Towards a Modern Theory of Property:
A Reconstruction Based on Old and New Ideas

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Abstract

This informal introduction to a modern theory of property develops hints from the Lockean labor theory of property, Hume's contractual mechanism, and the "band" of classical laborists who came before Marx. There is an invisible hand mechanism in the property system that underlies the price theoretic invisible hand. A descriptive understanding of how property is actually appropriated in a market system has strong implications for capital theory, corporate finance theory, and general equilibrium theory. The Fundamental Theorem for that mechanism is formulated and informally derived. In the last part of the paper, it is shown how the "natural system" of private property and contract is systematically violated by the legal contract for the hiring or renting of people, the employment contract.

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Introduction

This paper is an introduction to a modern theory of property rights. To some extent the theory is new and to some extent it represents a reconstruction in modern terms of older and long-neglected ideas about property rights. Like economic theory, this property theory has both a descriptive and normative side. The jurisprudential principle used is related to but is not reducible to the efficiency norm (Pareto optimality) used in economics.

The modern development of this theory of property has been much delayed by a number of factors in the conceptual worldview of orthodox economics and jurisprudence. It is not a matter of making a perturbation or two; a number of mini-shifts in conceptual framework or "paradigm" are required before things fall into place in a new configuration or *gestalt*. Also the theory has been much delayed by the critical implications for a specific but major institution, the employment relationship.

The Invisible Hand Mechanism of Property Appropriation

Since Adam Smith, economic theory has worked to elucidate the invisible hand mechanism embodied in the price system of a market economy.[1] But there is a much simpler invisible hand mechanism embodied in the underlying system of property and contracts. The operation of this system is concerned not with equilibrium in a competitive price system but with the basic contractual questions of fulfilling contracts with actual transfers of commodities (no breaches) and covering actual transfers of commodities with contracts (no externalities). These principles have important roots in the Scottish Enlightenment, particularly in the work of David Hume.

A property system has to account for the whole life-cycle of property rights; how property rights are created, transferred, and terminated. In the market system, the transfers of property between parties are the 'visible' or public part while the 'invisible' part deals with the creation and termination of property internal to the parties.

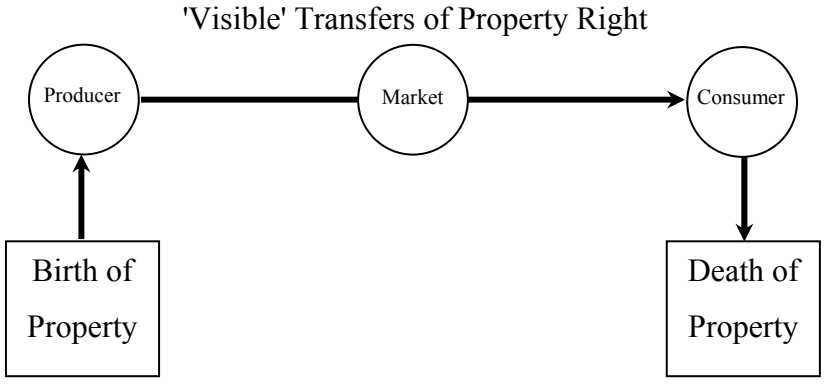

Diagram 1. "Life-Cycle" of a Property Right

[1] See Arrow 1951 for treatments of the basic theorems about the price system.

The legal assignment of an initial property right may be referred to as the "appropriation" of the property right to some new commodity or asset. The inverse or opposite operation is the termination of a property right which may be conceptualized as the "appropriation of the liability" for the consumption, using up, or destruction of some commodity or asset.[2] Hence the domain of the invisible hand mechanism is the mechanism for the "appropriation of assets and liabilities."

There is a visible-hand mechanism of appropriation used when the legal system intervenes. The prime example is a civil or criminal trial to assign the legal liability for property that has been destroyed. Such a trial also illustrates the underlying juridical norm of the *responsibility principle*: assign the *de jure* or legal responsibility to the person or persons who were actually *de facto* responsible for destroying the property.

The invisible hand mechanism for the legal assignment of initial and terminal rights comes into play when there is no explicit trial—when the visible hand of the legal authorities does not intervene and when it thus, in effect, renders the *laissez faire* judgment of "let it be." Using the Smithian metaphor, we might conceptualize "non-action" on the part of the legal authorities as the ruling of the "invisible judge" who always rules "let it be."

In the tradition of Ronald Coase [1960], there has been an emphasis on a legal system defining clear property rights. Yet it is useful to realize that property rights are also defined as much by the inaction of the legal system as by its actions. When sparks from a passing locomotive burn the crop growing in a farmer's field and the invisible judge rules "let it be" (i.e., the legal authorities for whatever reason allow no action), then at least the right to take that specific action was, in effect, established on the part of the railroad. Or if a certain contract has been made to transfer property rights, actions have been taken which one party claims fulfill the contract, and the invisible judge rules "let it be," then the legal transfer has, in effect, been consummated.

There are two types of contracts where the role of the invisible judge is particularly important, namely, the first and last transfer contracts in the life-cycle of a commodity.[3] When a newly produced commodity is first sold and the invisible judge lets it be, then the first property right was, in effect, assigned to the first seller. Conversely, when a purchased commodity is subsequently consumed, used up, or destroyed and the invisible judge lets it be, then the liability was, in effect, assigned to the last buyer. Thus the invisible hand or market mechanism of property appropriation is the assignment of the property assets or liabilities to produced or used-up commodities respectively to the first seller or last buyer of the commodities.

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[2] The termination of rights was an original meaning of "expropriation." "This word [expropriation] primarily denotes a voluntary surrender of rights or claims; the act of divesting oneself of that which was previously claimed as one's own, or renouncing it. In this sense, it is the opposite of 'appropriation'. A meaning has been attached to the term, imported from foreign jurisprudence, which makes it synonymous with the exercise of the power of eminent domain, ... " [Black 1968, 692, entry under "Expropriation"] Since "expropriation" now has this acquired meaning, I will treat the "expropriation (termination) of rights to the assets +X" as the "appropriation of the liabilities –X."

[3] Our focus is on commodities, rivalrous and excludable private goods that are produced and consumed as a part of deliberate human activity. Property created or destroyed by "Nature" or by accident presents special problems falling outside of the focus of this paper.

The most important and consequential application of the market mechanism of appropriation is to normal production activities. Abstractly considered, one legal party purchases (or already owns from past purchases or activities) all the "inputs" to be used up in the production process. When those inputs are used up and new products or "outputs" are produced, then the last buyer of the inputs is in a position to be the first seller of the outputs unless the legal authorities would intervene to overturn both sets of contracts. Hence when no such intervention takes places—as in normal production—then that one legal party in effect legally appropriates a bundle of legal rights and liabilities, the input liabilities and the output assets.

Property Theory and Economic Theory

Whole Product Vectors

It will be useful to develop the property theoretic notions by emphasizing the overlaps and contrasts with well-known concepts from economic theory. If a production opportunity during a certain time period were described by a production function Q = f(K,L), then the "inputs" would be the flow of capital services K (shorthand for all non-human inputs) and the flow of labor services L (shorthand for all the human activities of production), and the outputs Q produced during the period. The last buyer of the inputs would receive the *laissez faire* assignment or "imputation" of the liabilities for those used-up inputs which can be represented by the negative quantities –K and –L. Hence that party would have the legally defensible claim on the outputs (in the absence of any overturning of the input contracts) and thus the invisible judge would also let stand that party's first sale of the output assets +Q. Putting the bundle of assets and liabilities that were thus appropriated together in one list or "vector" yields (Q,–K,–L). This might be called the "production vector" or "input-output vector" but for historical reasons, I will call it the *whole product* vector.[4] Ordinarily, "product" just refers to the outputs Q but the whole product also includes the liabilities for the used-up inputs. It is sometimes useful to separate the positive and negative components into a *positive product* (Q, 0, 0) and a *negative product* (0, –K,–L) which sum, component-wise, to the whole product. While prices play no essential role in property theory, they will be used here to relate property theoretic notions back to economic theory. If p, r, and w are the unit prices of the outputs, capital services, and labor services, then the value of the whole product is the profits $\pi = pQ - rK - wL$.

Rethinking Marginal Productivity Theory

It should be particularly noted that there is no "distribution" or "sharing" of the property rights and liabilities in the whole product; it is appropriated by one legal party. The whole product is legally appropriated by that one party by virtue of its contractual position—being the last buyer of the used-up inputs and the first seller of the produced outputs. The whole product appropriator is often described using the price-theoretic metaphor of the "residual claimant." This makes it appear that the whole product appropriator is only the claimant on the "residual" after all the input suppliers have taken their "share." Actually, that party is the claimant on 100% of the produced assets and the input-liabilities are 100% claims against that party (claims already pre-satisfied in the input purchase contracts).

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[4] In the economics literature, a whole product vector is variously called an "input-output vector" [Quirk and Saposnik 1968, 27], a "production possibility vector" [Arrow and Debreu 1954, 267], an "activity vector" [Arrow and Hahn 1971, 59], or a "production" [Debreu 1959, 38].

But how can these 100% claims on the positive and negative products be squared with marginal productivity (MP) theory? Doesn't a unit of an input such as labor produce (at the margin) its "marginal product" $\partial Q/\partial L$, and under certain conditions (e.g., constant returns to scale) don't these shares "add up" to yield the product: $(\partial Q/\partial K)K + (\partial Q/\partial L)L = Q$? Moreover, under competitive pricing, the input prices r and w would equal the values of the marginal products, $r = p\partial Q/\partial K$ and $w = p\partial Q/\partial L$, so each factor gets paid for "what it produces." This interpretation of MP theory was explicit in the pioneers (e.g., Clark 1899) and is very often implicit "just beneath the surface" in the modern literature. However, this interpretation is problematic and unnecessarily so since there is an alternative mathematically equivalent way to develop MP theory that resolves the problems.

One immediate problem in the idea of a unit of an input X producing its marginal product $\partial Q/\partial X$ is that production requires other inputs. The marginal unit of X cannot produce $\partial Q/\partial X$ *ex nihilo*. In the absence of some remarkable form of "immaculate" production, other inputs must be consumed at the margin in order to produce any output so one needs a vectorial notion of marginal product with both positive and negative components. The usual scalar notion of marginal product $\partial Q/\partial X$ represents not production at the margin but a notional comparison of two infinitesimally close points on a "smooth" production function. If X is marginally increased, then instead of seeing how the other inputs would need to be increased to keep producing at minimum cost, there is a notional comparison with another slightly more X-intensive point on the production function where the increased X could be combined with exactly the same amounts of the other inputs to produce more outputs. The change in output between these two points is the scalar "marginal product" of X. Yet this movement on the production function solely along the X-axis is only notional since in general it would move the firm away from the least cost expansion path. Moreover, it requires a certain smoothness or substitutability between factors to have such a nearby point where the increased X could be combined with the same amounts of the other inputs.

The actual expansion of inputs by a cost-minimizing firm would be along the least-cost expansion path, and one can compute vectorial marginal products by considering variations along that path.[5] Moreover, under profit maximization and competitive pricing, the value of the vectorial marginal products would equal the prices of the purchased inputs, and the value of the marginal whole product vector would be zero. The vectorial development of MP theory[6] seems to have the status among mathematical economists of a folk theory, a theory that is known but with no reason to be published or developed in the texts. One needs a reason to turn away from the conventional scalar treatment, and the vectorial development of property theory provides that reason. The "distribution of the product" metaphor disappears in the vectorial treatment.

The "Fundamental Myth"

Being the whole product appropriator is the property-theoretic description of the legal party who might be called the "firm" or "residual claimant" with respect to the production opportunity. But

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[5] This also works for production functions without substitutability between factors as in input-output theory.

[6] See Chapter 5: "Are Marginal Products Created *Ex Nihilo*?" in Ellerman 1995.

one must be careful about the presuppositions embedded in certain descriptions. Being the last buyer of the inputs and "swallowing" those liabilities when the inputs are used up is, in the absence of any legal intervention, necessary and sufficient to be have a legally defensible claim on the outputs and thus to be the undisturbed first seller of those products of production. There is no additional "ownership of the firm" that is necessary in order to legally appropriate the whole product—although many other aspects or influences may have been important in order to have that necessary and sufficient *contractual* role.

The question of appropriation in production—and the answer of the market mechanism of appropriation—have not been a focus of attention due to the prevalence of an alternative approach. The alternative approach takes various forms but they have in common the idea that "the product" is part and parcel of previously existing property right. This idea is so pervasive that it might be called the "fundamental myth."

Neglect of Production Appropriation in "Law and Economics"

One might wonder why the description of the market mechanism of appropriation seems to be new in spite of the great simplicity of the mechanism. There are several reasons. One reason is that discussions of appropriation tend to be restricted in the philosophical literature to a rather mythical state of nature [e.g., Locke 1960 (1690)] or original position, or, in the economic literature, to the "appropriation" of unclaimed or commonly owned natural goods [e.g., Cooter and Ulen 2004] rather than the everyday matters of production and consumption of commodities where property rights are created and terminated "on the fly." For instance, Harold Demsetz [1967] considers how private property in land with fur-bearing animals was established as a result of the growth of the fur trade. John Umbeck [1981] considers how rights to gold deposits were created during the 1848 California gold rush on land recently ceded from Mexico. Yoram Barzel [1989] considers how the common property rights to minerals under the North Sea were privatized. But in Barzel's book [e.g., his Chapter 5, "The formation of rights"] as elsewhere in the economics of property rights literature, there is no recognition of the appropriation of the outputs and the symmetrical termination of rights to the used-up inputs in the normal production process (or in consumption for that matter).

Secondly, the role of appropriation in ordinary production tends to be overlooked due to the common but ill-formed idea—the fundamental myth—that the ownership of the product is somehow part of the ownership of some already-owned assets. One of the simplest forms of this idea is the assumption that the bundle of rights that constitute ownership of an asset includes "a right of ownership-over-the-asset's-products, or *jus fruendi*" [Montias 1976, 116], the "right of usufruct [which] entitles the holder to the 'fruits' or 'produce' derived from an asset" [Furubotn and Richter 1998, 79], or simply "the right to the products of the asset" [Putterman 1996, 361]. While some economists seem to carry over this rather ill-defined notion from the legal texts, it does not survive the reasoning familiar to economists from marginal productivity theory. The services of *many* assets may be employed in the production of the product and there are no grounds of unique physical causality to present the product as the "fruits" or "produce" of one asset (e.g., the land) rather than another. By the same token, there is little reason to interpret the renting or leasing of an asset as buying the "usus fructus" [Furubotn and Richter 1998, 132] since many assets might be leased in a production operation and there are no grounds to assign the rights to the products to any one of the leased assets. The whole usus fructus discourse is a

misunderstanding of the market mechanism of appropriation (which also deals symmetrically with the appropriation of the negative fruits, the input liabilities).

Rethinking Capital Theory

One form of the fundamental myth is the idea that the "product rights" are part of the ownership of the capital asset, say a widget-maker machine, from which the capital services K flow. Let us suppose that the capital asset would yield the capital services K without diminution for n years and then has no salvage value. The asset owner has the property right to the stream of capital services K or, in vectorial terms, (0,K,0) each year for n years. But if the asset owner also has the contractual role of "being the firm" or residual claimant in that production opportunity for the n years, then that party will additionally appropriate the whole products (Q,–K,–L) which sum to the stream of net ownership vectors (Q,0,–L) for n years [the first row plus the second row equals the bottom row in the following table 1].

Table 1.	Year 1	Year 2	...	Year n
Property vector owned by asset owner.	(0,K,0)	(0,K,0)	...	(0,K,0)
+ Property vector appropriated by last owner of inputs (residual claimant).	+ (Q,–K,–L)	+ (Q,–K,–L)	...	+ (Q,–K,–L)
= Net property vector accruing to asset owner who is *also* the residual claimant.	= (Q,0,–L)	= (Q,0,–L)	...	= (Q,0,–L)

Orthodox capital theory then discounts the value of the net vectors (Q,0,–L) [bottom row in table 1] back to the present to arrive as the "capitalized value of the asset" as if the right to the whole products [second row] had been part of the ownership of the assets. But the appropriation of the whole products is contingent on a certain contractual fact-pattern, and it is not a violation of the ownership rights of the asset owner to have the asset hired out instead of labor being hired in. Thus the value of the whole products ("profits") might or might not go to the asset owner depending on the future pattern of the input contracts. The so-called "capitalized value of the asset" is actually the value of the asset [discounted value of the (0,K,0) stream in the first row] plus the discounted value of the stream of whole products [discounted value of the (Q,–K,–L) stream in the second row]—where the latter may or may not accrue to the asset owner.

> When a man buys an investment or capital-asset, he purchases the right to the series of prospective returns, which he expects to obtain from selling its output, after deducting the running expenses of obtaining that output, during the life of the asset. [Keynes 1936, 135]

In fact, the man buys only the rights to the stream of capital services K (and any terminal scrap). Depending on who hires what or whom, he may or may not be the residual claimant in the production opportunity using that asset.

Rethinking Corporate Finance Theory

There is no legal necessity that the owner of the widget machine be the residual claimant (with respect to the widget making process), and the same holds when the owner is a corporation. Yet corporate finance theory carries over the same capital-theoretic fallacy of interpreting the whole product as part of asset ownership. For instance, the discounted cash flow method of valuation routinely assigns to the corporation the present value of the net cash flows [e.g., from (Q,0,–L) on the bottom row of Table 1] from production rather than the present value of the cash flows from the services of the underlying corporate assets [e.g., from (0,K,0) on the top row].

> There, in valuing any specific machine we discount at the market rate of interest the stream of cash receipts generated by the machine; plus any scrap or terminal value of the machine; and minus the stream of cash outlays for direct labor, materials, repairs, and capital additions. The same approach, of course, can also be applied to the firm as a whole which may be thought of in this context as simply a large, composite machine. [Miller and Modigliani 1961, 415]

But in order to plausibly count the future whole products as part of the present property rights of the corporation, all the future input contracts would have to be made in favor of the corporation at the present time. Moreover, since contracts are generally not enforceable until one side performs, the corporation would have to have paid all future input contracts at the present time. Only then could the corporation have a plausible claim on the future whole products. Since those conditions would hardly be fulfilled, the usual discounted cash flow method of valuation does *not* value the property rights "of the corporation." It values the underlying assets of the corporation plus the additional value that would accrue to the corporation *if* it had the contractual role of whole product appropriator throughout the projected future time periods (as opposed, say, to the rentier role of renting out the capital).

An analogy might clarify the point. Consider a beggar who has money put into his cup by passing pedestrians. When does the beggar acquire ownership to these gifts? Perhaps it is when the money passes into his possession by being put into the cup. But in any case, one could not say that he owned today the money that might be deposited in his cup in the future. Yet one could imagine an entrepreneurial beggar as "securitizing his future income stream" by selling shares in his future take for, say, the next day (we assume the necessary financial accounting and monitoring system in place to prevent cheating). Thus the beggar might sell for a certain amount today a 20% share of his take tomorrow. We have already ascertained that the beggar does not own today the money he may be gifted tomorrow. What property right has the buyer of the 20% acquired today? The buyer only has a right to 20% of tomorrow's take *whatever that may be.* The buyer might estimate it to be $5 but if it turned out to be only $1 then the buyer was not "robbed" of any property right. Lamentations about the groundless practice of booking the "purchased goodwill" as an "asset" on the buyer's balance sheet would be of little avail.

Corporate valuation theory is in an analogous position with respect to the future whole products and their value, the future profits—with "goodwill" as the discounted value. Buyers of corporate shares might assume that future contracts will be written in the same way but no property right backs up that expectation—and the unjustified practice of booking "purchased goodwill" as an

"asset" (i.e., a property right) changes nothing.[7] Yet the corporate shareholder does have a property right, implicitly or explicitly, to the future rental stream from the corporate assets (rK in the example). Thus when conventional corporate finance theory capitalizes both the rentals rK and the whole product values π into the "value of the corporation" then it is incurring the fallacy of the "fundamental myth" by presenting the value of the future whole products as part of the current value of the corporation.

Rethinking "Ownership of the Firm" in Economics

We have seen that ownership of a corporation is not equivalent to "ownership of a production opportunity"—an opportunity which a corporation may or may not undertake depending on its contracts, e.g., whether it hires in a complementary set of inputs or hires out its capital in a rentier role. Thus the ownership of a corporation is not the "ownership" of the production function or production set that may describe a production opportunity being undertaken by the corporation by virtue of its contractual position. If one continually thinks that "being the firm" as an owned property right (e.g., in confusing corporate ownership with "ownership of a production function"), then the market mechanism of appropriation will be entirely overlooked—as indeed seems to have happened.[8]

The idea that "being the firm" is a property right that is owned rather than a contractual position to be achieved in the market is nevertheless quite common in the economics literature, not to mention in lay beliefs. Entrepreneurs are "bidding for ownership of the firms" and become the "owners of the productive opportunity" [Hirshleifer 1970, 124-5]. A proprietor may sell "the rights to the transformation function" or "his rights to the venture" [Fama and Jensen 1996, 341] to another proprietor. The entrepreneur is the "owner of a production function" [Haavelmo 1960, 210] and even Robinson Crusoe "owns the firm" [Varian 1984, 225].

The "high brow" version of this property theoretic error can be pin-pointed in the Arrow-Debreu model of general equilibrium theory. Shareholders do indeed own corporations, but *corporations do not own production sets*. There is no problem in assuming that the i^{th} consumer owns "a contractual claim to the share a_{ij} of the profit of the j^{th} production unit" [Arrow and Debreu 1954, 270] where "production unit" is a corporation. The problem comes in the assumption that for "each production unit j, there is a set Y_j of possible production plans" [267] which no other party can undertake. In a private enterprise market economy, there is no property right or "ownership" of production sets of feasible production vectors. Any party can bid on

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[7] Some accountants have correctly argued that "purchased goodwill" is only an "anticipation," not a property right, and thus that it should be booked as a charge to equity to be replaced if and when the future whole products are appropriated, i.e., when the future earnings are realized. "The amount assigned to purchased goodwill represents a disbursement of existing resources, or of proceeds of stock issued to effect the business combination, in anticipation of future earnings. The expenditure should be accounted for as a reduction of stockholders' equity." [Catlett and Olson 1968, 106]

[8] For example in the Putterman and Kroszner anthology [1996] of papers on the "economic" nature of the firm, none of the papers pose the question of appropriation in their treatment of the firm. The question of appropriation in the firm is similarly ignored in the "economics of property rights" [e.g., Furubotn and Pejovich 1974], in the "property rights approach" to the firm [e.g., Hart and Moore 1990; Hart 1995], in the "property rights" literature of the new institutional economics [e.g., Furubotn and Richter 1998], or in the law and economics literature [e.g., Cooter and Ulen 2004]

inputs—and would bid on inputs that would yield positive pure profits which precludes the possibility of a competitive equilibrium with positive pure profits (see Ellerman 1992 for more discussion).

Intellectual Background to the Fundamental Myth

Since the fundamental myth can be exposed by a simple contract reversal argument, how has it been such a stable part of orthodoxy? Marx shares responsibility by having given his imprimatur but the idea goes back to older notions of land ownership. In feudal times, the governance of people living on land was taken as an attribute of the ownership of that land: "ownership blends with lordship, rulership, sovereignty in the vague medieval *dominium*,...." [Maitland 1960, 174] The landlord was Lord of the land. As Gierke put it, "Rulership and Ownership were blent" [1958, 88]. Marx mistakenly carried over that idea to his analysis of capital in capitalism. The command over the production process was taken as part of the bundle of capital ownership rights.[9]

> It is not because he is a leader of industry that a man is a capitalist; on the contrary, he is a leader of industry because he is a capitalist. The leadership of industry is an attribute of capital, just as in feudal times the functions of general and judge were attributes of landed property. [Marx 1967, 332]

Marx was simply wrong; he bought the fundamental myth. The employer's right of discretionary control over the actions of the workers is based on the employment contract. Such "rulership" is not blended with or part of the ownership of capital assets. Asset ownership by itself only gives the owner the right to make the worker a trespasser.

Marx's "ownership of the means of production," indeed Marx's notion of "capital," involves the mythical "ownership of the firm." By "capital" Marx did not simply mean financial or physical capital goods; he meant those goods used by wage labor with private ownership of the means of production. Otherwise, "capital" becomes just the "means of labor." In short,

Marx's "capital" = "means of labor" + "contractual role of being the firm."

If one wishes to use the word "capital" in that Marxian sense, then one gives up being able to talk about the "ownership of capital" since there is no "ownership" of a contractual role. But Marx continued to talk about "capital" (in the sense that includes residual claimancy) as being owned in a linguistic move that might be called a "semantic straddle."

There is a similar ambiguity in the common language notion of "owning a factory." There is the ownership of factory buildings (or corporations with such assets), but there is no "ownership" of the going-concern aspect of *operating* a factory as that is a contractual role in a market economy. By using the same phrase "owning a factory" to straddle both meanings, one could seem to have an argument that the contractual role of operating a factory was "owned." For instance, when it is argued to many economists today that "owning the factory" (in the sense of operating it) is a

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[9] This view survives to our day, e.g., the "rights of authority at the firm level are defined by the ownership of assets, tangible (machines or money) or intangible (goodwill or reputation)." [Holmstrom and Tirole 1989, 123]

contractual role, not an extra owned property right, a typical response is: "Yes, but it is that role which I call the 'ownership' role." After thus redefining "ownership" as a contractual role, they then straddle back to the old meaning and talk of it as a property right [see the "property rights approach" to the firm in Hart and Moore 1990; Hart 1995]. Those are some of the thought patterns that allow the fundamental myth to limp on.

Analysis of the System of Contracts

The life-cycle of a property right can be parsed into two parts: the transfers handled by the system of contracts and the initiation/termination of a property right handled by the mechanism of appropriation. There are clear normative principles that each part of the system might satisfy. The contractual system handles the visible relationships between the parties, and the legal authorities by their action and inaction might enforce certain principles in the contractual system. We have seen, however, that the market mechanism of appropriation follows from the pattern of contracts. What is to insure that the mechanism of appropriation satisfies its norms if the legal authorities insure that the contractual system functions correctly by its norm? That is precisely the content of the fundamental theorem of property theory. To put it in contrapositive form, if there is a norm violation in the system of appropriation, then it will show up as a norm violation in the contractual system. What are those norms?

The norms for the contractual system might be derived directly from David Hume: that any transfers in the possession between parties be covered by voluntary agreements or contracts, and that all contracts be fulfilled by the corresponding transfers in the possession of the property. To these two principles Hume added the respect for the possession of untransferred property to arrive at his three fundamental norms.

> We have now run over the three fundamental laws of nature, *that of the stability of possession, of its transference by consent,* and *of the performance of promises.* 'Tis on the strict observance of those three laws, that the peace and security of human society entirely depend; nor is there any possibility of establishing a good correspondence among men, where these are neglected. [Hume 1978 (1739), Book III, Part II, Section VI, p. 526]

There are two types of transfers involved: the voluntary contractual transfers of legal rights, herein called the *legal transfers* of the commodities, and the transfers in the factual possession and control of commodities, herein called the *factual transfers*. In modern terms, we would think to two "spaces," and *ownership space* wherein legal rights are transferred by contract between parties and a *possession space*[10] wherein the objects of property, the commodities, are transferred between the parties. The two principles "transference by consent" and "performance of promises" simply imply that the corresponding transfers are made in these two spaces. There is the *no (property) externality principle* that all transfers in factual possession should be covered

[10] A transfer in possession space is not to be confused with movement in physical space. When a new buyer takes possession and control of a purchased house, then the house moves in possession space from one party to another even though the house does not move in physical space. Or if a person shoots a gun and breaks a window 100 meters away, then this is represented as the factual transfer of the "window" to the control of the person who destroyed it.

by voluntary contracts, and there is the *no breach principle* that all voluntary contracts legally transferring property rights are to be fulfilled by the factual transfer and delivery of the corresponding items of property.

The natural mathematical framework to express these notions would be a flow network in graph theory [e.g., Rockafellar 1984].

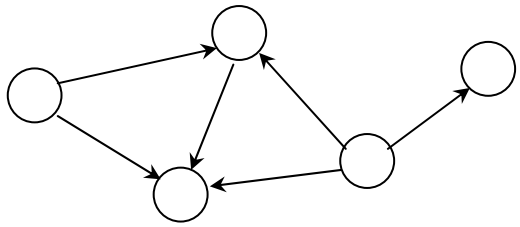

Diagram 2. A Directed Graph

The nodes would represent persons or groups of people acting together for some purpose such as production. The directed arcs would represent flows of property vectors between the parties during a certain time period with positive (resp. negative) flows going with (against) the direction of the arc. The two types of flows between parties would represent transfers in the two spaces, ownership space and possession space. When the legal and factual transfers agree, that might be called a *matching* so a matching is the situation where the no externality and no breach principles are satisfied.

Analysis of the Appropriation Mechanism

Appropriation as the Boundary of Contract

First we translate the appropriation mechanism into the imagery of graph theory, and then we investigate the norm for that mechanism. Given a set of vector[11] flows between the parties, one can sum all the outflows at a specific party with the inflows counting negatively. That assignment of a property vector to each party is called the *boundary* or *divergence* [Rockafellar 1984, 11] of the flows between the parties. For example, if the vector (3, 2, –3, 0) was

[11] There is an alternative to using vectors with positive and negative components. For over five centuries, double-entry bookkeeping has been used to describe the stocks and flows of scalar notions of value within and between parties. In earlier work two decades ago to develop mathematical machinery for property theory, double-entry bookkeeping was mathematically formulated for the first time and then generalized to vectors to describe the stocks and flows of physical quantities that underlie conventional scalar accounting [see Ellerman 1982, 1986a, or 1995]. The key idea was that the "T-accounts" of double-entry accounting were the ordered pairs in the group of differences construction which extends the monoid of non-negative numbers or even non-negative vectors, which have no additive inverses, to an additive group with additive inverses. The same ordered-pairs trick is used multiplicatively to extend the multiplicative monoid of integers to the rationals which include multiplicative inverses (division) and where the ordered pairs are written vertically as "fractions." Double-entry bookkeeping is mathematically formulated and extended to n dimensions by using (horizontally written) ordered pairs or "T-accounts" where the debit and credit entries are non-negative vectors. Property theory could be developed using that machinery of n-dimensional double-entry accounting. However, the additive group of T-accounts of non-negative vectors is isomorphic to the more familiar additive group of R^n so property theory will be developed simply using vectors of both positive and negative components.

transferred out of a node and (2, –6,0, 1) was transferred into the node, then the net outflow, boundary, or divergence is:

$$(3, 2, -3, 0) - (2, -6, 0, 1) = (1, 8, -3, -1).$$

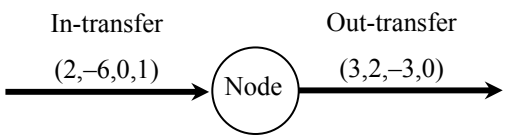

Diagram 3. Net-Outflow = Boundary = Divergence = (1,8,–3,–1)

Legal transfers through a party (buy-sell operations) are netted out in the calculation of the net outflow or boundary of the legal transfers. Hence the positive components in the boundary of the legal transfers at a party represent that party's first sale contracts and, similarly, the negative components represent the last buy contracts. We saw previously that the property vector legally appropriated by each party in the market mechanism is given by the last buy and first sale contracts. Hence the market mechanism of "last-buy/first-sale" appropriation has a very simple representation in the graph theoretic framework; the property vectors legally appropriated by the parties are given as the boundary (or divergence) of the legal transfers (i.e., contracts). Hence we have the formulation:

Market Mechanism of Appropriation:
Appropriation is the Boundary of Contract.

The Divergence Principle

The boundary or divergence operator shows how to go from the flows between nodes to the net outflow at each node. Given flows between nodes with the boundaries at nodes, there is a basic divergence principle that relates the two. It is the mathematical principle underlying the fundamental theorem given below. The basic idea is that given the flows in commodities to and from a node and given the inflows (sinks) and outflows (sources) at a node, if there are no other sources or sinks, then the net out-transfers on the arcs from the node must equal the net outflow at the node. Hence given the transfers on the arcs, we have defined a "divergence" operator to compute what has to be the corresponding net outflow at each node. The principle generalizes to any multi-node region; the net out-transfer over the border of the region equals the sum of the net sources within the region. This discrete version of the divergence principle [e.g., Rockafellar 1984, 55] is straightforward but the continuous versions are quite fundamental in analysis.[12] In the physical model of flows of an incompressible fluid, the divergence principle is that the sum of all the sources minus the sinks within a region (hence the name "divergence") equals the net outflow across the border of the region.

The property theoretic use of the divergence principle can be illustrated with a "property box diagram" (essentially a simple property version of the Edgeworth box diagram). Consider any party S and its interface with all the other parties which we can group together as the complementary party S^C ("everyone else"). Each party has certain production and consumption activities and there are transfers across the interface or border between S and S^C. The sign convention is that for production-consumption activities, positive components represent the net amount produced and negative components represent net consumption or using up of that commodity. For transfers along an arrow, positive components represent transfers in the direction of the arrow and negative components are transfers in the opposite direction.

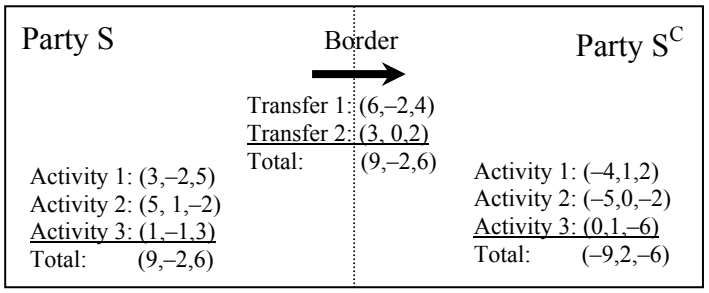

Diagram 4. Divergence Principle:
Net "divergence" of Party S = (9,–2,6) = Net outflow across border from S to other parties

[12] The one dimensional version is the Fundamental Theorem of Calculus and the n-dimensional versions in the calculus of differential forms include the classical theorems of Green, Gauss, and Stokes [see the Divergence Theorem in Fleming 1977]. For example, consider a one-dimensional "tube" from point a to point b along the x-axis with the amount of the flow in tube at point x given by F(x). At each point between a and b, there is a flow source of strength F'(x) = dF/dx so by the divergence principle, the sum (integral) of all the sources within the region or interval from a to b is equal to the out-flow minus the in-flow to the tube: $F(b) - F(a) = \int_a^b F'(x)dx$.

In property theory, we are interested in the unobserved sources and sinks within a region (appropriations) but the system only has controls on what goes through the border of the region (contracts). Under certain conditions, a mechanism based on what happens at the border of the region (appropriation defined as the boundary of contracts) can be led, as if by an "invisible hand" (actually the divergence principle), to be "correct" about the net sources within the region. In particular, if the legal and factual transfers agree across the border of any region, then the legal and factual net sources must agree within the region. But this is getting ahead of the story because we do not yet have a notion of "correctness" for the mechanism of appropriation.

The Responsibility Principle and Compossible Freedom

The market mechanism of appropriation, like the price mechanism, is an institutional arrangement that can be judged according to certain normative principles. How can one judge the invisible judge? The answer is simply to use the responsibility principle that would be used if a visible judge had intervened, e.g., to assign or impute the legal liability for destroyed property. The same juridical principle would apply regardless of whether a visible judge intervened or not. The fundamental theorem establishes the conditions under which the invisible judge would automatically satisfy that principle. That principle is to assign or impute the legal or *de jure* responsibility (i.e., the legal liability) for the destroyed property to the party *de facto* responsible for destroying the property—and similarly for created property. Thus the principle that will be applied to both the creation and termination of property rights, is the:

Juridical Responsibility Principle:
Impute *de jure* (or legal) responsibility in accordance with *de facto* responsibility.

This principle can be taken as a modern and symmetrical treatment of the old Lockean [Locke, 1960 (1690)] or natural rights principle [see Schlatter 1951] of people getting the fruits of their labor.[13]

The notion of "imputation" was metaphorically introduced into economics by the legally trained Austrian economist Friedrich von Wieser in his treatment of marginal productivity theory at the end of the nineteenth century. Things as well as human actions are causally efficacious at the margin so Wieser metaphorically used the notion of "imputation" according to marginal productivity which Wieser thought of as "economic responsibility." But he was well aware that this "economic" notion was not the same as the legal or moral notion of imputation which could only apply to human actions.

> The judge,..., who, in his narrowly-defined task, is only concerned with the legal imputation, confines himself to the discovery of the legally responsible factor,–that person, in fact, who is threatened with the legal punishment. On him will rightly be laid the whole burden of the consequences, although he could never by himself alone–without instruments and all the other conditions–have committed the crime. The imputation takes for granted physical causality.… The expression

[13] The intellectual history of the responsibility principle is more fully explored in Ellerman 1992. I call it the "Lockean" theory since the interpretation of John Locke's theory is a matter of some controversy.

> "this man has done it" does not mean "this man alone has done it," but "this man alone, among all the active causes and factors, is legally responsible for the deed."
>
> In the division of the return from production, we have to deal similarly...with…an imputation, – save that it is from the economic, not the judicial point of view. [Wieser 1889, 76-79]

The task of property theory is the opposite—to deal with an imputation, save that it is from the judicial, not the economic point of view. The original non-metaphorical judicial notions of imputation and responsibility are used in property theory, and, as noted by Wieser, they are applicable only to persons.

The responsibility principle is the norm underlying the mechanism of appropriation but what is the norm underlying the property system as a whole, the norm that underlies the role of Pareto optimality in the price system? Pareto optimality might be characterized as the compossible utility maximization; all possibilities have been exhausted for one person to increase his or her utility subject to other persons also increasing their utilities or staying at the same level of utility.

In a similar manner, the norm underlying the property system is the *free compossible realization of human intentions*—in a phrase, *compossible freedom*. Each party is to be free to realize their intentions but subject to the constraint of the consent of others applied to the past realizations of their intentions ("fruits of their past labor") or to such realizations obtained from others by consent.[14] In terms of the graph theoretic model, the norm is the free realization of intentional (i.e., *de facto* responsible) action at the nodes subject only to the compossibility constraint that all factual transfers between nodes be mutually voluntary. Like the notion of Pareto optimality, the notion of compossible freedom is an institution-free specification.

As price theory relates the institution of the price system to Pareto optimality, so property theory relates the property system to compossible freedom. The property system will implement this norm if 1) each party acquires property rights and obligations according to the positive and negative realization of their intentions (i.e., the responsibility principle), and 2) transfers of such property between parties are by mutual consent.

The legal authorities directly enforce the interpersonal contractual mechanism, i.e., the no externality and no breach conditions, so that actual transfers of property coincide with voluntary transfers.[15] No invisible hand mechanism is involved in that. The invisible hand in the property mechanism (the "invisible judge") is the market mechanism of appropriation (the imputation of initial and terminal property rights). The "fundamental theorem" says that if the contractual mechanism is enforced, then the market imputations will satisfy the responsibility principle.

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[14] Contrary to rather meaningless formulations of the constraint as being limited by "the freedom of others" or "the consent of others," this formulation specifies that the consent is applied to the realizations of intentions (including self) of the others.

[15] In computational algorithms, there are prices to guide allocation and there are penalties (which differ by orders of magnitude)—as in the "penalty method" in linear programming—to enforce constraints (e.g., the difference between the payment in a parking meter and a parking fine for unmetered use of a parking space). Punitive fines and other threatened punishments well above and beyond material damages serve as penalties (not prices) to enforce the constraints expressed by the no externality and no breach conditions.

Thus the "property" in the system is created and terminated by the intentional actions of the parties.[16] In this manner, a property system based on the market mechanism of appropriation and voluntary transfers of property will implement the norm of the free compossible realization of human intentions. We turn to the fundamental theorem.

The Fundamental Theorem of Property Theory

The general logic of the divergence principle is ubiquitous in accounting so it might help to motivate the fundamental theorem by looking at such mundane applications. The two levels of analysis, legal transfers and factual transfers are reflected in accounting in the distinction between the "booked" stocks and flows of resources ("ownership space") and physical stocks and flows ("possession space" as in doing a "physical inventory"). The whole system of legal property rights could be seen as a society's way of assigning resources to individuals on "society's books" although books of record are not usually kept unless the property is to be taxed (e.g., land cadastres or car registration). However, accounting books are routinely kept for business enterprises (again taxation provides a motivation), so the same issues of relating the books to the underlying physical realities will occur within enterprises.

The general logic can be illustrated using the divergence principle in its simplest form, the stock-flow equation: beginning stock + inflow – outflow = ending stock. Accounting typically keeps track of three terms in the equation and then calculates the fourth. Suppose we start with a beginning booked stock level in a merchandise inventory (assumed equal to the physical beginning stock level) which could be zero and we record the booked inflows (purchases of merchandise items). Then there are two choices of method according to which of the two remaining items to determine (outflows and ending stock) and then the other is inferred or imputed by the equation. In the periodic inventory method, the ending stock is determined by a physical inventory (e.g., monthly) and the outflow ("Cost of goods sold") is determined by the equation (see any accounting text). In the perpetual inventory method, the outflows (inventory changes due to sales) are booked and the ending stock level is then inferred by the stock-flow equation (physical inventories are still taken but not as often).

The laissez-faire system of appropriation which imputes appropriation from the legal flows between parties is closely related to the perpetual inventory system which imputes inventory from the inflows from (purchases) and outflows to (sales) other parties. In our simple one period flow model of the property system, the ending stocks are, in effect, treated as being used up and then recreated at the beginning of the next period. Moreover, goods are also being consumed and produced by the party and, in general, different types of property are being purchased and sold. With those differences in mind, the stock-flow equation in the form:

$$\text{Beginning inventory} - \text{Ending inventory} = \text{Outflows} - \text{Inflows}$$

would correspond to the divergence principle in the form:

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[16] Actual property systems use various conventions to treat as property that which is not the fruits of anyone's labor (e.g., land and natural resources) but we are focusing here on the 'hard core' of a property system that deals with the positive and negative realizations of human intentions (which includes the person of the individuals in addition to property).

Sources in S – Sinks in S = Outflows – Inflows across the border of S.

One can then consider the conditions under which these inferences or imputations will be correct. Whenever two things "A" and "B" are supposed to agree, then there are two types of error (e.g., type I and type II error in statistics): the "A and not B" error and the "B and not A" error. In the perpetual inventory method, we use the stock-flow equation (i.e., divergence principle in its simplest form) as follows:

Booked beginning stock (= actual beginning stock)
+ Booked purchases
– Booked reductions in inventory due to sales
= Booked ending inventory.

The two types of possible errors are the physical inflows or outflows that were not booked (slippages or, in property theory, "externalities") and the booked inflows or outflows that were not physically realized (non-deliveries or, in property theory, "breaches"). Suppose five widgets of merchandise stock was purchased but not delivered (a booked but not physical inflow) and the accounting system did not intervene to take account of the non-delivery. Then since the five widgets would not be sold, they would be misimputed to ending inventory. A more likely case would be inventory theft (a physical but not booked outflow). Again the items would be misimputed to ending inventory. There is also the internal matter of "accidents" where goods are damaged or spoiled and can no longer be sold which would still be there in the booked ending inventory. There is then a "fundamental theorem" for the perpetual inventory method which states that if there are no booked non-flows (no breaches) and no non-booked flows (no externalities) to other parties and no internal accidents or spoilage, then the booked ending inventory would be correct.[17] Since those assumptions are not "given" in a firm, a physical inventory is occasionally taken to take account of the various mismatches.

Since the ending inventory is inferred or imputed in the perpetual inventory method and is not directly recorded in a ledger account by the accounting system, we could use the "invisible hand" metaphor to say that it is recorded by the "invisible accountant." The "fundamental theorem" for the perpetual inventory method then states the conditions under which the "invisible accountant" makes the correct imputation for the ending inventory. The occasional physical inventories are used to correct the inevitable misimputations of the invisible accountant.

This divergence principle logic of imputation is also at work in metering systems. For instance, the idea is to impute a user's consumption of electricity, water, or gas by the "booked" inflow according to the meter during a time period. The imputation could be wrong in two ways:

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[17] A similar exercise could be carried out for the periodic inventory method. Another example is in "balancing a checkbook." There are transfers in and out recorded in one's checkbook ("booked") and additions and subtractions from the bank balance ("banked"). The two errors that needed to be taken into account in order to balance the checkbook are the "booked but not banked" transactions (e.g., checks not cashed) and the "banked but not booked" transactions (e.g., bank charges or interest payments in an interest-bearing account). In this case, "balancing a checkbook" means showing how the booked and banked balances agree after taking into account the two types of "errors."

"breaches" which are metered inflows not delivered to the user or "externalities" when a user acquires unmetered flows.

In property theory, the divergence principle equation at each node (like the stock-flow equation in the inventory example) has the form: In-transfer + sources – sinks = Out-transfer or, in net terms, Net source at a node = Net out-transfer from the node. The market mechanism of imputation imputes the legal "Net source at a node" (the party's legal appropriation) according to the booked "Net out-transfer from the node" (the party's legal contracts)—as in the slogan "Appropriation is the boundary of contract." The basic theorem then states the conditions under which that imputation by the "invisible judge" is correct.

"Correct" here means according to the responsibility principle. The fundamental theorem for property theory gives the conditions for the market mechanism of appropriation to correctly impute property assets and liabilities according to the responsibility principle. To arrive at the theorem, it only remains to connect the factual transfers between parties to the *de facto* responsible actions by the parties. This is done by two "boundary conditions."

The basic fact is that for a party to be *de facto* responsible for consuming or using up a commodity, the commodity must have been in the *de facto* possession and control of the party and the commodity must have "disappeared" out of possession but not by transfer to another party. In short, the consumer is the last possessor. This is a "no action at a distance" or locality principle in possession space. Symmetrically, if a party was *de facto* responsible for producing certain commodities during the time period, then those commodities must be first *de facto* possessed by that party and may then be transferred to other parties. The producer is the first possessor. This locality assumption about responsible human action is the:

No-action-at-a-distance Principle:
The *de facto* responsible producer (or consumer) of a commodity is the first (or last) possessor of the commodity.

This principle does not exclude accidents where, for example, a party might be the last possessor of a commodity but did not intentionally consume, use up or otherwise destroy the commodity. Accidents happen, and the responsibility principle is of little help in the absence of any *de facto* responsible party. When such cases reach a court (e.g., one party accidentally destroying another party's property), the court might use some principle of "strict liability"—principles much studied in the law-and-economics literature (e.g., Shavell 1987)—where *de jure* responsibility is imputed to a party on grounds other than *de facto* responsibility. Indeed, that is why it is called "strict" liability. Since the responsibility principle is of little help as a norm for imputing *de jure* responsibility for the results of accidents (including "positive accidents" or windfalls), we will heroically bracket aside accidents.[18]

[18] This is the mirror-image assumption to the law and economics literature that focuses on accidents and brackets aside deliberate actions. Thus there is an agreeable division of labor between the accident focus of the law and economics literature and property theory applied to normal deliberate production and consumption activities (the topic bracketed aside in the law and economics literature).

No-accidents Assumption:
A party is the first (or last) possessor of a commodity as the result of the party's *de facto* responsible production (or consumption) activities.

These two assumptions together imply the net results of each party's *de facto* responsible activities is precisely the boundary of the factual transfers between the parties.

Now the theorem follows directly. Consider any group of natural persons acting as a party S (which could be a singleton). If the factual and legal transfers agree on the "border" of the party S, then by the divergence principle, the imputations of the invisible judge must be in accordance with the *de facto* responsible activities of the party S.

Fundamental Theorem of Property Theory:
If there are no externalities and no breaches at the border of a party, then the market mechanism of appropriation will satisfy the responsibility principle for that party.

If there are no externalities (no factual transfers not covered by contracts) and no breaches (no contracts not fulfilled by factual transfers), then the legal transfers match the factual transfers between the party and all other parties. The legal imputation is, by definition, the boundary of the legal transfers, and by the two boundary conditions of the no-action-at-a-distance and no-accident assumptions, the net fruits of the *de facto* responsible actions are given as the boundary of the factual transfers. Hence, by the divergence principle connecting the border of a party with its internal activities, the legal imputation by the invisible judge to the party equals the net fruits of the party's intentional actions.[19]

In the contrapositive form, the theorem states that if there was a misimputation by the invisible judge, then it would have to show up "at the border" as a property externality or a breached contract. This is a property-theoretic refutation of Marx's charge that there could be exploitation in the "hidden abode of production" while the sphere of exchange "is in fact a very Eden of the innate rights of man" [Marx 1967, 176].

Using the language of the Scottish Enlightenment, the theorem shows that in the "natural system of liberty" there is a connection between the contracts that connect parties and their own internal activities. If the legal authorities can enforce Hume's no breach and no property-externality conditions, then the invisible hand mechanism of imputation—the invisible judge—will assign legal responsibility in accordance with *de facto* responsibility. Taking the responsibility principle as the modern explication of the Lockean "fruits of one's labor" principle of property appropriation, then the theorem shows that when Hume's contractual mechanism works correctly, the Lockean principle will be automatically satisfied.

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[19] The proof could be summarized as:

Legal responsibility =	(by the market mechanism of appropriation)
first-sale and last-purchase contracts =	(by enforcing no-externality and no-breach rules)
external changes in possessions =	(by divergence principle)
internal changes in possessions =	(by no-accident and locality assumptions)

de facto responsibility. [See Ellerman 2004]

Comparison to Price Theory

The transfers that are the focus of property analysis underlie the transactions considered in price theory, e.g., consumer purchases subject to a budget constraint. Property theory focuses on the totals transferred by voluntary contracts without the need to derive those contracts from optimizing behavior while price theory focuses on the marginal adjustments derived from the more specific assumption of optimizing behavior. In each case, there is a set of assumptions (implicit or explicit) necessary to connect the institutional concepts such as legal transfers or market transactions at given prices to the subjective aspects of the individual agents such as *de facto* responsibility or utility maximization. In both cases, the basic theorems (e.g., the first fundamental theorem of welfare economics which shows that a competitive equilibrium is Pareto optimal) have to assume away any possible leakages ("boundary conditions") or mismatches between the institutional and subjective aspects so that one can show that the institutional mechanisms satisfy certain normative principles defined in terms of subjective notions.

The no-externality and no-breach conditions are routinely assumed in price theory so that the commodity bundle purchased on the market will match the bundle consumed by the consumer as indicated in the utility function. No commodities are consumed that were obtained from others outside the market (no externalities) and all commodities purchased from others on the market are in fact obtained or delivered (no breaches). Thus the commodities in the possession of the consumer agree with those purchased on the market. But there can also be leakages between the commodities possessed by the consumer and what is consumed to yield utility. If the commodities delivered to the consumer disappear in accidents, then they cannot be consumed to yield utility so the routine assumption that what is purchased is consumed involves an implicit no accident assumption. And it is further assumed that the utility derives solely from the commodities in one's possession which is a "no utility as a distance" assumption. Otherwise the market purchase and consumption of commodities might leave other non-market deals to be struck that would increase the utility of the consumer as well the utility of the others who possess those 'distant' commodities. *De facto* responsibility for intentional actions is not the same as deriving utility from consumption but we need the similar sort of "no action at a distance" or locality assumption (in possession space) so that *de facto* responsibility is restricted to those commodities in one's possession and control. Thus, mutatus mutandis, the same assumptions are made in price and property theory to connect the institutional and subjective aspects. This is summarized in the following table.

Table 2

No "A & not-B" (All A is B) or "No B & not-A" (All B is A) Assumptions	**Price Theory**	**Property Theory**
No breaches assumption	All market purchases are delivered.	All legal transfers are fulfilled by factual transfers.
No externalities assumption	All commodities obtained from others are by the market.	All factual transfers are in fulfillment of legal transfers.
No accidents assumption	All loss of commodities in possession is by consumption.	All creation/loss of possessed commodities is by intentional action.

No action/consumption at a distance assumption	All consumption is of commodities in one's possession.	All responsible action deals with commodities in one's possession.

This completes the outline of property theory and the fundamental theorem showing how the property system implements the norm of the free and compossible realization of people's intentions. Now we turn to the major application which shows that a system of property which is based on the employment contract does not satisfy the responsibility principle and thus not the underlying norm of the free compossible realization of intentions.

Application to the Employment System

Analysis of the Employment Contract

It cannot long escape one's attention that this neo-Lockean theory of property has a major application to the current state of society. Since the theorem connects together the transfers between parties and the internal activities of parties, the application can be approached from either viewpoint. Let us begin with transfers.

The basic fact that connects the contractual mechanism and the imputation mechanism is that "things" can, in fact, be transferred from the factual possession and control of one person or multi-person party to another. Person A might rent a van (i.e., sell some of the van's services) to another person B. To fulfill the contract, the van would be factually transferred from A to B so that B can then use the van (i.e., use up the van services) independently of A and be solely *de facto* responsible for the results obtained by using up the services of the van. The contractual mechanism functions correctly when legal title to those services stays coordinated with the factual possession and use of the services. Then the legal imputation of the invisible judge to B for using up the van's services according to the legal transfer will be in accordance with *de facto* responsibility of B for the use of those services.

But this mechanism breaks down when person A (an "employee") tries to rent his or her self (i.e., sells his or her own services) to person B (the "employer"). There is no voluntary action to fulfill an employment contract so that the employer can "employ" the employee and be solely *de facto* responsible for the "employment" of those services. What actually happens to "fulfill" the employment contract is that the employee agrees to co-operate with the employer in a certain activity. But there is no voluntary transfer of *de facto* responsibility. Both the employee and the working employer are jointly *de facto* responsible for the negative and positive fruits of their joint activity.

When the legal authorities accept (NB: "accept" in the *laissez faire* sense of taking no action) the *de facto* responsible co-operation of the employee as "fulfilling" the labor contract for the sale of labor services from the employee to the employer, then the invisible judge mistakenly imputes all the legal responsibility to the employer for the using up of the "input" labor services and for the other positive and negative fruits of their joint activity.

The legal authorities take no action to declare that the employees are "non-responsible" or to declare that the employer is solely *de facto* responsible for the positive and negative product of the joint activity. And that is just the point; an invisible hand mechanism works by non-action.

The mis-imputation of the invisible judge is based simply on the legal authorities not rejecting the employee's responsible co-operation as "fulfilling" the legal transfer so that there is no "transfer failure" to give grounds for intervention.

The underlying facts of worker's *de facto* responsibility are not controversial. This is easily seen by considering the rather different reaction of the legal authorities when the employer and employee, or "master and servant" in the old-speak of agency law, co-operate together in the commission of a crime. The servant in work "becomes" the partner in crime.

> All who participate in a crime with a guilty intent are liable to punishment. A master and servant who so participate in a crime are liable criminally, not because they are master and servant, but because they jointly carried out a criminal venture and are both criminous. [Batt 1967, 612]

When the venture being "jointly carried out" is non-criminous, the workers do not suddenly become non-persons or automatons being "employed" by the employer. The facts about *de facto* co-operation remain the same. It is the reaction of the legal system that changes when no legal wrong is recognized. Then the invisible judge rules "let it be" and the contractual pattern imputes the whole product to the employer.

Of course, a contract involving a crime is null and void. But the worker is not *de facto* responsible for the crime because he made an illegal contract. The employee is *de facto* responsible because the employee, together with the employer, committed the crime (not because of the legal status of the contract). It was his *de facto* responsibility for the crime which gave the legal authorities grounds to intervene and set aside the contract. In the previous example, if person B went off and committed a crime with the van and if A, the owner of the van, had no personal involvement (aside from being the person hiring out the van), then person A, the seller of the van's services, would have no *de facto* responsibility for B's employment of those services and there would be no reason to invalidate the van rental contract.

The meaning of "immobility" depends on the "space" being considered. In trade theory, land and its services are immobile factors in geographical space. People and capital, in contrast, move about in geographical or physical space. But when it is said, for example, that a house was transferred into the possession of the buyer, then the house is transferred in what we have called "possession space" while it stays immobile in physical space. It is people who are the fixed coordinates in possession space, and thus people and their services cannot be transferred in possession space.[20]

As noted above, there is no factual transfer of labor services between parties—only *de facto* responsible co-operation. In terms of the contractual machinery, the employment contract is impossible to actually fulfill with the transfer of responsible actions from the seller (employee) to the buyer (employer). Thus the employment contract is always breached. In what might be

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[20] Strictly speaking, this applies only to the voluntary actions of people. A person can be physically coerced and thus not be *de facto* responsible for the results of that coercion. Hence involuntary "actions" are factually transferred in possession space but, unless otherwise stated, our concern is with normal voluntary actions.

taken as a fraud on an institutional scale, the responsible co-operation of the "employees" is taken by the legal authorities as "fulfilling" the labor contract which allows the employer to take the contractual position of the whole product appropriator. Since the employment contract is impossible to fulfill, it is invalid on grounds of impossibility. If the modest proposal were accepted that the contract for the renting of human beings be recognized as invalid, then production could only be organized on the basis of the people working in production (jointly) hiring or already owning the capital and other inputs they use in production. These implications will be returned to later in the analysis of production.

History of Related Contracts and Inalienable Rights Theory

The employment contract for the renting or hiring of persons is the short and limited term version of the indefinite term contract to sell all of a person's labor at once which historically was the voluntary self-sale contract. Although outlawed since the Civil War, this rump-and-stump labor contract is nevertheless necessary to have the conditions for full competitive equilibrium (i.e., full future markets in the "commodity" labor). Modern arguments against abolishing the employment or self-rental contract take the general form of arguing that efficiency requires full flexibility of contracts. This point is little noted in the usual neoclassical literature but the point was made in Congressional testimony by the econometrician Carl Christ.

> Now it is time to state the conditions under which private property and free contract will lead to an optimal allocation of resources.... The institution of private property and free contract as we know it is modified to permit individuals to sell or mortgage their persons in return for present and/or future benefits. [Christ 1975, 334]

The older voluntary slavery contract was treated as being legally valid from antiquity up to the Civil War (see Ellerman 1986b or 1992 for the history of these contracts). A person could voluntary agree to take on the legal role of a "non-person" in return for some consideration and the legal authorities would similarly take co-operation with the master as "fulfilling" the contract. Yet when the slave committed a crime, then the contractual "non-person" suddenly became a responsible person in the eyes of the law. Since the voluntary slave never actually became a *de facto* non-person, the self-sale contract was like the self-rental contract in being impossible to fulfill but where the legal authorities accepted an alternative performance as long as it did not involve legal wrongs. The legal fiction of considering the slave as a non-person—except for crimes—was quite explicit on the part of the legal authorities. For instance, an antebellum Alabama court asserted that slaves

> are rational beings, they are capable of committing crimes; and in reference to acts which are crimes, are regarded as persons. Because they are slaves, they are … incapable of performing civil acts, and, in reference to all such, they are things, not persons. [Catterall 1926, 247]

A third example of this sort of institutionalized fiction was the older and now legally invalid marriage contract that "identified" the legal personality of the wife with that of the husband. The baron-feme relationship established by the coverture marriage contract exemplified the identity

fiction in past domestic law. A female was to pass from the cover of her father to the cover of her husband; always a "feme covert" instead of the anomalous "feme sole." The identity fiction for the baron-feme relation was that "the husband and wife are one person in law" with the implicit or explicit rider, "and that one person is the husband." A wife could own property and make contracts, but only in the name of her husband. Again, obedience counted as "fulfilling" the contract to have the wife's legal personality subsumed under and identified with that of the husband.[21]

The last example of this type of impossible-to-fulfill contract is the historically important concept of a political pact of subjugation, a *pactum subjectionis*, wherein a group of people would "transfer" their decision-making powers to some authority, sovereign, or king. The Hobbesian contract was the best known example in philosophy but the idea was often evoked as an implicit contract between people and ruler wherever non-democratic government existed as a settled condition [Hobbes 1958]. It is important to be clear that the *pactum subjectionis* is a transfer or alienation of decision-making, not a delegation. The sovereign is not a delegate, representative, agent, or trustee making decisions in the name of the people; the sovereign governs the people in his own name.[22]

Many modern histories of thought project backward the idea that the transition from non-democratic to democratic forms of government was a transition from coercion to consent—the idea of democracy as simply government with the consent of the governed as if Hobbes and many others had not based autocracy on just such consent. The core of the development of democratic thought was not the argument against coercion since the sophisticated defenders of non-democratic government started with consent. The core was the contra-Hobbes argument that the sort of voluntary contract that legally alienated or transferred decision-making rights was naturally invalid and thus those rights were inalienable.

The basis for inalienable rights theory was the *de facto* non-transferability of decision-making, an idea that most forcefully entered history with Martin Luther's argument about liberty of conscience: "As little as another can go to hell or heaven for me, so little can he believe or disbelieve for me; and as little as he can open or shut heaven or hell for me, so little can he drive me to faith or unbelief." [Luther 1942 (1523), 316] Luther was making the point that the Church

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[21] In Carole Pateman's analysis of this sort of a "sexual contract" in a more general setting, she independently pointed out the connection to the employment contract and the *de facto* inalienability of labor. "The contractarian argument is unassailable all the time it is accepted that abilities can 'acquire' an external relation to an individual, and can be treated as if they were property. To treat abilities in this manner is also implicitly to accept that the 'exchange' between employer and worker is like any other exchange of material property. …The answer to the question of how property in the person can be contracted out is that no such procedure is possible. Labour power, capacities or services, cannot be separated from the person of the worker like pieces of property." [Pateman 1988, 147-150]

[22] This point is easier to understand when it is considered that the employment contract is the mini-Hobbesian contract for transferring decision-making in the workplace. The employer is not the delegate or representative of the employees; the employer manages the employees within the scope of the contract solely in the employer's own name.

could not in fact determine one's beliefs because the individual inextricably always had to accept the Church's decision so the decisions of conscience were *de facto* inalienable.[23]

From the Reformation, this theory of inalienability traveled to the Scottish Enlightenment where it was developed by Francis Hutcheson, Adam Smith's teacher and predecessor in the Chair of Moral Philosophy in Glasgow. Hutcheson contrasts *de facto* alienability of actual commodities where "the translation of them to others can be made effectually" with factually inalienable faculties where "the translation cannot be made with any effect." Hutcheson goes on to show how the "right of private judgment" or "liberty of conscience" is inalienable. In the case of the criminous employee, we saw how the employee ultimately makes the decisions himself in spite of what is commanded by the employer. Short of coercion, an individual's faculty of judgment cannot in fact be short circuited by a secular or religious authority.

> A like natural right every intelligent being has about his own opinions, speculative or practical, to judge according to the evidence that appears to him. This right appears from the very constitution of the rational mind which can assent or dissent solely according to the evidence presented, and naturally desires knowledge. The same considerations shew this right to be unalienable: it cannot be subjected to the will of another: tho' where there is a previous judgment formed concerning the superior wisdom of another, or his infallibility, the opinion of this other, to a weak mind, may become sufficient evidence. [Hutcheson 1755, 295]

From Hutcheson, the notion of inalienability of the rights of self-governance passed to Thomas Jefferson and then—with the American Declaration of Independence—into broader political history.[24]

In view of this intellectual history, the modern treatment of the theory of inalienable rights based on the *de facto* impossibility and thus natural invalidity of contracts to legally transfer decision-making and responsibility [e.g., Ellerman 1992] has been less a matter of discovery than rediscovery and retrieval. However, the notion of "inalienable rights" is often reduced to empty rhetoric, e.g., in an economy where daily work life is based on the mini-Hobbesian contract of employment, or is lost altogether by reinterpretation as in the work of the late Harvard philosopher Robert Nozick. Nozick [1974] interpreted an "inalienable right" as a right that may not be alienated without consent (which is actually only a right as opposed to a privilege), whereas the theory of inalienable rights was about rights that may not be validly alienated even with consent. Nozick had no notion of rights inalienable even with consent and accordingly he with perfect logic accepted the Hobbesian contract alienating self-governing rights of a group to a "dominant protective association" and similarly for the individual.

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[23] Kant made the point in an even more forceful way: "For in whatever way…the Deity should be made known to you, and even…if He should reveal Himself to you: it is you…who must judge whether you are permitted [by your conscience] to believe in Him, and to worship Him." [translated and quoted by Popper 1965, 182; original is: Kant 1960, 157 (Book Four, Part Two, Section 1, footnote)]

[24] "Jefferson took his division of rights into alienable and unalienable from Hutcheson, who made the distinction popular and important" [Wills 1979, 213].

> The comparable question about an individual is whether a free system will allow him to sell himself into slavery. I believe that it would. [Nozick 1974, 331]

The short-term renting of human beings in the employment contract is the basis for the present stage of economic civilization.[25] Since that contract is the short-term version of the lifetime labor contract and the limited workplace version of the Hobbesian contract, Nozick was perhaps the most consistent of all modern philosophers.[26]

Analysis of Production

We noted previously that in view of the fundamental connection between transfers between parties (contracts) and the internal activities of the parties (e.g., production), the employment system could be analyzed from either viewpoint. Having covered the analysis of transfers, we now move to the analysis of production.

Consider a productive opportunity represented by the production function Q = f(K,L) where K represents all the non-labor inputs used up during the time period in the productive opportunity and L represents all the intentional human actions performed by all who work in the enterprise (managerial and non-managerial workers). The basic argument is that in performing the intentional actions L, the people working in the enterprise are *de facto* responsible for using up the inputs K and for producing the outputs Q. By the responsibility principle, they should jointly be the legal appropriators of the input-liabilities –K and the produced assets +Q. These are the underlying facts about *de facto* responsibility and about the application of the responsibility principle regardless of the legal superstructure.

In vectorial terms, the people working in the enterprise, by performing the actions L, produce the positive and negative results (Q,–K,0) which might be called *Labor's product*. To put it in somewhat more conventional terms, this can also be obtained using marginal productivity theory. For, say, a Cobb-Douglas production function, $Q = AK^aL^b$, one can derive the vectorial marginal products by taking derivatives along the least cost expansion path where K/L = wa/br. The *marginal labor product* is the vector:

$$\mathbf{MLP} = \left((a+b)A\left(\frac{aw}{br}\right)^a L^{a+b-1}, \quad -\frac{aw}{br}, \quad 0 \right).$$

[25] "Since slavery was abolished, human earning power is forbidden by law to be capitalized. A man is not even free to sell himself; he must **rent** himself at a wage." [Samuelson 1976, 52 (emphasis in the original)]

[26] This was argued at length—with irony—in "The Libertarian Case for Slavery: A Note on Nozick" by the author writing under a pseudonym [Philmore 1982; reprinted with explanation in Ellerman 1995]. For more (non-ironic) analysis of inherently invalid contracts, see Ellerman 2005.

Since labor is the only responsible factor, one can compute its responsibility for the positive and negative results of production by "adding up"[27] or integrating its marginal product from 0 to L to obtain the result—which is Labor's product (Q,–K,0):

$$\int_0^L \mathbf{MLP}\,dL = \int_0^L \left((a+b)A\left(\frac{aw}{br}\right)^a \lambda^{a+b-1}, -\frac{aw}{br}, 0 \right) d\lambda = \left(A\left(\frac{aw}{br}\right)^a \lambda^{a+b} \Big]_0^L, -\frac{aw}{br}\lambda \Big]_0^L, 0 \right)$$

$$= \left(A\left(\frac{aw}{br}\right)^a L^{a+b}, -\frac{aw}{br}L, 0 \right) = (Q, -K, 0) = \text{Labor's product.}$$

It is customary in conventional economics to conceptualize the performance of these actions as the "producing" of the labor services L which are then "used up" in production. Using that representation, Labor's product can be parsed into two parts:

Labor's product = (Q,–K,0) = (0,0,L) + (Q,–K,–L) = "labor commodity" + whole product.

Under the employment system, one part, the labor services L, is recognized as belonging to Labor and is paid for in the labor contract. However, the labor services are not actually transferred. Instead, the people working in the enterprise (including any working employers) also produce the whole product which, however, is legally appropriated solely by the employer. The "trick" is to consider the *de facto* responsible co-operation of the employees as "fulfilling" the employment contract so that the employer would then be in the contractual position of the last buyer of all the inputs (including "labor") and thus as the defensible claimant on the product Q. Thus the employer, in sum, legally appropriates the whole product (Q,–K,–L). This is summarized in the following table.

Labor produces	(Q,–K,0)	= Labor's product
Labor appropriates	(0, 0, L)	= labor commodity
Labor produces but does not appropriate	(Q,–K,0) – (0, 0, L) = (Q,–K,–L)	 = whole product.[28]

Table 3: Production under the Employment System

If the responsibility principle were legally realized, then the legal members of the firm as a legal party would be the people working in it.[29] Such a firm is a *democratic firm* (or *self-governing*

[27] This is the "Adding Up Theorem" that resolves the non-metaphorical "adding up problem"—the problem of giving an account of "who is responsible for what" in production so that the marginal results add up to the total results of production. Note the asymmetric adding of the results of the responsible factor labor L instead of doing the same calculation for the non-responsible inputs K.

[28] This provides the modern reconstruction of the old slogan: "Labour's claim to the whole product" put forward by the "band" of classical laborists such as Thomas Hodgskin and William Thompson. For the history of that school, see the book by Carl Menger's jurisprudential brother Anton Menger [1899].

firm) and the market economy of such firms is an *economic democracy*.[30] To legally appropriate the input-liabilities –K, the firm would have to satisfy those liabilities by renting or already owning the capital and other non-labor inputs, and the firm would sell the outputs Q.

Thus the analysis of production based on the responsibility principle comes to exactly the same conclusion as the analysis of the contractual system—with the fundamental theorem showing the connection between the two. That is, the mistaken imputation in production implies a "transfer failure" in the contracts, namely the inherent non-transferability of responsible human actions. With the invalidity of the employment contract legally recognized, people could only rent (or already own) things instead of the owners of things renting people. Labor could only hire capital from its owners (including, in part, themselves). Thus in a democratic firm, as in a democratic polity at the town, municipality, or national level, there would only be debt capital (some of which would be "owed to ourselves"), never "equity capital."

In closing the analysis of production, comment is required on the treatment of labor in conventional economics. Over a century ago, the legally-trained economist Friedrich von Wieser clearly stated that for the legal, juridical, or moral imputation, only labor can be responsible.

> If it is the moral imputation that is in question, then certainly no one but the labourer could be named. Land and capital have no merit that they bring forth fruit; they are dead tools in the hand of man; and the man is responsible for the use he makes of them. [Wieser 1889, Chapter 3]

Wieser is not arguing that land or capital have zero "marginal productivity" but that the legal and moral "imputation takes for granted physical causality"; the imputation goes through the causally efficacious physical instruments back to the human users. Having acknowledged this, Wieser then left behind the notions of responsibility used in jurisprudence and developed a metaphorical notion of "economic responsibility" that could apply to all factors, namely marginal productivity. And the metaphorical idea that each unit of an input is "responsible" for producing its marginal product then conquered conventional economics "like the Inquisition conquered Spain."

There is no conflict between property theory and marginal productivity theory when the latter is seen only as part of a theory of price, not a theory of juridical imputation in the non-metaphorical sense, and when it is formulated vectorially to recognized the two-sidedness of production (positive and negative products). Property theory uses the normal jurisprudential principle of responsibility that deals with the responsible actions of persons, not the "non-responsible" services of things—a distinction that could never be discerned simply from the partial derivatives $\partial Q/\partial X_i$ of marginal productivity theory. By the same token, property theory has nothing to do

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[29] It was noted previously that when employer and employees engage in a crime and the legal authorities intervene to explicitly make the imputation in accordance with the responsibility principle, then the "business" is reconstituted as a "partnership" of all involved. Since the facts about *de facto* responsibility are unchanged when the business is non-criminous, it might be said that the people working in an enterprise should always be "treated as criminals" by rejecting the employment contract and legally reconstituting the business as a partnership.

[30] See, for example, Dahl 1985. The best examples today are probably the Mondragon industrial cooperatives in the Basque region of Spain [see Oakeshott 1978, 2000; Ellerman 1984; Whyte and Whyte 1988, or Lutz 1999]. Employee ownership schemes and codetermination arrangements are steps in the same direction.

with any theory of price, value, or wages. There was no argument that labor was *de facto* responsible only at certain wage rates or that labor was *de facto* inalienable only at certain wage rates. The wage rates played no role whatsoever in the analysis and critique of the employment system.

Historically, there has been some "entanglement" between the Lockean labor theory of property developed here and various "labor theories of value" as in Smith, Ricardo, and, most notoriously, Marx. The Marxian theory has now been developed in modern terms [e.g., Morishima 1973] and there is no connection whatsoever to the modern treatment of the labor theory of property developed here [see Ellerman 1992 for an extended comparison]. Not only does property theory have nothing to do with prices or value, the heart of the property theory is the normal "bourgeois" principle of responsibility. The current system based on the renting of workers is no more the "natural system of private property" than was the previous system of owning workers. The institutional implication of the responsibility principle is that the natural system of private property is the market system of democratic firms where people would be working for themselves and appropriating the positive and negative fruits of their labor—not the employment system of people being rented privately by the suppliers of capital or by the capital-owning government (as in the Marxian case).

Final Remarks

I mentioned at the outset that a number of small *gestalt* changes in framework, mini-paradigm shifts, are necessary before the ideas developed here fall together. Now we are in a better position to elucidate these shifts.

1. Fundamental myth: The idea that the "rights to the product" are part and parcel of the rights to some existing asset is easily defeated by considering the case where the asset is rented out. Then the product goes elsewhere while the ownership of the asset remains in the same hands. This shows that "being a firm" (i.e., whole product appropriator) is a contractual role. Then avoiding the semantic straddle of referring to this contractual role of being the firm (last buyer of all the inputs) as "ownership" will clear the path to moving beyond the fundamental myth in spite of the strong repercussions for capital theory, corporate finance theory, and general equilibrium theory.
2. Appropriation: If the rights to the product are not part of some pre-existing property rights, then the ground is cleared to raise the question of appropriation in normal production, not just in some mythical state of nature or when common property is being privately appropriated.
3. Vectorial treatment: By "vectorial treatment," I mean not just thinking in multi-dimensional terms but in algebraically symmetrical terms about "positives" and "negatives," i.e., assets and liabilities. This allows the symmetrical treatment of both ends of the life-cycle of a property right, initiation and termination, as being the appropriation of property assets and liabilities. Moreover it shows that consumption is also a site for appropriation since property rights are terminated in consumption (as well as in production).
4. Whole product: The conventional approach is dominated by the "distributive shares" metaphor, as if the suppliers of the inputs were producers and claimants on shares of the positive product. There is also a dual myth about the demanders of outputs using up the inputs and thus having shares in the negative product as claims against them. The dual myth

tells a "story" about marginal cost pricing of outputs just as the usual "story" leads to the marginal productivity costing of inputs. But these myths duel only with each other. There is in fact no legal imputation of the positive product to the input suppliers and no imputation of the negative product to the output demanders. Instead, the whole product (positive plus negative products) is legally imputed to one legal party, the party who would thereby be called the "firm." This reconceptualization of production changes the focus of normative questions from "distributive shares" to the basic question of "Who is to be the firm?".

5. Invisible judge: All four of the previous points come together to arrive at the formulation of the market mechanism of appropriation. This idea could not arise without getting beyond the fundamental myth, raising the question of appropriation, seeing appropriation in a two-sided vectorial fashion, and moving beyond the metaphorical picture of imputation in the firm (from distributive shares to the whole product). Then the idea quickly arises of a last-buyer/first-seller invisible hand mechanism of imputation by the "lowest court in the land," the invisible judge. Thus the Humean contractual mechanism also functions as a mechanism of appropriation for produced and consumed items of property.
6. Responsibility: One of the astonishing feats, or, rather, feints of conventional economics is the learned ignorance of the fact that while all the inputs are causally efficacious (otherwise, why use them?), only human action ("labor") can be *de facto* responsible and that the responsibility for using productive instruments is imputed back through the instruments to the human users. The basic reasons for the professional blindness are not hard to fathom; today's unnatural system of property and contract based on the renting of human beings, the "employment system," legally treats labor services *as if* they were "non-responsible" (outside of crimes) and transferable like the services of things.
7. Juridical principle of responsibility: One of the key connections to bring the pieces of the puzzle together was the realization that the "fruits of one's labor" principle from Lockean property theory was the positive application of the normal juridical principle of responsibility typically applied to the negative side of appropriation, the imputation of liabilities.[31]
8. Possession space: A focus on what happens when contracts for the purchase and sale of commodities are fulfilled and on property externalities quickly shows that the relevant transfers are not in physical space (although that may be involved), but transfers in possession. Similarly, the relevant "immobile" or "non-tradeable" factors would be what cannot in fact be voluntarily transferred out of the possession of a person, i.e., a person's decision-making capability and *de facto* responsibility.
9. Fundamental theorem: One part of the theorem was seeing that putting the juridical principle together with the idea of possession space pointed out that the *de facto* responsible party for consuming or producing a commodity would also be, respectively, the last or first possessor of the commodity. That, in turn, established the connections to the contracts fulfilled by transfers in possession. Hence when all contracts are fulfilled and there are no extra-contractual transfers, then the last-buyer/first-seller imputation of the invisible judge will be

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[31] This connection has been independently noted by a legal scholar: "[T]he libertarian entitlement thesis, to the effect that persons are entitled to retain the fruits of their labor, and the libertarian thesis about outcome-responsibility, to the effect that persons are responsible for the harms that they cause, are two sides of the same coin. ... The basis of this unity is the idea that people "own" the effects, both good and bad, that causally flow from their actions." [Perry 1997, 352]

respectively to the last/first possessor and thus correct in terms of the responsibility principle, i.e., the fundamental theorem.

10. Analysis and critique of employment system: With the above pieces in place, the analysis and critique of the current system based on the renting of human beings is straightforward. With the connection between production and contracts established by the fundamental theorem, the analysis of the employment system had two parts both with deep historical roots.
    10.1. Lockean theory applied to production: Labor produces Labor's product (Q,–K,0), which is the sum of the *de facto* responsible actions conceived as a "commodity" (0,0,L) plus the whole product (Q,–K,–L), but Labor only appropriates (as first seller) the "labor commodity" while the employer appropriates the whole product.
    10.2. Inalienable rights analysis of the employment contract: The traditional theory of inalienable rights that descends from the Reformation through Hutcheson to Jefferson (once resurrected) was based on the *de facto* non-transferability of decision-making. The same *de facto* non-transferability holds for all non-coerced human activity such as that involved in production (and in crimes, where the inalienability is routinely recognized). Hence the voluntary contract for the renting of human beings, like the voluntary contract for the all-at-once renting or sale of human labor and the voluntary Hobbesian constitution of subjugation, is impossible to fulfill and naturally invalid.

The interesting implication is that, notwithstanding two centuries of economic theorizing, the current system is not the "natural system of property and contract" any more than would be a private property system where longer-term voluntary contracts in human capital were legally valid. The natural system is one where the "owner-operated" proprietorship and family farm generalize to democratic firms of any size where people are jointly working for themselves. Moreover, the system of economic democracy finally resolves the long-standing conflict between being a voting citizen bearing inalienable rights in the democratic political sphere and being a rented "employee" in the workplace.

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