have this role in the case of environmental selection (Ghiselin 1974, p.130). Even if the two domains are clearly distinguishable on the basis of the different selecting agents, the genotypes subject to the phenotypic changes associated with a certain type of 'investment' in one domain may sometimes coincide with the genotypes investing in the other domain. However, what matters is that,

because of the different nature of the selective agents, the rules by which they are selected in one domain act as parameters in the other domain.

Consider a population where all the individuals acting in each domain derive equal fitness from having a certain trait, and denote with X and Y respectively the natural selection and the sexual selection domains. X contains two traits $\{X_1, X_2\}$, which influence the natural fitness u of the individuals i selecting their traits in the natural domain X . Similarly, Y contains two traits $\{Y_1, Y_2\}$, which influence the sexual fitness v of the individuals j selecting their traits in the sexual domain Y . The advantage (disadvantage) of trait X_1 over trait X_2 increases (decreases) when trait Y_1 instead of trait Y_2 is chosen in the sexual selection domain and, similarly, the advantage (disadvantage) of trait Y_2 over trait Y_1 increases (decreases) when trait X_2 instead of trait X_1 is chosen in the natural selection domain. Thus the two standard "supermodularity conditions" (Aoki 2001 p. 226) are satisfied:

$$\text{for agent } i: \quad u(X_1, Y_1) - u(X_2, Y_1) \geq u(X_1, Y_2) - u(X_2, Y_2) \quad (1)$$

$$\text{for agent } j: \quad v(Y_2, X_2) - v(Y_1, X_2) \geq v(Y_2, X_1) - v(Y_1, X_1) \quad (2)$$

In the case of the peacock, (1) and (2) can be simply interpreted as conflictual complementarities. In the case of peacocks, a 'high armament' equilibrium arises. But other bird species invest less in sexual ornaments, and have 'low' armament equilibrium in their display of sexual ornaments.

In the case of the horns of herbivores, inequalities (1) and (2) can be interpreted as synergetic complementarities between horn ramifications and motility levels.

The first inequality (1) can be interpreted as follows. The selection of big horns Y_1 in the sexual selection domain makes it more convenient in the natural selection domain to choose traits X_1 (involving low motility and high defence capabilities) relatively to X_2 (traits associated with high motility and modest defence capability). Horns can easily develop other traits that make them more efficient against predators; and other characteristics such as large body size can be helpful in pursuit of the same strategy of enhanced defence capability and reduced motility. The big horns Y_1 (instead of small horns Y_2), chosen by the 'sexual selection agents', are taken as parameters by the selection agents acting in the environment, and they yield an increased advantage (or, a decreased disadvantage) of low motility traits X_1 (relatively to high motility traits X_2).

The second inequality (2) can be interpreted similarly. The selection of high motility X_2 by the natural selection agents makes small horns Y_2 more convenient in the sexual selection domain relatively

to big horns Y_1 . High motility may enable males to out-compete other males by dispersing more efficiently on the territory, rather than relying on costly sexual combats. Sexual competition may involve further investment in motility traits. Because small horns are consistent with high motility, they are more likely to be selected.

The effect of one trait chosen in one selection domain may not be powerful enough to make another trait preferable in the other selection domain. However, when these effects across domains are sufficiently strong, multiple equilibria may arise, and the species may develop either low motility and big horns traits (X_1, Y_1) or high motility and low horns traits (Y_2, X_2). When multiple equilibria exist, we can say that X_1 and Y_1 , as well as Y_2 and X_2 , are selection complements.

In most species, the ‘conflictual tails’ and ‘synergic horns’ types of complementarities co-exist and interact with each other to generate complex evolutionary paths. These interactions are closely analogous to the types of complementarities existing in human societies, where, to use Marxian language, history is at the same time shaped by class struggle (conflictual complementarities) and by the relations between productive forces and the relations of production (synergic complementarities).

The interactions between conflictual and synergic complementarities can be better understood by considering the selection processes characterizing our close relatives: chimps and gorillas (Battistini, Pagano 2008, Pagano 2013b). In both cases, females have an important role in the successful evolution of particular couples of complementary traits. Contrary to the unusual case of humans, both chimp and gorilla females signal sexual availability during their fertility period in mechanical and evident ways. For chimps and gorillas, the fertility period is no mystery. However, female chimps and gorillas differ greatly in their fertility advertising strategies: the former signal fertility by a strong and prolonged signal, while the latter provide only a weak and relatively short hint of their fertility state. As a consequence, male chimps find it too costly to fight for exclusive access to females; and they have little incentive to make positional investments in their body sizes – which are not substantially greater than those of females – to fight for a too costly exclusive access. By contrast, because of their almost private weak and short fertility signal, female gorillas have given gorilla males strong incentives to make positional investments in their body size.² Having exclusive access to a territory gives exclusive access to the females on that territory, because males living some distance away have no information about the fertility period.

² An opposite pattern characterizes the biological investments of these two species in their testis sizes. The promiscuity due to the females' long and prolonged signals induces chimps to make major investments in their insemination capacities, while the monopoly situation enjoyed by the male gorillas in their harems explains the small size of their sexual organs.

The investment by male gorilla in body size has been the result of a peacock-like arms race whereby the investment of other gorillas has made large size more convenient, indeed essential, for the survival of their genes. In the case of chimps, a similar arms race has been blocked by the high cost of armaments due to the different characteristics of the female fertilization system. Because of this different situation, male chimps have achieved a different equilibrium where the low level of armament (i.e. body size) of each chimp has decreased the benefits of larger body size. Interpreting chimps and gorillas as exemplifying two different possible evolutionary strategies by primates suggests that there are evolutionary complementarities which make it more convenient to adopt a gorilla strategy G to increase body size when others do so, and to choose a chimp strategy C to save on its costs when also the other chimps do so. For male gorillas and chimps, the net evolutionary benefits of C and G depend on the fertility system of their females. In this respect (X_1, Y_1) and (Y_2, X_2) can be interpreted as two equilibria (C, C) and (G, G) that may arise among primates. Unlike the case of the peacock tail, where the arms race is only blocked by the increasing cost of environmental fitness, in this case the arms race can also be dampened by particular characteristics of the female fertility system, and multiple equilibria can characterize the sexual selection process among primates.

Similarly to the case of herbivores, in the case of primates, evolutionary complementarities extend well beyond peacock-type conflictual complementarities. The outcomes of sexual selection involve different synergies with the environment and the development of different ‘technologies’ to increase fitness.

Because of big body size, a male gorilla’s motility is reduced, while its ability to defend a territory, where weak female fertility can be monopolized, is greatly increased. Dominating a territory becomes an obviously complementary strategy, which in turn requires other complementary choices, such as a powerful digestive system and a very large intestine allowing the digestion of all of the few kinds of food available in a limited space. All these adaptations make up what we call the gorilla technology T_G to deal with the environment – a technology that is favoured by the gorilla body B_G chosen in the sexual domain.

Similarly, the chimp male’s modest body size B_C favours high motility and the consequent evolution of a chimp technology T_C to gather food in a wide territory, while the variety of supply available in that large space allows the careful choice of food and requires a less demanding digestive system.

To be noted is that there is also a reverse causation whereby environmental technologies may stabilize the equilibria that have emerged in the sexual selection domains. T_C makes B_C relatively more convenient with respect to B_G , and T_G makes B_G more convenient with respect to B_C . Here again (X_1, X_2)

and (Y_1, Y_2) can be interpreted as two equilibria (B_G, T_G) and (B_C, T_C) characterizing the evolution of primates. However, here the nature of the complementarity is not ‘conflictual’ but ‘synergetic’. A trait does not make another trait more convenient by increasing the chance of winning conflicts; it does so by increasing the environmental fitness advantages of its carriers. In conflictual complementarities, hybrids give some advantage to one deviating individual. In synergic complementarities, by contrast, hybrids decrease the fitness of both traits. Conflictual complementarities are inherently unstable. They are the result of prisoners' dilemma-type games, and deviation may be advantageous. By contrast, synergic complementarities are the result of coordination-type games, and deviation is damaging. Thus, synergic complementarities can stabilize the outcomes of conflictual complementarities and make them permanent characteristics of a certain species. At the same time, in certain cases, some synergies may become impossible and the particular environmental niche, characterising the technology used by a particular species may become unsustainable. In this case, synergic complementarities cannot play a stabilizing role and may rather become the crucial engines of evolutionary change.

Although evolutionary analogies should not be pushed too far, the bifurcation of primates into different species can provide insights into the evolution of different varieties of capitalism. Social classes may, or may not, increase their level of armaments and may generate chimp-like or gorilla-like conflictual complementarities. In turn, these complementarities are reinforced by the synergic complementarities between the institutions arising from the class struggle and the associated technologies. In this way, different species of capitalism may evolve along alternative institutional-technological paths in different countries.

3. Class organizations and conflictual complementarities.

In his book “Strong Managers, Weak Owners” Mark Roe (1994: 4) observed:

“Although the defects of separation are today in the spotlight – without their own money on the line managers can pursue their own agendas, sometimes to the detriment of the enterprise – separation of ownership and control was historically often functional (and still is), because it allows skilled managers without capital to run the firm and separates unskilled descendants from control of the firm they could not run well. Sometimes successful founders became poor managers, because their accumulated wealth allowed them to slack off but still live well as historically was a problem in Britain.”

On this view, managerial hierarchies do not simply imply the usual problem of making the interests of the managers consistent with those of the shareholders. They also imply a broader and, somehow, opposite problem: that of the consistency between the “family allocation of control” and the internal meritocracy of the firm. In order to work well, managerial hierarchies must be organized according to fair rules of career advancement that may easily clash with the allocation of jobs on the basis of family connections. In spite of the well-known agency problems, the separation between ownership and control had some positive effects because it implied a prevalence of competence allocation rules over family connection rules. While small firms could easily work on the basis of a family allocation of control, this was much harder for large firms. For this reason, in spite of all its agency problems, managerial capitalism was bound to prevail and prosper in some countries.

The predominance of dynastic over competence criteria in the allocation of jobs has strong political roots. The way in which social conflict is settled has a crucial impact on how firms are owned and how authority is divided. According to Roe (1994; 2003), in particular, the separation of ownership and control is strictly related to the degree of ‘social democracy’, i.e. the strength of pressure by stakeholders, especially labour. Where social democracy is strong, labour is powerful and can pressure managers to take decisions that forgo profit-maximization: for example to avoid downsizing, to be cautious in taking risks that may affect the workplace. These are precisely the kinds of colluding activities that increase managerial agency costs and undermine the functioning of modern corporations. By contrast, a weak social democracy is conducive to the emergence of the meritocratic institutions necessary for the working of managerial hierarchies. The lack of class division removes the need to use dynastic rules as means to defend class positions, and it makes the delegation of control to salaried managers less risky for owners.

As suggested by Belloc and Pagano (2009, 2013), however, whilst the presence of social-democratic job protection may prevent the radical diversification of asset ownership and the transfer of power from owners to managers, also the reverse causality may hold: social democratic job protection becomes stronger when the lack of restrictions on block holders makes it easier to gain private benefit from ownership. When there is no separation between ownership and control, workers are more likely to seek protection against interference by owners and their social circles, including their relatives and friends, who may otherwise monopolize the best jobs in the company. Conversely, when the interests of capitalists are dispersed, workers have little incentive to assume the collective action costs associated with the strengthening of their social protection. Thus, whilst social democracy may prevent the separation between ownership and control, the existence of powerful block holders may favour

some sort of reaction in terms of workers' protection. This relationship entails multiple co-evolution paths between ownership concentration (business) and workers' organization (politics): a certain degree of centralization of one side's interests may easily induce a corresponding concentration of the other side's interests. As in a primates-like biological arms race, the conflictual complementarities between business and politics can produce different types of strategies among competing agents and divergent patterns of institutional speciation.

The role of conflictual complementarities in shaping the nature of capitalism can be modelled by means of a simple game. Consider an economy populated by three types of (representative) agents: owners (o), managers (m) and workers (w). Agents o , m and w contribute to production by interacting within an institutional environment that we call a 'firm'. A firm is a private ordering characterized by a well-defined structure of authority relations according to which o exercise authority over m , who in turn exercise authority over w (for a similar approach see Pagano, 2000). In this economy o and w select the degrees of interest concentration that characterize their class organizations. Agent o 's organizations pertain to the domain of property (O), while w 's organizations pertain to the domain of polity (W). Agent m , on the contrary, is assumed to have no class organization but instead to be affected by the choices made by o and w .

In domain O two main alternatives are available: a high concentration of property rights, (O_H) and a low concentration of property rights (O_L), i.e. $O = \{O_H, O_L\}$. O_H combines the presence of a single (or a few) powerful owner so that family ties and dynasties have an important role in determining career advancement within the organization. O_L , on the contrary, combines a dispersed ownership structure with heavy reliance on public markets as job-allocation devices. These two alternatives reflect the different models of corporate governance usually associated with the family business and the managerial enterprise.

In domain W , similarly, agent w can choose between two distinct options: high concentration of their interests (W_H) and low concentration of its interests (W_L), i.e. $W = \{W_H, W_L\}$. W_H reflects a situation in which what we have called 'social democracy' exists, i.e. labour is highly unionized and the market is heavily regulated. W_L , instead represents the opposite situation in which unions are weak and the market mechanism operates freely.

As stated above, in this context we assume agent m to be not directly involved in the class struggle between o and w . However, m is not completely indifferent to the outcome of that struggle. In fact, the

choices made in domains O and W affect the structure of second-order jural relations within the firm and thus affect m 's decisional power.

High and low concentrations of interests correspond to different levels of safeguards within the firm. In particular, if o choose O_H (O_L), this implies that it is relatively easy (difficult) for shareholders directly to influence and control the activities of m . Consequently, they have strong (weak) safeguards on their interests in their firm. We define this case as a situation in which the power (inability) of o corresponds the liability (immunity) of m . Similarly, if w choose W_H (W_L), this implies that it is relatively easy (difficult) for workers to exploit the threat of collective action to affect the firm's operations. Consequently, they can enjoy strong (weak) safeguards on their jobs. In this case, we say that the inability (power) of m is counterbalanced by the immunity (liability) of w . On this basis, for each combination of O and W we can define a specific structure of second-order jural relations. In particular, by calling the relations between o and m 'upstream relations' and the ones between m and w 'downstream relations', we have the structure depicted in Table 1.

Table 1

<i>Owner (o)</i>	<i>Worker (w)</i>	
	<i>High Concentration (W_H)</i>	<i>Low Concentration (W_L)</i>
<i>High Concentration (O_H)</i>	upstream: o 's power \leftrightarrow m 's liability downstream: m 's inability \leftrightarrow w 's immunity	upstream: o 's power \leftrightarrow m 's liability downstream: m 's power \leftrightarrow w 's liability
<i>Low Concentration (O_L)</i>	upstream: o 's inability \leftrightarrow m 's immunity downstream: m 's inability \leftrightarrow w 's immunity	upstream: o 's inability \leftrightarrow m 's immunity downstream: m 's power \leftrightarrow w 's liability

The decision-making process is modelled as follows. Each agent o and w chooses in its domain of choice in order to maximize individual utility. In particular, o selects the degree of ownership concentration that maximizes utility u_o for a given concentration of workers' interests, while w selects the degree of interest concentration that maximizes u_w for a given ownership structure, where u_i (for $i=o, w$) is the utility of agent i . Note that, in this framework, the actions of o and w involve two distinct causalities: the actions of o capture Roe's (2003) causality running from polity to ownership structure; whereas the actions of w imply the reverse causality running from ownership structure to polity, as suggested by Belloc and Pagano (2009, 2013).

Agents' utility depends on three components: economic return, exercise of choice freedom, and the benefit (cost) associated with the extraction of organizational rents. In addition, we assume that w incurs a positive cost of collective action when choosing concentrated interests because of the dispersed nature of labour (Belloc and Pagano, 2009). We write the agents' utility functions as follows:

$$u_o(O, W, t) = \pi_o(O, W, t) + \zeta_o(O) + z_o(O, W) \quad (3)$$

$$u_m(O, W) = b + \zeta_m(O, W) + z_m(O, W) \quad (4)$$

$$u_w(O, W) = s + \zeta_w(W) + z_w(O, W) + c_w(W) \quad (5)$$

where $\pi_o(O, W, t)$, b and s are the agents' economic return, $\zeta_o(O)$, $\zeta_m(O, W)$ and $\zeta_w(W)$ is a set of freedom of choice functions, $z_o(O, W)$, $z_m(O, W)$ and $z_w(O, W)$ are organizational rent extraction functions, and $c_w(W)$, for $c_w(W_H) = c_w > 0$ and $c_w(W_L) = 0$, is w 's cost of collective action.

With respect to economic return, we assume that o appropriates all of the firm's profit. Depending on the degree of interest concentration and on the type of technical assets used in production, however, this profit can differ. Hence, we write $\pi_o(O_H, W_H, t) = \pi_{H,H}(t)$, $\pi_o(O_H, W_L, t) = \pi_{H,L}(t)$, $\pi_o(O_L, W_H, t) = \pi_{L,H}(t)$ and $\pi_o(O_L, W_L, t) = \pi_{L,L}(t)$ where t is the feature of technology. For the time being, we take technology as given and study how choices concerning interests concentration are made for a given t . Later, we will remove this assumption and investigate how technical assets adapt to interest concentration. With reference to m and w , we assume that economic return takes the form of a unitary compensation $b (> 0)$ and $s (> 0)$ respectively. To make collective action an economically viable strategy for workers, we also assume $s > c_w$.

The second component in the agents' utility functions is choice freedom. As suggested by the structure of second-order jural relations reported in Table 1, the choices made in domains O and W affect the distribution of power within the organization and thus impact on the agents' welfare. To capture this effect, we follow Pagano (1999) and represent power (p) as a continuum in the interval $[-1, 1]$, where $p = -1$ stands for full dependence on the power of others and $p = 1$ stands for full exercise of power over others. On this basis we define a freedom of choice function $\zeta(p)$ such that, $\zeta(1) = \zeta$, $\zeta(-1) = -\zeta$ and $\zeta(0) = 0$, where $\zeta > 0$ represents the benefit (cost) associated with the exercise (lack) of choice freedom. In this framework, $\zeta(0)$ represents a situation in which the distribution of power among the agents is even: that is, a jural relation in which the inability of one agent is counterbalanced by the immunity of the other, and *vice versa*.

Given this setting, we define the agent-specific freedom of choice functions by explicitly considering the two layers of authority relations depicted in Table 1. Agents o and m are involved in one type of authority relation, either upstream or downstream. Hence, we can define their freedom of choice functions only in terms of their domain of choice. In particular, we write $\zeta_o(O)$ and $\zeta_w(W)$ as follows:

$$\zeta_o(O) = \begin{cases} \zeta, & \text{if } O = O_H \\ 0, & \text{if } O = O_L \end{cases} \quad \zeta_w(W) = \begin{cases} 0, & \text{if } W = W_H \\ -\zeta, & \text{if } W = W_L \end{cases}$$

Agent m , instead, is positioned in the middle of the hierarchy and is thus influenced by both upstream and downstream relations. In this regard, we call $\zeta_m^u(O)$ and $\zeta_m^d(W)$ m 's upstream and downstream freedom of choice functions, respectively. The latter take the following form:

$$\zeta_m^u(O) = \begin{cases} -\zeta, & \text{if } O = O_H \\ 0, & \text{if } O = O_L \end{cases} \quad \zeta_m^d(W) = \begin{cases} 0, & \text{if } W = W_H \\ \zeta, & \text{if } W = W_L \end{cases}$$

On this basis, m 's degree of choice freedom is precisely the sum of the two functions above, i.e. $\zeta_m(O, W) = \zeta_m^u(O) + \zeta_m^d(W)$. To ensure that the firm is economically viable as an institution of production, we also assume that $\zeta < s$ and $\zeta < b$.

The last component of the utility function is organizational rent. Whenever there is a mismatch between the degrees of concentration in domains O and W , it is possible for o and w to collude with m in the extraction of upstream and/or downstream rents. Under the combination (O_H, W_L) , for instance, o and m can exploit their position of relative power to extract organizational rents from w . By selecting working conditions that are more favourable to o than to w , in fact, m can transfer resources from labour to capital while obtaining a partial compensation for their service. This is possible because the lack of strong safeguards to protect w 's interest limits their ability to oppose such collusion. Similarly, under (O_L, W_H) w can exploit their immunity position to offer m a collusion agreement that goes in the opposite direction, i.e. it makes m transfer resources from capital to labour in exchange for an appropriate compensation. By doing so m can improve upon their position and partially compensate for

the lack of downstream power. This makes the collusion agreement economically convenient for m . In addition, organizational rents can be extracted even when both domains O and W are characterized by low concentration. In this case, in fact, m can enjoy both upstream immunity and downstream power. Although the impossibility of reaching collusive agreements limits the size of the actual rent, the fact that the rent can be extracted both in upstream and downstream relations still makes m better off with respect to all the other possible combinations.

We assume that agents o and w have a fall-back position equal to zero, and we call $z_u(L, j) = \pi_{L,j}(t)$ (for $j = H, L$) and $z_d = s - \zeta$ the upstream and downward rents extracted from capital and labour respectively. Under combination (O_L, W_L) , we assume that m can extract only a fraction ε of the upstream and downstream rents, where $\varepsilon > 0$ is a measure of m 's decisional authority. On this basis we define the organizational rent extraction functions as follows:

$$z_o(O, W) = \begin{cases} 0, & \text{if } O = O_H \wedge W = W_H \\ (s - \zeta)/2 & \text{if } O = O_H \wedge W = W_L \\ -\pi_{L,H}(t) & \text{if } O = O_L \wedge W = W_H \\ -\varepsilon\pi_{L,L}(t) & \text{if } O = O_L \wedge W = W_L \end{cases} \quad z_w(O, W) = \begin{cases} 0, & \text{if } O = O_H \wedge W = W_H \\ -(s - \zeta) & \text{if } O = O_H \wedge W = W_L \\ \pi_{L,H}(t)/2 & \text{if } O = O_L \wedge W = W_H \\ -\varepsilon(s - \zeta) & \text{if } O = O_L \wedge W = W_L \end{cases}$$

$$z_m(O, W) = \begin{cases} 0, & \text{if } O = O_H \wedge W = W_H \\ (s - \zeta)/2 & \text{if } O = O_H \wedge W = W_L \\ \pi_{L,H}(t)/2 & \text{if } O = O_L \wedge W = W_H \\ \varepsilon(\pi_{L,L}(t) + s - \zeta) & \text{if } O = O_L \wedge W = W_L \end{cases}$$

where we assume that, under all combinations, the collusion agreement foresees an equal split of the extracted resources between the colluding parties.

On the basis of the above assumptions, the conflictual interaction between o and w can be represented in game theoretic form by the triplet $\Gamma = \{I, \Theta, u\}$, where $I = \{o, w\}$ is the set of players, $\Theta = O \times W$ is the set of strategy profiles and $u = \{u_o(\theta, t), u_w(\theta)\}$ for $\theta \in \Theta$ is the vector function of the players' payoff, where $u_o(\theta, t)$ and $u_w(\theta)$ are given by Eqs. (3) and (5). Table 2 reports a normal-form representation of Γ , with the payoff of m (who is a passive player in this game) in squared brackets. With respect to game Γ we consider the following definitions:

Definition 1. A politics-business arrangement in game Γ corresponds to a pure strategy profile $\theta = \{\theta_o, \theta_w\} \in \Theta$, where $\theta_o \in O$ and $\theta_w \in W$ is the pure strategy adopted by players o and w , respectively.

To every politics-business arrangement corresponds a specific way to resolve the conflict between workers and owners. In particular, game Γ offers a representation of four distinct arrangements, namely $\{O_H, W_H\}$, $\{O_H, W_L\}$, $\{O_L, W_H\}$ and $\{O_L, W_L\}$. In this set we are particularly interested in the combinations that qualify as self-sustaining equilibria. We call the latter politics-business varieties and define them as follows:

Definition 2. A politics-business arrangement $\theta^* = \{\theta_o^*, \theta_w^*\}$ is a politics-business variety if the corresponding pure strategy profile is a Nash equilibrium of game Γ .

Table 2

Owner (o)	Worker (w)	
[Manager (m)]	Concentrated Interests (W_H)	Dispersed Interests (W_L)
High Concentration (O_H)	$\pi_{H,H}(t) + \zeta, s - c_w$ [$b - \zeta$]	$\pi_{H,L}(t) + \zeta + (s - \zeta)/2, 0$ [$b + (s - \zeta)/2$]
Low Concentration (O_L)	$0, s + \pi_{L,H}(t)/2 - c_w$ [$b + \pi_{L,H}(t)/2$]	$\pi_{L,L}(t)(1 - \varepsilon), (s - \zeta)(1 - \varepsilon)$ [$b + \zeta + \varepsilon(\pi_{L,L}(t) + s - \zeta)$]

On this basis, the following proposition holds:

Proposition 1. Suppose $\zeta < s$, $\zeta < b$ and $s > c_w$. Then: a) for any t , $\{O_L, W_H\}$ and $\{O_H, W_L\}$ are never politics-business varieties; b) for any $\pi_{L,L}(t) < \pi_{L,L}^*(t)$ or $c_w < c_w^*(t)$, where

$$\pi_{L,L}^*(t) = \frac{1}{1 - \varepsilon} \left(\pi_{H,L}(t) + \frac{s + \zeta}{2} \right) \quad c_w^*(t) = \frac{\pi_{L,H}(t)}{2} + \zeta + \varepsilon(s - \zeta)$$

$\{O_H, W_H\}$ is the only politics-business variety; c) if $\pi_{L,L}(t) \geq \pi_{L,L}^*(t)$ and $c_w \geq c_w^*(t)$, then two politics business-varieties exist, namely $\{O_H, W_H\}$ and $\{O_L, W_L\}$.

Proposition 1 suggests that, depending on the value of the firm's profit and the cost of collective action, different types of politics-business varieties may exist. If either the profit obtainable under $\{O_L, W_L\}$ or the costs that workers incur when concentrating their interests are sufficiently small, then $\{O_H, W_H\}$ is the unique equilibrium of the game. In this case, owners have very little to gain from ownership dispersion, and high concentration is their dominant strategy. The same applies to workers, for whom it is relatively cheap to coordinate individual participation in their class organizations. As a result, an arms race between owners and workers will make the variety characterized by symmetric class armament likely to emerge.

The result is different, however, if a combination of external factors can dampen the conflict between owners and workers. To be effective, such factors should operate at two distinct levels. On the one hand, they should raise the value of $\pi_{L,L}(t)$ relative to $\pi_{H,L}(t)$, thereby making ownership dispersion increasingly convenient for owners. For instance, these factors could take the form of a new set of technologies that makes governance models based on hired managers highly profitable. On the other hand, a symmetric group of factors should also increase the cost of collective action for workers, so that individual participation in class organizations becomes costly. In this case, both the weakening of class ideology and the implementation of *laissez-faire* market interventions may serve the purpose. If both types of factors operate jointly, the race towards increased interests concentration can be blocked and a new type of highly dispersed equilibrium emerges. In these cases, multiple politics-business varieties can co-exist, and history is indeed the main force that determines towards which variety a specific social system will converge.

The existence of multiple politics-business varieties raises some intriguing questions concerning the role of institutional changes. When both armament-like and disarmament-like conflictual complementarities exist, the nature of the interactions between classes can be the source of institutional lock-in, which impedes the transition from one institutional arrangement to the other. In this regard, two important aspects need to be considered. The first concerns the asymmetry that characterizes the role of economic and political forces in fostering changes within the property and polity domains. As suggested by Belloc and Pagano (2009), while politics is essential to curb capitalist concentration and

to induce workers' unionization, it may be irrelevant in regard to the concentration of capitalist ownership and the dispersion of the workers' interests. Spontaneous economic forces (by which here we mean ordinary self-seeking behaviour in standard competitive markets) have a tendency to concentrate capital and to disperse labour (or, at least, to concentrate capital more than labour), whereas political forces are necessary to disperse capital and concentrate labour. This in turn implies that a mix of both economic and political forces is needed for institutional changes to occur.

The second important aspect to be considered concerns the role of technology. As observed in the case of primates, distinct types of conflictual complementarities can create incentives for agents to invest in different types of 'technologies', which makes transitions across distinct equilibria even more difficult. In the world of social institutions, the stabilizing effect of technology is strengthened by the existence of synergetic complementarities between organizational rights and technical assets. As the next section will show, such complementarities can stabilize the features of politics-business varieties and increase the institutional stability of each variety.

4. Rights/technologies synergetic complementarities

The relation between technology (i.e. the technological characteristics of the resources used in production) and organizational rights (i.e. the set of rights on the resources employed in the organization and on the organization itself) has always been a controversial issue in social science. Causation can go both ways. On the one hand, organizational 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 cause of changes in organizational rights.

New Institutional Economics³ has furnished a powerful rationale for the second direction of causation. In a world of positive transaction costs and contract incompleteness, it is argued, the characteristics of the resources and assets used in production (i.e. the nature of technology) inevitably affect the allocation of property rights. Under the force of competition, in particular, property rights will tend to be designed so as to minimize the sum of transaction and production costs. By doing so, organizations can improve efficiency and enjoy a competitive advantage in the market. This in turn makes efficiency-enhancing property rights predominant in the economy.

³ The New Institutional approach stems from Coase (1937, 1960) and includes Williamson, 1985 and the property rights (Hart, 1995) literature.

The technological neutrality of property rights implicit in New Institutional Economics was strongly criticized by so-called ‘Radical’ economists.⁴ Braverman (1974), for instance, argued that the characteristics of the assets employed under classical capitalism were outcomes of its property rights. This view implies a substantial inversion of the standard New Institutional line of reasoning (Pagano, 1993). In a world of positive transaction costs, when given a certain allocation of property rights, agents may have an incentive to design and adopt technologies minimizing the costs associated with the initial rights. As a result, also in the framework of standard agency theory, we should expect technology and property rights to optimally adjust to each other, except that in this case the direction of causation is reversed. Whereas the standard New Institutional approach views causality as running from technology to property rights, under the Radical approach causality runs from property rights to technology.

Although these two views have often been considered antithetical (Williamson, 1985), they are not mutually exclusive. On the contrary, as suggested by Pagano (1993), it may happen that both causalities hold at the same time. When this is the case, economic organizations qualify as self-sustaining institutions in which for any given technology there exists an optimal allocation of organizational rights, and for any given allocation of organizational rights there exists an optimal technology. This two-way relationship leads to situations of ‘organizational equilibrium’, where rights self-reinforce via technology and vice versa. Following Aoki (2001), this self-reinforcing relation can be viewed as the source of institutional complementarities, with the obvious consequence that, when such complementarities obtain, multiple organizational equilibria may exist.

The notion of organizational equilibria has been employed in several contexts to study institutional evolution.⁵ The key insight that emerges from this literature is that in most social systems neither are technical assets *rights-neutral* nor are institutional arrangements *technology-neutral*. Rather, these are systems in which technical assets and organizational rights adjust each another in a way that is very similar to the synergetic adaptation of complementary traits in complex biological species. Synergetic complementarities do not only characterize the world of nature; they also shape the world of institutions.

The synergetic relation between technical assets and organizational rights adds a further variable to the politics-business framework discussed in Section 3. In addition to conflict between owners and

⁴ See for instance Marglin (1974), Rowthorn (1974), Pagano (1985) and Bowles (1985, 1989).

⁵ See for instance Pagano and Rowthorn (1994), Pagano and Rossi (2004), Pagano (2011), Earle et al. (2006), and Landini (2012, 2013).

workers, the nature of capitalism is also affected by the specific ways in which technology and the politics-business arrangement adjust each other. The combination of these distinct relations is at the very root of the Marxian theory of history, where both conflicts and synergies play an essential role. According to Marx, history is shaped by two main forces: social class conflicts and the synergetic adaptation of productive forces and production relations (i.e. distinct modes of production). On this view, capitalism is a system in which conflictual and synergetic complementarities co-exist and are the main drivers of the system's evolution.

To model the co-existence of conflictual and synergetic complementarities formally, we extend the setting developed in Section 3, where four politics-business arrangements existed: $\{O_H, W_H\}$, $\{O_H, W_L\}$, $\{O_L, W_H\}$ and $\{O_L, W_L\}$. In Section 3 we left the features of technology unspecified, taking them as given and, on the basis of this assumption, we studied the conflictual complementarities between interests concentration in the property rights and polity domains. We now depart from that setting by making technical assets endogenous to the analysis and focusing on their synergetic adaptation to the politics-business structure. Proposition 1 suggests that, for any type of technology, $\{O_H, W_L\}$ and $\{O_L, W_H\}$ are never politics-business varieties. On the contrary, for sufficiently high levels of $\pi_{LL}(t)$ and c_w , both $\{O_H, W_H\}$ and $\{O_L, W_L\}$ are politics-business varieties. Hence, in what follows we focus on combinations $\{O_H, W_H\}$ and $\{O_L, W_L\}$ and consider the space of parameters in which both are politics-business varieties⁶. To simplify the notation, let us define a new domain $P = \{P_H, P_L\}$, where $P_H = (O_H, W_H)$ and $P_L = (O_L, W_L)$ denote a politics-business variety characterized respectively by a high and low degree of interest concentration. On this basis, we will define a variety of capitalism as a pair (P, t) , where t stands for the features of technology.

We assume technology to be represented by three types of production factor, namely capital (K), managerial knowledge (M), and labour (E), where E stands for work effort. K is supplied by owners (o), M is supplied by managers (m) and E is supplied by workers (w). We assume the existence of a standard production function $Q(K, M, E)$ such that the output Q can be produced with different combinations of capital, managerial knowledge and work effort (K, M, E) .

In line with the organizational equilibria literature, we assume that different politics-business varieties entail different agency costs for the firm. In particular, we assume that when the interests of both owners and workers are highly concentrated, o pays an additional agency cost x to employ one

⁶ In all the remaining parts of the parameter space, no synergetic complementarities between rights concentration and technologies can arise, in that only one type of politics-business variety is viable.

unit of M . The reason is that, under P_H , m is both exposed to the power of o and unable to exercise authority over w (see Table 1), and it may thus require some additional safeguards before making specific investments in managerial knowledge. This cost is saved under P_L because m 's upstream immunity and downstream power themselves work as safeguards. By contrast, when class interests are characterized by low concentration, o pays an additional agency cost y when it employs one unit of K and E . In this case, in fact, the immunity of m (see Table 1) may scare shareholders, who may find it difficult to get rid of opportunistic managers. To invest, they may thus ask for the inclusion of some additional safeguards, which may take the form of a higher return on investment or the form of legal safeguards for shareholders.⁷ Similarly, the low degree of concentration in w 's class interests exposes workers to the power of managers and reduces the incentives to make specific investments in the firm. Such additional agency costs are saved under P_H where w 's downstream immunity and o 's upstream power themselves work as a safeguards.

We denote with r , b and s the prices of respectively K , M and E . We set the price of output equal to 1. On this basis, we write the firm's profit under P_H as follows:

$$\pi_{H,H}(K,M,E) = Q(K,M,E) - [rK + (b+x)M + sE] \quad (6)$$

Similarly, we write the firm's profit under P_L as follows:

$$\pi_{L,L}(K,M,E) = Q(K,M,E) - [(r+y)K + bM + (s+y)E] \quad (7)$$

Given Eqs. (6) and (7), we may formulate the 'organizational rights causes technology' approach by simply assuming that the firm maximizes $\pi_{H,H}$ under P_H and $\pi_{L,L}$ under P_L . The degree of interest concentration influences technology because it involves changes in the relative costs of using the factors. The relative prices of K and M are $(b+x)/r$ under P_H and $b/(r+y)$ under P_L . Similarly, the relative price of E and M are $(b+x)/w$ under P_H and $b/(w+y)$ under P_L . Thus, under standard

⁷ The demand for, and the production of, law are very different in the two systems. For instance laws protecting shareholders make sense in decentralized systems with dispersed ownership. Their transplant in systems with concentrated ownership can produce unintended, and often undesirable, results (Milhaut and Pistor 2008), reinforcing political constituencies which, holding already a disproportionate power, threaten the integrity of managers' and workers' incentives. The political consequences of economic reforms must also be taken into account since they influence future economic policies (Acemoglu and Robinson 2013) and, therefore, the overall process of economic change.

assumptions on the shape of $Q(\cdot)$, the intensity of K and E relatively to the intensity M is higher under P_H than under P_L . In this framework, the value of the elasticity of substitution among factors becomes a measure of the ‘strength’ of the effects of changes in interest concentration on the nature of technology.

We have seen that a causation mechanism running in the opposite direction can also be considered. According to this view, for given technical assets, the degree of interest concentration that guarantees the highest return is supposed to be adopted. Therefore, P_H can prevail if, given the factors currently employed, $\pi_{H,H} \geq \pi_{L,L}$, or alternatively,

$$(K+E)/M \geq x/y$$

On the contrary, P_L can prevail if, given the factors currently employed, $\pi_{H,H} \geq \pi_{L,L}$, or alternatively,

$$(K+E)/M \leq x/y$$

Technologies characterized by a higher $(K+E)/M$ ratio bias the politics-business structure P , making it relatively more appealing (or less disadvantageous) to have high (instead of low) interest concentration.

The ‘organizational rights causes technology’ approach focuses on the choice of the firm’s technical assets for *given (high or low) interest concentration*. By contrast, the ‘technology causes organizational rights’ view analyses the politics-business arrangements of the firm for any *given combination of factors employed in the firm*. We say that we have an organizational equilibrium when both directions of causation are simultaneously taken into account. In particular, we say that a variety of capitalism (P, t) is in *organizational equilibrium (OE)* when t is the technology that maximizes the firm’s profit under the degree of interest concentration P , and P is the degree of interest concentration that maximizes firm’s profit with the factor intensities associated with t .

Let:

$$(K_H, M_H, E_H) = \operatorname{argmax} \pi_{H,H}(K, M, E) \quad (8)$$

$$(K_L, M_L, E_L) = \operatorname{argmax} \pi_{L,L}(K, M, E) \quad (9)$$

and let the features of technology be denoted by the ratio $t_j = (K_j + E_j) / M_j$, for $j = H, L$. On this basis, we introduce the following definitions:

Definition 3. The variety (P_H, t_H) constitutes a concentrated OE for the set of values for which the degree of interest concentration P_H maximizes profit under the prevailing technology t_H and, in turn, the factors intensity t_H maximizes profit given degree of interest concentration P_H . This occurs when the following holds:

$$t_H = (K_H + E_H)/M_H \geq x/y \quad (10)$$

Definition 4. The variety (P_L, t_L) constitutes a dispersed OE for the set of values for which the degree of interest concentration P_L maximizes profit under the prevailing technology t_L and, in turn, the factors intensity t_L maximizes profit given degree of interest concentration P_L . This occurs when the following holds:

$$t_L = (K_L + E_L)/M_L \leq x/y \quad (11)$$

Definitions 3 and 4 furnish a useful representation of the self-reinforcing nature of technology and interest concentration: once a given politics-business arrangement is in place, the choice of technology, defined in terms of the relative intensity of K , M and E , will not upset it. Rather, within certain limits related to degree of malleability of the technology, it will be such as to reinforce the convenience of keeping the initial politics-business arrangement in place.

The type and number of equilibria existing in the economy depend on the extent to which, for any given degree of interest concentration, there exists an optimal combination of K , M and E , and *vice versa*. In particular, the following proposition holds:

Proposition 2.

(a) Multiple OEs exist when the following condition is satisfied:

$$t_H = (K_H + E_H)/M_H \geq x/y \geq (K_L + E_L)/M_L = t_L \quad (12)$$

i.e., when both condition (10) and (11) are satisfied.

(b) A unique concentrated OE exists if:

$$t_H = (K_H + E_H)/M_H \geq (K_L + E_L)/M_L = t_L \geq x/y \quad (13)$$

i.e., when condition (10) is satisfied but not condition (11)

(c) A unique dispersed OE exists if:

$$x/y \geq t_H = (K_H + E_H)/M_H \geq (K_L + E_L)/M_L = t_L \quad (14)$$

i.e., when condition (11) is satisfied but not condition (10).

(d) For any ratio x/y at least one equilibrium exists.

Proposition 2 highlights the existence of an interesting relationship between the malleability of technical assets and the existence of different varieties of capitalism. As suggested by condition (12), in fact, multiple equilibria exist as long as the ratio between the two additional costs x and y falls within the close interval defined by t_H and t_L . Pagano and Rowthorn (1994) show that this condition is more likely to be satisfied, the greater the elasticity of substitution among production factors, that is the greater the malleability of the technology and the possibility to adapt it to a particular type of business organization. This in turn implies that, depending on the value of such elasticity, different patterns of institutional speciation may emerge.

Suppose for instance that the production environment is such that the elasticity of substitution is very low, and in particular that condition (13) is satisfied. It follows that high concentration is predominant in domain P . In this case, the main force producing such results is a technological one, with the property rights domain and polity domain adjusting accordingly.

The results is different, however, if some degree of technical malleability exists. In this case, in fact, for every politics-business variety there will be an optimal combination of technical assets. Hence technology, rather than being the leading force that drives institutional adjustment, tends to adapt to the other institutional domains and operates as a factor stabilizing the system. In these cases different trajectories of institutional speciation may co-exist.

When both concentrated and dispersed equilibria exist, it is interesting to investigate their relative efficiency. From the social point of view, in fact, convergence towards one equilibrium as opposed to the other has strong effects on the distribution of welfare; and this can have important implications for public policies. In this regard, it should be noted that, in the standard arms race argument, the mutual disarmament equilibrium (*i.e.* dispersion), is likely to be Pareto superior. Under this equilibrium, in

fact, both types of agents save the costs of investing in further armaments and can avoid conflict. By contrast, in our case it is not possible to rank equilibria *a priori*. The synergetic adaptation of technical assets may induce economies characterized by different politics-business arrangements to accumulate distinct types of technologies, and thus to differentiate their pattern of specialization across industries (Belloc, Pagano 2012). In these cases, the total welfare generated at the two equilibria depends on the profit that firms can earn in each of these industries, and the ranking of equilibria can vary. In particular, we obtain the following result:

Proposition 3. *Suppose that both concentrated (P_H, t_H) and dispersed (P_L, t_L) OE exist. Then: a) If $\pi_{L,L}(K_L, M_L, E_L) < \pi_{L,L}^*$, where*

$$\pi_{L,L}^* = [\pi_{H,H}(K_H, M_H, E_H) + \zeta] / (1 - \varepsilon),$$

then (P_H, t_H) and (P_L, t_L) are not mutually Pareto comparable; b) If $\pi_{L,L}(K_L, M_L, E_L) > \pi_{L,L}^$, then (P_L, t_L) is Pareto superior; c) The greater m 's decisional authority ε , the smaller the set of parameters for which (P_L, t_L) is Pareto superior; d) For any t , the two disequilibria characterized by asymmetric concentration of class interests are never Pareto superior.*

The intuition behind Proposition 3 is straightforward. Managers are always better off under equilibrium (P_L, t_L) as opposed to (P_H, t_H) , where the combination of both upstream immunity and downstream power enables them to extract large organizational rents. This in turn implies that equilibrium (P_H, t_H) can never be Pareto superior. For workers, the superiority of one of the two equilibria depends instead on two components, namely m 's decisional authority ε and the cost of collective action c_w . Whenever m 's authority is sufficiently low and the cost of collective action is sufficiently high, workers are better off under equilibrium (P_L, t_L) . In these cases, in fact, the cost of being subject to m 's power is more than off-set by the possibility to avoid the collective action problem associated with interest concentration. In particular, we find that for the set of parameters in which both (P_H, t_H) and (P_L, t_L) are equilibria this condition is always satisfied, so that workers always prefer equilibrium (P_L, t_L) . It follows that the Pareto superiority of the dispersed equilibrium rests on the utility gained by owners, and in particular on the value of the firm's profit. If we interpret the adoption

of technique t_L as the specialization in industries that make intensive use of managerial knowledge, we find that as long as the profit obtainable through dispersed ownership within such industries is above a certain threshold, (P_L, t_L) is Pareto superior. Otherwise, the two equilibria are not Pareto comparable. Moreover, we find that the set of parameters for which the two equilibria are not Pareto comparable is larger, the stronger the managers' decisional authority, and that the two disequilibria characterized by asymmetric concentration of class interests can never be Pareto superior (due to the asymmetric extractions of organizational rents).

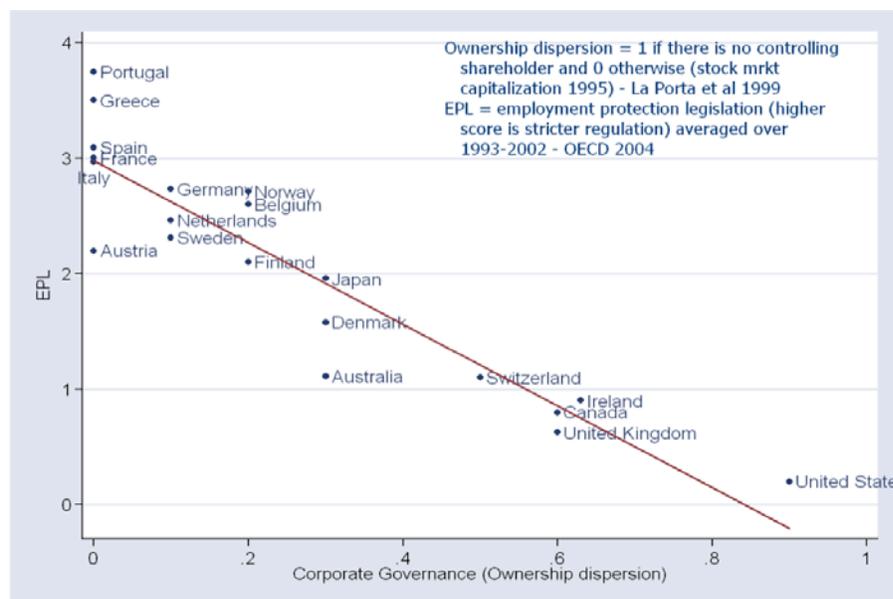
The impossibility of ranking equilibria for a large proportion of the parameter space differentiates the result of our model from those of the previous literature. Both the legal origins (La Porta et al., 1999; 2006) and the electoral system approach (Pagano and Volpin, 2005) to the study of corporate governance tend, in fact, to draw up a ranking of the different systems available, suggesting consequent measures for public policies. Differently from our approach, this literature focuses on a one-way causality as determining ownership concentration, and does so by relying on either the degree of shareholder protection or the proportionality of the voting system. Neither of these approaches, however, considers the existence of institutional complementarities in corporate governance systems, and the co-evolutionary dynamics that the latter generate. Belloc and Pagano (2013) report empirical evidence supporting the superiority of the co-evolution approach over competing theories. In this respect, the results of our model add to this evidence by identifying the variables that contribute to making concentrated and dispersed equilibria Pareto unrankable. Among the latter, the strength of managers' decisional power (or even the abuse of such power) and the associated inefficiencies of the dispersed equilibrium play a particularly relevant role.

5. Synergetic and conflictual complementarities: a comparative history illustration.

Figure 5.1 (Belloc, Pagano 2009) shows the relation between the level of employment protection and the dispersion of ownership. Concentrated ownership and high employment protection can be interpreted as high-level armaments that both owners and workers have adopted. In terms of the framework considered in the first section, we have a 'gorilla equilibrium' where each competitor has become strong because also its competitors are strong in an environment where the benefits of conflicts are greater than their costs. In terms of Section 3, the countries on the left of our figure approximate a $\{O_H, W_H\}$ equilibrium where both employers and employees have concentrated their interests. By

contrast, the countries on the right of our figure (mainly the US) approximate the $\{O_L, W_L\}$ equilibrium where both the interests of the employers and those of employees are dispersed – a disarmament equilibrium resembling the biological analogy of the ‘chimp equilibrium’ where the costs of conflicts exceed their benefits

Figure 1 – Employment protection and ownership dispersion



The US and most European countries are characterized by different types of ‘conflictual complementarities’. The focus of most European countries has been the ‘social governance’ of the conflicts between employers and employees, while the American political and economic debate has concerned ‘firm-level’ governance of the conflicts between managers and dispersed ownership. The German co-determination system (as well as most European industrial relations systems) "originated in the social movements of late nineteenth-century Europe". By contrast "corporate governance is a younger concept" which emerged "not in response to social conflicts, but rather as results of developments in the American economy, which seemed to be giving dispersed shareholders less and less control and allowing manager to become even stronger." (Pistor 1999 p. 164). Consequently, in

the American system the production of law and economic analysis have focused on shareholder protection – a policy less relevant (and sometimes even counterproductive) in countries characterized by concentrated block-holding (Milhaut and Pistor, 2008)

In the late nineteenth century, social conflicts played a much less important role in the US than in Europe. The reason resides in the fact that the early emergence of democracy allowed an exceptional American historical path different from those of most European countries (Pagano 2013a).

At the beginning of the second half of the nineteenth century, the US was the only country (perhaps besides Switzerland⁸) where the landed aristocracy had no political power. Because of its anti-aristocratic attitude, the US reacted early to the concentration of economic power which came with the second industrial revolution. The Sherman Act (1890) was the first, and by far the most important, piece of anti-monopoly legislation to be enacted in a modern economy. After Theodore Roosevelt's clashes with big business, Wilson continued the endeavour to set limits on the power of the major block holders. The Clayton Act (1914) ruled that the ownership of substantial stakes in different firms may induce self-dealing and unfair competition and should therefore be supervised by anti-trust authorities. F.D. Roosevelt completed these policies by using taxation to dismantle the pyramids (Randall, 2004) that, in many cases, had enabled a few “economic royalists” to use “other people’s money” to impose a “new industrial dictatorship” (Roosevelt quoted by Roe, 1994, p. 40).

The same strong democratic state was able to limit the power of the unions also because workers had fewer incentives to organize, given the dispersion of shareholder power. Because of the dispersion of shareholder and union power, managers had considerable power and the American corporation became known as the typical kind of managerial firm.

In all the other countries, aristocratic privileges were quite widespread and no strong democratic state could act early against the concentration of power which came with the industrial revolution. The new bourgeois class internalized many values of the aristocracy, including respect for individuals who had inherited large amounts of wealth and some contempt for the new rich. Ever since the ‘Glorious Revolution’, Britain was characterized by an important role of the aristocracy (which fought against

⁸ There are remarkable similarities between the historical backgrounds of the US and Switzerland. Similarly to the US (where the war of secession terminated the political influence of the slave-owning landed aristocracy of the South) Swiss big business had “democratic origins” in the sense that a full-blown post-feudal society had already emerged before the second industrial revolution (Belloc and Pagano 2013).

and executed the king)⁹, and in post-Napoleonic France the aristocracy had regained many privileges. In the mid-nineteenth century, the power and the values of the aristocracy went even more unchallenged in Germany and in other parts of Europe. As a result, the growth of firms' size, which came with the second industrial revolution, coincided with an increase in the power of the capitalist family dynasties, which, thanks to pyramids and financial connections, could control a range of activities much greater than that allowed by their wealth. Managers had little independence from owners. Usually, good managerial jobs were given to family members or to their acquaintances. Faced with the concentration of the owners' power, also workers had a strong incentive to protect their interests through the organization of centralized unions and by promoting legislation aimed at the protection of their jobs.

In ways analogous to the different varieties of primate equilibria, the diverse conflictual complementarities of the US and the European countries have involved different synergetic complementarities with the assets, the technology, and in general the environment with which they have co-evolved. Also in this instance, the synergetic complementarities have stabilized the outcome of conflicts that, in this case, were the rights and the institutions stemming from the conflictual complementarities of the different class strategies.

The American dispersed equilibrium encourages investment in human skills of professional managers, the diversification of ownership, and the concentration of large amounts of capital in corporations. By contrast, it provides only very mild incentives for the human capital of owners and workers. Much specific knowledge concerning the company is concentrated in the hands of professional managers – a phenomenon that in turn enhances the relative stability of managerial hierarchies in comparison to the frequent changes of firms' affiliation of both absentee owners and workers. Whilst the figure of Taylor and the scientific management movement is often correctly associated with the de-skilling of workers, it can be equally seen as movement in favour of the skilling of professional managers, who were required to concentrate much of the knowledge that was traditionally dispersed among the workers (and some owners). The conditions of asymmetric information between managers and workers were not resolved by aligning workers' incentives, but rather by concentrating information and all sorts of capabilities in the hands of the managers. The American system therefore became a top-down system in the sense that much valuable information was

⁹ In spite of the recent clustering of the U. S. and Britain in the recent concept of Anglo-Saxon model, until the Thatcher years, England had institutions similar to those of the other European countries. In this respect, legal origins cannot explain these institutions nor the recent British metamorphosis (Belloc and Pagano 2013).

heavily concentrated and a considerable flow of instructions ran from top management to workers. The fact that globalization implies that many workers may now be employed in foreign countries has not meant that the model has been substantially abandoned; rather, that it has been successfully extended by using the opportunities provided by the global economy. Thus, a counterpart to the American 'dispersed equilibrium' is that, while owners and workers do not concentrate their interests, there is the tendency to adopt technologies characterized by the concentration of much knowledge in the hands of managers and by a system of 'top-down' instructions to the workers. Such technologies in turn make it 'efficient' to attribute substantial powers to managers, thus creating a self-sustaining path of interaction among politics, technology and corporate governance. Rights stemming from conflictual complementarities are stabilized by their synergetic complementarities with the environment, in much the same way as the small bodies of male chimps, arising from the nature of their (too costly) sexual conflicts, are stabilized by their synergetic complementarities with the environment. A species of capitalism different from the European ones has emerged on the other side of the Atlantic and the large firms, made possible by dispersed ownership, prospered in the large American market that favoured big business.

The diversity of the European countries' histories makes it difficult to find characteristics shared by their systems. However, they all seem to have a less pronounced diversification of ownership, a related small size of their firms, and a policy of employment protection associated with the greater power of the unions. This distribution of rights entails a stronger incentive for owners (and especially their heirs) to invest in the human capital necessary to run firms while, at the same time, employment protection creates the conditions favourable to firm-specific investments also for some workers. By contrast, investments in the human capital of professional managers is discouraged, and information – because it is more widely dispersed among some owners and workers – must often follow a bottom-up path. As in the American case, the technology, favoured by the European forms of corporate governance, reinforces in turn the distribution of rights characterizing these systems: 'concentrated' owners and workers have a vested interest in finding the political safeguards that protect their investments in physical and human capital associated with this technology. Also in the European cases, the strong rights of employers and employees, arising from their conflictual complementarities, have been stabilized by the adoption of synergic complementary technologies to deal with the environment. Again it is possible to suggest a parallel with natural selection: the large size of concentrated employers' and employees' interests may recall the large gorilla bodies arising from conflictual sexual

selection; and in this case, too, the outcomes of conflictual complementarities have been stabilized by environmental synergetic complementarities.

6. Conclusion

When 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 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: 66).

In 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. Evolutionary change is often affected by the existence of conflictual and synergetic complementarities within and among species, and among members of the same species. Similar mechanisms characterize the rule governing the structure and change of institutions, and they should not be confused with simplistic models yielding an unproblematic survival of the fittest variety. The analogies which we have considered show that the evolution of complex structures may lead to vast biological and socio-economic diversity. However, these analogies should not be pushed too far.

According to North (1990), "institutions are the humanly devised constraints that structure human interactions". The speciation of 'chimps' and 'gorilla' types of capitalism in the US and Europe respectively, was a largely unintended consequence of human actions. We have concentrated on unintended design because this focus reinforces the analogies between evolutionary biology and human history and clarifies the role played by different types of complementarities in engendering institutional variation. At the same time, however, it should be recognized that intended human actions have an important role in fostering institutional change. Indeed, many formal and informal institutions arise from conscious attempts to improve social outcomes.

Most institutional arrangements originate from a deliberate endeavour to devise solutions that can produce better outcomes. Again, their complexity may make the task exceedingly difficult. It may involve numerous, and often undesirable, unintended consequences, and it may be the cause of rigidity and evolutionary stasis (Pagano, 2010). From a purely theoretical point of view, it is difficult to say when and how humans are able to solve conceptual and collective action problems and consciously improve their institutions. For this reason, historical specificity matters because “past institutional choices open up some paths and foreclose others for future institutional development” (Ostrom, 1990: 202).

Starting from this conviction, in this paper we have analysed how the inherent complexity of capitalist society led to the historical evolution of different varieties of capitalism worldwide. In analogy with the case of primates, conflictual complementarities among social groups favoured the emergence of equilibria characterized by either highly concentrated (‘gorilla-type’) or widely dispersed (‘chimp-type’) class interests. Thanks to its populist non-aristocratic tradition, combined with some early pieces of anti-monopoly legislation, the US converged towards the ‘chimp equilibrium’. On the contrary, the European countries, although with some differentiation, converged to the ‘gorilla equilibrium’. The synergetic adaptation of technology and institutional arrangements has further stabilized the two equilibria, favouring a process of technological specialization. Globalization and the increasing strength of intellectual property have reinforced this process of institutional and technological specialization even further (Belloc and Pagano 2012).

Policy proposals should take into account that, whilst hybrid forms (where only one side has organized its interests) can never be Pareto-superior, symmetric concentrated and dispersed equilibria, when supported by the appropriate technology, can have these characteristics. Indeed, capitalist societies can realize what Acemoglu and Robinson (2012) call “inclusive institutions” in the symmetric cases of concentrated and dispersed equilibria. By contrast, asymmetric organizations of interests may involve that some constituencies are excluded from the distribution of benefits of society and there can be a resistance to processes of creative destruction necessary to generate economic development. In this respect, our paper reinforces Acemoglu and Robinson (2013) claim that policies ignoring the links between political and economic equilibria may easily induce feedbacks that lead to a deterioration of the level of welfare. For instance, a limitation of unions' monopolies can be beneficial in an economy with dispersed capitalist interests but may harm an economy which has developed the institutions supporting a concentrated equilibrium.

Standard neoclassical theory has ignored many dimensions of scarcity, such as the cognitive, social and institutional ones. Institutions have been treated as a "free lunch" (Pagano 2012) by assuming that markets are available without sustaining the costs of the complex complementary institutions that they require. In this framework, the issue of substitution and production of costly institutions does not arise. As a consequence, the constraints imposed on these processes by the (non)existence of the complementary institutions do not belong in the realm of economic analysis. Thus, restricting the dimensions of scarcity implies that most economics has forgotten history (Hodgson 2001).

Most important institutional changes are the (often partially unintended) outcomes of costly collective action by groups and classes with conflicting objectives. Many institutional complementarities are the outcomes of these struggles. This paper has focused on some interactions between these conflictual complementarities and synergetic types of complementarities. In conclusion, we point out that, in some ways, the paper has implicitly dealt with 'second-order' complementarities (or complementarities among complementarities). Perhaps, careful identification of 'hierarchies of complementarities' is needed to gain better understanding of the evolution of complex biological and social systems.

References

- Acemoglu D., Robinson J. (2012) *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. Profile Books, London.
- Acemoglu D., Robinson J. (2013) Economics versus Policy: Pitfalls of Economic Advice. *Journal of Economic Perspectives* 27 (2): 173-192.
- Amable, B. (2000) "Institutional Complementarity and Diversity of Social Systems of Innovation and Production," *Review of International Political Economy* 7.4: 645–687
- Amable, B. (2003) *The Diversity of Modern Capitalisms*, Oxford University Press, Oxford
- Aoki, M. (1994) "The Contingent Governance of Teams: Analysis of Institutional Complementarity," *International Economic Review*, 35: 657–676
- Aoki, M. (2000) *Information, Corporate Governance, and Institutional Diversity. Competitiveness in Japan, the USA, and the Transitional Economies*, Oxford University Press, Oxford
- Aoki, M. (2001), *Toward a Comparative Institutional Analysis*, MIT Press, Cambridge
- Battistini A., Pagano U. (2008) Primates' Fertilization Systems and Evolution of the Human Brain. *Journal of Bioeconomics*, Vol. 10 N. 1 pp. 1-21.
- Belloc F., Pagano U. (2012) Knowledge Enclosures, Forced Specialization and Investment Crisis. *The European Journal of Comparative Economics*. Vol. 9, N. 3 pp. 445-483.
- Belloc, M. and U. Pagano (2009), 'Co-evolution of politics and corporate governance', *International Review of Law and Economics*, 29:106–114
- Belloc, M. and U. Pagano (2013), 'Politics–business co-evolution paths: Workers' organization and capitalist concentration', *International Review of Law and Economics*, 33:23–36
- Boyer, R. (2000) "The Political in the Era of Globalization and Finance; Focus on Some Regulation School Research," *International Journal of Urban and Regional Research*, 24.2: 274–322.
- Boyer, R. (2001) "The Diversity and Future of Capitalisms: A Régulationnist Analysis," in G. M. Hodgson, M. Itoh and N. Yokokawa (eds) *Capitalism in Evolution*, Edward Elgar, Cheltenham.
- Bowles, S. (1989), 'Social Institutions and Technical Change', in M. Di Matteo, R.M. Goodwin and A. Vercelli (eds.), *Technological and Social Factors in Long Term Fluctuations*, Springer-Verlag, New York
- Bowles, S. (1985), 'The production process in a competitive economy: Walrasian, neo-hobbesian, and marxian', *American Economic Review*, 75 (1): 16–36.

- Braverman, H. (1974), *Labour and Monopoly Capital: The Degradation of Work in the Twentieth Century*, Monthly Review Press, New York
- Coase, R. H. (1937), 'The nature of the firm', *Economica*, 4: 386–405
- Coase, R. H. (1960), 'The problem of social costs', *Journal of Law and Economics*, 3: 1–44
- David, P. A. (1985), 'Clio and the Economics of QWERTY', *The American Economic Review*, 75: 332–337
- Earle, J., U. Pagano and M. Lesi (2006), 'Information technology, organizational form, and transition to the market', *Journal of Economic Behavior and Organization*, 60: 471–489
- Ghiselin, M. T. (1974). *The economy of nature and the evolution of sex*. Los Angeles: University of California Press.
- Gould, S. J. (1992), 'The Panda's Thumb of Technology', in S. J. Gould (ed.), *Bully for Brontosaurus*, Harmondsworth: Penguin Books, pp. 59–78.
- Hall, P. and D. Soskice (eds) (2001) *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*, Oxford University Press, Oxford
- Hart, O. D. (1995), *Firms, Contracts and Financial Structure*, Clarendon Press, Oxford
- Hodgson G. M. (2001) *How Economics forgot history*. Routledge, London and New York.
- La Porta, R., F. Lopez-de-Silanes, and A. Shleifer (1999), 'Corporate ownership around the world', *Journal of Finance*, 54: 471–517
- La Porta, R., F. Lopez-de-Silanes, and A. Shleifer (2006), 'What works in securities laws?', *Journal of Finance*, 61(1): 1–32
- Landini, F. (2012), 'Technology, property rights and organizational diversity in the software industry', *Structural Change and Economic Dynamics*, 23(2): 137–150
- Landini, F. (2013), 'Institutional Change and Information Production', *Journal of Institutional Economics*, 9(3): 257-284
- Marglin, S. A. (1974), 'What do bosses do? the origins and functions of hierarchy in capitalist production', *Review of Radical Political Economy*, 6: 60–112
- Milhaupt C. J., Pistor K. (2008) *Law and Capitalism*. The University of Chicago Press. Chicago and London.
- North, D. (1993), 'Economic Performance Through Time. Douglass C. North – Prize Lecture', http://nobelprize.org/nobel_prizes/economics/laureates/1993/north-lecture.html

- Ostrom, E. (1990), *Governing the Commons: The Evolution of Institutions for Collective Action*, New York: Cambridge University Press.
- Pagano, M. and P. Volpin (2005), 'The political economy of corporate governance', *American Economic Review*, 95(4): 1005–1030
- Pagano, U. (1993), 'Organizational equilibria and institutional stability', in S. Bowles, H. Gintis, and B. Gustafsson (eds.), *Markets and Democracy: Participation, Accountability and Efficiency*, Cambridge University Press, Cambridge
- Pagano, U. (1999), 'Is Power an Economic Good? Notes on Social Scarcity and the Economics of Positional Goods', in S. Bowles, M. Franzini and U. Pagano (eds.), *The Politics and the Economics of Power*, Routledge, London
- Pagano, U. (2000), 'Public Markets, Private Orderings and Corporate Governance', *International Review of Law and Economics*, 20 (4): 453-477
- Pagano, U. (2010), 'Legal Personae: the Evolution of Fictitious Species', *Journal of Institutional Economics*, 6: 117–124.
- Pagano, U. (2011), 'Interlocking complementarities and institutional change', *Journal of Institutional Economics*, 7 (3): 373–392
- Pagano U. (2012) No institution is a free lunch: a reconstruction of Ronald Coase. *International Review of Economics*, 59 (2) pp. 189-200
- Pagano, U. (2013a), 'The Evolution of the American Corporation and Global Organizational Biodiversity', *Seattle University Law Review*, 35: 1271-1298
- Pagano U. (2013b) Love, War and Cultures: an institutional approach to human evolution. *Journal of Bioeconomics*, V. 15 pp. 41-66
- Pagano, U. and M.A. Rossi (2004), 'Incomplete contracts, intellectual property and institutional complementarities', *European Journal of Law and Economics*, 18 (1): 55–67
- Pagano, U. and R. Rowthorn (1994), 'Ownership, technology and institutional stability', *Structural Change and Economic Dynamics*, 5 (2): 221–242
- Pistor K. (1999) Codetermination: A Sociopolitical Model with Governance Externalities. In M. M. Blair and M. J. Roe *Employees and Corporate Governance* Brookings Institution Press, Washington pp. 163-193.
- Roe, M. J. (1994), *Strong managers, weak owners: The political roots of American corporate finance*, Princeton University Press, Princeton, NJ
- Roe, M. J. (2003), *Political determinants of corporate governance*, Oxford University Press, Oxford
- Rowthorn R. (1974), 'Neo-classicism, Neo-Ricardianism and Marxism', *New Left Review*, 86: 63-82

Williamson, O. E. (1985), *The Economic Institutions of Capitalism*, The Free Press, New York

Winter, S. G. (1987), 'Competition and Selection', in J. Eatwell, M. Milgate and P. Newman (eds.), *The New Palgrave: A Dictionary of Economics*, London: Macmillan, pp. 545–548.