

**CAPITAL AS A LAYER CAKE:**  
**THE NATURE OF CAPITAL AND ITS STRUCTURE**

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**Abstract:**

We elaborate a structural or morphological approach to the nature of capital that develops the work of Menger and Lachmann (the “ML trajectory”). We propose a layer-cake metaphor to capture the kernel of the ML approach and contrast it with the neoclassical metaphor of capital as an amorphous, homogeneous jelly. According to the ML approach, capital is combinatorial and is organized structurally and relationally. The approach examines capital as it exists “out there” in the world, as it is actually formed and experienced by entrepreneurs. Capital goods only exist and become productive once they are connected in entrepreneurs’ production plans so that the focus is upon relations of complementarity between heterogeneous capital goods as used in production. Hence, capital is a layered structure: there is a nested hierarchy of capital goods, capital combinations and economy-wide capital structures. Using Bunge’s theory of systems, we investigate how each of these entities is a concrete system at a different layer of economic reality. Both capital combinations and overall capital structure arise in an irreversible, causal-genetic process in real time and capital structure has the added distinction of being an emergent, spontaneous order.

**Key words:**

Capital, Lachmann, Menger, complementarity, production, ontology.

**JEL classification codes:**

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Blobs are out; we require layer cakes. Reality must have more fundamental structure.

(Armstrong 1989: 135)

**1. Rival approaches to the nature of capital: Jellies versus layer cakes**

The nature of capital has proven to be as elusive for economists as it is complex. Controversy in economics over the “nature of capital” reached a high point in the late nineteenth and early twentieth centuries.<sup>2</sup> Yet beneath what appeared on first reading to be arid arguments over definitions were camouflaged deeper, telling preconceptions about the essential constituents of capital and its causal relationships in production. This early controversy was in fact concerned with the fundamental features of capital; it provided the building blocks for the now received neoclassical theory of capital embodying a notion of capital as a “factor of production” cast in a “production function” (e.g., Cobb and Douglas 1928; Robinson 1954; Hicks 1974: 309-10). We concur with Mark Blaug (2002: 37) who has argued recently that capital in this sense is “scandalously unrepresentative” of capital in “any recognizable economic system”. Nevertheless, the “production function view” of capital still enjoys currency in equilibrium price theory, growth theory and the modern economics of organization (Foss 2005: 33).

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<sup>2</sup> Notable contributions to the first “capital debate” include Clark (1888), Menger ([1888] 1935), Fisher (1906), Fetter (1907) and Veblen (1908). See too Böhm-Bawerk’s ([1921] 1959: 10-66) long discussion of different definitions of capital. Hayek (1941: 5) considered this controversy “among the least edifying chapters of economic science”.

The recent appearance of substantial studies concerning the “ontology of economics” (Mäki 2001) offers fertile ground upon which to revisit questions originally posed in the early controversies over the nature of capital. (Economic ontology studies the kinds and structures of fundamental entities that make up economic reality.) Our orientation will be largely to avoid a discussion of economists’ capital concepts per se since these are usually constructed to suit the formal properties of economic models and do not describe capital formation in any real-world economy. The question “What is capital?” should not be treated as a game of playing with fictions. Instead we wish to ask: What is capital to those entrepreneurs who actually create and organize it? What are the constituents and building blocks of capital in this context? What are its real structure and properties? What dimensions of human behavior are necessary for its ongoing existence?

Our objective therefore is to describe capital as it really exists “out there” in the world, as it is actually formed and experienced by entrepreneurs who organize real production processes. We elaborate such a realist vision of capital by developing and extending the writings of two economists within the Austrian school. We trace a trajectory specifying a common understanding of capital originating in Carl Menger (1871) and elaborated by Ludwig Lachmann (1956). Both authors sought to make the order, shape and coherence of capital intelligible in terms of individual choice. Their structural or morphological approach deals with capital goods as they are used and combined in actual production plans. It is expressed in terms of the complementarity, specificity, heterogeneity and indivisibility of resources that we observe in reality.

Although our study of capital is Mengerian and Lachmannian in spirit, we do not limit ourselves to any previous statements of that position—rather we try to present it in its boldest and most compelling form. We try to bring the “Menger-Lachmann trajectory” on the nature of capital up to date by drawing upon recent developments in scientific realism (e.g. Mäki 2008) and theories of systems (e.g. Bunge 1979).

We initially juxtapose two antithetical trajectories of economic thinking on the nature of capital: the Clark-Knight-Cobb-Douglas (broadly, neoclassical) account of capital and the aforementioned Menger-Lachmann account. Both approaches had their roots in the early controversies and both have profound implications for the way we view the fundamentals of economic organization in capitalist, industrial societies. A capsule summary comparison is offered in Table 1 below. The table headings use contrasting metaphors describing the positions of the two trajectories. In the neoclassical trajectory originated by J. B. Clark, capital was first likened to “jelly” by Böhm-Bawerk (1907:280). Clark (1888: 10) asserted that capital was “a fund that is permanently [owned], though it may not retain for a single day its exact present form of embodiment”. While expressible as a monetary fund, capital was not embodied in money. Capital as a scientific term must be conceived in the most “abstract” manner. Capital must be seen as a perpetual fund or substance “the destiny of which is to migrate through an endless series of outward forms” (Clark 1888:10). For example, capital “may stay for an instant in steam, and for an hour in the fuel that generates it. It stays for weeks in unfinished products and for years in the machinery that makes them” (pp.14-15). In short: “All capital... lives by transmigration.

It must eventually cast off one set of bodies and put on others” (Clark 1899:147). Hence, Böhm-Bawerk’s (1907:280, 282) complaint that Clark had produced a “mythology of capital”: Clark “strips off everything which may suggest material existence, and retains only a value jelly, existing externally and never destroyed”.

After Clark’s contribution in the early capital controversies, it became conventional analytically to collapse heterogeneous capital goods into a homogeneous mass, like jelly, that could be conveniently divided up and instantly set or made durable. Jelly capital was perfectly adaptable and freely mobile. The vision of economic organization associated with jelly capital is a black box: inputs and outputs are synchronized but the structure of production is obscured. While twentieth-century neoclassical capital theory was not monolithic, Klaus Hennings (1987: 116, 117) demonstrates that the neoclassical economists had a vital preconception in common—capital was “seen more and more as a homogeneous mass”. For example the Cobb-Douglas macroeconomic production function was implicitly reliant on this idea. In the 1930s Frank Knight followed Clark and thought of capital as “an amorphous mass which could take on different forms” and Paul Samuelson gave this conception his “seal of approval” in the first edition of his textbook in 1948. Mathematical tractability demanded that capital must be non-specific in its physical form especially in long-run analysis. The jelly-like homogeneity of capital in a production function made it infinitely divisible and its identical elements were more amenable to aggregation. Accordingly, transaction and information costs incurred in organizing homogeneous capital are “relatively unimportant” (Foss *et al.* 2007: 1168).

By contrast, in Table 1 we apply the “layer-cake” metaphor to the Menger-Lachmann trajectory on the nature of capital, and we shall substantiate this application in the main sections of the paper. A layer cake is a cake comprising multiple levels of sponge, typically connected by thin seams of sweet filling. Unlike a blob of jelly, a layer cake has lots of rich texture, variable consistency and complex flavors. It is not a smoothly continuous, uniform, homogeneous material medium. Nor is it a permanent substance that maintains its sameness and continuity over all time and across all situations. A layer cake has a definite structure because its layers and fillings are arranged in a particular way; the frosting sandwiches layers together in a certain order.

The layer-cake metaphor indicates hierarchical levels of different kinds of entities. Just as the cake is divided into tiered strata, with distinct fillings between each layer, so too capital structure is hierarchical, decomposable and modular. Consequently, the layer-cake approach portrays economic reality as stratified, with different entities existing at different levels of organization that stand in relations of existential dependence to one another. “That the world is layered in this way means that universals [e.g. properties, relations, structures] belonging to one level cannot be reduced to, or replaced by, universals belonging to another level” (Johansson 2004: 22). Like vertically ordered layers of a cake, structures of physical capital resources occur at three levels of increasing generality (i.e. capital goods, capital combinations and economy-wide capital structures). (See Table 2.)

**Table 1: Alternative ontologies of capital: Jellies versus layer cakes**

	<b>Capital as jelly</b> (“Clark-Knight trajectory”)	<b>Capital as a layer cake</b> (“Menger-Lachmann trajectory”)
1	Primary focus: What is the nature of capital, what differentiates the “whole fund of capital” from particular concrete capital goods, and how does this fund of capital coordinate economic activity?	Primary focus: What combinations of capital goods are profitable, how and why will they be used; in what circumstances might capital structure exist, what forms might it take, and what are the causes and effects of changing capital structure?
2	Capital is a congealed, amorphous, blob-like jelly that lacks structure	Capital has a layered structure; there is a nested hierarchy of capital goods, capital combinations, and overall capital structures; capital resources at each level stand in relations of complementarity or consistency to each other
3	Capital is a permanent substance that is never destroyed	Capital is neither substance-like nor permanent; although durable capital goods exist, capital combinations are continually modified, and overall capital structures are transitory
4	Capital can exist on its own; in its most abstract form, it is mind-independent and complete in itself; it has independent and objective productivity	Capital goods only exist and become productive once they are connected in entrepreneurs’ production plans; hence their existence and productivity depend upon the mental processes by which plans are constituted
5	Capital is fundamentally abstract and separable from matter (concrete capital goods); it lives by “transmigration”, moving through an endless series of external forms of material embodiment	Capital is fundamentally material; it really exists “out there” in the world; capital exists only to the extent that it is instantiated by concrete capital goods, capital combinations and capital structures
6	Capital is homogeneous jelly (“an abstract fund”)	Capital goods as used in production are heterogeneous objects
7	Capital is readily and costlessly mobile between different material forms before it “sets”; within the blob of jelly, every portion is perfectly substitutable for another	Layered nature of capital combinations and functional specificity of capital equipment constrain substitutability between capital goods
8	Capital is a scalar exhibiting increasing magnitude as capital accumulates	Capital is a directed graph (a system, network), exhibiting increasing complexity and emergent properties as capital accumulates
9	Equilibrium growth: capital inputs always synchronized with outputs; any changes and responses are predictable; expectations constant	Disequilibrium growth process: integration of the economy-wide capital structure is precarious and is always in the process of formation given changing expectations
10	Time is causally inefficacious with respect to capital formation because capital is permanent and instantly mobile between alternative uses	Time and causality are inseparable because capital combinations and the capital structure emerge in an irreversible, causal-genetic process in real time

Within the layer-cake approach, systems or structures are a category of entity in economic reality that is on a par with individuals, properties, relations and causal powers. (By system, we mean a network of connected elements.) As systems, layer cakes and capital orders are characterized by their composition (constituent elements), structure (the set of relations between elements), environment (context of production and use) and mechanism (processes of formation) (Bunge 2003). Neither cake parts (sponge, filling) nor capital resources are isolated entities; they all interact with other things and cohere to form bigger structures. Just as the frosting is both a complex object (containing butter, eggs, chocolate and icing sugar) and a component of the final cake, so too every capital good is simultaneously a concrete system and an element of a higher-level system (such as a capital combination). “There are no stray things” (Bunge 1979: 245). The filling (i.e. frosting) removed from a cake is filling in name only but not in fact; similarly, a capital good removed from a production plan is not actually a capital good—it is a capital good only potentially but not in reality.

The body of the paper is organized into four main sections. In the next section, we examine Menger’s analysis of capital. Section 3 outlines Lachmann’s extension of the Mengerian project by explaining the inner workings of capital and its structure. Modern literature has produced illuminating descriptive ontologies of various economic phenomena, though capital has not yet figured among them (Zúñiga 1999; Mäki 2001, 2002; Beaulier and Boettke 2004). Menger and Lachmann are scientific realists about capital: they see capital and its structure as things really “out there” in the economy. Section 4 examines Lachmann’s scientific realism about structures (or systems) and

relations and the interdependencies between these two categories of entity. The focus is upon the relation of complementarity between heterogeneous capital goods that are connected to form capital combinations.

In Section 5, we use Bunge's (1979, 2003) systemic approach to explicate the Menger-Lachmann trajectory and to focus in more detail on "systems" as an important kind of entity in economic reality. Using this framework, we explain how capital goods, capital combinations and economy-wide capital structures are each concrete systems at three different levels of organization. (See Table 2.) The conclusion section briefly summarizes our findings and discusses the implications for economic research of the Menger-Lachmann account of capital.

## **2. Carl Menger's analysis of the nature of capital**

Menger (1985: 37n, 146-7) recommends investigating (i) the general nature of capital and other phenomena constituting various fundamentals of the economic world, including economy, money, commodity, value, and price and (ii) the essential building blocks of these fundamentals, including capital. He enquires: what is their "nature" and what causes their "movement"?

In Menger (1950: 303-04), capital is said to be a subset of "economic goods". The existence of economic goods, that is goods regarded as scarce relative to human requirements for them, is fully predicated on a valuing mind. Valuation refers to the

importance of an economic good; it presumes a causal connection between things over which the valuing subject has control, and the satisfaction of a human requirement (Menger 1950: 53-55). Superficially a scarce thing is seen as an economic good but does not often achieve “goods character by itself, but only in combination with other goods” (p.75). For instance, a book of meal recipes will include various food constituents and requisite utensils though these must be connected by a series of typical causal-mental connections in a use plan as well as physical actions to achieve a satisfactory meal. The fundamental nature of an economic good, what makes a “tasty meal” an economic good along with its constituents, is the creation of mutual dependencies between certain intrinsic properties of the food ingredients. In this sense an economic good can be said to possess physical or technical properties that have a mind-independent existence; these properties exist prior to the valuing mind connecting those properties in a causal nexus to the ultimate satisfaction of a human requirement.

Capital goods are first and foremost economic goods: they are heterogeneous, scarce, “technical means of production”, such as machines, fertilizer, ploughs and implements (p.157, 162). A “productive sum of money” and “credit” are also capital goods as are a whole host of concrete durable goods such as property—houses, farms, animals (Menger [1876] 1994: 61-65; [1888] 1935: 174; 1950: 304). While such capital goods are conceivably species of something called capital and may be classed for accounting purposes into actual asset-types, they cannot be “elevated into the status of the genus itself” (Menger 1950: 304). In its pure, abstract representation, the genus is a mentally selected combination of capital goods, that is “complementary quantities” of those goods

“whose productivity is of an essentially different nature” from the things that constitute them considered as unconnected intrinsic elements. Menger’s capital is a deliberately connected combination of goods possessing an emergent productive property that arises in the process of selection. Capital is therefore more than the sum of its parts since its parts are ordered (or layered) in a particular manner. In addition, the real genus, capital, is a production notion as distinguished from ‘investment’. Capital does not inhere in money, but investment in capital goods and the productivity of those goods may be calculated in terms of money (as a rate of yield or rent) (Menger [1888] 1935: 174).

Capital formation has four main preconditions:

1. Economic goods must presently be available for combination in future time periods.
2. Economic goods must possess real properties that bestow causal powers: they must be capable of being organized in a production process; they cannot immediately perish and must therefore have some durability. Therefore, before capital can be formed its potential constituents either have a prior mode of functioning and existing given their physical components or possess recurring features. Machinery is an obvious example of the former, and intangible business services and commercial goodwill examples of the latter.
3. Individuals must have command over potentially *complementary* economic goods that may form capital for a sufficient time period, that is, control over those goods that are seen as necessary for a production process that the user has in mind.

4. Individuals must have knowledge of causal connections between capital goods and the satisfaction of needs. Capital goods are not mere data; their use and connections to human needs must be specified.

Menger's capital is a source of production. Once formed, it implies a "process of transforming" some things into other things (Menger 1950:159). Capital has existence independently of economist's representations. The functionally specific properties of the capital goods that constitute capital are, however, dependent on the minds of the entrepreneurs who use them.<sup>3</sup> Again, capital is *more* than the sum of its constituent parts precisely because the mode of use of inherent properties of capital goods can vary from user to user.

Necessary for capital formation are various entrepreneurial acts that presuppose some knowledge of the causal nexus between instruments of production and numerous human requirements for their outputs (Menger 1950: 55, 160). Capital and the entrepreneurial act are inextricable; they cohere, for example, to transform capital goods into consumer goods. Yet the transformation process, the mode of using capital goods, is not universally given or uniform.

Menger's analysis of capital, in conjunction with its necessary behavioral conditions, namely "entrepreneurial activity" (p.162), renders capital in several dimensions. First,

capital has an emergent value dimension. Capital goods combinations have a perceived, prospective productivity. The attribution of “productivity” to capital is a mental event. A causal link is drawn in the entrepreneur’s mind between the value of prospective outputs (effects) and their ultimate causes—the desires and valuations placed on the outputs. Desires and valuations of imagined end-users of the output of capital are causally prior to the originating mental events creating capital; they exist objectively and externally and are often taken as invariant even though they are not certain. In their review of relevant literature on causation, Cowan and Rizzo (1996:290) report that causal explanation in general accepts the *reality* of originating causes. Menger’s entrepreneurs are no exception in their attitude to originating causes; they accept that real causes operate, legitimate their capital-creating actions and produce effects external to them. Nonetheless, the effects flowing from those actions are not fully predictable. Future desires and valuations are changing, changeable and require the entrepreneur’s ongoing interpretation. Capital formation in the economy as a whole may then be the result of a Mengerian invisible-hand process, a spontaneous order or “organically” created structure (Menger 1985: 147, 218).

The second key dimension of capital is its structural organization. Here we may, by implication following Menger, distinguish three structural layers:

1. *Compositional structure*: insofar as capital is composed of complementary capital goods, these items are intentionally fixed in their mode of use when devoted to a specific production process. Once established and implemented in a production plan, the

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<sup>3</sup> Of course, capital goods may have required capital to produce them in the first place; their very

composition is frozen for the period of production and may not easily be changed. The production outcome is more or less assured. In other words, using Machlup's (1963:80) terminology, capital has "structure" in that the entrepreneur who composes it operates under some invariant pre-conditions that are "outcome-determining" but not "outcome-determined". The pre-conditions may change at some future date.<sup>4</sup>

2. *Synchronic structure*: the real-time structure of capital-goods combinations exhibits a constant horizontal structure because capital goods are used in a synchronous process. Capital-goods combinations are deliberately and purposively set for a period of irreversible historical time.<sup>5</sup>

3. *Diachronic structure*: the real-time structure of capital-goods combinations exhibits a constant vertical structure because the intended use of capital goods in a certain composition or mode is distributed in a sequence extended through historical time.

The time dimensions deserve further reflection. Time and causality are ontologically inseparable in Menger's discussion of capital.<sup>6</sup> That is, capital formation presents itself as a temporal process in that time elapses between cause and effect. And the organization of capital has real effects in time. These effects are evident once an entrepreneur's production plan is implemented in response to originating causes—the demands for final products. Time is regarded as an endogenous variable when Menger discusses capital in

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production presumes a prospective value embodied in them for future end-users.

<sup>4</sup> This idea of structure—invariant pre-conditions imposed over the duration of a process—is originally due to Hood and Koopmans (Machlup 1963:80). Machlup generalizes the idea, defining the structure of a plan, system or explanation as "the set of outcome-determining but not outcome-determined conditions" (p.81).

<sup>5</sup> Thus Menger (1950:152): "The transformation of goods of higher order [i.e. capital goods] into goods of lower order [e.g. consumer goods] takes place as does every process of change, in time" (bracketed inserts added). Furthermore, in Menger's vision of capital formation, according to Hicks (1976:139) "time is unidirectional".

its most abstract form; it is not a technical datum determined by the inherent properties of capital goods. Decisions to organize capital goods in a specific composition in time are tantamount to committing and distributing those goods to produce goods required by end consumers.

The entrepreneur's "plan" to create capital is profit-motivated. It is propelled by the "human impulse of self interest" and must have some economic purpose in view (Menger 1985: 87; 1950: 160-61). Furthermore, the actualization of the profit motive and self-interest necessitates that capital formation be embedded in a system of private property, market exchange and a money economy in which relative price signals foster ongoing economic calculation. Nevertheless, it is still not clear under these circumstances whether or not entrepreneurs are fully in control of their capital-creating plans. At least at the level of the individual's production plan, the structural implications outlined above are intended. However, those individual intentions are founded on fallible conjectures about the demands for the products of capital. To be sure, Menger (1950: 109) ascribes to the entrepreneur capabilities to develop "deeper insights into the causal connections between things" in time. These insights motivate capital formation and generate economic progress.

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<sup>6</sup> In general the "idea of causality...is inseparable from the idea of time" (Menger 1950:67).

### 3. Lachmann's elaboration of the Mengerian vision

The questions, answers and presuppositions in Lachmann's treatment of capital are in concordance with Menger's analysis. Like Menger, Lachmann tries to capture the inner workings of capital and its structure.<sup>7</sup> Lachmann (1956: 53) is interested in the existence of the structural feature of capital:

We shall be concerned with what is meant by *capital structure*; in what circumstances might it exist or continue to exist; what forms might it take in varying circumstances; and what effects its changes or its disappearance would have on the economic system (italics in original).

Lachmann insists on realism, that is, on making his categories and concepts describing capital faithfully “reflect the actual pattern of capital use” (p.4) and immediately “intelligible in terms of human action” (Lachmann 1976: 147). Like Menger, he presupposes that all heterogeneous “resources” (Menger's “capital goods”) exist initially as scarce means with many possible alternative uses, that they exist for the sake of uses to which they may be put and that they become capital when they are organized effectively in practice to produce something. For Lachmann (again, like Menger), capital reflects certain actual and intended complementary relations. He continues the Mengerian focus on the appearance of different compositional forms, structure and uses of capital.

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<sup>7</sup> In terms of Lachmann's place in the history of Austrian capital theory, Lewin (1997:523) cites Lachmann's express desire further to “retreat” from Böhm-Bawerk's “objectivist” and technical notions of

Lachmann's restates a key Mengerian idea: capital comprises complementary combinations of heterogeneous capital goods. He objects to Hayek's (1941:56) elimination of "really permanent resources" either original or augmentable (though not consumable in any way) from the capital-goods category. For example, natural surface features of place, human temperament, topography and climate would not qualify as capital goods in Hayek's theory. For Lachmann, capital is brought into existence by an entrepreneurial act of "planned complementarity" and *any* resource qualifies if it is used in that plan. Permanent and impermanent resources are often conjoined; different plans may well organize those very resources in multifarious ways. Therefore, actual use is the pre-eminent feature of "capital"; the historical origin of a resource is irrelevant (Lachmann 1956: 11-12).

Capital is also the outcome of structural consistency emerging from the interaction of the plans of individual entrepreneurs. The infinite varieties of plans forming capital are constituents of a system (Lachmann 1956: 72). The system is not determined by any particular entrepreneur's plan; it is "a complex of relationships that exhibit a coherent pattern" (p. 59). In other words, the "pattern" or capital structure exists independently of an entrepreneur's capital since it is an overarching network of connections between various and possibly changing complementarities (Lachmann 1975: 201; 1976: 147; 1986: 61).

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capital. See too Lewin (1999: ch. 7). Our contention is that the "retreat" was to ontological foundations

The intertemporal and interlocal organization of production will nevertheless take a particular shape (and confer that shape on the whole capital structure) insofar as technology and market conditions dictate that certain raw materials have only limited feasible uses in time and space. Moreover, durable capital goods may embody a given vintage, scale, indivisibility and specificity (Lachmann 1956: pp.84-5). In fact, “*complementarity plus indivisibility*” influence the capital creation process (Lachmann 1956: 80, his emphasis). Thus, in reality capital is neither completely specific nor completely non-specific. Capital structure in the sense of shape begets function for capital goods (p.53). It calls into being specific uses of those goods and so renders an arrangement of resources in the economic system as a whole constituting a Mengerian spontaneous order.

At the outset, Lachmann rejects a static and idealized notion of capital structure as an invariant (and perfectly dovetailed) composition of capital-goods combinations, in which the process of eliminating all less effective combinations has already been completed. Although it is an “order”, structural consistency does not imply fixed coefficients of production (p. 109). Lachmann rejects an equilibrium sense of capital structure precisely because it lacks realism.<sup>8</sup>

Crucially, structural consistency has a time dimension. A capital good could easily lose its “capital character” and become scrap in a plan that is extended in time and that is

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constructed originally by Menger.

imperfectly referenced to, and yet intricately connected with, the plans made by others (p.80). Structural consistency is not equivalent to predictability. The structure of capital is unpredictable because the economy in disequilibrium presents itself as a long, complex assemblage of production. So there is nothing entirely predictable about the nature of the capital structure of an economy dominated by a long, complex, changeable assemblage of production processes. Deeply embedded in the representation of capital as the outcome of plan complementarity is the potential for creating more complex multiplicative “layers of specialized capital”. Lachmann’s focus is on the “mode of change” in these “layers” that give shape and order to the stages of transformation of mere things into consumer goods (p.83). Creation of more complex Lachmannian “layers” of capital complementarities amounts to variations in the capital structure and is the basis of economic progress. Indeed, an important implication of Lachmann’s treatment of capital is that “*capital accumulation entails a changing capital structure*” (Lewin 1997: 534, his emphasis). Capital accumulation makes possible a higher degree of the division of capital and results in ever higher degrees of complexity of the capital structure (Lachmann 1956: 80, 84).

The existing function of a capital good is not the only thing that counts in apprehending capital as an “order”. Lachmann favors disequilibrium *process analysis* (a “causal-genetic method”) to conceptualize incessant movements in the order of capital-goods combinations in reality, “tracing the effects of decisions made independently of each other by a number of individuals through time, and showing how the incompatibility of

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<sup>8</sup> Thus, the concept of capital “as a complex structure in which each unit is a complement to every other unit” is an “ideal type”, a “pure equilibrium” concept *not* “found in actual experience” (Lachmann 1947: 109). See also Lewin (1997: 531).

these decisions after a time necessitates their revision” (p.39). The revision process of “regrouping” capital combinations, of generating novel capital combinations, is a response to perceived *incoherence* in the existing or expected pattern of relations between entrepreneurs’ matching of present capital goods (Lachmann 1986:80). Entrepreneurs discern breaks in the overall structure of capital and then constructively create a response pattern by forming new combinations. This combinatorial, entrepreneurial act is forward-looking and forward-matching. The entrepreneurial “mind is an instrument for reducing chaos to order”; it is a source of creative intelligence, stimulating new plans and organizing new functions for capital goods (Lachmann 1956: 37-8, 40, 54-5).<sup>9</sup> Entrepreneurship is therefore vital for capital heterogeneity.

Lately, Foss *et al.* (2007: 1179) emphasize “the importance of capital heterogeneity for theories of entrepreneurship... If capital were homogeneous, the entrepreneurial act would be trivial. Many...of the interesting problems of economic organization would disappear”. In fact, Menger and Lachmann locate the *source* of heterogeneity in entrepreneurial acts. Thus, whereas Foss *et al.* state that capital heterogeneity establishes the necessary conditions for entrepreneurship, Menger and Lachmann consider the reverse to be the case: entrepreneurship establishes the necessary conditions for capital heterogeneity. Entrepreneurial acts create and simultaneously solve problems of economic organization. Even if entrepreneurs begin with physically homogeneous materials, their specific mode of use and functional differentiation will be the outcome of

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<sup>9</sup> Lachmann is aware of the possibility that when breaks in the order occur, some capital goods could be used “in ways other than those for which they were originally planned” (p.37). Again structure, in this case changes in structure, begets function.

intertemporal production plans. “Even in a building which consisted of stones completely alike these stones would have different functions [within a construction plan]” (Lachmann 1956: 53). Entrepreneurs bring capital to life; they discover, experiment with and ultimately organize complex capital-goods combinations.<sup>10</sup>

#### **4. Systems and relational structures in the theory of capital**

The notion of system (and its corollary, structure) is a leitmotiv that permeates Menger’s and Lachmann’s theories of capital. Indeed, structures are examined in well over seventy paragraphs in Lachmann’s magnum opus, *Capital and Its Structure*. Lachmann (1956: 72) explicitly mentions how capital combinations, embedded in plans, are “ultimate constituents” or “atoms” that tend to form a “system”, the capital structure. As the phrase suggests, the “order of capital” is not a jumbled heap of productive resources, but a complex system itself composed of interconnected subsystems of various kinds. There is a nested hierarchy of capital goods, capital combinations and overall capital structures.

Systems are an addition to the ontology of capital. They are a distinct category of entity in economic reality that is something over and above properties and relations. They cannot be reduced to properties and relations. “What there really is, are systems” (Bunge 1977: 16). There are no completely independent things; there are no totally isolated capital goods. All capital resources are complex entities (concrete systems) that are themselves

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<sup>10</sup> Modern literature has of course advanced on these insights. Realizing functional differentiation depends on entrepreneurs’ production plans being inserted into networks of social relations, particular organizational contexts of use and interpersonal routines. See, for example, Lawson (2008: 53).

components of some higher-level system or other: “all capital goods have to fit into a pattern or structure” (Lachmann 1956: 10).

The structural conception of capital presupposes realism about not only “structures” (which we call “systems”) but also relations, for the very reason that “structures” consist of entities in relations to each other (cf. Grossmann 1983: 238). The systems are real. The relations are real: “relationships exist between entities” (Lachmann 1956: 59). Without relations, there are no systems (cf. Grossmann 1983: 51). Equally, without systems, there are no relations. This principle was first expressed by Meinong ([1899] 1978) along the lines of “where there is a system, there is a relation, and vice versa”.

In accordance with this principle, Menger and Lachmann recognize that systems (structures) and relations are tightly bound together and mutually dependent. For example, let us consider the relation of complementarity between means used by an entrepreneur for the same end. Plan complementarity is “the complementarity of the capital combination of the firm” (Lachmann 1986: 64). It is impossible for this relation to exist without the relevant production plan (itself a system of planned actions): “Factor complementarity presupposes a plan within the framework of which each factor has a function” (Lachmann 1947: 110). In effect, what Lachmann is saying is that if there is a relationship of complementarity between two or more distinct capital goods, then, by that very fact alone, these economic objects (the *relata*) are elements of a higher-level system. Adapting Bunge’s (1979: 284) formalism, we can say in more exact language that a capital good  $x$  is complementary to a capital good  $y$ , where  $x \neq y$ , if and only if there is a

production plan  $z$  (= a system) such that  $x$  and  $y$  are in the composition (i.e. membership) of  $z$ .

Relations are a kind of universal, they are types, and following Armstrong (1989), we suggest that they are best thought of not as things but as ways—ways that actual things stand to each other. Consequently, complementarity will here be understood as a dyadic relation that is an economic universal. Complementarity between any pair of capital goods (that are embedded in the same plan) is the very same relation. The complementarity that holds between capital goods  $q$  and  $r$  in one production plan is the very same entity as the complementarity holding between capital goods  $x$  and  $y$  in another plan. For capital combinations, complementarity is a way that two or more capital goods stand to each other in the context of a production plan for the firm's output. It makes no sense to think of the relation of complementarity existing separately and apart from the particular capital goods between which it holds. Like other economic universals, it cannot exist uninstantiated, hovering over concrete objects. The relation of complementarity is instantiated whenever an entrepreneur's plan involves the use of heterogeneous means for a common end (Lachmann 1956: 55). Thus, for complementarity to exist, it must be the case that there exist at least two capital goods that are actually connected by this relation. For its existence, the relation of complementarity is as dependent upon its relata as the economic type "capital combination" is dependent upon the relation of complementarity for its existence.

Both complementarity and substitutability are relation types and categories of human action (Lachmann 1956: 55). Complementarity is a relation that is mind-dependent, goal-directed and causal in that it has real effects. It is attuned to particular entrepreneurial purposes. Like the heterogeneity of capital, the complementarity and substitutability of capital resources are also empirical facts (Lachmann 1947: 113).

Complementarity and substitutability are an important type of relation—they are what Bunge (1979: 20) calls *bonding* relations. In contrast to non-bonding relations, bonding relations make some difference to the things related. In a bonding relation, at least one of the objects related acts upon the other—where “to act upon” is interpreted broadly to include not just bringing about specific concrete outcomes but also eliminating or making available certain possibilities or opportunities (Bunge 1979: 6). Complementarity between means employed for the same end involves a kind of fusion into a combination, and it constrains capital goods to a tentative unity that they did not have before they were welded to each other within the context of an entrepreneur’s production plan. Complementarity modifies the behavioral trajectory of at least one of the capital goods that enters into the relation. At least one of the capital goods will be used differently in the future from how it would have been used if it had not been made part of that combination. (Williamson’s notion of ex post asset specificity is a case in point.) Lachmann seems to be aware of the bonding potential of complementarity and the impact it can have on future economic possibilities: “The importance of complementarity lies in that ‘technical rigidity’ (invariability of the mode of complementarity) may often make it

necessary to change the end rather than the means; an existing combination of factors is used to produce a different output” (1947: 110).

Relations of plan complementarity and substitutability as well as other relation types are important for the order in the capital structure. “In a world of planned human action ... structural order ultimately rests on the complementarity of the means employed in a given area of action for distinct ends” (Lachmann 1956: 86). The relations of complementarity and substitutability connect capital goods. Complementarity is the glue that holds capital goods together in combinations. “For most purposes capital goods have to be used jointly. Complementarity is of the essence of capital use” (Lachmann 1956: 3). Substitutability, on the other hand, indicates the scope for putting one capital good in place of another in an existing means-end scheme. “Substitutability indicates the ease with which a factor can be turned into an element of an existing plan” (Lachmann 1947: 110). However, of all the technically possible modes of complementarity between physical capital resources, only those that are economically significant contribute to generating the capital order (Lachmann 1956: 4).

What distinguishes relations, such as complementarity and substitutability, from entities in other categories is that all relations, including symmetric and non-symmetric ones, have a direction. Every relation has distinct places and this fact accounts for why certain relations can form the basis for the capital order (cf. Grossmann 1992: 57). For example, the relation *being substitutable for* has two distinct slots, which can be expressed as \* R # where \* indicates the first slot, R the relation of substitutability and # the second slot. A

change in what occupies a particular slot brings about changes in the resulting capital order. If  $x$  and  $y$  are two non-identical capital goods and  $R$  is the relation of substitutability, the capital order contained in the state of affairs  $x R y$  is quite different from that contained in the state of affairs  $y R x$ . The relation of substitutability is non-symmetric (i.e. neither symmetric nor asymmetric). From the fact that  $x$  is a substitute for  $y$ , it does not follow that  $y$  is a substitute for  $x$ , nor does it follow that  $y$  cannot be a substitute for  $x$  (cf. Grossmann 1992: 56). For example, from the fact that a pen is a substitute for a pencil, it does not follow that a pencil is a substitute for a pen, nor does it follow that a pencil cannot be a substitute for a pen. Indeed, a pencil can substitute for a pen in one production plan (e.g. writing a note to oneself), but not in another (e.g. writing a check).

Grossmann (1983) identifies asymmetric relations as the ontological source of what brings order into the world.<sup>11</sup> The temporal relation of *preceding* between events is an example of such an asymmetric relation. Let  $e_1$  and  $e_2$  be two events in accordance with a production schedule, where  $e_1$  is the event of bringing capital good  $x$  into operation at time  $t_1$ , and  $e_2$  is the event of initiating use of capital good  $y$  at time  $t_2$ . If event  $e_1$  precedes event  $e_2$ , then  $e_2$  cannot precede  $e_1$ . Time is the “dimension of processing, the medium of complementarity” (Lachmann 1947: 114). Complementary capital goods come into operation in accordance with a time schedule as specified in the entrepreneur’s production plan. First-line capital goods are those whose services provide inputs of the

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<sup>11</sup> “Ontologically speaking, what brings order into the world is a combination of two facts. First, there are relations and these relations have distinct places. Secondly, some of these relations are asymmetrical, that is,

production plan right from the very beginning as the venture is launched (Lachmann 1956: 90). Second-line capital goods are planned to come on stream at a future date during the planning period after the venture has got up and running. “Whatever their position in time, all capital instruments are linked together by complementarity [over time]” (Lachmann 1947: 114). Complementarity is a symmetric relation. If capital good  $x$  is complementary to capital good  $y$ , then capital good  $y$  is complementary to capital good  $x$ . (Note that although it is symmetric, the relation of complementarity still has a direction. Even in this case,  $x R y$  is strictly speaking a different state of affairs from  $y R x$ .) However, when the complementarity relation is combined with a temporal relation, e.g. capital good  $x$  is complementary to capital good  $y$  in the production plan  $z$ , and the use of  $x$  is planned to precede the use of  $y$ , it brings order to the capital structure and an element of irreversibility in the production plan (the metaphorical “arrow of time”).

In the following section, we explore the three levels of organization of capital resources according to Lachmann: capital goods, capital combinations and the overall capital structure of the economy. It is noteworthy that these three systems of physical capital resources are all economic types which themselves are also tokens falling under a higher-order type of structure—they are each particular instances of an *asset structure* (a higher-order economic universal) (Lachmann 1956: 86-87, 92). Thus, “capital good”, “capital combination” (or “production plan structure”) and “economy-wide capital structure” are simultaneously first-order types and second-order tokens in the same way that “redness”, “whiteness” and “blueness” are all types and at the same time tokens falling under the

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they are such that if  $a R b$  is a fact, then the different state of affairs  $b R a$  is not a fact” (Grossmann 1992:

higher-order type “color”. Lachmann maintains that other types of capital structure and relation types exist outside the level of physical capital goods (p.86).<sup>12</sup> In particular, there is an “overall asset structure” which has physical capital structure, portfolio structure and control structure as its parts. These three types of capital structure are interdependent and stand in dynamic relations to each other (Lachmann 1956: 92). The overall asset structure is thus a relationally structural universal because its parts have properties which it does not have, and its parts stand in one or more relations to each other.

In a similar vein to our earlier discussion of bonding relations, Lachmann emphasized that these structural relationships between capital goods and other assets are channels for the transmission of knowledge and they also provide incentives for action and adaptive adjustments (Lachmann 1956: 60, 89, 92-95, 98). Along with the structure of relative prices, these structural relationships are therefore connections in the market-wide system of communication. Capital complementarity serves as an amplifier of internal capital change (i.e. capital regrouping in the firm) (Lachmann 1947: 114; 1956: 58), but relationships in the capital structure transmit knowledge well into the far reaches of the economic system. As entrepreneurs form and dissolve capital combinations, they affect

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57).

<sup>12</sup> Lachmann identifies at least six types of capital structure within the realm of economic action: (i) physical capital good (e.g. a building or plant as a finished structure); (ii) capital combination or plan structure (structure of complementary physical capital goods within a single production plan); (iii) portfolio structure (structures of property rights and claims to productive resources (i.e. operating assets) within an investment portfolio); (iv) control structure (structure of debt-titles and equities within the total securities of the firm); (v) overall asset structure of an individual business enterprise (integrated firm-level structure comprising a plan structure, portfolio structure and control structure); and (vi) economy-wide capital structure (the capital structure of the economic system as a whole). To each of these types of structure, there corresponds a distinct and economically significant type of capital relation type that exists within that structure. For instance, within a portfolio structure, we find portfolio complementarity which refers to the complementarity between titles to the control of operating assets within the firm (p. 55).

flows of productive services from one capital combination to another. They indirectly transmit knowledge from their part of the market to the rest of the economy through the networks of structural consistency between capital combinations at successive production stages in different firms. “The appearance of malinvestment in any kind of capital resource will affect the processes of its maintenance and replacement and thus the output of its means of production, and possibly also maintenance and replacement of the latter in turn” (Lachmann 1978: x).

## **5. Capital combinations and capital structures as concrete systems**

Bunge’s (1979, 2003) theory of systems is a useful framework for explicating a structural approach to capital. Three core ideas in Bunge’s philosophy are “wholeness (or systemicity), variety, and change” (1979: xiii), themes that mirror Lachmann’s own emphasis upon structure, heterogeneity and dynamic change in the order of capital. Both Bunge and Lachmann focus upon the structural characteristics of systems. Systems are complex entities whose components are connected rather than detached. Systems are things *in relations* (cf. Grossmann 1992: 51).

**Table 2: The systemic (and relationally structural) character of capital**

	<b>Level of organization</b>	<b>System type</b>	<b>Composition (“elements”)</b>	<b>Structure (nature of “connections”)</b>	<b>Environment (“context of operation”)</b>	<b>Mechanism (“processes of formation”)</b>
<b>Type of object</b>						
Physical object (including naturally occurring objects)	$S^0$	Natural (physical, chemical, biological)	Molecules, compounds, polymers etc...	Energy flows, electromagnetic fields, chemical bonds etc	Source and sink of chemicals and energy	Chemical syntheses, other natural assembly processes
Capital good	$S^1$	Technical	Technical subsystems (e.g. parts of a machine)	Technical complementarity (dependency relations between functions of various components)	Plan of use for capital good (“use plan”), routines	Industrial, artificial assembly processes
Capital combination	$S^2$	Socio-technical	Capital goods	Plan complementarity, substitutability	Production plan for firm’s output, organization of firm, competitors’ activities	Deliberate assembly and direct result of entrepreneurial production planning
Overall capital structure (economy-wide)	$S^3$	“Undesigned” socio-technical	Capital combinations in different firms interacting with one another	Structural consistency	Markets	Spontaneous self-assembly generated by market processes, indirect result of interaction of plans in the market

According to Bunge (1979: 6), an object is a *concrete system* if and only if it consists of at least two different interrelated things (i.e. two or more material objects). A concrete system is analyzable into its *composition* or membership, its *environment* or context of operation, its *structure* or relationships and the *mechanism* or the processes of its formation and maintenance (see Table 2).

In Lachmann's theory of capital, structures of physical capital resources occur at no less than three levels of organization (i.e. system-levels). There are capital goods, capital combinations and the overall structure of physical capital resources in the economic system. Table 2 describes the make-up of each of these concrete systems in terms of Bunge's approach.

As it is a structured array of two or more physical capital goods, a capital combination clearly qualifies as a concrete system. According to Lachmann, "a capital combination is a material manifestation of a production plan, an *array of capital goods* which gives outward expression to the *order of means* in the means-ends scheme which underlies and *guides planned action*" (1986: 63; emphasis added). In this short statement, Lachmann provides most of the building blocks for recasting capital combinations as concrete systems in line with Bunge's approach. In the case of capital combinations, the composition of the system—the collection of elements—comprises capital goods. They are technical subsystems at a lower level of organization. The environment of capital combinations includes the operations and organization of the relevant business enterprise, and especially the production planning activities of the entrepreneurial team. The

mechanism of formation involves entrepreneurs and subordinates deliberately putting together elements (i.e. capital goods) to form capital combinations as they go about developing the firm's production plan. The structure (the nature of connections) of capital combinations comprises relations of plan complementarity and substitutability between capital goods. "[Plan] complementarity is a property of means employed for the same end, or a group of consistent ends" (Lachmann 1947: 110). Because structure is a major object of interest to us, we will investigate this aspect in more detail below.

In the case of the overall concrete system of capital resources in the economy as a whole (Lachmann's "capital structure"), the composition consists of capital combinations in different firms (or some other governance structures) that trade or compete with each other. (See Table 2.) The most important structural dimension is the relation of structural consistency that Lachmann (1956: 54) defines as the over-all consistency of use of capital goods within the economic system. This type of consistency is the indirect result of the interaction of entrepreneurial plans in the market (p. 54, 86). The relevant environment is markets and the complex interaction of economic forces (both internal and external to the economy). As for its "mechanism", the overall capital structure (in Lachmann's sense) is generated through processes of self-assembly. It is a spontaneous order. (More on this shortly.)

A note on terminology is warranted. A structure is the set of relations by which elements are related. "A structure is a complex of relationships which exhibit a coherent pattern" (Lachmann 1956: 59). A capital combination is a collection of capital goods arranged in a

structured way. Thus, like all systems, a capital combination *has* a structure but it is not itself a structure (cf. Bunge 1979: 10). Alternatively stated, a capital combination is a complex object that possesses a relationally structural property (Armstrong 1978, 1986). A capital combination  $x$  is a concrete system if and only if: (i) the set of its properties is a *property-system* (i.e. a set of interrelated properties); or (ii) the set of processes it undergoes is a *functional system* (i.e. a set of coupled processes) (Bunge 1979: 15).<sup>13</sup> Sometimes Lachmann uses the term “structure” in Bunge’s more restricted technical sense to refer to the relational structure of a system. At other times Lachmann uses the term “structure” to refer to the entire system itself (i.e. the elements and the relational connections between them). We will retain Lachmann’s terminology (e.g. by referring to the overall capital structure) and it should be clear from the context whether we are talking about a system or just the structure of relationships of a system.

Capital resources cannot exist independently of human action—they are not mind-independent. Capital goods and capital combinations are intentional products of entrepreneurial action. At least in part, capital goods only exist from the subjective viewpoint of the participants. “As long as no need arises for using a hammer, there will not be any hammers, however many suitable T-shaped objects there may be around” (Koffka 1935: 393). Capital goods are organized by human minds and inserted into the production plans of human actors. Hence, capital goods and capital combinations are at

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<sup>13</sup> Bunge says that “in a system all properties and processes are lawfully interrelated”. For a related distinction, see Kroes (2006) on the separate, but interwoven, physical and functional descriptions of technical artifacts.

least partly constituted by the expectations, purposes and plans of human individuals (Mäki 1990: 295).

Although they are causally connected to the human mind, capital resources at all levels persist externally to the mind and generate effects outside people's heads. In addition, they exist independently of and wholly unconstituted by economists' theorizing about them. They have the properties they do irrespective of economists' beliefs, models and theoretical representations of capital.

The overall capital structure emerges spontaneously as the result of an invisible-hand process. This distinguishes it from capital at other levels of organization. It is an "organically" (i.e. unintentionally) created socio-technical structure. It is generated by invisible-hand processes of origination and emergence. That is, it is the unintended social consequence of numerous actions of dispersed agents who are pursuing their own interests in the market place.<sup>14</sup> The resulting capital order is not part of the intentions of any individual agent or group. As Mäki (1991: 163) might say, the overall capital structure is a large-scale social phenomenon that is "neither I-intended nor we-intended". It comes into existence without any cooperative actions aimed at bringing it about. Thus, although it does not emerge as a stable social institution, on a par with language, merchant law, or money, the capital structure is as "organic" in origin as any of these freely grown institutions. It comes into being in the same manner as these organic social institutions. However, in contrast to these social institutions, which gradually crystallize

as *persistent* spontaneous orders, the formation of capital structure is a *transitory* and *recurring* spontaneous order, like the formation of market-clearing prices for goods. (This two-fold distinction is made by Menger (1985: 146, 158), Hayek (1955: 41) and Lachmann (1971: 57).) The capital structure is kaleidic, precarious and vulnerable to unexpected change. “The forces inherent in a market economy tend to operate towards consistent capital change and a coherent pattern of service streams flowing into and out of capital combinations; ... in this sense we may say that a capital structure, though it could hardly ever exist for any length of time, is always in the process of being formed” (Lachmann 1956: 73).

The overall capital structure is a concrete system that exhibits strongly emergent properties—it is a whole that is more than the sum of its parts (see Francescotti 2007; Stephan 2006). Capital structures are not mere aggregates of simpler components (i.e. stocks of capital goods). First, there is genuine, historical novelty in the process of forming a capital structure. The existing building blocks of capital are arranged in new configurations that instantiate new properties. Second, in a dynamic world of unexpected change, the overall capital structure forms in a way that is unpredictable in principle. The properties of an overall capital structure cannot be known or deduced *ex ante*, no matter how complete our knowledge of the properties of its parts (e.g. capital combinations). The specific functionality of capital combinations embedded in a production plan does not follow from the functionality they exhibit when they occur in isolation or in simpler kinds of systems. Capital goods and capital combinations have different functional

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<sup>14</sup> For a critique of Lachmann’s solution to the problem of advancing a subjectivist view of human action

characteristics (indeed they lose their mode of use) when they are outside any production plan.

Third, the overall capital structure has irreducible, downwardly directed causal powers. Gaps in the existing higher-level structure influence the creation of new kinds of capital goods and combinations at lower levels: “The shape in which new capital goods make their appearance is determined largely by the existing pattern [i.e. the overall capital structure], in the sense that ‘investment opportunities’ really mean ‘holes in the pattern’” (Lachmann 1956: 10). Furthermore, the properties of capital combinations (e.g. their productivity) are causally dependent on their being parts of a higher-level emergent capital structure that is formed within an abstract order of market rules, private property rights and money prices that facilitate economic calculation by entrepreneurs of the relative profitability of new capital projects. Hence, a configuration of physical instruments of production in a socialist economy is not a capital combination in Lachmann’s sense; though it might superficially have the same physical properties as a combination in a capitalist economy, it is not brought into being by disequilibrium market prices and entrepreneurial perceptions of profit opportunities generated by breaks in the existing capital structure.

## **6. Conclusion**

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while simultaneously seeking a plausible account of overall economic order, see Lewis and Runde (2007).

We have provided a reconstruction of what we have called the Menger-Lachmann (ML) trajectory of thought on an important aspect of economic reality: the nature of capital. According to this approach, capital is combinatorial and is organized structurally and relationally. Relational properties are part of the very being of capital goods. Capital goods are not solitary and self-contained entities that can exist independently. Capital goods without, and apart from, an entrepreneur's production plan are incomplete; to be productive, they must be connected together to form capital combinations. Hence, capital goods, capital combinations and economy-wide capital structures are each concrete systems (Lachmannian "structures") that occur at three distinct levels of organization. Each of these systems exists objectively and externally. None of them is mind-independent, but the overall capital structure has the distinction of being an organic, spontaneous order unlike capital at other levels of organization.

Consequently, we proposed a layer-cake metaphor to capture the kernel of the ML approach and contrasted it briefly with the metaphor of capital as jelly—an approach that was expounded by Clark, Knight, Cobb and Douglas, among others. When capital is portrayed as an amorphous, homogeneous blob, real features of the capital formation process are obscured and capital appears as an all-purpose phenomenon, instantly durable and completely adaptable. Whereas the jelly approach has been an impediment to economic theorizing on capital, the ML approach opens up promising research vistas for elucidating the real features of capital, such as the heterogeneity and complementarity of capital goods and the self-organizing and emergent properties of the overall capital order.

When economists debated the fundamental nature of capital in the early capital controversies associated with Clark, Menger, Böhm-Bawerk and others, they presumed, quite rightly, that they were contributing to economics. In this they were on strong ground. As Mäki (2008) maintains, the study of the kinds and structures of entities in economic reality has “bite” for economics—it makes a difference to the questions economists may ask. The ML trajectory helps us dissolve pseudo-questions that arise because they are based on misconceptions about the nature of capital. For example, the question that has occupied many prominent economists over the last century, “What determines the value of the aggregate capital stock?” has limited explanatory power once we realize that such an aggregate does not really exist. Aggregative reasoning about capital is coextensive with the “homogeneity assumption”, with capital as jelly. In such reasoning, capital accumulation is understood in terms of the “meaningless notion” of the “marginal efficiency of capital” that supposedly falls with increasing investment (Lachmann 1956: 80-81). Yet when investment is deconstructed, revealing the layered nature of capital, it becomes evident that the income flows of all capital goods will not uniformly be affected; new capital will often substitute for old capital and differentially alter the incomes of complementary capital goods. Unless we accept that economics is merely a pure science of formal implications, the ML trajectory suggests that we should be wary of pseudo-questions about the capital combinations of hypothetical “representative firms” that are a mere replica of some average industry combination since they are extreme abstractions from reality.

Our enquiry has analyzed fundamental organizational features of capital such as structure (or system), relation (or connection) and property, which are precisely the aspects of economic reality neglected in the twentieth-century capital debates (Knight-Hayek and later Cambridge controversies). Therefore, it is scarcely surprising that a “deep issue” in those debates concerning “the meaning ...of capital in the analysis of industrial capitalist societies” was to remain unresolved (Cohen and Harcourt 2003:200).

The study of the nature of capital can generate new research strategies that suggest the need to include new empirically significant categories. For example, the ML trajectory steers us towards framing questions about capital in terms of entrepreneurial choice, temporal process and unintended consequences of action. It also allows us to appreciate how capital combinations, produced by a locus of individual acts, become the ultimate constituents of capital structure. Research in the ML program would thus turn on: (i) explicitly choosing a clear set of realist commitments about capital as it presents itself to entrepreneurs and that emphasizes its combinatorial, relational and structural character; (ii) explaining actual relations of complementarity between heterogeneous capital goods as well as the inner workings of capital and its structure; (iii) integrating process analysis and entrepreneurship into the study of dynamic, heterogeneous capital problems; and (iv) avoiding treating capital as universally substitutable in the long run and untied to any specific physical form so that it does not require or presuppose any organizational structure whatsoever.

Indeed, future research is required to elaborate the implications of the ML approach for micro-, meso- and macro-levels of economic organization and the interactions between them. In addition, it should examine how discontinuous adjustment of capital combinations to unexpected change affects dynamic transaction costs and their relation to production costs. This in turn would place the formation and regrouping of productive capital combinations at the core of the firm as a mode of economic organization and would thereby bring the capital structure of production plans (i.e. how capital goods are used in productive activities) to the foreground of the economics of organization.

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