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New perspective on the evolution of double-entry bookkeeping

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A NEW PERSPECTIVE ON THE EVOLUTION OF DOUBLE-ENTRY BOOKKEEPING

Abstract: Inquiry into the origin of double entry accounting has typically focused on form as the causal factor. In the present article the arguments supporting this view are reviewed and challenged by developing the substantive framework of double entry accounting in equation form and linking it to the evolution of mathematics in the Arab-Hindu cultures. The article concludes with specific suggestions for obtaining empirical evidence which might support the "substantive hypothesis" as the causal factor of double entry accounting.

One of the great evolutionary advances in the history of accounting was the conceptualization of "double-entry" and its subsequent manifestation in form and substance. Accounting historians agree that Paciolo's famous treatise of 1494 represents the first complete synthesis of double-entry bookkeeping in *published* form.[1] Substantially less agreement exists in the literature on the underlying stimuli responsible for the "state of the art" prevailing at the end of the fifteenth century.

The methodology employed by accounting researchers in addressing the latter issue is largely inductive and is akin to that of historians in general. By the same token, general observations on the "form" of double-entry bookkeeping as *evidence of origin* requires a deductive approach which is extremely fragile within an historical context. This paper examines, in a brief manner, the major hypotheses debated in the literature as to the causal factors giving rise to double-entry bookkeeping and offers an alternative explanation in view of the amassed empirical evidence.

Writing in 1494, Paciolo explicitly denied any responsibility for the origin of double-entry accounting and asserted that he was merely "writing down the system" which had been in existence for roughly two hundred years in Venice.[2] However, Paciolo apparently did express his acknowledgment to one renown mathematician of this era namely Leonardo da Pisa.[3] The possible contribution of this medieval scholar and the genesis of his knowledge appear to have been extremely understated and perhaps omitted entirely as a source of *first order* importance to the development of double-entry

bookkeeping. This will become more evident after we define the fundamental elements underlying the framework of "double-entry" accounting and review some of the major arguments.

If Paciolo simply unified the existing practice of his time, what were the developments contributing to the accounting systems which he borrowed from in writing his *Summa de Arithmetica, Geometria, Proportioni et Proportionalita*. The empirical evidence usually relied upon in attempting to answer this question are the historical accounts of various bankers, family enterprises, and merchant ventures which dominated the expansionary growth experienced throughout Italy during the Renaissance era. One eminent accounting historian exhaustively studied several such sources. In presenting his evidence, de Roover claims that "Double entry does not depend in the least upon the form in which accounts are presented."[4] From his viewpoint, the fundamental criterion is revealed by the following test: "At the end do we have a real balance showing the assets on one side and the liabilities and the owners' equity on the other? Only if this question can be answered affirmatively, is one justified in speaking without hesitation of books kept in double entry."[5]

This question is so critical to the present purpose that it deserves elaboration before we confront any arguments from the literature. Littleton divided the problem into one of form versus substance.[6] The former explicitly encompasses the condition of duality and equilibrium in the various phases of recordkeeping. According to Littleton, we could have three forms of duality: (1) duality of books; (2) duality of account form; and (3) duality of entry.[7] Littleton probed further and suggested that equilibrium of results may be the cornerstone of double entry.[8] However, he argued convincingly that these two conditions (i.e. form and equilibrium) were not sufficient for a complete, coordinated system of double entry bookkeeping. The substantive element of "proprietorship", with its primary emphasis on the calculation of gains and losses, was absent.[9]

Unfortunately, Littleton did not elaborate on precisely *how* his definition of "substance" was manifested in a complete system. Schrader, on the other hand, offers a provocative insight into this matter.[10] Employing an inductive approach, he demonstrates that debits are in fact "consideration received" while credits are "consideration given" in an exchange transaction (i.e. for goods and/or services) which is the "essence of business activity."[11] Moreover, Schrader indicates that at the whole life level of analysis, net income

results *naturally* from the recording process with no further manipulations of data.

Schrader's analysis illustrates unequivocally that the accounting equation is an *equivalence* of values between *two* fundamentally different attributes (i.e. variables) expressed as debits and credits. Classification in the usual accounting sense of the word does not change the nature of these attributes.

Introducing periodicity into the exchange activities of an entity does not disturb the standard (i.e. transaction) for admission of the data into the system. However, to generate the real balances cited by de Roover, or Littleton's complete system, a concept of net income is mandatory. Again, under the historical cost model, accountants have agreed in principle that criteria be established for "revenue recognition" (the independent variable) and matching of related expenses (the dependent variable). Net income is merely the balancing residual in the system.[12]

Clearly, all three writers have in mind a bi-variate equation system (i.e. the historical cost model) based on an entity, exchange transactions, and a common monetary unit. To avoid any misunderstanding later, it should be observed that the historical cost model *does not compete* with a "current value" model since the phenomena under observation are entirely different. The latter model focuses on "things" or "elements of wealth" as the fundamental attribute. Price coefficients are attached to these things and summed: equilibrium is attained by setting the aggregate total (i.e. assets) equal to liabilities and equities. Obviously, the equation is an identity and represents a uni-variate model since only one kind of attribute (i.e. "asset" or "thing") is involved. Net income emerges as the difference between the net assets at two points in time assuming no capital adjustments. It should be apparent that an understanding or conceptualization of the bi-variate model (i.e. historical cost) requires a more profound knowledge of the relationship between variables than the identity equation of the current value model which is nothing but an equilibrium feature of any uni-variate model.

Returning to the arguments on the origin of double-entry accounting, de Roover notes that in Tuscany, approximately midway through the fourteenth century, double-entry was achieved before the general adoption of the bilateral or tabular form.[13] Prior to 1350, the northern part of Italy had been exposed to the bilateral form—as early as 1327 in Genoa for example. Despite this movement away from the narrative form of accounts and balances, Roman numerals remained the accepted mode of presentation. De Roover further asserts that:

> . . . improvement was achieved by placing the amounts in extension columns instead of inserting them in the narrative. Summations were thereby greatly facilitated, but the use of Roman numerals continued to impose the aid of the abacus.[14]

It is difficult to comprehend how the vertical arrayment of Roman numerals and their characteristic absence of place value would be comfortable to summation. If one wants to add, say, 1,012 and 1,308, writing down MXII and MCCCVIII in columnar format contributes nothing to the process of summation. Another authority, de Ste. Croix, specifically suggests that this limitation in the Roman numeral system prevented the concepts of debit and credit from emerging and therefore inhibited any notion of double-entry bookkeeping.[15]

A somewhat different viewpoint on the emanation of double-entry form centers on our conventional Arabic numeral system. De Ste. Croix is of the opinion that the arrangement of figures in columns in our notation is not an intrinsic virtue but an incidental defect due to a combination of its two greatest virtues: place-value and the small number of symbols it uses. Furthermore, this defect, paradoxically, provided the stimulus toward the advanced concepts of debits and credits.[16]

Both of the above positions imply that form, augmented by some type of number system, was instrumental in yielding the substantive element in double-entry accounting. Why should form alone necessarily lead to the complete concept of double-entry; is it not equally plausible that the idea was first conceptualized and that the element of form merely reflected a lag effect in the application or modification of existing accounts? De Roover's own testimony on the state of accounting in Tuscany tends to lend credence to the latter possibility. But even if form is accepted as a causal factor, what underlying event or set of phenomena can explain the motive behind the emergence of the bilateral form, in a total framework of duality (i.e., journal entries, trial balance, and final ledger balances) regardless of the number system (i.e., Roman vs. Arabic).

Unfortunately, an inductive approach can not provide solutions to this question and some resort to deductive reasoning is essential. At issue here is *not* the appearance of double-entry *form*, which at one time, was generally understood to be in Genoa around 1340. In fact, de Roover claims that this hypothesis has virtually been shattered and the focal point is now the simultaneous emergence in several Italian trading centers around the beginning of the thirteenth

century.[17] Instead, the question of interest lies in discovering the compelling force that provided the substantive element of double-entry bookkeeping. Several alternatives are couched in the literature but they appear to be incomplete upon further emphasis.

De Roover, for example suggests that three factors, namely partnership, credit, and agency were of paramount importance. The notion of partnership, with extant documents dating from 1157, is singled out as the most important because it generated the concept of entity. Borrowing from Kats,[18] both Littleton[19] and Gilman[20] have argued though, that the charge-discharge record of the Roman master-slave relationship is sufficient for conceptualizing a separate entity from proprietorship. Credit, enhanced substantially by the Crusade movement, is offered as a second factor. But trade and credit have co-existed since antiquity and the rise of money economies merely added varying degrees of intensity to the complementarity of these two factors. Keister, for instance, rigorously documents the existence of columnar form, summations and a relatively sophisticated level of trade as far back as ancient Mesopotamia.[21] The third factor, agency, is plainly evident generations prior to the advent of Italian merchants. In short, these three factors have paralleled one another for centuries.

As a prelude to discussing these three factors, de Roover emphasizes the duality of exchange transactions embedded in the nature of business and then asks the interesting question "Is it then surprising that the merchants would *eventually* hit upon a system founded on an *equation* between debits and credits?"[22] (emphasis added). In the absence of any additional stimulus, the answer seems to be affirmative. Partnership, credit, and agency, in any proportion would not necessarily yield a complete bi-variate system of equations (i.e. in the Littleton or Schrader framework). Nor is it at all clear that the thinking of merchants or businessmen of any description would envelop and comprehend the relationship of independent and dependent variables from an evolutionary process of partnership, credit, and agency. The analogy of gunpowder and ancient weaponry is an interesting paradigm. No amount of improvement in the technology of making spears, swords, knives, etc. would match (or transform them into) the explosive power of a chemical mixture.

A competing hypothesis is advanced by de Ste. Croix who revives the idea that the rise of the substantive element of double-entry accounting can be closely linked with the introduction of the Hindu-Arabic system of numeration.[23] However, he is careful to point out

that this idea has been totally rejected, by the accounting historians Melis and Besta, on two grounds.[24]

First, there is the argument that even though double-entry bookkeeping appeared not later than the first half of the fourteenth century, literally all of the extant accounts were maintained in Roman numerals until about 1500. But Struik, a mathematics historian, writes that the statutes of the *Arte del Cambio* of 1299 prohibited the bankers of Florence from using Arabic numerals; yet they are found on documents dating back to 976 and 1275.[25] Undoubtedly, our contemporary number system was both known and in use prior to the fourteenth century. It should be carefully noted though, that this evidence does not adequately defend the polemic that double-entry bookkeeping requires the Hindu-Arabic number system. Moreover, the legal interference (i.e., the statutes) may explain why de Roover discovered substantive double-entry in the Tuscany accounts but lacking in form.

The second argument repudiating the connection between the Hindu-Arabic number system and double-entry bookkeeping is that the abacus, which was in general use throughout the Middle Ages, precluded the need for a place-value system complete with a zero characteristic. While the observation on the use of the abacus cannot be refuted, it contributes little or no basis whatsoever for rejecting the substantive appearance of double-entry bookkeeping.

Cognizant of these objections, de Ste. Croix nonetheless suspects that the maturation of double-entry bookkeeping can be traced to the seminal work *Liber Abbaci* written in 1202 by Leonardo da Pisa, himself a merchant as well as a mathematician. In translating directly from the original Latin script, de Ste. Croix observes that da Pisa traveled extensively throughout the Mediterranean as a merchant prior to 1200. Not only did he encourage adoption of the Hindu-Arabic numerals for commercial accounting, but he actually set out an account contrasting completely the Roman figures versus the Arabic numerals.[26]

Unfortunately, de Ste. Croix is biased in the same manner as other historians by suggesting that account *form* was the causal factor leading to a complete double-entry system. He states that:

> Once figures began to be disposed in a *single* column, instead of being scattered all over the page and reduced to order only outside the account-book, on the abacus or in the mind, the advantages of having *two* clearly separated columns, simply to facilitate computation, would very quickly become apparent; and this would of itself result

> in the emergence of the bilateral form of account, with debits and credits visibly distinguished. The final step, the further advance to double entry, could then equally well be made by those (no doubt still the large majority) who continued to employ Roman numerals.[27]

This conclusion leads us full circle from the arguments raised earlier and still leaves undetermined the order of form and substance in the emergence of a unified, complete system of double-entry bookkeeping.

It is evident from the above analysis that various social factors—trade, partnerships, and so forth—in combination with technical factors such as accounts and a numeral system, are necessary for double-entry bookkeeping. It is the view of this writer however, that taken together, they are not sufficient for explaining the appearance of a complete double-entry system. Perhaps some process of serendipity did take place at some point but the transition in "accounting" from the middle of the twelfth century to approximately the end of the thirteenth century seems to have required a *radical change of thinking.*

One possibility lies not merely in the introduction of the Hindu-Arabic number system but in the fundamental system of equations which accompanied its introduction into Spain by the Moors. The former event is obviously well-known in the accounting literature; the crux of the hypothesis of mathematics which did not necessarily emanate *from* the *Liber Abbaci* but rather, *pre-dated* it. The reasons for adopting this avenue of inquiry are several. Prior to the Arabs, Europe was virtually ignorant of mathematics. However, the Arabs, having obtained, preserved, and translated the great works of Greek geometry and, also having acquired the Hindu numerical notation complete with the algebra of linear and quadratic equations, made this body of knowledge accessible to Europeans in the colleges at Granada, Cordova, and Seville around the beginning of the twelfth century.[28] Not only did Leonardo da Pisa become exposed to this knowledge, but he also traveled extensively throughout Egypt, Syria, Greece, and Sicily, eventually returning to Italy where his famous *Liber Abbaci* was published in Latin during the year 1202. There is some likelihood that da Pisa was influenced by the commercial activities of these other cultures but no definitive evidence has thus far been uncovered.

Also, there was a contemporary mathematician at the time of Leonardo da Pisa by the name of Jordanus Nemorarius who introduced the use of letters for magnitudes in his algebra. Apparently

this was a significant step forward in the evolution of algebraic symbolism.[29] The dispersion of this knowledge was quite slow since all of the Arab script was translated into Latin first and then retranslated into various vernaculars. Nonetheless, this particular development may have been linked to the conceptualization of debits and credits because symbolic representation of these two concepts would permit a surrogate generalization at the "system" level in addition to the apposed physical numbers at the "transaction" level.

But why should mathematics, especially the notion of equations, serve such a paramount role? In the first place, equations require an equality of variables, both independent and dependent. It then becomes a logical step to delineate the equivalence of two variables in an exchange transaction which is the basis of Littleton's concept of duality. Finally, there emerges a rationale for the substantive element in the Littleton-Schrader framework—the calculation of entity income which requires a precise understanding of an independent variable (usually revenue) and a dependent variable (usually expense). Naturally, a condition of equilibrium is maintained at any balance sheet date if the equivalence of exchange transactions is preserved.

Although higher level mathematics found its way into the Arab culture, why did it traverse the boundaries of north Africa *vis-à-vis* the Moors and culminate in the Spanish universities before spreading to Italy as opposed to a movement across land through Syria and northward, or via Syria by sea-trade. The reason for eliminating the land route through Syria is answered in most medieval history books. Apparently, the empires that lay between Syria and Italy were not in the least culturally interactive.[30] This is certainly a tenable proposition since history is replete with examples of colonization (conquest even) where isolated communities for trading were established while, paradoxically, there was a failure (intentional or othrwise) to abstract even a modicum of the indigenous culture. Preserving the ideology and customs of the homeland was the rule rather than the exception. Intriguing as it may be, this phenomenon did not exist among the cultures dominating trade in the western Mediterranean, including Sicily, Corsica, Pissa, Spain, southern France, and the north African coast.[31] Historically then, cultural transmission from the eastern Mediterranean lagged substantially behind economic trade with the western Mediterranean.

The same rationale would appear to nullify sea-trade with Syria as a possible source of mathematical knowledge from the Arabs. Byrne offers some supporting evidence for this position:

> By 1154 Genoese merchants are found trading freely, through most of the year, with Sardinia, Sicily, southern France, Spain, northern Africa; but trade with the Orient, and especially with Syria, was undertaken only at regular intervals.[32]

Moreover, Byrne indicates that:

> Between 1154 and 1164, it can be said with assurance that only five commercial ventures to Syria were made; between 1177 and 1206, only fifteen years can be cited in which voyages were certainly undertaken.[33]

It would be astonishing indeed if such a small number of trading missions dominated by mostly sailors, one or two merchants, and a scribe for inventory control, could have imbibed an understanding of mathematics and carried it back to Italy.

In summary, the relationship of the evolution of mathematics to accounting development seems remarkably direct. Almost all accounting historians speak of the *concepts* of debit and credit which requires a plurality of variables. But even more important, the idea of the fundamental balance sheet equation, alluded to by de Roover, could possibly have emanated from this source of knowledge. Having grasped the equilibrium nature of the final double-entry product, it would then be a matter of decomposing the whole framework into a series of logical component parts, i.e. the journal entries, a trial balance, and a ledger account complete with calculations of profit. This would imply that substance preceded form and not vice-versa as suggested by the spurious reasons documented in the literature. If this is a tenable hypothesis, it need not matter what particular numerical format is superimposed on the basic equation, for a complete double-entry system will manifest itself in the final analysis. Of course efficiency and understanding would eventually dominate the accepted form and numerical base as witnessed by history.

Providing direct evidence for the "substantive" hypothesis is beyond the immediate purpose of this paper. However, future research by accountants with the requisite skills might focus on several areas which are currently absent in the accounting literature. One approach could center on the historical teachings, artifacts, and other documents located in the various universities and museums throughout Spain with emphasis on the Moorish influence. Alternatively, a rigorous search of the lifetime works of special individuals such as Leonardo da Pisa and others who were in contact with the influx of

the Hindu-Arabic number system into Spain may prove rewarding. Finally, a thorough search of the Arabic and Hindu cultures themselves may reveal a knowledge of the substantive element in double entry accounting. Not only did they experience trade, credit, various forms of business, account formats, and a number system, but they also created and commanded the higher power of mathematics—an essential ingredient for a complete system of double-entry bookkeeping.

FOOTNOTES

[1]Some accounting historians maintain that Paciolo plagiarized the work of Giorgio Chiarini which pre-dated Paciolo's synthesis but was published later. Taylor, "Luca Pacioli", in Littleton and Yamey, "Studies in the History of Accounting", p. 180, challenges this accusation: "Pacioli in this and other writings has been wrongly accused of plagiarism."

[2]Taylor, p. 180.

[3]Taylor, p. 180.

[4]de Roover, p. 115.

[5]de Roover, p. 119.

[6]Littleton, pp. 24-27.

[7]Littleton, p. 24.

[8]Littleton. p. 25.

[9]Littleton, pp. 26-27.

[10]Schrader, pp. 645-649.

[11]Schrader, p. 646.

[12]Schrader, pp. 45-54.

[13]de Roover, p. 115.

[14]de Roover, p. 119.

[15]de Ste. Croix, p. 60.

[16]de Ste. Croix, p. 55.

[17]de Roover, p. 115.

[18]Kats, pp. 203-210.

[19]Littleton, p. 32.

[20]Gilman, pp. 40-41.

[21]Keister, pp. 371-376.

[22]de Roover, p. 115.

[23]de Ste. Croix, p. 64.

[24]de Ste. Croix, p. 64.

[25]Struik, "A Concise History of Mathematics," p. 87. He further specified that the 976 manuscript, *Codex Vigilanus,* written in Spain is the oldest dated European document containing Hindu-Arabic numerals. The earliest French document dates from 1275.

[26]de Ste. Croix, p. 65.

[27]de Ste. Croix, p. 66.

[28]Sullivan, pp. 18-19.

[29]Sullivan, p. 24.

[30]Braudel, Vol. I, Part One, Chapter II, pp. 103-162.

[31]Braudel, Vol. II, Part Two, Chapter VI, pp. 757-835.
[32]Byrne, p. 136.
[33]Byrne, p. 132.

BIBLIOGRAPHY

Braudel, Fernand. *The Mediterranean and the Mediterranean World in the Age of Philip II.* Volume I and II. New York: Harper & Row, Publishers, 1972.

Byrne, E. H. "Commercial Contracts of the Genoese in the Syrian Trade of the Twelfth Century." *Quarterly Journal of Economics,* 1916, pp. 128-70.

de Roover, Raymond. "The Development of Accounting Prior to Luca Pacioli According to the Account-Books of Medieval Merchants," in A. C. Littleton and B. S. Yamey. *Studies in the History of Accounting.* Homewood, Illinois: Richard D. Irwin, Inc., 1956.

de Ste. Croix, G. E. M. "Greek and Roman Accounting", in A. C. Littleton and B. S. Yamey. *Studies in the History of Accounting.* Homewood: Illinois: Richard D. Irwin, Inc., 1956.

Gilman, Stephen. *Accounting Concepts of Profit.* New York: The Ronald Press Company, 1939.

Kats, P. "Early History of Bookkeeping by Double Entry." *Journal of Accountancy,* April, 1929, pp. 203-210.

Keister, Orville R. "Commercial Record-Keeping in Ancient Mesopotamia", *The Accounting Review,* April, 1963, pp. 371-376.

Littleton, A. C. *Accounting Evolution to 1900.* New York: American Institute Publishing Co., Inc., 1933.

Schrader, William J. "An Inductive Approach to Accounting Theory," *The Accounting Review,* October, 1962, pp. 645-649.

_____. "A Critical Evaluation of Income Measurement by 'Products' and 'Periods'." *Industrial Research Bulletin No. 6,* Bureau of Business Research, The Pennsylvania State University, 1962. pp. 1-169.

Struik, Dirk J. *A Concise History of Mathematics.* New York: Dover Publications, Inc., 1967.

Sullivan, J. W. N. *The History of Mathematics in Europe.* London: Oxford University Press, 1925.

Taylor, R. Emmett. "Luca Pacioli", in A. C. Littleton and B. S. Yamey. *Studies in the History of Accounting.* Homewood, Illinois: Richard D. Irwin, Inc., 1956.