Critique of the Functions of Money

Introduction

This article seeks to open a discussion on an issue that is commonly treated in economic literature as a self-evide axiom, taught to university students with complete confidence and rarely subjected to critical scrutiny—namely, t functions performed by money. According to the prevailing conception, money fulfills multiple roles across the spheres of production, circulation, and distribution, and is employed in everyday transactions as well as in saving investment, and speculation. Within this framework, a consensus has emerged that money performs three fundamental functions: it serves as a medium of exchange, a store of value, and a measure of value.

While this article acknowledges the role of money as a medium of exchange and recognizes the possibility of its u a store of value, it raises a specific challenge to the validity of treating money as a measure of value. Proceeding fr this premise, the article is concerned with demonstrating that money cannot, in principle and from a scientific standpoint, measure value. To this end, the analysis follows three conceptual steps. It begins by clarifying the cor of value and the nature of its measurement; it then moves to an examination of the concept of money and its historical, dialectical development; finally, subjects the dominant conception of money in political economy to a systematic critique, culminating in a re-positioning of money—as a social phenom —within its proper scientific framework.

First: Value and the Correction of Its Measure

Value, as we have argued in our previous studies **(1)**, is a property of a thing—a quality that distinguishes and determines it—much like weight, length, volume, or height. When an object has mass, such as a hammer, we say that it has weight. When it extends between two points, like a road or a piece of fabric, we say that it has length. When it occupies a certain space, like a table or a bench, we say that it has volume. And when it rises vertically from a b to a top, like a lecture hall, we say that it has height.

The same applies to value. Any object or product that is the outcome of human labor—regardless of whether this labor is free, coerced, or contractual—a therefore contains a certain amount of embodied human effort, becomes endowed with value. It is, however, necessary to distinguish between the huma effort embodied in the product *as value*, and the act of expending effort itself *as an activity* that may or may not result in the creation of value. The wor performed by a shop clerk, for example, does not create new value.

On this basis, the existence of value does not depend on its measurement or estimation. It is logically incoherent to claim that an object has no value sir because we are ignorant of the amount of human effort expended in its production. Value, as a property, is immanent in the object as soon as this effort embodied in it, whereas its measurement or estimation—by means of a Quantity of something else—comes at a later stage. This is analogous to the measurement of length, which becomes possible only after the property of extension between the object's endpoints has been established.

Once a property is established as a pure quality—whether weight, length, volume, height, or value—the only remaining step is to determine it quantitati using an appropriate measuring instrument and a unit of measurement suited to its nature. The measuring instrument is the tool or device by which th property is measured, such as a graduated tape or a ruler in the case of length, while the unit of measurement is the centimeter or the meter. According when we say that a piece of fabric is twelve meters long, this means that we have used a length-measuring instrument and adopted the meter as the uni measurement.

Despite the self-evident and elementary nature of these rules, political economy departs from them in its conception of value when it posits, as an unquestioned axiom, that the value of a Commodity is measured by the number of labor-hours socially necessary for its production. When political eco states that the value of a pen equals half an hour of labor, what it actually means is that the human effort embodied in the pen was expended over the co of half an hour. Yet this conception collides with the foundations of measurement science and contradicts the very concept of value itself. Scientifically, invalid to say that human effort *equals* a number of minutes or hours, even if it is legitimate to say that such effort was *performed during* that period of time. The value itself remains unknown. Value is a Quantity of embodied labor. When we say that human effort was expended *over* a given time span, v have not measured that effort; we have merely identified the duration it took. In other words, we have identified the time during which value was forme without knowing the magnitude of the value itself.

Consequently, the insistence of political economy, over the course of two centuries, on treating labor-time as the measure of value leads to a genuine epistemological impasse. Either we must acknowledge, scientifically, that we are employing an incorrect measure when we assess human effort in units time—much as if we were to measure length using the Richter scale or height using the imperial gallon—or we must concede that the dominant concept of value in political economy itself suffers from a structural flaw and requires radical revision. For it defines value as embodied human effort, yet treats measurement, as expended time.

In fact, political economy, despite its use of a scientifically unsound measure, was never entirely at ease with it. Smith and Ricardo both expressed their discomfort, and Ricardo explicitly stated that science might one day uncover the correct measure. Marx alone, curiously, turned a blind eye to the error the measure. Unlike his predecessors, he voiced no reservation, and proceeded on the assumption that value is measured by the quantity of socially necessary labor-time. When he encountered the problem of exchanging one hour of a blacksmith's labor for one hour of a surgeon's labor, or one hour o builder's labor for one hour of an architect's labor, he did exactly what his predecessors had done: he referred the entire matter to the market, on the assumption that the market would determine the ratios of exchange between an hour of the blacksmith's labor and that of the surgeon—perhaps makin hour of the surgeon's socially necessary labor equal to twenty hours of the blacksmith's, or equating one hour of the architect's labor to fifty hours of the builder's.

Yet, in reality, the market does not resolve the issue as the founders of our discipline assumed. Rather than bringing us closer to the scientific foundatio and the goal of uncovering the objective law governing the phenomenon under investigation, it merely increases the level of complexity. The market itse may equate one hour of socially necessary blacksmith labor with one hour of socially necessary carpenter labor in one place, while in another place it m equate that same hour of blacksmith labor with ten hours of carpenter labor. In neither case do the market or political economy explain the reason for t equality or this disparity. At best, they merely point to the existing state of affairs—to momentary fluctuations, to what is immediate—without arriving a

objective law governing the natural ratios of exchange between different kinds of labor. Most dangerously, the moment of referring the problem to the market marked a decisive turning point in economics as a whole: a historical shift from science to empiricism, and from objective law to the subjective a impressionistic.

Accordingly, it may be said that political economy, over the span of two centuries, has relied on a non-constant measure to assess value. When political economy realizes that the Quantity of labor cannot fulfill the function of a measure of value—because different kinds of labor vary in both intensity and —it refers us to the market. This, however, amounts to abandoning science in favor of what is merely given; it means ceasing to search for the objective governing the phenomenon under investigation. This compels us to correct the measure of value and its unit of measurement, beginning with a correct understanding of value itself, and consequently to rethink the foundations of political economy—the science concerned with the phenomena of the capi mode of production articulated around the law of value.

The scientific reality is that the human effort expended in producing an object, and embodied in the product, is properly assessed in calories **(2)**, which constitute the unit of measurement of thermal energy that the body requires, generates, and expends in order to perform work—through the consumpti food, that is, by converting chemical energy (nutrition) into mechanical energy (work). When this energy is embodied in the product, it confers value up it. Using this unit of measurement—which is a constant one—it becomes possible to determine both the energy absorbed by the body and the energy it expends, that is, to measure what the body requires under different conditions and in the performance of any kind of work. This Quantity of energy is precisely what our science failed to reach when it halted at measuring value in units of time. The measuring instrument, which is itself constant, is the calorimeter, by means of which the thermal energy emitted by the body during exertion can be measured.

Let us take one step further. The worker—whether a miner or a university professor—who produces value, that is, who expends the effort embodied in t product, requires necessary means of subsistence such as food, clothing, housing, and so forth. Let us begin with foodstuffs, which supply the energy th enables the worker to perform labor—more precisely, let us begin with the actual expenditure of effort through which chemical energy is converted into mechanical energy. According to nutrition science, physics, biochemistry, and physiology, we now possess scientifically precise knowledge of the Quant calories consumed in performing different kinds of human labor, which are in turn embodied in the product **(3)**. We now know, for example, that a construction worker consumes 1,400 necessary calories over eight hours, meaning that 1,400 necessary calories are embodied in the product. A steel fa worker, over the same duration, consumes 1,900 necessary calories, which are thus embodied in the product; a blacksmith consumes 2,400 necessary calories, which are embodied in the product; a female factory worker who consumes 1,100 necessary calories embodies 1,100 necessary calories in her product; while a schoolteacher consumes 800 necessary calories, which are embodied in the service she provides. And so on. The implication is clear: o knowledge of the value of a product—and, by extension, of the value of any object, whether a Commodity or a service, that is the outcome of labor—depe on our knowledge of the Quantity of energy expended in its production, not on the time during which this energy is expended, as political economy has assumed for two centuries.

The conclusion, then, is that value is a Quantity of labor. Labor is conscious human effort, and this effort is measured in socially necessary calories. Valu therefore, can be measured scientifically only through the correct unit of measurement and the correct measuring instrument. Money, in this sense, can be a valid measure of value. To complete our argument, we must proceed to a second conceptual step and examine the nature of money itself and its dialectical development.

Second: Money and Its Dialectical Development

In its essence, money transcends being a mere “colored piece of paper” or a “metal token” exchanged for Commodities and services. It is a historically complex entity formed at the intersection of political will and the social labor expended in its production. The fundamental distinction between money other means of exchange—such as time, effort, or even paper instruments like checks—lies in the fact that money does not derive its capacity to confron world of Commodities from its intrinsic material or natural properties, but from an external force that confers upon it the attribute of *officialness* and a unlimited power of discharge. In the contemporary world, a piece of paper cannot become money unless the state, through its legislative authority, deci to grant it a specific legal form. It is this form that transforms it into a vessel expressing a legally imposed Quantity of social labor, thereby enabling its holder to command the products of other people’s labor.

A historical view of human societies reveals that this conception is far from recent. The linguistic term for money—whether associated with gold and sil Arabic, or with cattle in Latin—evolved to signify the transformation of raw material, through human labor, into a dominant means of exchange. Wheth this means took the form of *diwara* shells among Pacific tribes, the gigantic *rai* stones, or even contemporary “digital currencies,” its character as mone remains contingent upon two fundamental conditions: its issuance under the supervision of political authority (or at least without its opposition), and t subjection of its primary material to an organized productive process marked by toil and effort. From here, the class dimension of money becomes appa its issuance and control are bound to the dominance of a particular social class that imposes its financial ideas to serve its interests, rendering the flow o money into society dependent upon the initial expenditure of this ruling class.

Accordingly, a precise distinction must be drawn between money and other concepts with which it is often conflated. Money differs from means of payn such as bonds and bills of exchange, which merely serve to circulate money itself. It also differs from “wealth,” a broader concept encompassing all form owned assets and real estate. Equally significant is the growing separation between money and actual productive activity within financial markets, when share appears as a title of ownership generating profits through legally sanctioned “gambling” on stock exchanges, independent of real production. This autonomy within “gambling economies” deepens the rift between the realm of money and the realm of labor, and underscores the fact that an increase i Quantity of money does not necessarily imply an increase in wealth; rather, it remains constrained by the value of the labor expended in creating it. Mo in this sense, remains “potential capital.” When viewed as a material product, it stands apart from all other products in being surrounded by the highest degrees of secrecy and technical sophistication, making an understanding of its essence a necessary intellectual step toward grasping the objective laws governing the development of the human economy.

This understanding of the nature of money cannot be complete without identifying the objective law governing its development as a means of exchange Exchange in human history presents itself as an objective phenomenon governed by three basic conditions: the existence of a social organization that fa contract over plunder; the availability of a surplus beyond immediate consumption; and agreement upon a general and shared measure of values groun in essence, in the human effort expended in production.

From this perspective, the development of the means of exchange did not necessarily proceed along a straight chronological line, but unfolded accordin an objective law rooted in the product’s capacity for satisfaction and its capacity for exchange. The transition occurred from the simple form—manifeste the product not originally intended for exchange—to the dominant Commodity form, and then to the more complex form embodied in money in its

contemporary legal shape, culminating today in cryptocurrencies. In the earliest stages, the means of exchange consisted of products primarily intende direct satisfaction, such as fish or meat, in which the capacity for exchange appeared only incidentally and exceptionally. This was historically reflected practices such as the exchange of pottery for fish in ancient Egypt, or the silent trade of salt for gold across the African desert.

With the increasing complexity of the social division of labor, the latent capacity for exchange within the product became more active, giving rise to the second form: the "dominant Commodity." In this stage, direct satisfaction receded in importance in favor of comprehensive exchangeability. Societies adopted specific Commodities—such as rice grains in Asia, tobacco in Siberia, or precious metals like gold and silver—as means for settling transactions product thus came to be produced primarily for the market (as a Commodity), while retaining its material capacity for satisfaction.

Yet true dominance ultimately settled upon metal due to its physical properties, paving the way for the third and more abstract form: money. Here, the means of exchange became entirely detached from any capacity for direct satisfaction, assuming instead a purely legal form whose nominal value expre a presumed ability to confront the world of Commodities.

This governing law of development reveals an intense historical contradiction between "real value," grounded in socially necessary labor-time, and "presumed value," imposed by the political system. This contradiction explains the transformation of money from metallic ingots to compulsory "colore paper," and finally to encrypted "digital currencies" in our contemporary world.

At each stage, material usefulness steadily receded in favor of the absolute dominance of exchangeability, until money reached a phase in which it is produced through algorithms and vast amounts of electrical energy, stripped of any intrinsically useful material existence. Thus, the history of the mea exchange remains a living record of the struggle of social forces within the spheres of production and distribution. Money does not represent the final destination of this process; rather, it is one link in a continuous chain of development that progressively displaces matter in favor of symbol, transformi tangible human effort into abstract numbers that dominate the movement of economic activity on a global scale.

Third: The Myth of Money as a Measure of Value

Political economy, following a long-established tradition **(4)**, defines the functions performed by money—as noted above—as three basic functions: mo serves as a medium of exchange, a measure of value, and a store of value **(5)**. This triad can be inferred from an overall reading of Adam Smith's concep of the historical transition from barter to money, before turning to the views of his successors.

A. From Adam Smith to Official Theory

Smith begins from the well-known example according to which the butcher, assuming the absence of money, possesses a surplus of meat beyond his ow needs. If he also already has bread and beer, and requires no additional quantities of either at the moment, then neither the brewer nor the baker will fi anything with which to barter for the butcher's meat. Exchange, consequently, cannot take place. It is here, for Smith, that the importance of money emerges, and with it the first of its functions: money as a medium of exchange. Money enables the baker and the brewer to obtain meat even if the butc does not desire bread or beer, because he seeks monetary units which, by relinquishing them, allow him to obtain whatever products of others' labor he wishes, even if those others have no desire for the meat he sells.

When Smith observes the advantage that metals eventually acquired among people—due to their divisibility and durability in comparison with other products, and thus their suitability for use at any time—he arrives at the second function of money: that of a store of value. When he then turns to the difficulties that accompanied the early use of metals in exchange, he reaches the third function of money: its function as a measure of value. Smith iden two major difficulties associated with the use of metals in exchange: weighing and assaying. Each transaction required the metal to be weighed and its quality to be examined, distinguishing the good from the inferior—procedures that were highly onerous and obstructed buying and selling, as well as sir transactions that constantly required weighing and testing the metal. To overcome these difficulties, governmental marks and inscriptions were placed specific quantities of metal in circulation, such that each mark and inscription indicated the amount of metal contained in a unit of money. At that mon coined money emerged, which came to be used by count rather than by weight after its weights were fixed by state mints.

In this way, as noted, the function of money as a measure of value crystallized in Smith's conception. Coined money made of a particular metal became measure of the value of things in the market, whether Commodity or service. Things thus came to have their values measured by monetary units, as Sm held—at least in an early phase of his thinking.

If the function of money as a medium of exchange follows naturally from the very nature of money, then belief in its function as a measure of value, and in its role as a store of value, are merely the natural outcomes of an unsound and arbitrary understanding of value itself. Historically, we are thus confro with two distinct analyses of the functions of money, reflecting the divergence of their theoretical foundations. The first is the analysis offered by politic economy. The second is that presented by official theory, which absorbed the analysis of political economy and then hurled it—consciously or unconscio —at its victims in universities. When political economy defines the functions of money in this manner, it proceeds from a specific theory of value: value Quantity of labor embodied in the product, and from a historically determined reality marked by the dominance of metallic money based on gold and si Official theory, when it adopted the functions of money from political economy, disregarded both of these foundations.

If we move beyond the function of money as a medium of exchange—whose validity political economy rightly affirms—and examine the function of mon a measure of value, we find that money cannot scientifically measure value. This is not only because value, as a Quantity of labor embodied in the produ possesses a scientifically fixed measure, as we demonstrated in the first section, but also because money is the monetary expression of value. One cannc measure the value of a thing by the monetary expression of its exchange-value. I do not know the value of nine grams of silver when I exchange them fo three grams of gold, even if I know that the value of those grams of gold equals nine hours of labor. What I have learned is that the value was produced *during* nine hours, not the value itself as a Quantity of labor embodied in the metal. Even if, starting from an incorrect assumption, I claim to know the value of the silver because the value of the gold exchanged for it equals those nine hours, the measure here is not grams of gold but hours of labor. Yet political economy persists, throughout its history, in violating its own foundations and insists that monetary units—especially coins minted from gold a silver—constitute the measure of value **(6)**.

Although Adam Smith eventually retreated, after hesitation, from the view that money serves as a measure of value **(7)**, this retreat was not due to the invalidity of money as a measure per se, but rather to its lack of constancy. That is, Smith's acceptance of money as a measure of value would have been possible had money possessed the attribute of stability.

This hesitation and retreat likely influenced Ricardo's convictions. Ricardo held that gold (money), before being a standard of value—thus conflating th standard with the measure—is itself a Commodity produced using both fixed and circulating capital. Consequently, any rise or fall in the capital employ the production of gold, or in its conditions of production due to the abundance or depletion of mines, would lower or raise its value, which would in tur

reflected in the value of gold itself and in profits, which might correspondingly fall or rise.

B. Ricardo and His Arbitrary Assumptions

Yet because Ricardo, like all political economists, employed a scientifically unsound measure of value, he was—as is well known—never fully convinced gold as a measure of value, nor even by the Quantity of labor itself. He found no alternative but to declare explicitly that he *assumes* **(8)**, contrary to rea the constancy of the value of gold and the identity of its conditions of production with those of other Commodities, in order to make it usable as a meas their values. When Malthus—who also believed that money constitutes the most practical measure of value**(9)**—attempted to rescue Ricardo's idea fron futile assumption, he advanced a proposal that itself rested on an assumption and failed, even in Malthus's own view, to resolve the problem of the mea At best, it could only approximate accuracy. Malthus proposed restating Ricardo's conception by restricting the measure to the Quantity of labor expen in producing gold (money), excluding profits, which do not usually equalize across different branches of production. Since Ricardo had already *assume* away the deviations and fluctuations affecting gold as a Commodity, Malthus argued, it would be all the more permissible to disregard capital profits—v may amount to 10 percent in one branch and range between 5 and 20 percent in another—and to rely solely on labor as the measure of the value of gold **(10)**.

Yet the old problem persists unresolved. It cannot be solved by Malthus's method any more than by Ricardo's. Regardless of the arbitrary exclusion of capital—which is itself a Quantity of stored labor—and the equally arbitrary exclusion of profits—which are, in essence, a Quantity of surplus labor—we do not know the *value of gold* produced in five hours of labor. We know only that it was produced *during* five hours, not the value produced over those hours.

C. Marx's Indifference

Marx, for his part, proceeded while ignoring Smith's retreat, Ricardo's doubts, and Malthus's reservations, and even overlooking the inadequacy of his measure of value. He asserted that:

"*Gold is the measure of value, as the social embodiment of human labour… It thus serves to convert the infinite values of commodities into prices, into imaginary quantities of gold… Gold became the measure of value because all commodities measured their values by it*." (Marx, *Capital*, pp. 143, 159)

"*The first chief function of money is to supply commodities with the material for the expression of their values, or to represent their values as magnit of the same denomination, qualitatively equal, and quantitatively comparable. It thus serves as a universal measure of value. And only by virtue of t function does gold, the equivalent commodity* par excellence*, become money… It is not money that renders commodities commensurable. Just the contrary. It is because all commodities, as values, are realised human labour, and therefore commensurable, that their values can be measured by on and the same special commodity, and the latter be converted into the common measure of their values, i.e., into money*." (*Capital*, pp. 143, 159)

In fact, gold, in Marx's own text, cannot fulfill the role of a measure of value because, as a product, it itself requires a measure of its value—which, as Ma rightly states, is socially embodied within it. Hence, one cannot be persuaded by this peculiar justification whereby gold supposedly becomes the measu value simply because all Commodities measure their values through it. One cannot say, for example, that exchanging one gram of gold produced in seve hours of labor for nine grams of silver means that those nine grams of silver acquire a value of seven hours of labor. Rather, the correct procedure is firs determine the value of gold using the scientifically valid measure of value, then to determine the value of silver using the same valid measure, and only that basis to carry out exchange **(11)**. To know the value of gold first and then infer the value of the other Commodity on the basis of gold's value is an obscure and unjustified detour—perhaps explicable only by the prior use of an incorrect measure of value.

Having completely disregarded his predecessors' acknowledgment of the difficulty of finding an accurate measure of value, Marx introduced a distinctio which ultimately proved of no assistance—between gold as a measure of value and gold as a standard of prices. The same problem remained unresolved are still confronted with an incorrect measure of value, not only for the metal itself but also for the Commodities exchanged against it. Moreover, when claims that gold is a standard of price—the monetary expression of value—he assumes the prior existence of a definite price for a Commodity, serving as pre-established model that money merely comes to express. This necessity arises from the assumed identity between value and its monetary expression identity that Marx himself denied by emphasizing the divergence of price from value, upward and downward **(12)**. The introduction of the distinction between gold as a measure of value and gold as a standard of prices thus yielded nothing that would allow money, in Marx's framework, to be regarded scientifically valid measure of value.

D. Ramsay: Putting the Cart Before the Horse

Ramsay, too, proceeding from the same doctrine of political economy, held that the metal embodied in monetary units constitutes a measure of value. H stated that:

"*Everything possessed of value may either measure, or be measured by, everything else possessed of value. If a quartern loaf is sold for a shilling, it would be quite as correct to say that the quartern loaf measures the value of the shilling, as that the shilling measures the value of the quartern loaf. there is some colour of truth in this statement, the relations of all values being dependent upon each other, it contains no practical truth, and is contr to all his own theory and previous reasoning*."(Ramsay, *Essays on Interest, Exchange, Coins, Paper Money, and Banks*, p. 84). **(13)**

In reality, when we say that a quarter loaf measures the value of a shilling, we have not, in any sense, come to know either the value of the quarter loaf o value of the shilling. This is no different from saying that the value of one gram of gold measures the value of fifteen grams of silver. We may learn that value of one gram of gold equals fifteen grams of silver—that is, we learn the *exchange-value*—but we do not learn the value of silver, nor do we learn th value of gold. Consequently, in Ramsay's example, the quarter loaf does not measure the value of the shilling; it merely expresses the shilling's exchang value, without revealing its value as such.

E. Samuel Bailey and the Persistence of Error

The same applies to Bailey (1791–1870). When Samuel Bailey claims that a measure of value is something that enables us to compare the value of two Commodities—such that Commodity (A) equals one pound sterling and Commodity (B) equals two pounds sterling, and therefore one unit of Commodi (B) equals two units of Commodity (A) **(14)**—he fails to tell us why Commodity (A) is worth one pound sterling in the first place, or why Commodity (B worth two pounds sterling. Here we encounter the same problem rooted deep within political economy: the persistent refusal to recognize that money—whether metallic or paper—cannot determine value. Value must first be determined using the correct measure of value and the correct unit of measure only then can it be expressed in monetary units of equivalent value, whether real or imposed, for the Commodity in question **(15)**.

Fourth: Money as a Store of Imposed Value, Not a Store of Real Value

If we turn to the function of money as a store of value, contemporary money holds nothing but its own worth. At best, it can be said to represent a value imposed by the state. Money is thus a store of a value—expressing value—rather than a store for valu**e** as a measure of real, socially embodied labor in a product. This is not merely a semantic distinction; it reflects the historical evolution of money as a social phenomenon.

To regard money as a store for value assumes it contains inherent value, so that any change in its worth would stem solely from shifts in socially necessa labor under prevailing production techniques. In contrast, to see money as a store of a value recognizes that fluctuations in its worth are determined by preferences of the political system and by the pressures of dominant social and economic forces, both domestic and international. The historical separa of money from its original role as a store for value stands as one of the clearest expressions of its evolution over time.

Conclusion

Money, therefore, is neither a measure of value nor a store for value. At best, it functions as a temporary store of value, usually imposed by the political system. Once these two functions are excluded, monetary units can only be understood in terms of their one viable and realistic role: that of a medium exchange **(16)**.

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Endnotes

(1) For further details, see our study: Muhammad Adel Zaky, "***A Critique of the Measure of Value***," *IA-Forum*, A Critique of the Measure of Value International Affairs Forum.

(2) See: Muhammad Adel Zaky, ***Critique of Political Economy*** (Berlin: Darat Ibn Al-Dhikri, 2023), Chapter 6: "On Value." For the introduction of into value measurement, see also: Muhammad Adel Zaky, "***Value / Time: An Essay on the Principles of Political Economy***," *African Journal Economic Review*, Vol. 13, No. 2 (June 2025).

(3) See: Robert Weber, ***Heat and Temperature Measurement*** (New York: Prentice-Hall, 1950), Chapter 10: "Calorimetry," pp. 171–189; D. Fenna ***Elsevier's Encyclopedic Dictionary of Measures*** (Amsterdam: Elsevier Science B.V., 1998), p. 72; ***Handbook on Human Nutritional Requirements*** (Geneva: W.H.O., 1974); Allan Camron and Yvonne Collymore, ***The Science of Food and Cooking*** (London: Edward Arnold, 1979 6543–7654; See also the encyclopedic work: ***Temperature: Its Measurement and Control in Science and Industry***, Papers presented at the Symposium held in New York City, November 1939, under the auspices of the American Institute of Physics (New York: Reinhold Publishing Corporati 1941), Chapter 6: "Temperature and its Regulation in Man," pp. 525–575.

(4) Since the time of Greek philosophers, particularly Plato and Aristotle.

(5) See: Adam Smith, ***An Inquiry into the Nature and Causes of the Wealth of Nations***. Edited by Edwin Cannan (New York: Modern Library 1937), pp. 20–25. Compare with: W. Stanley Jevons, ***Money and the Mechanism of Exchange*** (New York: Daniel Appleton and Co., 1876), p.22. Jevons observed that the roles historically played by gold were successive: first in adornment, second as a store of value, third as a medium of exchange finally as a measure of value.

(6) "Money is a value made by a law; and the difference of its value is known by the stamp, and size of the piece. One use of money is, it is the measure value, by which the value of all other things are reckoned; as when the value of anything is expressed, it's said, it's worth so many shillings, or so many pounds…" See: Nicholas Barbon, ***A Discourse of Trade***. Edited by Jacob H. Hollander (Baltimore: The Johns Hopkins Press, 1905), p. 16.

This doctrine of measuring value in money is common and established in political economy. See also: W. Petty, ***The Political Anatomy of Ireland***. ***The Economic Writings of Sir William Petty***, edited by C. H. Hull (Cambridge: Cambridge University Press, 1899), vol. I, p. 183. Richard Cantill ***Essay on the Nature of Trade in General***. Translated, edited, and with an introduction by A. E. Murphy (Indiana: Liberty Fund, 2015), p. 35. San Bailey, ***Money and Its Vicissitudes in Value; as They Affect National Industry and Pecuniary Contracts: with a Postscript Join-St Banks*** (London: Effingham Wilson, 1837), p. 3. Jacob Vanderlint, ***Money Answers All Things, or An Essay to Make Money Sufficiently Plentiful*** (Baltimore: The Johns Hopkins Press, 1914), p. 12. Dudley North, ***Discourses upon Trade; Principally Directed to the Cases of the Interest, Coynage, Clipping, Increase of Money***, edited by Jacob Harry Hollander (Montana: Kessinger Publishing, 2010), p. 10. David Buchan ***Inquiry into the Taxation and Commercial Policy of Great Britain with Observations on the Principles of Currency, and of Exchangeable Value*** (Edinburgh: William Tait, 1848), p. 231. J. H. Marcet, ***Conversations on Political Economy, in which the Elements o Science are Familiarly Explained*** (London: Longman, 1816), p. 297. John Gray, ***Lecture on the Nature and Use of Money*** (Edinburgh: Ada and Charles Black, 1848), p. 79.

(7) See: Smith, ***The Wealth of Nations***, p. 34.

(8) See: David Ricardo, ***On the Principles of Political Economy and Taxation*** (New York: Barnes & Noble, 2005), p. 55.

(9) See: Thomas Robert Malthus, ***Principles of Political Economy***, ed. John Pullen (Cambridge: Cambridge University Press, 2008), p. 102. This b extends from his view that "a quarter gallon of wine can serve as a measure of the value of four loaves if exchanged in that proportion." See: Malthus, Ib 58.

(10) See: Malthus, Ibid, p. 121.

(11) Marx's confusion and hesitation are evident when he asserts, after claiming that gold is a measure of value, that gold is in reality an exchange value Karl Marx**,** ***Capital: A Critique of Political Economy***, vol. 1 (New York: The Modern Library, 1906), p. 153.

(12) In addition to Marx's own explanation for the divergence of value from price, these divergences are themselves pillars of his model in production p See: Karl Marx, ***Capital: A Critique of Political Economy***, vol. 3 (New York: The Modern Library, 1906), pp. 155–172.

(13) See: J. R. McCulloch, ***Essays on Interest, Exchange, Coins, Paper Money, and Banks*** (Philadelphia: A. Hart, Late Carey and Hart, 1851), 84.

(14) See: Bailey, ***Money and Its Vicissitudes in Value***, p. 4.

(15) In the context of official university doctrine, there is complete faith in money as the correct and suitable measure of value. For example, in Egypt, w Zaky Shafie (1922–1988) observed that money is not like the meter, ampere, inch, or pound, and discovered it lacks the characteristics of natural units measurement, he coined a misleading term, calling money a "common denominator of values rather than a direct measure." See: Muhammad Zaki Sha ***Introduction to Money and Banks*** (Cairo: Egyptian Renaissance Library, 1953), p. 12. Similarly, Sami Khalil lamented that the unit of value, mon which is the most important measurement unit in the economic system, is subject to large fluctuations, unlike foot, inch, and meter. See: Sami Khalil, ***Money and Banks*** (Kuwait: Kazma Publishing, 1982), p. 38. F. Morgan (1915–1996) also expressed skepticism that money could function as a measu value while itself being unstable, highlighting concerns about index numbers that show average prices over a period as percentages of base-period price See: Victor Morgan, ***History of Money***, p. 55.

(16) No function of money in its role as a medium of exchange—whether as a means of payment, a counting or accounting unit, etc.—can be understood except as derived from this single, scientific function of money.

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