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Substance and semantics: The question of capital☆

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ABSTRACT

The perennial question 'What is Capital' has been getting some attention recently. Although the distinction between capital as a financial construct and capital as a collection of physical production-goods is well known, we argue that the former concept is undepreciated. The two concepts are often conflated in practice, and the relationship between them is seldom well understood. We spell out the financial concept of capital emphasizing its importance as an indispensable instrument of calculation and accounting. We consider some views of human, social and other capital and how we differ from them. We present reasons for rejecting the notion of an aggregate production function in standard growth theory (which uses the notion of an aggregate stock of physical capital) and as recently used by Thomas Piketty in his well-known work.

1. Introduction

Perhaps no word in the history of economic thought has provoked more controversy than 'capital'. This is surely an argument about more than semantics – or aesthetic preference. It goes to the fundamentals of the functioning of the 'capitalist economy'. It is well known that 'capital' as used in economics, has a dual nature – one financial and one physical. On the one hand, it may be used as a sum of money or money-value for the financing of productive projects. On the other hand, at least since the time of Adam Smith, economists have used the term to mean a collection of physical productive resources. Capital, in the financial sense, is the one that comports with common-usage and is the one that captures the essential nature of 'capitalism' as an historically specific institutional setup. Capitalism without financial capital-markets is inconceivable. So to understand capitalism one needs to comprehend this view of capital. This essay considers the implications of this in more detail and the relationship of capital generally to human and other types of capital. We argue that the money-value

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approach facilitates accounting and calculation and, for that reason, this view of capital applies to any productive resource, or productive condition, that is the object of valuation.

Perhaps the most enlightening way to think of the financial approach to capital is to think of the word 'capital' as the result of the verb 'to capitalize'. It is the value of the stream of expected (net) earnings that will result from any investment/production project. Though this may seem trivially obvious, consistent adherence to this view of capital in economic thinking turns out, we believe, to be indispensable to an understanding of all aspects of what is known in economics as capital theory. It is a perspective that has been very much neglected in this literature.

Section 2 following explains the financial view of capital, emphasizing the importance of calculation and accounting. Section 3 considers how the financial concept of capital applies to 'human capital'. Section 4 examines the relationship of financial capital to the aggregate production function. Section 5 considers briefly some views of social and other capital. Section 6 concludes.

2. What is financial capital? It is an individualistic, mental tool for the purposes of making calculations that inform decisions, and is unique to a market economy

2.1. Capital, income and calculation

Production-goods are combined with labor to produce valuable outputs. These production-goods are most often called 'capital-goods'. But, as Ludwig von Mises tells us, "From the notion of *capital-goods* one must clearly distinguish the concept of *capital*." Following Mises' terminology, we hereafter use the unmodified term "capital" to designate the money-value attributed to particular business projects, the direct or indirect results of which are valuable consumer goods. For non-labor inputs attributed to particular business projects, we will speak of "physical-capital" or "capital-goods." Mises adds, importantly:

> The concept of capital is the fundamental concept of economic *calculation*, the foremost *mental tool* of the conduct of affairs in the market economy (Mises, 1949, p. 260, italics added).
>
> […]
>
> Capital is the sum of the money-equivalent of all assets minus the sum of the money-equivalent of all liabilities as dedicated at a definite date to the conduct of the operations of *a definite business unit*. It does not matter in what these assets may consist, whether they are pieces of land, buildings, equipment, tools, goods of any kind and order, claims, receivables, cash, or whatever (Mises, 1949, p. 262, italics added).

And Israel Kirzner, explaining Mises's approach, puts it like this:

> Capital is properly defined as the subjectively perceived monetary value of the *owner's equity* in the assets of a particular *business unit. Capital* is therefore to be sharply distinguished from *capital goods*. (Kirzner, 1996 [1974], p. 124, first set of italics added).

This view of capital is firmly rooted in the concept of *the value of the business-unit*. The value of the business is its *capital*. Capital is a monetary representation of the value of the combined resources of the business (net of its business).[1]

In this approach, Mises is following a number of (dissident) economists including Frank Fetter and Irving Fisher, who clearly emphasized a money-value approach to capital. But, unique to Mises it would appear, is the combining of Fetter's recognition of the importance of *calculation* for understanding capital, with Fisher's concern about capital as a useful *accounting* concept.

According to Fetter,

> Capital is defined as a conception of individual riches having real meaning only within the price system and the market where it originated, and developing with the spread of *the financial calculus* in business practice (Fetter, 1930, p. 190, italics added; Hodgson, 2014, p. 1069).

Fisher (1906) develops a book length accounting approach to the theory of capital.

According to Fisher (1906), valuable phenomena can be classified in one of two broad categories, stocks or flows, or, more specifically, capital and income. Income consists of a flow of services that consumers value, like nutrition, shelter, security, entertainment. The physical items that produce these services have value because, and only because, they produce these valuable services. The value of the sources of these services is the valuer's estimation of the (net) value of the services that can and will be produced by them for oneself or for sale for money, taking due account of the time-value of money (discounting). Thus, Irving Fisher, makes no distinction between different sources of income, physical or human, owned or unowned. A capital-value is an individualistic phenomenon. It is the value an interested individual puts upon a particular productive project or process. He notes that, as a matter of accounting *practice,* only owned resources feature in capital

[1] This perspective is also consistent with Kirzner's notion of capital as 'unfinished plans'. The production plan involves the combination of physical resources over time to create an emergent value greater than the original value of the resources used, due account being taken of the time value of money. See Kirzner (1966).

Table 1
Business balance-sheet (capital-account) as of a particular date.

Assets	Liabilities
value of production-goods	accounts and notes payable
inventory	other
value of 'soft' assets.*	
Cash	
accounts receivable	
Other	
	Equity (Net Worth = value of the business)
Total assets =	Total liabilities

*like enduring contracts, long-term leases, licenses, patents and copyrights.

accounts, though the services of all resources feature in income accounts, and he indicates at length how this inconsistency can be remedied by a more complete capital accounting procedure, something we consider in the following section.

2.2. Capital accounting

In his work, Fetter refers to the importance of ownership, and, therefore, of the institutions of private property and exchange.

> Capital is essentially an individual acquisitive, financial, investment *ownership* concept. It is not coextensive with wealth as physical objects, but rather with *legal rights* as claims to uses and incomes. It is or should be a concept relating unequivocally to *private property and to the existing price system*. (Fetter, 1927, p. 156, italics added)

This view of capital and its function is clearly reflected in modern accounting practice. Only those items that can be owned appear in the capital-account (balance-sheet) depicting the capital-value of the business at any point of time. The value of a business emerges as the *residual* after accounting for the total values of assets and liabilities as, for example, illustrated in Table 1 below. The balance-sheet relates to the capital side of the capital-income relationship. Its purpose is to provide an estimate of the value of the business and its parts in terms of significant categories.

Values must be attributed to the items in the capital account. Most conspicuously, production goods must be valued. One possibility is to use their 'book values'. From an economic perspective this is not useful as book values (historical value, purchase prices) are irrelevant for current decisions. Market (or current/present value is the relevant concept. The market value of any set of physical assets, as explained above, depends on the value of the saleable outputs, that they, together in teams (combinations) of productive resources (including labor), are expected to produce. The value of any combination of production-goods is the present-value of its expected output over time.

Note, significantly, that the value of labor-services is not listed in the account. This is because, as mentioned earlier, labor cannot be owned. Labor services cannot be alienated from their owner. Thus, labor can only be rented. The value of the expected future contribution to output to be provided by labor-services will be paid as wages. If the productivity of the firm's fixed assets is enhanced by the cooperation of labor this is attributed, by default, to the physical production goods. The same is true for the services of all rented productive assets. Their value is paid in rent and any synergistic additional value attributed to the business's fixed assets whose product is enhanced by their cooperation.[2] We see here one aspect of accounting convention that is dependent on the phenomenon of 'ownership,' that is on property-rights. By convention only those items owned by the business organization are included in an assessment of its value. Fisher (1906) provides a 'more comprehensive' accounting technique in which all the stocks of productive resources, human and physical, owned and rented, are included in both the capital (balance-sheet) and income accounts.

We may wonder about the effect of excluding the value of some of the resources expected to be available to the business to produce the income attributed to it. To get the whole picture one has to imagine the rented resources that will be needed and the value that will be produced with their help. An entrepreneur appraising a particular business must, therefore, endeavor to see more than is visible in the accountant's balance-sheet, which reflects the values imputed to its items by the accountant who created it. The entrepreneur must endeavor to impute his own values to all of the resources he imagines to be available (owned or rented) to the business over time. His *mental* balance-sheet is thus crucially contingent on his particular expectations. We may say that the balance-sheet of any business is in significant part 'in the eyes of the beholder'.[3]

Accounts are potentially useful for decision-making (like investment), financial reporting, and managing. There is, however, an important difference between financial accounting and managerial accounting. A manager looking at a balance sheet

[2] An anonymous reviewer points out that labor services may be attributed to 'intangibles' if the balance sheet includes an item for this, which not all do. In any case, it does not change the point we are making, namely, that the balance sheet does not have an item for the present value of the flow of labor services that are expected to be used by the business.

[3] For a financial interpretation of Kirzner's entrepreneurial *alertness* and the subjective valuation of productive resources see the discussion in Cachanosky (2017).

Table 2
Income statement Business cost and revenue as recorded at the end of a particular period.

Income	Expenses	
Sales	Depreciation allowance	
	Interest	*Contractual Payments*
	Wages	
	Equipment rental	
	Occupancy rental	
Total Revenue	Total Cost	
Total revenue - Total cost = Profit = Cash Flow *(CF)*		

sees *results*, but not the *reasons* for the results, and, in particular, the labor component is entirely absent. So, the manager as well must dig behind the balance-sheet when seeking guidance for managerial decisions.

A useful supplementary picture can be provided by looking at the revenue and cost *flows* of the business over time using income statements such as depicted in Table 2 below. Logically, cash flows must be considered to flow from the firm's assets – hence the corporate-finance practice of using the concept CFFA (cash-flow from assets) derived from *changes* in balance sheet items.

Using the income statement *prospectively*, that is, to estimate *future* profit flows, provides an alternative, related, way to evaluate a business. This is closer to the usual theoretical procedure using discounted cash-flows (profits aka net-earnings). While the balance-sheet at any time should reflect in the values imputed to the productive assets of the business, the (present-value of the) expected flow of profits, the income statement reflects the value of the services in terms of their costs to be compared with the revenue earned over a period of time. The value (cost) of the services of rented assets (or assets to be rented) is recorded in the income statement in terms of the contractual rents paid (to be paid). In a sense this is 'the market's' estimate of what these services are worth in their next best use. It is more fundamentally the result of a multitude of individual appraisals of their worth distilled out of individual offers in the market for their services and reflected as the minimum price for which the firm can rent them.

Even though prices originate in the subjective valuations of economic agents, it does relieve the entrepreneur/manager of forming his own estimate of the money value of their cost. The entrepreneur still needs to perform his own forecast of profit and loss, but the market is already providing to him some prices *he* does not have to estimate because they are contractually fixed. This is a significant benefit of the joint institutions of private-property, voluntary contracting, money, and capital-accounting.

For non-contractual services, such as those yielded by owned assets, the accountant/entrepreneur must provide his own private imputation. Economically speaking a useful way to think about it is as the cost of renting the asset to oneself – or as how much could be earned by renting it to someone else.

Once again, the picture is crucially dependent on the expectations of the particular observer, but the historical income statement does provide an additional important objective measure, namely, the recorded historical profit or loss. To be sure, it is not wholly objective because, as explained, depreciation (the amount necessary to put aside to make good the value of durable-goods 'used up' in production, so as to maintain one's capital) must be estimated. But, *if this is not done correctly for a sufficient period of time, the business will experience a cash-flow deficiency from the need to use funds to repair or replace production-goods*, that will ultimately be reflected in reduced or negative profits. *Market feedback* from consumers thus provides the ultimate judgment concerning the values attributed to the business, its capital.

2.3. The three 'capitalist' institutions – money, calculation and accounting

The importance of capital thus inheres in its calculation function. Capital as a concept derives from its institutional context – an economy in which there are *capital-markets*. In the absence of capital-markets the extensive division of labor upon which capitalism depends, could not exist. Capital-accounting provides the means for the entrepreneur to both evaluate and acquire productive resources. Again, Fetter, 'Capital is essentially an individual acquisitive, financial, investment ownership concept.' (1927, p. 156).

The concept of capital as value rests on the connected social institutions of money and accounting. Money, as universal purchasing power and unit of account, serves not only to separate the acts of purchase and sale, but also the acts of saving and investment. Money-values provide a way of evaluating productive resources and outputs upon which the entrepreneur/investor/manager may form a judgment of the worth of particular actions. This is the economic function of capital. Current outputs are valued in markets in terms of money by the current supply and demand conditions. Future outputs are not valued (in the absence of futures markets), but the means to their production are, thanks to the institutions of money, (financial-) calculation and accounting. Capital-value implies the 'capitalization' of expected future money flows. Capital connects these three historically specific institutions and institutional practices.

From this perspective, it is not clear that capital, in referring to the valuation of particular productive resources, should be confined to the valuation of physical productive resources, what we normally call 'capital-goods'. All capital valuations

are contextual and depend on the particular purpose for which they are done. This is perhaps nowhere more so than in the case of human capital.

3. Human capital

Human capital is now very well-established concept, not only within economics, but also in related social sciences like sociology and political-science. Yet it was not always like this. Though there are precedents to the concept dating back to Adam Smith and probably before, the term was not in use, and its introduction by the 'Chicago School' in the 1960s was greeted with substantial criticism and resistance.[4] Over time, however, as indicated, this opposition has substantially reduced, perhaps owing in large part to the huge body of work that has applied the concept in a variety of contexts. Human capital is now widely seen as the single most important explanation of the pattern of individual earnings over time and across workers. And while we may suggest, as with physical capital, that the term 'resources' be preferred over 'capital', the capitalized value of these contracted resources should clearly be included in the capital-value of any project or of any investment decision. Recently, however, arguments in favor of excluding human capital from capital broadly understood have re-emerged.

Perhaps the most notable is that of Thomas Piketty (2014). Although he adopts a view of 'capital' in physical terms (though somehow valued and aggregated for use in an aggregate production function, of which more below), Piketty excludes human capital.

> I always exclude what economists often call (unfortunately, to my mind) 'human capital,' which consists of an individual's labor power, skills, training and abilities. In this book, capital is defined as the sum total of non-human assets that can be owned and exchanged on some market. Capital includes all forms of real property (including residential real estate as well as financial and professional capital (plants, infrastructure, machinery, patents, and so on) used by firms and government agencies.
>
> There are *many* reasons for excluding human from our definition of capital. The most obvious is that human capital cannot be owned by another person or traded on a market (not permanently at any rate). This is a key difference from other forms of capital. (Piketty, 2014: 46. Italics added)

This approach is revealing in number of ways. First, it establishes Piketty's use the term 'capital' to denote physical things, tools. He refers to capital as the set of these physical things, not of the value of these things. Clearly, he, in common with many, simply assumes it possible somehow to go from the objective identification of these physical items to their value, which, implicitly is also considered to be objectively measurable. It diverges greatly from capital as a value, necessarily subjective and contextual.

Second, this approach carries over into his view of human capital. He identifies the components of human capital in physical, not value terms and according to him there exist *many* reasons to exclude human capital from the category 'capital', but he only mentions one, namely, the fact that it cannot be alienated from its owner. This indeed is the key difference between productive physical and human resources, but it is hard to see why this should be thought a reason for excluding it from a treatise devoted "to understand[ing] the growth process and the inequalities it engenders" (Piketty, 2014: 46). One may wonder how any accounting of the distribution of wealth (or 'well-being') could fail to include what we understand as human capital in 21st century economies where education is such a potent force for economic mobility.

Third, it is clear from the surrounding text in which the quoted paragraph appears that Piketty does not understand (or at least shows no evidence of understanding) the importance of the relationship between stocks and flows, in particular capital and income, when it comes to human capital. It is precisely because human capital cannot be alienated from its owner (in a non-slave economy) that it must be rented, so that its *services* can be purchaloan sed. There is a market in human capital services. It is called the labor market.

Finally, a few pages later (48) Piketty states that he regards 'capital' and 'wealth' as synonymous. Yet, the possession of physical items constitute wealth only to the extent that they do have a market value. And insofar as wealth is understood as a *value* term and not as a set of physical objects, the value of one's education, training, and experience is surely part of one's wealth. So if capital and wealth are synonymous, these things must be part of one's capital. For all these reasons, we believe that Piketty's approach is a flawed approach to the study of capital in economic life.

An even more recent approach, a related variant of Piketty's, is provided by Hodgson (2014). Hodgson (2014:1070–1074) considers *collateralization* (as distinct from ownership *per se*) to be the pivotal characteristic distinguishing productive human-resources from physical-resources. Because the valuable services of labor cannot be separated from the owners of those services, namely the laborers, in the same way that the services of a productive physical-asset can, a borrower cannot provide the value of his labor as collateral against default. For that reason, according to Hodgson, human-resources should be considered to be categorically different and should not be included in the same category of things that are objects of any calculated capital-value.

[4] A recent survey is provided by White (2017) who quotes Garry Becker crediting T.W. Schultz, Jacob Mincer and Gary Becker as pioneers of modern human capital theory.

We agree that human and physical resources are categorically different, but we do not agree that the former should not be the object of capital-valuation. Significant amounts of lending and borrowing occur on the basis of the expected future earnings of the borrower. When a medical student signs a contract for a bank loan to cover her tuition and expenses while studying to be a physician, she is pledging to pay back the loan with the enhanced expected earnings that will result from the investment in her human capital. The bank, knows this and, for that reason, values the loan more than it values a loan to an electrician's apprentice for a similar investment. It is true that, in the event of default, the options of the bank are limited, for two reasons. First, it may not be legal for the bank to forcibly take part or all of the earnings of the borrower to repay the loan (though in some legal jurisdictions it is indeed possible to garnish the wages of borrowers pursuant to a court-order). Second, as already noted, since the earnings from labor are not separable from the earner, it is not possible for the lender to reposes the source of the services as would be the case for a physical-asset, like a car in the case of a car loan. The car provides, in effect, a lump-sum payment for the loan, an option that is not available in the case of human-resources. So, human-capital is certainly less liquid than physical-capital. But this by no means implies that it is useless as an assurance to lenders.

We thus do not see either collateralizability or ownership as the distinguishing categorical feature of human-resources. It is, more fundamentally, alienability of earnings. This indeed is a vital distinction for many reasons, not least of which is the difference between managing and deploying human and physical resources. Since workers have to be present to deliver their services in a way that physical-resource owners do not, the practice of managing rented human resources is fundamentally different from that of managing rented physical resources (even aside from the fact that the latter may be owned by the manager and the former not). Managing human-resources entails formidable knowledge and incentive problems that are absent in the case of physical-resources. And this is the reason also for the different degrees of collateralizability as just noted.

However, this does not mean that human-resources should be excluded as objects of capitalization. In fact, as explained in the previous section, the value of the services of the human-resources that the decision-maker expects to employ in combination with physical-resources in a particular business venture are, by implication, reflected in the value of the physical-resources listed in the capital-account; and are also explicitly referenced in the income account. Two decision-makers with different appraisals of the value of the services to be expected from workers in a particular business will value the business differently for that reason.

The capitalized value of labor-services is, in fact, the basis of all sorts of real-life decisions, whether or not this is reflected in any conventional accounting procedure. A college graduate contemplating a choice between law-school and medical-school cannot logically avoid consideration of the prospective lifetime earnings of each alternative. Similar calculations are behind migration decisions. An understanding of capital as 'capitalized-value in the service of decision-making' would suggest a broader rather than a narrower view of the objects that are the targets of that capitalization.

We further agree with Hodgson that it might be better not to refer to productive resources in general with the word 'capital' – that, for example 'human-resources' is preferable to 'human-capital' and 'physical-assets' (or production-goods) preferable to 'physical-capital'. Since, however, on the terminological issue, the toothpaste is long-ago out of the tube, a successful appeal in favor of the financial view of capital ought, at least, to produce a better understanding of what we are dealing with.

4. Social and other capital[5]

Piketty's and Hodgson's rejection of the category human-capital stems in part from its use by neoclassical growth theorists as an argument in the neoclassical production function to reduce the residual in explaining sources of growth, and similarly with such vague phenomena as 'social capital' to refer to the favorable institutional structures (that militate in favor of productive efficiency, or economic growth).

Our view of this is that if capital is a category to be understood in terms of individual (subjective) calculation for particular, often idiosyncratic, decisions, there is no limit to what it may include – certainly anything that the decision-maker considers helpful to her/his decision. The value of the 'social-capital' expected to be available in a particular destination would be something that a potential migrant would, formally or informally, consider, and certainly something that the observing economist would want to take into account by some sort of estimating procedure when accounting for these decisions. An implicit or explicit capitalization process is taking place.

What used to be called 'amenities' is certainly part of what we today call social capital. While one can certainly see the potential to overuse this idea, attributing all types of benefits to the 'cloud' of social capital, there is no denying its importance in private valuations. The danger lies in ignoring the fundamentally subjective nature of these valuations, and thinking that the contribution of social capital to aggregate economic value (economic growth) can be objectively measured and used for economic policy purposes. This raises interesting questions of public choice and local community governance that are beyond scope of this paper, but whose examination should always start with individual decision-makers' valuations.

[5] As Hodgson (2014: 1074) notes, many qualifiers have been attached to capital, including 'natural capital', 'health capital', 'religious capital', 'linguistic and cultural capital', 'symbolic capital', 'reputational capital', organizational capital', and 'academic capital'. We shall be content to encapsulate all of these under 'social capital'.

For this reason one must dismiss its use as an explanatory variable in an aggregate production function. In fact this approach would suggest the bankruptcy of that notion.

5. The aggregate production function

Piketty's narrow view of capital is used in a simple production function framework to derive implications about the distribution of income and wealth. Could his project be saved by expanding his view of capital to include human and social capital? Not if the very notion of an aggregate production function is problematic, as we and others believe it is. The aggregate production-function relies on fundamentally flawed general aggregation logic, notwithstanding its continued widespread use in theoretical and empirical studies in the neoclassical genre. Just how problematic this is has been known for decades because of the immanent criticism of Franklin Fisher and his collaborators (See Fisher, 1993, for articles up to that date; see Felipe and Fisher, 2003 for the most recent review). A summary must suffice here to give the flavor of the overall critique (Fisher, 2005: 489).

Imagine that a production process can be characterized by a function of the form

$$q = f(k, l) \tag{1}$$

where q is output and k and l are the factors of production – knowing the values of the quantities of k and l one can accurately predict the quantity of q that will be produced. Imagine further that there are p firms such that

$$\begin{aligned} &q_z = f(\boldsymbol{k}_z, \boldsymbol{l}_z);\ z = 1 \ldots p, ; \\ &\boldsymbol{k} = k_i, (i = 1 \ldots n) \text{ and } \boldsymbol{l} = l_j, (j = 1 \ldots m). \end{aligned} \tag{2}$$

$\boldsymbol{k}_z$ and $\boldsymbol{l}_z$ are vectors of different types of production goods and labor used in the z firms.

Finally, consider the function

$$Q = F(K, L) \tag{3}$$

Q, K and L are composites (aggregates) purportedly measuring the *quantity* of production, *quantity* of capital employed and *quantity* of labor employed.[6] There are p consumption-goods, n production-goods, and m types of labor-services.

Fisher et al. consider the following questions.

1. Under what conditions does Eq. (1) make sense? These are not trivial conditions. Clearly, k and l must be homogeneous identifiable entities whose services can be measured per period of time. The technical conditions must be known and, of the options available to combine them, the decision-maker is assumed consistently to choose the 'correct' one. If, by contrast, k and l are heterogeneous collections, an aggregation problem exists even at this firm or project level. Further, if more than one output is jointly produced there is a problem of aggregating outputs.
2. How does one get from Eq. (2) to Eq. (3)? This is the better-known question of the two. Fisher et al. answer in no uncertain terms: except under the most unusual of circumstances, one *cannot*. And this applies *whether or not one assumes the economic system is in macro-equilibrium*.

Fisher recently exclaimed at a symposium on the subject

> [I]t is truly amazing that, after so many years, we should be having a symposium on aggregate production functions; for perhaps even more than the square root of negative one, aggregate production functions are truly imaginary (Fisher, 2005: 489).

Even ruling out the problem of within firm aggregation by assuming well-behaved production functions at the level of the firm, with comprehensive categories of homogeneous inputs, the conditions for successful across-firm aggregation are vanishingly likely to be met. First, there must be a state of *perpetual* long-run equilibrium. Second, if not in equilibrium, there must be *universal* constant returns to scale. Third, "even under constant returns to scale, the conditions for aggregation are so stringent as to make the existence of aggregate production functions in real economies a non-event. This is true not only for the existence of an aggregate capital stock but also for the existence of such constructs as aggregate labor or even aggregate output." (Fisher, 2005: 489)[7]

The last point raises the important question of why capital alone has been seen to be problematic in relation to the aggregation problem. As we argued above, the answer to this question goes to the very meaning of the concept of 'capital' as used in economics.

Given these serious limitations of the aggregate production function as an empirically meaningful construct, what is one to make of the empirical studies that claim to find a 'close fit' to the usual Cobb-Douglas form in the data on earnings for

[6] More accurately, it is the *services* of capital and labor that are the inputs into production. K and L are stocks that when employed yield a flow of services per period of time.

[7] Successful aggregation would mean that the aggregate production function that resulted, behaved as the neoclassical theory says it should, with the input categories, like K and L, providing unambiguous information about the variation of the components of these categories. K and L will behave like quantities of identifiable factors of production contributing marginal products (in terms of variations in the aggregate output) and for which there are the expected downward sloping demand curves. Realizing this, it is perhaps not surprising that aggregate production functions are never likely to be found in the real-world.

capital and labor? Fisher et al. find no validity in this instrumentalist defense of the aggregate production function as a close enough approximation.

Consider the aggregate accounting identity (available from aggregate data like national accounting data)

$$Q = wL + rK \tag{4}$$

Where Q is the value of final output (like GDP adjusted for inflation), L is the constant-price-index aggregate of Labor, K is the constant-price-index aggregate of Capital, w is the average wage of a unit of L and r is the average rental-rate of a unit of K.

Totally differentiate this identity as follows.

$$dlog\ Q\ =\ \left(\frac{wL}{Q}\right)dlog\ L\ +\ \left(\frac{rK}{Q}\right)dlog\ K = \ \propto dlog\ L + (1 - \ \propto)dlog\ K$$

Where α is the *share* of L and $1 - \alpha$ is the *share* of K, since the shares must add to one. Integrating this equation gives,

$$Q = AL^{a}K^{1-a} \tag{5}$$

where A is the constant of integration. This looks like a Cobb-Douglass form (constant returns to scale). It should be emphasized, however, that $Q = AL^{\propto}K^{1-\propto}$ is not an approximation to $Q = wL + rK$; it is an *exact transformation*. Thus, it is not surprising that the Cobb-Douglas form of production-function estimation gives a relatively good 'fit' (see Felipe and McCombie, 2014: 68–69 for more detailed discussion). The production-function thus specified does not so much 'explain' factor-shares as express them in a different but equivalent way. A good fit does nothing to solve the heterogeneity problem or the ambiguities that attach to the categories of physically heterogeneous inputs and their earnings.

> While, over some restricted range of the data, approximations may appear to fit, good approximations to the true underlying technical relations require close approximation to the stringent aggregation conditions, and this is not a sensible thing to suppose. … When one works – as one must at an aggregate level – with quantities measured in value terms, the appearance of a well-behaved aggregate production function tells one nothing at all about whether there really is one. Such an appearance stems from the accounting identity that relates the value of outputs to the value of inputs – *nothing more*. (Fisher, 2005:489).

The phrase "quantities measured in value terms" is noteworthy, and, as we have tried to argue, this, indeed, is the root of all capital controversies.

Considerations of the fundamentals underlying the capital concepts in current use, both from a Mengerian–Austrian perspective and from a critical neoclassical perspective, suggests many unresolved, and perhaps irresolvable, problems. Some theorists, like Irving Fisher and Frank Fetter seem to have realized the problems and implicitly offered a solution by adopting a different approach to capital. It was Ludwig von Mises, however, who focused on the role of capital in ordinary business life in facilitating decision-making through accounting and calculation (see Braun et al., 2016).

The heterogeneity of capital, understood as a collection of physical production-goods, has been emphasized by Lachmann (1956). The significance of heterogeneity is not diminished by the terminological shift we advocate in this paper. Capital as a financial value is a tool for coping with the undeniable bewildering heterogeneity of productive resources. It is what enables us to make decisions despite the multiple specificity of most capital goods.

6. Conclusion

We call for redirecting the emphasis in capital away from physical and human productive resources toward the financial capital-value of those resources. We think that the confounding of quantities and values has been responsible for much mischief including protracted and unnecessary 'capital controversies'.

Rather than associating the unmodified term 'capital' with a factor of production, we should think of it as the result of the verb 'to capitalize'. Capital is the capitalized value of the expected stream of earnings of the services of *all* of the production resources (factors of production) at the disposal of the business unit (or household). Capital is thus the result of a personal evaluation process, and, as such, is subjective. It depends on the evaluator's particular goals and expectations, on his appraisal of the value of the project in question. Different appraisers will have different expectations and valuations, even while observing the same accounting data. The notion, therefore, that micro-level capital values can somehow be aggregated into a composite total for the economy as a whole is incoherent insofar as it proposes to combine incommensurate mental images.

The function of capital is the facilitation of decision-making in an uncertain world, a world of unknowns and unknowables where outcomes result from competition between rival mental images. Capital facilitates decision-making by providing a framework for accounting and calculation. A calculated capital value is not objectively true, it is a summary of what may result from events that may occur. It is a summary that allows the decision-maker to focus on some of the most essential aspects that will influence his investment or management decision.

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