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Property, Possession and Knowledge*

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Abstract

As Hodgson has nicely pointed out, capitalism can be only understood if we accept that, unlike possession, property is a social construction and a relation among individuals. Unlike possession, property does not require a material thing on which it should be applied. Property rights can create fictitious commodities on intangible assets symbolizing the relationships among persons.

The commoditization of knowledge and the emergence of contemporary intellectual monopoly capitalism must be understood in this framework. Knowledge is a non-rival good and its possession by others is not incompatible. Since we can all possess the same piece of knowledge, the so-called knowledge economy is often seen as place where capitalist relations should weaken. However this view confuses property with possession. In modern societies, intellectual property is becoming the most important part of capital. In spite of the non-rival possession of knowledge, intellectual property rights can be defined as the exclusive right to a piece of knowledge involving the corresponding restriction of others' liberties to use it. Modern intellectual monopoly capitalism is built on sophisticated property rights that should be not confused with any sort of primitive possession.

1. Introduction.

As Geoff Hodgson (2015a, 2015b, 2015) has observed, economists have often confused possession with property.

Possession is a relationship between an individual and an object. It entails that a person has access to that object and uses it to satisfy his or her needs. Animals can possess things, and for long periods possession may be unchallenged by rivals if each animal devotes more energy to defense of its territory than to invasion of the territories of the other animals.

Property is a relation among individuals. It entails that third parties impose corresponding duties not to interfere with others' property rights. Third parties have the power to enforce property rights. Property rights require elementary community enforcement and can assume complex forms in sophisticated legal systems. They cannot evolve from a struggle among individuals, characterized by hawkish behavior, defending their possessions and its nature is completely different. The proverb "possession is the nine-tenths of the law" is fundamentally wrong[1]. As Rose (2015 p. 62) maintains, "if *de facto* possession is nine-tenths of the law, we know that in effect, there is no law. There are probably not even social norms that would define property informally".

Hodgson (2015c) has aptly pointed out that capitalism can only be understood if we accept that, unlike possession, property is a social construct and a relation among individuals. Unlike possession, property does not require a material thing to which it should be applied. Property rights can create fictitious commodities[2] that are intangible assets characterizing the relationships among persons. Unlike ordinary commodities these fictitious commodities do not have a substance, independent of property rights, over which exclusive possession could be exercised. The commoditization of knowledge and the emergence of contemporary capitalism, based on intellectual monopoly (Pagano 2014b) can only be understood within this framework.

Knowledge is a non-rival good. Its possession by others is not incompatible with our possession. Since we can all possess the same piece of knowledge, the so-called knowledge economy is often seen as a

[1] Possession can signal the existence of property rights but it should not be confused with them (Arunada, 2015).

[2] The use of the term fictitious commodities is somehow related to (but different from) the meaning that it has in Polanyi (1944). Polanyi means by the term "fictitious" the fact that these commodities are not produced for the market (even if they are treated as they were). Hodgson (2016) observes that Polanyi contradicts often this definition. However, this may be due to the fact that Polanyi operates at meta-theoretical level (Zaman (2016). According to him, theories, which may vary across classes, are often wrong but nevertheless they shape history and they are an important part of reality.

domain in which capitalist relations should weaken. However, this conclusion confuses property with possession. In modern societies, intellectual property is becoming the most important part of capital.

Notwithstanding the non-rival possession of knowledge, intellectual property rights can be defined as the exclusive right to a piece of knowledge involving the corresponding restriction of others' liberties to use it. Modern capitalism, which relies to a very large extent on the existence of intellectual property (Pagano 2014b), is built on sophisticated property rights that should not be confused with any sort of primitive form of possession. Intellectual property rights are sophisticated constructs of modern law. They cannot evolve from possession struggles because the possession of knowledge does not require the exclusion of others. No struggles about the possession of knowledge can therefore arise in ways analogous to those occurring for standard rival goods. By contrast, private ownership of knowledge is well possible and it is an important characteristic of contemporary capitalism where forms of intellectual property are becoming the most important assets for many firms.

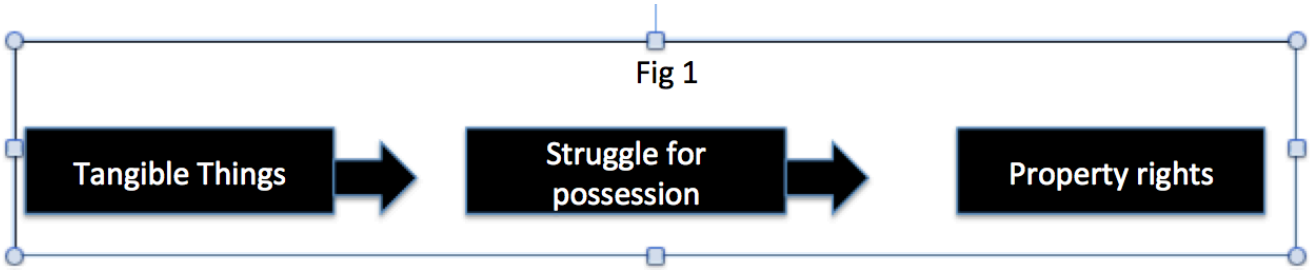
This paper is structured in five sections.

The next section reviews and criticizes the theory that possession can evolve into property. We examine the famous Maynard Smith's Hawks-Dove model and argue that, without an "Eagle" enforcing the rules, it is impossible to evolve a system of property rights. The third section will focus on the nature of legal relations. The relationship between rights and liberties is examined by joining together Mill's theory of liberty with Hohfeld's analysis of legal rights. The fourth section will argue that private property is a special case of human rights and human liberties. It requires evolutionary explanations different from those that rely on the dynamics of possession struggles. Sexual and group selections seem to offer more reliable explanations for the emergence of private property than the struggle for possession of natural resources. This argument reverses the traditional explanation and implies that uncontested possession evolves from property rights. The fifth section considers how private property of non-rival goods, such as knowledge, can be used to restrict the universal potential possession that would otherwise arise form the non-rival nature of these goods. In the case of non-rival goods, property rights do not only allow their limited possession but they also define also the things to be possessed. A piece of knowledge, which can be possessed by only one individual, is an intangible thing created by the definition of intellectual property. In the conclusion we argue that there is no simple evolutionary story leading from contested possession to property rights. By contrast, property rights do not only favor un-contested possession of rival goods. They can also define intangible things limiting the universal possession of non-rival goods.

2. The myth of bourgeois animals.

Possession is visible power or control over something. The possessing individual has access to the possessed object and can benefit from its use. Animals can have possession over certain things. When animals are alone, possession is unchallenged. By contrast, when several animals live together, other animals can challenge possession and sometimes it may be difficult to state whether a certain animal has possession of a certain object. Some form of "respected possession" can evolve among animals. According to John Maynard Smith (1982), animals can adopt certain bourgeois strategies. Some form of respect for possession can evolve from conflicts.

J. M. Smith's famous Hawk and Dove model has been taken as suggesting that property rights can evolve from the natural tendency of all living beings to acquire control over resources and support the claim that possession is nine-tenths of the law. Smith's argument, summarized in fig. 1, entails that property rights may evolve from a struggle for the possession of preexisting tangible things.



In this section, we will criticize this view and argue that property rights cannot evolve from simple possession struggles. There is a substantial discontinuity between property rights and the (challenged) possession considered in the Hawk-Dove games. Conflicts over resources may be characterized by truces. However, wars and truces do not provide a plausible evolutionary foundation for the emergence of property rights. At the end of the next section, we will argue that their emergence requires alternative evolutionary explanations.

In Smith's model, animals can behave either like hawks (fight for resources) or like doves (share equally with doves and flee from hawks). The basic insight of the model is that, if there are many hawks, it is very costly to behave like a hawk, whereas hawkish behavior is convenient if there are many doves. The best strategy depends on the distribution of strategies in the population. Some dovish

behavior may therefore be evolutionarily convenient. Individuals who adopt a mixed strategy (showing hawkish behavior when they defend a resource that they possess and dovish behavior towards resources possessed by others) can achieve even better results. This mixed behavior, which may be also justified by the well-known endowment effect (Gintis 2007), can be seen as a proto-recognition of property rights. For this reason, the corresponding mixed strategy is defined as a bourgeois strategy. In order to discuss the validity of this claim, let us consider the model in more detail.

In the Hawk-Dove model, V stands for the value of the resource whose possession is contested and C denotes the cost of fighting for that resource. Hawks meeting hawks have on average half probability of getting possession of the resource and half probability of being injured. However, when they meet doves, hawks get the entire resource. By contrast, doves meeting hawks get no resource and receive no injury. When meeting other doves, they peacefully share the resource.

	Hawks	Doves
Hawks	(V – C)/2	V
Doves	0	V/2

An evolutionary stable strategy (EES) cannot be invaded by a small number of players with a different strategy (otherwise it cannot last for long). It is immediately evident that a pure strategy of uncontested possession (all doves) is impossible because the pay-off E(D,D) which doves obtain when they meet each other is less than the pay-off E(H,D)that a hawk obtains when meeting a dove, or:

$E(D,D) < E(H,D)$

Thus, a pure dove strategy cannot be an EES. When introduced into a world of all doves, a few hawks (or even better one hawk) have a great time!

By contrast, hawk behavior is the only possible strategy when the risk of injury is more than offset by the benefits of the resource. When 1/2 (V-C) > 0 or when V > C, no group of invading doves can do better than the hawks.

There is only one over-emphasized case in which some dovish behavior can emerge. This occurs when the cost of fighting is greater than its benefit or when C > V. In this case, both hawkish and dovish behaviors are viable. The two behaviors yield the same expected benefits when P (the probability of meeting a hawk) is such that:

$P\ E(H,H) + (1-P)\ E(H,D) = P\ E(D,H) + (1-P)E(D,D)$

where the left side expresses the expected benefit of hawks and right side expresses the expected benefit of doves.

Or referring to the payoff matrix:

$1/2\ (V-C)\ P + V\ (1-P) = 1/2\ V(1-P)$

which implies

$P = V/C$

In other words, fraction of hawks will be equal to the ratio (less than 1) between the value of the resource to be possessed and the cost of fighting.

Individuals can increase their fitness if they can assess the hawkish or the dovish nature of their opponents and behave as doves with hawks and as hawks with doves. They can do even better if they adopt a convention whereby they behave as hawks when they are already in possession of a resource and as doves when somebody else is in control of the resource or, in other words, if they adopt a “bourgeois strategy”. This conclusion is used to justify the claim that some bourgeois behavior may emerge among animals. In this perspective, according to Maynard Smith, property rights are a natural evolution of the possession struggles existing in nature within several species.

However, it is doubtful that the famous hawk-dove model can justify this claim. Dovish behavior can only emerge when the cost of fighting is greater than the value of the resources. This is unlikely to be the case for many valuable resources, and it is even more unlikely when the different animals are characterized by different strength and fighting capacity. For the strongest animal, the value of the resource can easily match the cost of fighting. Possession is likely to be contested in many circumstances because C is unlikely to be very high for the strong in bilateral asymmetric contexts. Only multilateral enforcement of incumbent possession can make C sufficiently high to make hawkish behavior infrequent and protect the weak against the strong. However, this requires an intervention by the community in defense of what it considers to be a legitimate possession. Nothing in the model

suggests an evolution in that direction. An Eagle should monitor and punish the aggressive behavior of the hawks but no Eagle can evolve from the relations between hawks and doves considered in the model.

3. Liberty and legal relations.

Possession is the relationship between an individual and a thing. An animal or a human in isolation can enjoy uncontested possession of a thing. By contrast, property rights and, in particular private property rights, cannot exist for isolated individuals because they are a social construct. They require the existence of a community for which some rights are legitimate and which enforces the correlative duties and liberties of each individual. Private property rights *in rem* (on a particular thing) are rights of a particular type that hold *erga omnes* (towards all individuals). In order better to understand the nature of private property (and its relation with possession), it is useful to consider first the general characteristics of rights. We will do so by referring to Mill's classic case of liberty and only thereafter, in the next section, consider the particular case of private property rights.

According to J. Stuart Mill, liberty was not a gift of a human nature. It was a late conquest of civilization, and it protected a sphere of individual sovereignty not only from authoritarian regimes but also (often even more so) from democracies. Mill (1859, p. 11) argued, "The only part of the conduct of anyone, for which he is amenable to society, is that which concerns others. In the part, which merely concerns himself, his independence is, of right, absolute. Over himself, over his body and mind, the individual is sovereign." According to Mill (1859, p. 12), "Liberty as a principle, has no application to any state of things anterior to the time when mankind have become capable of being improved by free and equal discussion. Until then, there is nothing for them but implicit obedience to an Akbar or a Charlemagne, if they are so fortunate to find one".

There is a sphere of human activities in which no individual should be limited in the exercise of liberty. "It comprises, first, the inward domain of consciousness; demanding liberty of conscience, in the most comprehensive sense; liberty of thought and feeling; absolute freedom of opinion and sentiment of all subjects, practical and speculative, scientific, moral and theological" (Mill 1859 p. 14).

By contrast, the "liberty of expressing and publishing opinions may seem to fall under a different principle, since it belongs to that part of the conduct of an individual which concerns other people" (Mill 1859 p. 14). Other individuals are exposed to the exercise of this liberty. However, while the effects on others are negligible, limitation on the exercise of liberty is very damaging not only for the liberty-restricted individual but also for the entire society, which can greatly benefit from the free expression of opinions and ideas[3].

Actions are different from published material, and they have a greater impact on the welfare of other people. Even the liberty to spread ideas should be limited when it directly induces harmful actions. Thus, the context in which ideas are expressed is an important factor in determining the area of human activities over which the individual is sovereign. " No one pretends that actions should be as free as opinions. On the contrary, even opinions lose their immunity when the circumstances in which they are expressed are such as to constitute their expression a positive investigation to some mischievous act" (Mill 1859 p. 69).

We can summarize Mill's treatment of liberty of opinion with the language later employed by Hohfeld (1919) and Commons (1924) in their famous works on legal relations. Using their terminologies, one can say that Mill refers to three different cases:

L1) Liberty of unexpressed opinions

In this case, given two individuals A (Adrian) and B (Beatrix), Mill's argument states that B has full liberty over her own unexpressed opinions and feelings. Adrian's exposure to Beatrix's unexpressed opinions does not give him the right to force Beatrix to change her opinions for the simple reason that they do not affect him. This can only happen if he investigates what is going on in her mind, thus violating her privacy. Beatrix has no duty to be conditioned by Adrian. A must realize that he must accept B's liberty of conscience and that he has no right to force her to alter her opinions and feelings.

L2) Liberty of expressed opinions (not instigating harmful action)

[3] Berlin (1958) recognized that there were trade-offs between liberty and other values. However, their possible incompatibility was one of the reasons for the importance of a sphere of (negative) liberty. Moreover he pointed out how the love of truth could also grow at least also in severely disciplined communities. He had personally experienced the cases of intellectuals such as Anna Athmakova and Boris Pasternak who had produced excellent work in under the Soviet regime (Ignatieff 2000).

Without violating Beatrix's privacy, Adrian may be affected by the opinions that Beatrix expresses or even publishes. He is exposed to B's liberty of opinion and may suffer because of her views. However, Mill argues that, as long as B's opinions do not instigate harmful actions, A has no right to stop her from expressing them. Beatrix has no duty to change her behavior because of A's suffering, and she has an unrestricted liberty to express her opinions.

L3) Liberty of expressed opinions (instigating harmful actions on others)

The situation changes if Beatrix expresses opinions instigating violent actions against Adrian. In this case, according to Mill, the liberty of B should be restricted. It is unfair that A is exposed to B's behavior. A has a right to restrict her expression of such aggressive opinions. B has a duty to comply with the implications of this right and no liberty to continue to express opinions instigating harmful actions.

Note that each of the above cases involves some necessary relations among liberties, exposure to liberties, rights and duties. In the three cases, Beatrix's liberty of opinion involves Adrian's increasing exposure and a restriction of his rights (which are correlated to the duties of Beatrix). This raises the ethical and legal issue of establishing a boundary between the liberties of B and the rights of A – a boundary difficult to define that Mill locates somewhere between L2 and L3.

We can express the problem in terms of the legal relations considered by Hohfeld. With a simple scheme, Hohfeld expressed the idea that the boundary between RA (the rights of A) and EA (the exposures of A) must coincide with the boundary between DB (the duties of B) and LB (the liberties of B).

According to Mill, L1 and L2 pertain to LB, which implies that the corresponding duties D1 and D2 to refrain from these liberties are not part of DB. This also entails that Adrian's EA set does not include E1 and E2, which are the exposures to Beatrix's liberties L1 and L2.

By contrast, Adrian's RA set includes R3, i.e. the right not be exposed to Beatrix's liberty to express opinions instigating harmful actions against him. This entails that DB comprises the duty D3 not to express those opinions. Beatrix lacks the liberty L3 to do so.

Table 1: First-order jural relations.

Rights of A (RA): R3	Duties of B (DB): D3
Exposures of A (EA): E1, E2	Liberties of B (LB): L1, L2

In Hohfeld's original scheme, "rights and duties - quite as much as the elements in each of the other three pairs of legal positions - were always correlative by definition" (Kramer 1998 p. 24). Hohfeld "did not draw his Correlativity axiom as a contingent conclusion from empirical data. He posited the correlativity of Rights and Duties in such a way that each entails the other; each is the other from a different perspective, in much the same way that an upward slope viewed from below is a downward slope viewed from above. Hence, the adducing of empirical counter-examples is a task as pointless as the adducing of empirical counter-examples to the proposition that all bachelors are unmarried" (Kramer, 1998 pp. 24-25). However, an ex-post/ex-ante distinction may be useful. Ex-post rights and duties can be regarded as accounting identities. Similarly to supply and demand, their retrospective values must necessarily coincide. If Beatrix is enjoying the positive value of expressing her liberties, Adrian must simultaneously be experiencing the exposures to these liberties and the absence of his right to stop Beatrix, who has no duty to show any restraint. However, the set LB of activities for which Beatrix expects ex-ante to have liberty to perform may include L2, but Adrian may have the expectation that his set of rights RA includes R2 and that Beatrix should not expose him to the liberty L2.

If Beatrix and Adrian shared a system of common ethical values, Adrian's boundary between RA and EA would be perfectly correlated to Beatrix's boundary between DB and EB. Indeed, Commons (1924), and later Wellman (1978), observed that Hohfeld's legal relations may also be interpreted as ethical relations and be supported by traditional beliefs. However, Commons (1924 p. 85) added "There

is, however, a difficulty with these ethical mandates. They are mental processes and therefore as divergent as the wishes and the fears of individuals. Hence, when they emerge into action they are individualistic and anarchistic. They are unrestrained in action by an actual earthly authority to whom each party yields obedience." For this reason, according to Commons (1924, p. 86), "It seems that the only procedure that will correlate the wishes and fears of each and prevent anarchy is to resort to a third person of an earthly quality whom each consents to obey, or each is compelled to obey."

In this sense, an important task of law-making – conceived as purposive activity with the object of subjecting human conduct to the governance of rules (Fuller, 1969) – is to reduce the gap between inconsistent expectations and, as a consequence, the gap between the prospective and retrospective views of individuals about their entitlements. In other words, the purpose of law is to eliminate "legal disequilibrium" and to induce agents to hold relative legal positions that are ex-ante consistent: that is, a situation of "legal equilibrium" where the RA/RB boundary coincides with the DB/LB boundary (as it does in Table 1). When A and B have different interpretations of their rights and liberties, and therefore different ex-ante expectations, either the rights of A or the liberties of B are going to be sacrificed. According to Kelsen (1992), the elimination of these inconsistencies and the establishment of the validity of the rules is the fundamental purpose of law. He argued that the validity of legal rules should be distinguished from their justice and efficacy. If some final "grundnorm" were transcendentally given, the unity, consistency and completeness of the legal order could be established by checking the consistency of the rules with the hierarchically superior rules. Only the rules that satisfy this consistency test are valid rules of the legal system.

Kelsen's analysis of the validity of law implies that inconsistent interpretations of the rules must be settled by referring to rules of a higher order. This approach assumes not only the necessity of an agent (the State) with monopoly over enforcement but also the existence of a constitutional *grundnorm (founding norm)*. Such a *grundnorm* is necessary to halt an otherwise potentially infinite regress in the analysis of the validity of rules.

A limitation of the Kelsenian approach is that the existence of legal rules can only be conceived within the framework of a developed legal system. By contrast, common expectations about rights, duties and liberties can often arise even in the absence of intervention by the State.

In this regard, Hart (1961) significantly developed the positivist approach to legal theory by using an evolutionary approach to explain the formation of real-life legal systems. However, he retained the Kelsenian idea that the validity of law is the core concept of positive law. A primitive society could well develop a system of primary rules without the intervention of a central authority, and without

some *grundnorm* from which the validity of the other rules could be logically derived. However, such a system will be beset by uncertainty because in many cases the agents will maintain that different rules exist or should be applied in particular cases. It will also be static because, besides custom and tradition, nobody has the power to change the rules even when it may be urgent to do so. Moreover, the system will be characterized by numerous conflicts and by an inability to impose sanctions that extend beyond a system of private revenge. For this reason, any such social arrangement will tend to evolve a system of "secondary" rules that can provide solutions to the problems encountered by the system of "primary" rules that we have just considered. A *rule of recognition*, establishing the "Kelsenian" validity of the primary rules, is the first attribute that a proper legal system should evolve. A proper legal system is necessarily based on the existence of "second-order" jural relations that empower some agents to identify clearly, change quickly, and enforce efficiently those primary rules that may also emerge in a primitive society.

The institution of “second-order” jural relations can require some agents to invest in the ability to verify and enforce ex-post the rights and the corresponding duties among individuals. In this way, they can also create the conditions for expectations that are consistent "ex-ante". The agents involved in these second-order jural relations may be private individuals or public officials. Also third-order and higher jural relations are likely to characterize a complex system that has a hierarchy of powers. This hierarchy of powers must be completed with agents possessing a monopoly of physical violence and provide the basis for enforcement of the other relations. For instance, when these agents – typically State officials – perform their tasks efficiently, Adrian’s rights involve the enforcement powers $\pi 3$ of his rights R3 corresponding to a liability $\lambda 3$ of Beatrix to perform her duties D3. Also these second-order relations are characterized by the fact that the boundary between the sets πA (the powers of Adrian) and δA (the disabilities of Adrian) should (and at least ex post) coincide with the boundary between λB (the liabilities of Beatrix) and ιB (the immunities of Beatrix).

Table 2: Second-order legal relations

Powers of A (πA): $\pi 3$	Liabilities of B (λB): $\lambda 3$

Disabilities of A (δA): δ1, δ2	Immunities of B (ιB): ι1, ι2

These relations hold not only for State officials but also for the powers possessed by private citizens. For instance, Adrian may have the power to sell membership of a club to Caesar, and Beatrix, who is also a member of the club, suffers because she does not like Caesar. However, Beatrix may have no immunity against Adrian's power and she is liable to suffer the consequences of his decision.

Also second-order legal relations may be in a situation of disequilibrium. In spite of the fact that Beatrix's liberty of opinion incites damaging actions against Adrian, she may believe that she has, not the liability λ3, but rather the immunity ι3. For instance, Beatrix may believe that her liberty is guaranteed by the Constitution and that State officials are unable to enforce what Adrian believes to be his rights. In other words, the Law, conceived a la Fuller (1969) as the human activity to subject to rules human behavior, is necessarily an incomplete enterprise (Pistor, Xu 2004). Legal relations are accounting identities only ex-post. Ex-ante rights and/or duties are often incompletely defined and some interpretation of the law (which is sometimes creating in fact new law) may be necessary ex-post. When this happens an ex-ante legal disequilibrium is likely to arise. The law can only sometimes restore ex-post the equilibrium among the different legal positions. Far from being a natural state of affairs the rule of law is an unfinished business absorbing many energies and skills.

We have used the liberty of opinion to illustrate the general nature of legal relations. Unlike possession, private property is an important special case of legal relations and, as such, a sophisticated but imperfect outcome of human society. In the next sections, we will see how private property, sharing the sophistication and imperfection of all legal relations, cannot simply evolve from simple possession struggles.

4. The Evolution of Private Property

The fact that the relations defining private property apply *erga omnes* (no particular person is a well-identified counterpart of the owners) may give the false impression that private property is a relation between a person and a thing and not among persons. By contrast, private property rights are rights of a particular type involving a complex bundle of legal positions. They have little to do with the simple relation between a person and a thing. Also in this case, numerous first-order and second-order legal relations are entailed by the existence of private property.

The private ownership of a thing involves the liberty to decide how to use it, the right to exclusive access, the power to sell it to others, and the immunity against others altering the title of ownership.

Each of these legal attributes is characterized by the interdependencies summarized in Tables 1 and 2. The relations in these two tables are general characteristics of legal positions among people and apply as a particular case to private property. Owners' liberty of choice among different uses of a thing exposes others to this liberty. They may not like the plants or the benches that the owner puts on a piece of land, but they are exposed to the agenda of the owner and have no right to interfere with his choices. The right to the exclusive use of assets by some individuals must be correlated to the duties of others not to use those resources. The choices of the owner determine whether trespassing on his/her land is partially or totally forbidden for the others, who have the duty to respect the will of the owner. The power that the private owner has to transfer his/her title entails that the other agents have a liability towards those transfers of property. Adrian's neighbors may not like his decision to sell his property to Beatrix but they have no immunity against that decision. Finally, the immunity of the owner against having his/her title altered or transferred by the act of another should be aligned with the disability of others to perform these acts. They have no power to force Adrian to sell his land to Caesar, who is their ideal neighbor.

As in the case of Mill's liberty of opinion, all these characteristics of legal positions require often higher-order legal relations by which other agents can arbitrate among conflicting claims and enforce lower-order legal relations. As we have seen, H. Hart pointed out that conventions and traditions can only change slowly and are often characterized by conflicting claims. A modern economic system must contain a rule of recognition stating which particular claims are legitimate, which rules are valid, and who is entitled to make decisions.

The simple primary rules from which a sophisticated system of private property evolves should not be confused with those that allow some dovish behavior concerning possession. The primary rules from which the higher-order rules evolve already contain elements of reciprocity, involving some degree of respect for other individuals. They may be rules such as (quasi-)monogamy. This is an institution that

has characterized most small-scale primitive societies. It involves liberties as well as limitation of liberties corresponding to the rights of other individuals that one has the duty to respect. A society which has evolved relations of this type is also able to respect the property of others in the same way as it considers it to be a (quasi-)duty not to steal other individuals' sexual partners.

The dove-hawk model cannot explain the evolution of the complex bundle of rights that characterizes private property. The main problem with this type of evolutionary explanation is that it considers only individual fitness with respect to the environment. The relationships with other individuals are simply driven by rivalry over the acquisition of resources. By contrast, individual fitness depends on two other mechanisms. The first of them is group selection, which is particularly strong in the case of humans, who, thanks to cultural diversity, can identify with different groups. The second mechanism, described by Darwin at great length in his book "The Descent of Man", relies on sexual selection. Individual fitness depends not only on the resources acquired from the environment but also on the ability to find mates.

Courage, pugnacity, perseverance, strength and size of body, weapons of all kinds, musical organs, both vocal and instrumental, bright colours and ornamental appendages, have all been indirectly gained by the one sex or the other, through the exertion of choice, the influence of love and jealousy, and the appreciation of the beautiful in sound, colour or form; and these powers of the mind manifestly depend on the development of the brain. Darwin (1871 p. 687).

I have argued elsewhere (Pagano 2013, 2014a) that the peculiar human mechanism of exercising sexual choice (absence of a clear fertility signal) can explain the exceptional human development of capabilities for shared experience and for empathy. This may in turn help to see liberties and rights from the viewpoint of others and understand their reciprocal limitations. The recognition of property rights derives from this peculiar human evolutionary path. It cannot derive from the struggle for possession that is common to all living species. Hodgson (2014) has entitled his commentary on my paper "*Sex on the brain*". His ironic title reveals some skepticism about the role of sexual selection and some revealed preference for group selection, which has certainly also an important role in human evolution[4]. However, the argument that possession and property arise from different evolutionary

[4] Pagano (2013, 2014a) argues that both sexual and group selection are important to explain the human unique evolutionary path but sexual selection can claim a logical and historical priority. Group selection is highly effective in the human species (Bowles 2014). This is due to the fact that cultural diversity makes human groups stable and cultural selection can act in times much shorter than natural selection. However, this begs the questions related to

mechanisms is certainly consistent with Hodgson's clear and sharp distinction between these two concepts and his criticism of their confusion, unfortunately so frequent among economists. Thanks to dubious analogies, private property has been seen as possession, and recently intellectual monopoly has been as private property.

Fig 2

Whatever are the relative weights that we give to group selection and to sexual selection in the emergence of empathy and reciprocity, we have here a different quasi-evolutionary story (Fig 2) where property rights do not originate from possession struggles. The opposite is true. Un-contested possession is the result of the establishment of property rights.

5. Property and possession of knowledge.

Non-human species struggle over rival goods because only limited access to these resources is possible. Typically, in the case of food if one individual consumes the resource the others cannot consume it. By contrast, there is no struggle over possession of non-rival resources such as knowledge. If a chimp learns how to use tools to crack nuts or to fish for termites, there will be no hawkish behavior about possession of these techniques. These know-hows are non-rival: all chimps can simultaneously possess them, and it does not make sense to be hawkish with a chimp that imitates the fishing or the cracking technique.

In economics, the (non-) rival nature of goods is used to define the nature of public goods. Public goods are defined as simultaneously non-rival and non-excludable. From this definition it follows that all agents must consume the same quantity of these goods. However, rivalry and exclusion are two different characteristics. (Non-) rivalry is a characteristic of assets that holds independently of a

the reasons for the unique emergence of a human proto-culture that was able to originate cultural diversity. Sexual selection, and in particular the unique human fertilization system, can provide an explanation for the emergence of this proto-culture and for the differences in the evolutionary paths of humans and other primates. (Battistini, Pagano 2008).

particular institutional context and refers to the number of simultaneous uses that can be made of a certain resource. Whereas others cannot consume the food consumed by one person, many people can simultaneously consume a piece of knowledge. By contrast, (non-) exclusion depends on the institutional context. Exclusion from my food can be impossible if property rights are weak, while exclusion from the use of my knowledge may be possible if a strong system of intellectual property rights is introduced.

In the case of non-rival goods, individual possession does not involve exclusion because the simultaneous possession by many other individuals is possible. By contrast, property rights can be defined in such a way that this exclusion is possible. If an asset is rival or non-rival, the introduction of private property has very different effects on individuals' welfare.

Let us start with an ideal situation in which there are complete and costless markets for all the uses of a resource – a hypothesis that requires also the existence of complete law (Pistor and Xu, 2004). Also in real life we sometimes trade uses of the resources instead of resources. For instance, the price of land zoned for residential development is different from the price of land without building permission. Let us make the heroic assumption that we are in a zero-transaction cost world where we have a market for each level and type of use of each resource. Individuals are endowed with uses for each resource and exchange them with other individuals. While this world is characterized by Pareto optimality, it looks like a nightmare to the non-economist: we have to make transactions with others for such personal things as rearranging our furniture or changing the color of our bedroom wall! However, since transaction costs are zero, all these deals are costless. When we remove the assumption of costless and complete markets, the inefficiency of this solution (and its limitation of individual liberty) is evident. It is obviously better to give each agent the liberty to change the uses of a resource in all circumstances when nobody else is exposed to the consequences of those changes. If private property entailed precisely this liberty, one could achieve the same Pareto improvements that would be achieved by useless (even if assumed to be costless) market transactions. Whenever individuals re-arrange the uses that they make of their private property (for instance their furniture), they are increasing their welfare without decreasing the welfare of others not exposed to the consequences of that re-allocation. In other words private property increases the liberty of one individual without infringing the rights of others. This is a case analogous to the L1 case (liberty of unexpressed opinions) considered by Mill.
Also the other two cases considered by Mill find their counterparts in that of property.

In the L2 case (expressed opinions not instigating harmful actions), Mill argues that in this case the benefits from expressed opinions outweigh the disutility of those who are exposed to these opinions. By contrast, according to Mill, L3 (expressed opinions instigating harmful actions) should not be allowed. The individuals should instead have the duty D3 to avoid expressing these opinions corresponding to the Right R3 of the other agents not to be exposed to this liberty. Like the liberty of expressing opinions, also the liberty of utilizing an object can be allowed even in cases when it gives a limited disutility to other individuals. If this disutility is sufficiently small, the transaction costs to be sustained to take others' preferences into account are likely to be greater than their benefits. However, in other cases, the external effects generated by the liberty to use the things that one owns in a certain way is greater than the disutility incurred by the others who should be granted the right not be exposed to this liberty.

Within certain limits, the exercise of liberty granted by private property has the same beneficial effects as the liberty to express opinions. In the limiting case in which the resource on which this liberty is exercised is a pure rival good, private property entails that no Pareto improvement in the consumption of liberty is possible: we can increase the liberty of the other agents only by limiting the liberty of the present owners. The rivalry of the different uses means that no struggle for possession can improve the positions of all the members of society. Property rights allow uncontested possession and limit a destructive struggle for rival uses of resources.

The situation is very different for non-rival resources. In this case, the nature and the intensity of each use is not rival to alternative uses. Simultaneous possession by all is possible, and individual exclusive possession is impossible. The fact that Adrian is controlling uses of a piece of knowledge does not stop Beatrix from using that same piece of knowledge. By contrast, exclusive or private ownership of knowledge is very possible. It requires that only one agent has the liberty to use knowledge for certain purposes while all the others have a duty not use knowledge for those purposes without the agreement of the owner. They have to buy this liberty from the owner of the knowledge, who has the power to make or not to make this transaction and has immunity against alteration of this right by the other agents. In any case, this power involves *inter alia* the power to extract monopoly prices from the other agents and the ability to monopolize future patterns of innovation that require use of the monopolist's private knowledge.

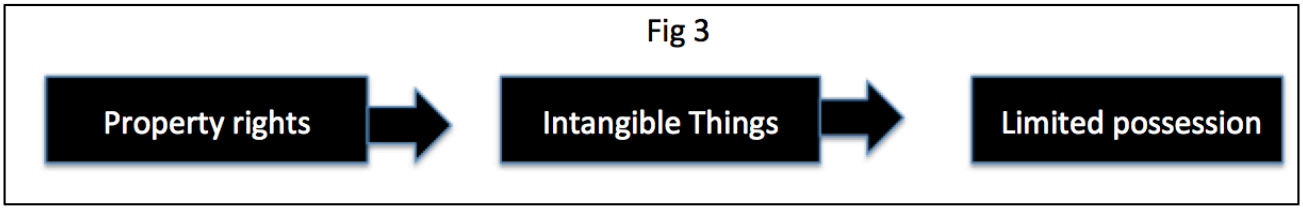
In the case of a non-rival good, the introduction of private property has effects opposite to those that it has for rival goods. Instead of increasing the liberty of everybody and of reducing transaction costs,

private property decreases the liberty of all the individuals different from the owner and increases transaction costs enormously. The right of the owners to exclude others from the uses of knowledge does not only restrict their liberty; it also involves huge transaction costs. A relatively cheap guard of a single thing cannot prevent infringements of property rights by non-owners. Their expensive prevention requires monitoring the actions of many individuals in many different locations across the entire world. We can summarize the different effects of private property and possession on liberty and transaction costs in the case of rival and non-rival goods with the following table 3:

Table 3

	Rival	**Non-Rival**
Possession	Low liberty, High Transaction Costs	High liberty, Low Transaction Costs
Private property	High liberty, Low Transaction Costs	Low liberty, High Transaction Costs

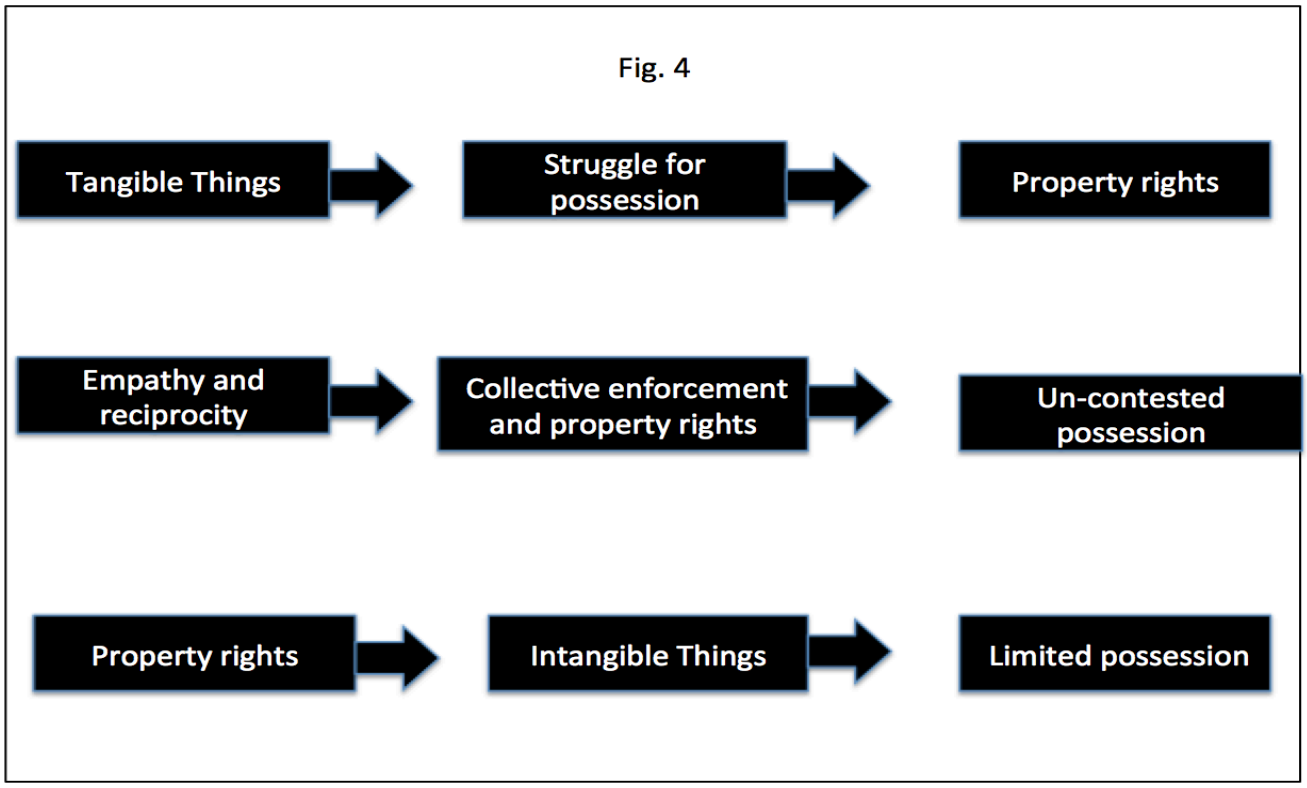
According to standard economic theory, the huge decrease in welfare due to intellectual monopoly may be compensated by an increase in the production of knowledge arising from the incentives of privatization. However, this argument does not take account of the fact that an increasing amount of privatized knowledge makes the production of new knowledge more risky. New innovators may have to gain the permission of the owners of existing knowledge complementary to their discoveries. Thus, after some time, an extension and a reinforcement of the privatization of knowledge is likely to have also negative effects on the production of new knowledge (Pagano 2014). Hence, the limits and legitimacy of intellectual property are inevitably a very controversial issue – which, however, falls outside the scope of this paper.



However it is clear that the quasi-evolutionary story related to intellectual property (Fig 3) involves an even more radical departure from the traditional account. In this case, property rights do not only originate possession. They do also shape its nature by creating the very things to be possessed. Being knowledge a non-rival good a piece of knowledge over which one can exercise exclusive possession and limit the possession of the others does not exist independently of property rights. It is rather an intangible asset created by the institution of private property.

6. Conclusion.

In this paper we have considered three quasi-evolutionary stories that are again schematized together in figure 4. The first quasi-evolutionary story considers the evolution from struggles about possession to property rights without any form of collective enforcement in a way in which property rights could involve from any animal species. The second quasi-evolutionary story considers how, because of specific forms of sexual and group selections humans have evolved forms of empathy and reciprocity that have created a framework of liberties, rights and duties which could allow private property and, as a consequences, forms of uncontested possession for rival resources. The third story shows how property cannot only determine un-contested possession but also define artificial things that limit universal possession of the assets. We have seen that the first quasi-evolutionary story cannot show the emergence of private property from unbounded possession struggles whereas the second two evolutionary stories involve a substantial inversion of the argument: property rights is at the origin of un-contested possession of rival goods and also at the origin of limited possession of non-rival goods.



The struggle of individuals for possession of economic resources cannot evolve into the institution of private property rights under which the weak are collectively defended against the violence of the strong. Private property does not arise from an evolutionary mechanism where individuals fight for rival resources. It arises from different evolutionary mechanisms that make it convenient to recognize others' liberty and rights, as well as some forms of (initially rudimentary) collective agreements. It has properties analogous to those of other liberties and rights such as the liberty of opinion.

However, the discontinuity between property and possession is such that property rights can also restrict human liberty in a way that possession could never do. Possession of knowledge does not exclude others' possession of it. Private property rights can restrict this liberty[5].

Moving from possession to private property may greatly enhance or greatly restrict liberty. It can increase or decrease transaction costs. These opposite effects are evident signs of the fundamental differences between property and possession. As Hodgson (2015a p. 701) has pointed out, the "focus

[5] Private property rights have also replaced other forms of peaceful common possession, based on systems of rights and duties different from those characterizing private property (see Ostrom 1991). The privatization of knowledge can be seen a second enclosure movement, the first one being the land enclosure movement that preceded the industrial revolution (Boyle 2003). However, the fact that knowledge is a non-rival input, not subject to overcrowding, makes its enclosure different from the preceding privatizations.

on possession, rather on property and rights" has many "deleterious consequences"[6]. Only a focus on property and rights allows us to understand how much private property has contributed to the emergence of capitalism and how its unbounded application to a knowledge-intensive society can become an obstacle to economic development.

[6] This emphasis can be found in the concept of "economic property rights" considered by Barzel (2015).

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