Pacioli's double entry – part of an intellectual and social movement

Graeme Dean, Frank Clarke & Francesco Capalbo

To cite this article: Graeme Dean, Frank Clarke & Francesco Capalbo (2016) Pacioli's double entry – part of an intellectual and social movement, Accounting History Review, 26:1, 5-24, DOI: 10.1080/21552851.2015.1129083

To link to this article: https://doi.org/10.1080/21552851.2015.1129083

Published online: 19 Feb 2016.
Pacioli’s double entry – part of an intellectual and social movement

Graeme Dean², Frank Clarke² and Francesco Capalbo³

²University of Sydney, Sydney, Australia; ³Second University of Naples, Naples, Italy

ABSTRACT
Our research contains unashamedly speculations about Pacioli, and his Renaissance heroes. It seeks to codify prior research which has speculated on many aspects of Fra Luca Pacioli’s (1445–c.1517) life. Regarding teaching, not surprisingly, most students are less than enthused by the experience of being taught double-entry bookkeeping (DEB) as a mechanical exercise. The focus on control in many research papers has misplaced emphasis on the origins of DEB, generally ignoring the socio-economic and intellectual contexts in which it was forged. This study speculates on DEB’s intellectual foundations, namely perspective, proportionality, harmony, order and balance captured in the Venetian form of DEB. By emphasising DEB’s recourse to these aspects, it is placed in Renaissance Italy’s fifteenth- and sixteenth-century intellectual and social movement. Academics including Bryer have suggested that a broader notion of financial accountability is appropriate. We concur. Accountability is generally a missing dimension in DEB teaching and related research. A major complaint in the aftermath of the Global Financial Crisis (GFC) levelled at the banks, and their shadow banking arms in particular, is that their group accounting failed ‘to tell it how it actually was’ – that is, it failed to truly account. Companies were unaccountable. The ‘morality’ of audited accounting with a lack of corporate accountability, namely its recourse to truth, balance, proportionality of the kind the Renaissance players sought, was certainly absent during the GFC.

Introduction

Prior research has considered many aspects of the Fra Luca Pacioli’s (1445–c.1517) life. That interest endures. Alexander and Servalli (2013) explore ‘Pacioli as Renaissance man’, while Garcia (2015) seeks to synthesise things, noting that

[Int relation to Pacioli, for example, the author’s exact name has been analyzed (Geijsbeek, 1914/1974; Boursey, 1943; de Roover, 1944a; Taylor, 1942/1980; 1944), along with his legacy as an accounting educator (Sangster and Scataglinibghitar (sic), 2010), his importance in teaching double entry (Sangster, 2010), his influence on Durero’s artistic works (Mackinnon, 1993), and his relationship with Leonardo da Vinci (Capra, 2007; Pisano, 2013) [and Piero della Francesca], among other questions. Garcia (2015, 4)
Similarly, multiple aspects of double-entry bookkeeping (DEB) have been examined, including socio-economic conditions underpinning its emergence in the thirteenth century, its initial place of emergence, and its significance in the development of capitalism (see note 2 for a number of authors who have debated such matters). Recent works include Yamey (2005) who examines non-Sombartian claims that relate to: ‘DEB and Manichaeism or Manichaeistic notions; the rhetoric of DEB, the legitimisation of capitalist enterprise and profits, and the validation of the merchant’s probity; and DEB and the mathematical concepts of zero and negative numbers’, while Macve (2015, abstract) contestably claims that:

- even a brief genealogical examination of the conditions of possibility that have led to the growth and changes in accounting and auditing practices and discourses, and in the power-knowledge relations that they have engendered at different stages over the millennia of recorded history, suggests that their power has always been more that of ‘institutional rationalised myth’.

Digressing from our main speculations, research into aspects of DEB often seeks contestably to imply theoretical significance in an entity/proprietary distinction. A reviewer of an earlier version of our paper lamented that there was little discussion of the distinction amongst its speculations about DEB’s intellectual foundations, especially regarding perspective and proportionality. We contest this distinction, as it provides only marginal theoretical insights for researchers or teachers, a position long held by the ‘Sydney School of Accounting’. For the following reasons, our paper is neutral regarding the distinction. Premises of the paper are (i) the importance of double entry to distinguish accounting for the entity from accounting for its interested parties, and (ii) the mathematical duality principle. Thus, it is purely for exposition that, when accounting for the entity, we generally adopt the balance sheet ‘Assets = Equities’ form (or in extended form, ‘Assets = Residual Equity and Liabilities’). Seeking to make something of these or other forms of equality, such as ‘Assets minus Liabilities equals Residual Equity’, has resulted in substantial research over many decades since the monographs of Sprague, Hatfield and Paton in the early-1900s. It has resulted in enduring inconsistencies – for example, ideas that are inconsistent with the law and business actions, such as the notion that shareholders ‘own’ the assets (a proprietorship notion).

That any differences in the proprietary/entity theory protagonists’ views are marginal at best is demonstrated in Meyer (1973), ‘The Accounting Entity’. In essence, Meyer examines eight notions of the accounting entity which had appeared in the accounting literature (across continents – not just in the USA) since those early-twentieth-century monographs. He concludes that seeking to draw general theoretical implications from the minimal differences identified is not fruitful. We agree.

We return to the main speculations in this study. When taught to novitiates, DEB is generally viewed as a mechanical exercise, emphasising the duality-control feature of the recording of transaction entries and the rote learning of transactions’ processing rules. How the data are to be used as formal memory aids for decision making and other purposes is discussed minimally, and where it is, the links between the data and those purposes are often not clearly identified. Students usually are less than enthused by this experience. Regarding research, there is an overemphasis on the origins of DEB and related matters, rather than the context in which it was forged.
Chambers’ (1994) ‘A Tale of a False Creed’ is an example of seeking to move the discussion forward. It captures the difficulty of explaining those origins, while acknowledging accounting’s undeniable benefits, including its record and memory reinforcing features and the interrelationship between profit and the value of property:

Whether the art arose from the imagination of some banker or trader, or some independent observer with arithmetical skill and insight, is unknown. But it is commonly held that it originated in the necessity of a record, and adjunct to memory, of debts owing and owed. Hence the terms debity (roughly ‘he owes’) and credit (roughly ‘he trusts’). By the 15th century, the scheme had become generalized to cover all kinds of property (debits) and financial interests in property (credits) and periodical increments in property (credits or debits, as the case may be). Pacioli was thus able to write: ‘By summing the debit and credit entries to this account [capital], the profit or loss will be known … you may learn the entire value of your property.’ (Pacioli 1494, 96; cited in Chambers 1994, 77)

Whereas double entry has been popularised by an ‘origin emphasis’ and the suggestion by some of its key role in the development of capitalism, there is minimal recourse to the significance of the fifteenth- and sixteenth-century intellectual movement within which the Venetian form emerged. Like the research of Aho (1985, 2005), Bryer (1993), Yamey (2005, 2010), Sangster (2010), Sangster, Stoner, and McCarthy (2008, 2011), Lee (2013), Alexander and Servalli (2013), Macve (2015), Garcia (2015), and, to a lesser extent, Crosby (1997), Parks (2005), Gleeson-White (2011) and Soll (2014a), the current paper’s speculation adds a dimension to teaching and researching DEB. Accepting Heeffer’s (2011), Sangster, Stoner, and McCarthy (2011), Macve (2015) and others’ pleas of the need to understand the socio-economic context, we use accounting history and Luca Pacioli to put relevance into the teaching and researching of double entry. Speculating about Pacioli’s emphasis on perspective and proportion, harmony and balance provides that other dimension. It adds to the recent resurgence in research about DEB, including its role in the development of capitalism – especially so in respect of merchants’ product diversification and long-distance trading in their drive to accumulate capital. Further, this broader understanding of DEB indirectly supports the case for those who continue to argue that accounting appropriately is a tertiary discipline, not simply a technical one.

The main thrust of our argument is as follows. Similar to the way High Renaissance artists, like painters such as Durer (1471–1528), following Piero della Francesca (c.1416–1492), and all-rounders like da Vinci (1452–1519), were moving from flat views in their drawings and paintings to one with perspective based on mathematics, in a major intellectual quest of the time, so perspective in the mathematical form of DEB (as one nineteenth-century Cambridge mathematician, Cayley [1894, Preface] has described it, the perfect form of Algebra) can be shown to have replaced the charge-and-discharge and single-entry accounting systems.

Much has been written about DEB – with accounts by many, including sociologists, economic and accounting historians. DEB is shown in those accounts to have many variants. Our focus is on what Lane and others have described as the Venetian form (‘The Italian method’). Hoskin, Ma, and Macve (2013, footnotes deleted) describe its essential features:

It can be used to cover a range of accounting procedures that involve entering transactions ‘twice’. … ‘full’ DEB (as described in print for the first time by Luca Pacioli in 1494, e.g. Macve, 1996) goes further and links all transactions into a completely integrated system of
doubled entries, one precipitate of which is a periodic ‘trial balance’ of all the accounts that generates the production of summaries that show both ‘profit and loss’ and a ‘balance sheet’ of the current net assets, equal to the ‘capital’ (de Roover, 1956, p. 114). ... de Roover (1956) shows that a variety of layouts ... can be found ... [but] it is the ‘bilateral’ Venetian layout that came to dominate in handwritten books, whereby the debits and credits are arrayed in columns on opposite sides of the page or on opposite pages ... so that the current balance of an account can easily be inserted. It is this most advanced form of DEB for which the strongest claims have been made by leading economic sociologists (e.g. by Sombart, Weber and others — cf. Yamey, 1949), namely that it was essential to the development of Renaissance capitalism, and later to the development of the ‘rational’ cost accounting of the Industrial Revolution (cf. Hoskin & Macve, 2000). (Hoskin, Ma, and Macve 2013, 3)

Appearing more recently are works for a broader audience discussing the importance of DEB. These include Gleeson-White’s (2011) Double Entry: How the Merchants of Venice Created Modern Finance and Soll’s (2014a) The Reckoning: Financial Accountability and the Rise and Fall of Nations. The former popularised DEB’s heritage with her account of Pacioli’s treatise and its legacy. She placed the modern method in its historical setting – explaining not only ‘how the merchants of Venice shaped the modern world’ but contestably portending ‘how their invention could make or break the planet’. Soll looks mainly at historical settings, specifically addressing the importance of financial accountability or ‘balancing’ in administering city or nation states during the Renaissance and beyond, and for administering the affairs of contemporary major merchant’s affairs, like those of the fourteenth-century Francesco Datini and the fifteenth- and sixteenth-century Medici. Soll laments the failure of subsequent governments to rely on that accountability check on many occasions. Further, like the Cambridge historian Crosby (1997) in his Measure of Reality: Quantification and Western Society and Parks’ (2005) Medici Money: Banking, Metaphysics, and Art in Fifteenth-century Florence, he notes the interconnectedness of developments in commerce, religion, art, mathematics and DEB during the Renaissance. This interconnectedness also underpins the speculations of our work.

We next introduce DEB and perspective. The following section considers accounting as a communication device. We then illustrate how understanding DEB’s intellectual roots provides insights into its abuse in the Global Financial Crisis (GFC). The final section provides our study’s implications for accounting research and teaching.

DEB and perspective – potential capacity to ‘tell it as it is’

To reiterate, our main speculation is that dissemination of the basic technology of modern accounting is rooted in a foremost intellectual movement of the ‘High Renaissance’ period, a movement grounded on geometry, proportion and perspective. This view goes some way to support those hyperbolic claims of Goethe, Sombart and Weber. Goethe, for instance, wrote of the ‘bilateral Venetian form’ of DEB that ‘it is amongst the finest inventions of the human mind’ (Goethe, Wilhelm Meister’s Apprenticeship, 1795).³ Luca Pacioli’s Summa de Arithmetica, Geometria, Proportioni et Proportionalita (‘Everything about Arithmetic, Geometry, Proportion and Proportionality’ – hereafter Summa) in 1494, included a treatise section on bookkeeping, Particularis de Computis et Scripturis (hereafter De Scripturis). It is highly likely that fifteenth-century developments in mathematics (accounting) and commerce were intertwined (Pisano 2013; Crosby 1997). Pacioli’s printed Summa thus placed that Venetian form in a position to become an enduring intellectually-
grounded product of that period. The observation of Shweicker’s (1549; under an unpagi-
nated plate, as reproduced in Reeves 1960, 331) Zwifach Buchahiten that ‘Arithmetic
[hence also accounting], [is] applied or related to the noble art of music [and we would
add the other noble arts like astrology, engineering and architecture]’, is therefore most
apt.4

The speculations that we propose provide a base to contest the ideas of Yamey and
others, like the attempts of Hoskin, Ma and Macve (2013) and Macve (2015) to debunk
what they see as myths concerning the significance of the DEB form of accounting, includ-
ing that it can facilitate decision making by providing a memory aid and the type of rate of
return (return on capital) information that Bryer, Weber and others have described as criti-
cal in the developments of capitalism in the sixteenth, seventeenth century and beyond. It
also takes an alternative path to other recent analyses, such as those seeking to highlight
the role of networks (rather than accounting) in facilitating that development of capitalism
(Gervais, Lemarchand, and Margairaz, (eds.) 2013. Merchants and Profits in the Age of Com-
merce 1680–1830); and to those like Aho (2005) who have suggested DEB was a rhetorical
device that the Catholic Church and businessmen invented to justify commercial behav-
iour in the fifteenth century that otherwise would have been viewed as immoral.

Our approach also addresses partly the concerns raised by others, such as Macve (1996, 4),
that: ‘the minutiae of scholarly dispute may become more concerned with challenging their
[manuscript] authorship or date than with critical appraisal of their contribution’. For, by
alluding to the interconnectedness of the ideas of leading artists, architects, inventors
such as della Francesca, Alberti and da Vinci and the leading mathematician of the day,
Pacioli, we speculate further about the significance of ‘interrelatedness of disciplines and
in the special importance of those exhibiting a “natural” harmony and balance’ (Chat-
field 1977, 45) and the especially strong links between the ideas of Pacioli and arguably the
Renaissance’s greatest perspective painter, Piero della Francesca (e.g. Stevelinck 1987, 1994).

Effusive claims about DEB (referred to immediately above) include Weber’s (1947) extol-
ling of the significance within DEB of the capital account that ‘supports the rational com-
putation of yield through modern bookkeeping’ (Toms 2010, 1); and Sombart’s claim,
drawing on Goethe, that DEB helped to ‘give practical effect to the entrepreneurial
spirit that began to flourish in the period of early capitalism’ (Edwards, Clarke, and Dean
2009, 556). Further, Edwards, Clarke, and Dean observe that those claims have under-
pinned a line of research over many decades of the twentieth century considering
whether DEB encouraged a ‘capitalist mentality’ among the fifteenth- and sixteenth-
century merchant class such as proposed by Sombart, Weber, Schumpeter, and more
2013) and Macve (2015) reject the claim.

Advocates suggest this ‘encouragement of a capitalist mentality’ was achieved by DEB
communicating to merchants the potential for presenting economic events in an ordered
financial form that enabled them to evaluate the amount, profitability, and rate of return of
their business investments; thus providing relevant data on which to base decisions
designed to enhance, amongst other things, the ‘Value and Condition of [their] Estate’
(Stephens 1735, 4). Arguably, the socio-economic circumstances of the Renaissance
period presaged a change for merchants from the extant charge-and-discharge and
single-entry accounting systems. The emerging Venetian double-entry form was
characterised by symmetry, mathematical balance, order, and harmony – all general features of the perspective movement of the Renaissance.

The context of this communication breakthrough (as discussed later) illustrates double entry’s intellectual foundations. Few modern technologies of communication (see Gleick 2011) have had as an illustrious intellectual background as DEB, and yet, accounting is not accepted in many countries by academics of cognate university disciplines; and it is habitually abused by its current practitioners (Clarke and Dean 2007; Jones 2011; Clarke, Dean, and Egan 2014; Clikeman 2013). We return briefly to this point in a later section.

As a plausible starting place we take the commencement of orderly, written, systematised financial recording as a convenient source of modern accounting. In the High Renaissance, this recording is illustrated in book form in Pacioli’s (1494) De Scripturis, which was integrated as part of his Summa. The reason for Pacioli’s excursion into his treatise on bookkeeping appears puzzling without thought (our speculation) on his fascination with algebra which he spent three years teaching in Perugia in the mid-1470s. According to Heeffer (2009), while there, he wrote an unpublished (untitled, and no longer extant, according to Stevelinck (1987, 5)) book on algebra for his students at the university. It contained material on commerce and bartering solutions that relied on the use of algebraic proportions. As well, there was a section on bills of exchange identical with that published in 1475 by Benedikt Kotruljević (Benedetto Cotrugli – 1416–1469; original version was published in 1458). This source may shed light on the source of Pacioli’s ideas on DEB in the Summa. Interestingly, four years after his Summa, Pacioli completed his La Divina Proportione (in 1498) with drawings by da Vinci. It was published in 1509. According to his dedication, in 1496 Pacioli began De viribus quantitatis (‘The power of numbers’), a compendium of recreational mathematics and proverbs that treats mathematics as magic and play which was not published in his lifetime. A facsimile edition was, however, published in 2009. Although Pacioli was a mathematician of ‘unimpeachable seriousness’, he also ‘loved mathematics for the pleasure it gave him and his enthusiasm for the subject infects all he wrote’ (Gleeson-White 2012). She further observes:

According to his dedication, Pacioli began De viribus … in 1496 and finished it 12 years later in Venice in 1508. He refers to Leonardo often in the manuscript, including making the first recorded mention of the fact that Leonardo was left handed. He also praises Leonardo’s assistance in drawing the figures for La divina proportione when ‘in happy times we two were in the same service in the marvellous city of Milan’ [for several years from 1496]. He then writes of ‘this our newest compendium called De viribus quantitatis’, which he dedicated to the Marquis and Marchionese of Mantua, Gian Francesco Gonzaga and Isabella d’Este. Isabella — a leading Renaissance woman, intellect and famed chess player — she had given refuge to Pacioli and Leonardo in Mantua when they were forced to flee Milan to escape the invading French army in 1499. (Gleeson-White 2012)

As noted, the use of barter in commerce as an exchange mechanism required resolution of the proportion puzzle. Moreover, as Crosby notes (1997, 149) facilitating it at the time was an interest generally in the measurement of quanta in the liberal arts, known then as the Quadrivium (astrology, music, geometry, arithmetic). Yet, it has been noted elsewhere (Pisano 2013, 42) that the Pacioli and da Vinci theories of proportions (Pacioli’s Summa, 77–78) possibly differ, the former, is:

… based on the Book VII (of Pacioli’s Summa] the first of the three arithmetic books of the Elements) that … [use] the proportions in the practical scope of the calculation, … The
subject of the proportions is the core of the scientific program of mathematization [and hence accounting] pursued by Luca.

This point leads to another speculation, namely, to what extent was Pacioli’s approach to proportion influenced by della Francesca. Heeffer (2011), amongst others, observes that one of the earliest written algebraic examples to consider and solve the proportion puzzle in a bartering exchange context is accredited to della Francesca.

Accordingly, Crosby’s (1997) Measure of Reality: Quantification and Western Society properly used the Venetian form of DEB, with its emphasis on calculating profits on transactions (Lane 1944), balance and equality, as one of the main exemplars in his account of the major Renaissance developments drawing on quantification, perspective and proportion. He also suggests that it was a product of the intellectual movement of the Renaissance, with similarities to the perspective movement generally occurring at the time in art, mathematics, music, architecture, astrology, and landscaping. Stevelinck (1987, 1994) had drawn attention to the influence of Renaissance artists on Pacioli, in particular della Francesca who Pacioli praises as the ‘greatest of his fellow citizens’ (as quoted in Stevelinck 1987, 1). However he had not sought to relate this influence to the wider perspective movement of the Renaissance. Macve (1996), alternatively, noting the work of Taylor (1956) and Eisentein (1979), does refer to the influence of Alberti, della Francesca, da Vinci and Euclid on Pacioli’s ideas on proportion and perspective.

More recently, referring to Dutch merchants and the importance of their accounting during the fourteenth to sixteenth centuries, Soll (2014a, 2014b) describes accounting within a broader context as being ‘valorized in great art’, philosophy, religion and commerce – illustrating this point with Jan Gossaert’s early-sixteenth-century Portrait of a Merchant and the contemporary Jan Provost’s Death and the Miser. Specifically, accounting is suggested by Soll (2014b) to contribute to the ‘moral health of their society,’ and to underpin the economic development taking place in Holland and elsewhere. Soll (2014a, xiv) adopts a type of Sombartian, Weberian and Schumpeterian view of the role of DEB in the development of capitalism, noting contestably that ‘[W]ithout double-entry accounting [bookkeeping] neither capitalism nor the modern state could exist, for it is the essential tool in calculating profit and loss, the basis of financial management’. In a recent review of this work, Sangster (2015) is critical of the failure to differentiate ‘The Italian method’ and the form of bookkeeping used in Holland at the beginning of the seventeenth century – namely factor or agent accounting. The debates on the significance of accounting, as noted earlier, are legion and endure.

Unquestionably the general rules underlying modern financial recording and reporting in the statements of financial position (balance sheets) and statements of financial performance (income statements) of public companies, of movements in the financial characteristics of their assets, liabilities, revenues, expenses and shareholders’ equity are traceable to the Venetian’s double-entry mechanism. Pacioli arguably perceived it to be a perfect algebraic illustration of proportion and symmetry. Moreover, although Pacioli was not the ‘father of DEB’ (earlier applied instances are discussed in many works such as Littleton 1933, Lee 1977, Nobes 1982, 1987, 1995a, 1995b, and Macve 1996) – his Summa contains the oldest surviving printed treatise of the Venetian system of double entry – and it is the system and what it presented that is our focus.6
The accounting equation. As part of an illustration of Cayley’s ‘perfect proportion’, the new commercial perspective of the Venetians’ ‘Italian method’ in respect mainly of merchants’ stock, reflected what we now know as the balance-sheet accounting equation reflecting the assets of an entity and the proportional claims of the internal (residual) and external equity holders in those assets. This view is consistent with teaching ‘Accounting 101’, from the basis of a holistic perspective, namely first understanding via a balance-sheet view that a duality exists – that is, the amount of an entity’s reported assets will have a corresponding equity interest in the financial worth of those assets of the entity – and then moving on to recording the entity’s transactions, again reflecting their duality effect. It is generally represented as ‘assets = residual equity + liabilities’ (\(A = RE + L\)), and in its extended form, ‘assets + expenses = residual equity + liabilities + revenues’ (\(A + E = RE + L + R\)). This aspect is well canvassed in Crosby (1997, Chapter 10, ‘Bookkeeping’).

Edwards (2014) notes Heeffer’s (2011, 112) observation that the parallel early-fourteenth-century developments in DEB and symbolic algebra were ‘instrumental in the objectivation of value’ in the sphere of business. The earliest example of DEB found in the Farolfi ledger of 1299–1300 (Lee 1977) is aligned with the ‘earliest extant vernacular text dealing with algebra’ which was written in 1307. Edwards continues: ‘Both algebra and double-entry bookkeeping were practised throughout the mercantile centres of Northern Italy from around that time onwards, with their initial appearance in “the very same” treatise occurring in Pacioli’s Summa (1494).’ (Edwards 2014, 228)

Proportionality is evident directly in Pacioli’s use of that equality, specifically in his ratio-based approach, namely assets equals equities or by rearranging, assets/equities equals one (i.e. \(A/E = 1\)). It is contested whether the equation (as described here) was used for only trading account purposes, producing a limited ‘capital’ amount balance to be augmented (possibly in a private book) by merchants’ physical assets. Edwards (2014), in an aside in the following extract (excluding footnotes), alludes to the prospect of what may have appeared in the writings of Pacioli or other mathematicians using algebra in that fifteenth- or early-sixteenth-century accounting setting:

an early English-language contribution to the accounting literature which demonstrates an algebraically rooted understanding of the interrelationship between double-entry bookkeeping (DEB) and the structure of the balance sheet. …John Clark (1683–1736) elucidated the balance sheet equation, now expressed as \(C + L = A\) in 1738 … 80 years before the currently acknowledged architect of that mathematical association, Frederick William Cronhelm. (Edwards 2014, 228)

Significantly for the argument presented here, Edwards later observes:

The [John Clark] discovery … is not important because it reveals that writers have been wrong to hail Cronhelm’s work as the original English-language contribution. Indeed, it is possible that Clark got some or all of his ideas from someone else. (Edwards 2014, 228–229; emphasis added)

Our research has not yet unearthed that ‘someone else’, possibly an Italian or German probably during the Renaissance (suggested by Clark 1738, cited in Edwards 2014), or others, such as an Indian (as suggested by Scorgie 1990). Yet, more importantly the work of Edwards (2014) highlights that

given Clark’s position as a teacher … journal-based learning was not the exclusive training method employed by bookkeeping instructors during the eighteenth century (Chatfield,
1977, pp. 217–18) … [and] it raises the possibility that other teachers of bookkeeping [during the eighteenth century and possibly earlier] were providing a more thoughtful education for aspiring clerks, bookkeepers, managers and businessmen than has hitherto been thought the case. (Edwards 2014, 229)

Hence, the origins are not as important as the significance of what was occurring in the period in which DEB was being developed. Pacioli’s form of DEB, with its focus on the value of a businessman’s estate and changes in it, is shown to be the end-word in balance and proportionality, perfect symmetry. Intellectually, some like mathematician Cayley’s observation that DEB is ‘like Euclid’s theory of ratios an absolutely perfect one’, provide support for the view that DEB’s algebra allows comparisons with Euclid’s line-to-mean ratio (and the derivative, da Vinci’s ‘Divine Proportion’). As noted, it is documented in the accounting literature that, at the time, Pacioli, della Francesca, da Vinci and many others shared a common interest in mathematical, especially algebraic matters. Chatfield (1977, 45) notes, Pacioli ‘was drawn to Alberti, Leonardo and other artists [like the Italians Paolo Uccello, della Francesca, and the German, Albrecht Dürer] in whose work the ideas of perspective, proportion and symmetry found practical expression’, and he was keen to depict these ideas through algebra.

Drawing on proportionality and moving to the accounting for a merchant entity’s transactions (cash and barter), the recording of business affairs during the Renaissance period recognises the dual financial consequences of each transaction, such that the recording of them changed (increased or decreased) both sides of the equation equally. This aspect is codified in Pacioli’s Summa. Every transaction was thus interpreted as affecting (increasing or decreasing) in equal proportions financially one or more of the items on either or both sides of the accounting equation in the manner of algebraic calculation. We noted earlier how the proportion puzzle in bartering had been solved by some before della Francesca and, later by others, such as Pacioli, using algebra.

Those mathematical underpinnings are best understood by a brief exploration of who were Pacioli’s mathematical and artistic colleagues in the decades before and after the turn of the sixteenth century. Pacioli, who was appointed in 1475 by the Duke of Urbino as a teacher and later professor of mathematics at the University of Perugia, taught mathematics in several other major Italian universities, and in 1514 and was appointed by Pope Leo X as a professor of mathematics at Sapienza in Rome. He is revealed to be a foremost mathematician. The DEB discussion in his Summa is part of a general movement in the High Renaissance, injecting human activity with a sense of symmetry and proportion, to bring order and to inform thought and behaviour. Perspective and proportion through the developments in measurement were missing elements previously in the Quadrivium (Pisano 2013; Crosby 1997). Focussing on art, it is clear that earlier artists’ representations of the world were deficient. Yet, up to the invention of the printing press, art was a major (but imperfect) means of mass communication. Without the injection of perspective and proportion, artistic communication generally failed miserably to depict ‘it how it really is’.

Algebra in art and elsewhere during the High Renaissance was perceived to reflect ‘God’s will’, to inject mankind with precision, intellectual and social order. Soll (2014b) reinforces this view in the context of accounting as a management tool:

In 1602, the Dutch government in essence created modern capitalism by founding both the first publicly traded company — the Dutch East India Company, or VOC — and the Amsterdam
Stock Exchange. Accounting was central to managing not only these companies, but also the Dutch government itself ... It was also seen as a necessary skill for civic participation. Most members of Dutch society were fluent in accounting, having studied at home or in publicly funded city accounting schools.

Double-entry accounting made it possible to calculate profit and capital and for managers, investors, and authorities to verify books. But at the time, it also had a moral implication. Keeping one’s books balanced wasn’t simply a matter of law, but an imitation of God, who kept moral accounts of humanity and tallied them in the Books of Life and Death. It was a financial technique whose power lay beyond the accountants, and beyond even the wealthy people who employed them.9 (Soll 2014b)

Art was a major connector with religion, philosophy and commerce. Indeed it was the major medium of mass communication in Pacioli’s time. At that time, the lack also of an understanding of the need for proportionality to be recognised, for perspective to be depicted, increasingly worried contemporary artists. As noted, it was then a nagging intellectual problem in other areas, such as music, astrology, geometry and mathematics. The Byzantine one-dimensional representations in art up to the middle of (say) the thirteenth century reflected this. Experimentation with injecting painting with perspective became common. For instance, Giotto’s (c.1267–1337) paintings (c.1305) in Padua’s Capella Scrovegni illustrate that early attempts to inject perspective were not always successful.

Bearing in mind the interests in perspective and proportionality and the anatomical lectures at the University of Padua, it is reasonable to speculate that the Veneto would have been a fertile place for such experimentation in art. There is good reason to expect heightened local interest in (and tolerance for) such things. Medicine had been taught in Padua since 1222 and a temporary anatomical theatre had existed from circa 1446. There can be no doubt the ideal proportions of the human body were enquired into in earnest once Leonardo’s depiction of Vitruvian Man was completed around 1490. Little doubt also seems to exist that da Vinci’s interest in Marcus Vitruvius’ (c.80BC – c.15BC) ideal proportions for the human body was both mathematical – perhaps founded in the belief that Vitruvius was trying to solve the age-old problem of squaring the circle10 (a square fitting perfectly into the ultimate in geometric creation – a circle of the same area) and was consistent with a dominant art controversy of his time – perspective. Pisano (2013) states that Pacioli was born into the ferment of controversy regarding perspective and proportionality; that he had to debate whether mathematics (hence accounting) qualified as a recognised scientific discipline, along with the likes of anatomy and physics. Although Pacioli’s main focus lay in the mathematical, we have alluded earlier that his guide (perhaps mentor) in thinking about such things was Piero della Francesca, especially given Piero’s forays into solving value-in-exchange bartering.

Piero’s understanding of the perspective controversy should not be doubted. For an insight into his dabbling with perspective, one might consider the famous tiled floor in his The Flagellation of Christ (1470, Galeria Nazionale delle Marche, Urbino). Interestingly, it took centuries of architects’ work to understand that the tiles’ pattern bears witness to his developed understanding of the complexities of perspective and proportion.

Consider the work of Paolo Uccello (1397–1475) – another interested in perspective – well exemplified by his mosaics in St Mark’s in Venice. Recall also that Leonardo is said to have placed a nail near Christ’s ear when drawing the cartoon11 for his Last Supper as the anchor point for strings to guide him in achieving the perspective that he sought in the
painting – and achieving the placement of Christ at its centre. Consider too how the continuing quest for perspective gained architectural maturity (after both Pacioli’s and da Vinci’s deaths) in Palladio’s (1508–1580) Teatro Olimpico (commenced just prior to Palladio’s death in 1580 and completed in 1585). It represented a superior understanding of perspective. By the end of the sixteenth century, the grasp of perspective, its contribution to understanding generally, attempts to depict an object, a position, as it is, was a significant cultural achievement in communication.

Pacioli’s (1494) depiction of accounting was part of that intellectual development of the Italian High Renaissance – as much so as the ideas of the contemporary artists, mathematicians, architects, musicians and astrologers. Thus, Pacioli’s Summa not only gave a template for later developments in accounting, but also made it timely that printing and other reporting media be developed for better communicating businesses’ financial affairs in general. This interpretation gives a broader meaning to the notion of accountability. It is no surprise that Crosby (1997) opines in the unpaginated note preceding the Preface to his Measure of Reality:

Western Europeans were among the first, if not the first to invent mechanical clocks, geometrically precise maps, double-entry bookkeeping, exact algebraic and musical notations, and perspective painting. By the sixteenth century more people were thinking quantitatively in Western Europe than in any other part of the world. (emphasis added)

The developments in quantification abstractions that Crosby notes reflect a sustainable and predictable accounting of the essential, continuous, elements of business affairs, as well as the social and a conceptual economic framework within which they functioned. Accounting was thus a timely precursor for the subsequent growth in commercialisation and industrialisation in response to increasing knowledge of the physical world.

Contemporaneously, the move from one-dimensional to multi-dimensional painting was indicative of the awakening to the idea that the world was not as prior art was representing it. Pacioli’s perception was that the Venetian form was a means of telling it ‘how it is’ in commerce, of representing the financial performance and the financial status of the enterprises. The emphasis was not just on control, but on trying to aid decision making. This aspect was revisited in a recent article (Edwards, Clarke, and Dean 2009) that provides ‘new evidence’ from all of the English-language manuals on DEB written from 1450 to 1798. Based on that evidence, the authors conclude that the writers of those manuals:


**Accounting as communication – an economic development stimulus in the sixteenth to eighteenth centuries**

Accounting is an archetypal communication technology. The development of printing and other technologies during the fifteenth and sixteenth centuries hastened both the
dissemination and understanding of accounting processes, and an understanding of how orderly commerce might be undertaken. It is claimed by Sombart, Weber, Bryer and others that a ‘capitalist mentality’ was encouraged by DEB’s decision-making and accountability functions from the time of the High Renaissance. It possessed the potential to show how to increase capital through profitable activities. Crosby’s abstract monetary quantification claim supports those like, Winjum and Bryer, who have suggested DEB was, in later centuries, the core technology that manufacturing, the development of cost accumulation records, costing and pricing mechanisms demanded. More recently, in a non-accounting specialist work, Soll (2014a, especially 117–131) provides a similar view when describing the cost accounting innovations of Josiah Wedgewood. However, regarding cost accounting developments, Gleeson-White (2011, 136–41) poses that ‘these sorts of non-financial transactions of internal transfers of labour, raw materials within a manufacturing plant were as Littleton [1933] puts it “strangers” to the types of external merchants’ transactions for which DEB had been invented. An alternative speculation regarding factory accounts is provided by Wells (1978a, 1978b), namely that the internal costing data simulated the unobservable market price for internal transfers of materials and goods. In his view, they may not have been the complete ‘strangers’ Littleton envisaged. As with much of the literature on DEB, speculations are rife. Those proffered in this study are in good company.

Smith’s (1776) depiction of an invisible hand and the specialisation and division of labour provides the seeds of ‘modern’ capitalism. Accounting became a public matter with the Industrial Revolution’s demand for large capital inputs from multiple contributors. Business up to the eighteenth century had been undertaken mainly by sole traders, partnerships, often with a limited number of partners, joint-stock partnerships, and only a few chartered companies – for example, as noted above, the Dutch East India Company, as well as the Hudson’s Bay Company, the Levant Company and the East India Company.12 Capital demands arguably led to the creation of companies by general registration, rather than by charter. As Maltby (1998) details, in the UK, this occurred under the 1844 UK Companies Act. In the USA, it had emerged a few years earlier in the companies legislation of various states. Other corporate features later were made more easily available in the UK also, through the general registration facility of 1844, for example, ‘limited liability’ introduced in 1855 (French 1990), and the voluntary requirement for audit in 1856.13 The need for accurate and reliable periodic reporting of a company’s wealth and financial progress became an imperative as multiple shareholders were separated from the management and control of their investments.

Before and after the Industrial Revolution, the conventional wisdom on the teaching of DEB was that it was journal-based, rote learning of the rules of debit and credit transactions. Control was claimed by many to be the focus, and not surprisingly, it was still suggested by latter-day Venetian School of Accounting proponents (Besta et al. 1909; Besta 1880). The more recent works of Sangster (2010) and Edwards (2014) proffer another speculation, namely that another training method employed by early bookkeeping instructors was a more thoughtful education for aspiring clerks, bookkeepers, managers and businessmen than has hitherto been thought the case. It entailed a holistic approach: beginning with a balance sheet – a merchant’s estate or ‘capital’– it then related the dual impact of transactions, and facilitated the relationship of profits from those transactions to the existing balance sheet. Consistent with the ideas of Winjum,
Bryer and others, comparisons of profit with capital were thus more easily facilitated. It should be noted that during the eighteenth and nineteenth centuries, the major businesses had shifted from merchants to manufacturing factories and mills, and the ‘estate’ mentioned above now included major physical assets. Nonetheless, in principle, the accounting required had not altered.14

The reality of DEB in the GFC – failing to ‘tell it as it is’

Describing the rise and fall of Nations, Soll (2014a) stresses the importance of the history of financial accountability. This view meshes with the one proposed here that accountability is currently a missing dimension in the teaching and research in respect of DEB. In the fallout from the GFC, a major complaint levelled at the accounting for arguably worthless securitised subprime mortgages and related credit default swaps by the likes of Northern Rock and (say) Bradford and Bingley in the UK, and at Lehmann Brothers, Bear Stearns, AIG, Countrywide, Wachovia, Washington Mutual and their likes in the USA, is that their accounting failed to ‘tell it like it is’. It was especially so in three major areas: fair value accounting for financial instruments, financial institutions’ loan loss provisioning, and accounting for off-balance sheet transactions (Laux and Leuz 2009, 2010). The resulting financial statements (especially statements of financial position) produced figures that had no external referent, and were based largely on expectational data provided by managers and their judgements (e.g. in respect of financial instrument measures based on the proposition that the current values of those instruments were said to be in temporary decline, not permanent) that could not, therefore, be audited. Appropriate risk and return assessments were unable to be made. Accordingly, there was a lack of financial accountability that was critical in the ensuing financial mess that undergirded the GFC (2007–2010) and the related national sovereign debt crises, an argument discussed in detail in Clarke, Dean, and Egan (2014).

Truth, balance and proportionality of the kind the Renaissance players sought, and to which Soll (2014a) refers, were nowhere to be seen. Nor was there order in business of the kind Crosby attributes to abstract quantification. Financial institutions accounting for their loans and the accounting for the collateral underpinning those loans were shown to be clearly inadequate – grossly misleading and deceptive, lacking in balance and leading to chaos.15

A peculiar feature of the debate over the GFC corporate shenanigans is the similarity to the disorderliness revealed following the 1929 crash and ensuing Depression. The financial statements of many companies then were grossly misleading. Grossly misleading, not telling it how it is, not only by virtue of deliberate acts of deceit, but also as a consequence of following the prescribed accounting conventions (rules) of the day, possibly with the best of intentions. Now, as then, few seem to appreciate the prospect that the reported financials of the companies that have not failed, those deemed the current high-flyers and ‘travelling swimmingly’, are frequently as misleading as those for companies that crashed or were noted to be in financial trouble. In the early 1930s, the general lead taken in the USA was to specify accounting ‘rules’ (incorrectly labelled then, and now, as ‘principles’) for the processing of financial aspects of business transactions, and disclosure rules for reporting their financial outcomes. That push for rules in respect of fair value accounting, loan loss provisioning and group accounting (enabling the ‘tick-a-box’
mentality) to govern accounting practices that has been pursued for the best part of 80 years, is underpinned by the idea that comparability would be achieved were each company’s financials prepared to accord with the same rules. The mistaken proposition is that uniformity of essentially input and processing rules would produce uniform output in the form of comparable, ‘fit-for-use’ financial statements representing a true and fair view of statements of financial performance and present financial position. The latter is especially so where those rules institutionalise recourse to expectational input data. Yet the falsity in the reasoning of that proposition was clearly demonstrable, and clearly evidenced by the variances in the outputs in the financial statements of companies following the same rules. It remains so today.

**Implications for teaching and research**

Tertiary teaching of DEB, as primarily a mechanical exercise involving the recording of transactions and generally emphasising the duality control feature of transaction entries, misses an opportunity to highlight accounting’s intellectual foundations. It thus overlooks a platform to instil in students’ minds a critical sense of inquiry. For, whereas the duality feature is self-evident from the reckoning mantra that ‘for every debit there has to be a credit’, without the algebraic context in which Pacioli placed it, duality becomes a meaningless operational rule. Operational rules are important for keeping a system ship-shape but provide no explanation of it. Yet as part of an algebraic structure, the intellectual setting in which it was practised by the Venetian merchants is arguably important to students’ understanding. The previously misplaced duality and control emphasis likely has reinforced the lack of the holistic approach in the teaching of DEB.

DEB was a means by which order and concord was introduced to business. Telling it how it actually was, recording and reporting the financial reality of transactions and their monetary consequences during the Renaissance, was a business equivalent contemporary of the pleas to show it how it (then) really was, in the artistic representations of human endeavour in perspective. The injection of perspective in painting was a giant step forward in making painting representations more accurate depictions of the world in which the events occurred – equally so in Venetian accounting. Proportion in accounting brought a kind of order in a commercial world of otherwise minimal communication. For students, the inculcation of an appreciation of that environment in Pacioli’s time, of the major proponents of the focus on perspective (and therefore on proportionality), the study of their successes and failures, the perfection and communication of that focus and of the part played by DEB, is critical.

Regarding the research implications, the demonstrated intellectual foundation lends credibility to those researchers who have speculated, based on an analysis of, albeit limited, evidence that the Venetian form most likely had both a decision-making and an accountability (record and memory aid) function; and by virtue of this, we also speculate that it was likely, as Goethe, Sombart, Weber, Bryer, Chiapello and others have noted, to have been a major factor in the development of the earlier phases of capitalism. Without the consequential financial order, capitalism may well have failed, or at least taken much longer to obtain prominence.

Not only is there a need to reinstall relevance to the teaching of accounting, the curriculum must contain a strong injection of the true intellectual foundations of the Venetian
form of DEB to justify its university discipline status. For to ignore the intellectual movement regarding perspective and proportionality denies students not only the context in which Pacioli pursued mathematics, but also a sound basis upon which to speculate in respect of the significance of his interest through algebra in the mechanics of the Venetian accounting system. This approach may provide insights into why this invention is essentially as it was over 500 years ago.

Notes

1. The name was attributed by Murray Wells in his July 1976 article, ‘A Revolution of Accounting thought?’ in The Accounting Review; and was acknowledged as a legitimate title in the AAA SATTA document – a major review of accounting theory. It was later used by Clarke, Dean, and Wells (2010, 2012) reviewed in The Accounting Review by Zeff (2011).


3. Macve (2015) is critical of the attention given to this attribution, suggesting it was irony.

4. Reeves (1960) notes that Schweicher (1549, 329) is ‘credited with introducing [DEB] into Germany’ – it was ‘published in Nurnberg … Schweicker, then living in Venice based his treatise closely on Domenico Manzoni’s Quaderon Doppio col Suo Giornale [1534] …, in turn based on Pacioli’s exposition’. Chatfield (1997, 53) notes: ‘Manzioni’s innovations included subordinating the memorial to the journal and ledger, using ledger posting references to journal entries and journalizing transfers of nominal counts to profit and loss’.

5. De viribus quantitatis is a foundational European text of magic and number puzzles. The unpublished manuscript was stored for 500 years in the library of the University of Bologna. It reportedly caused a sensation in 2007 when magician William Kalush, founder of the Conjuring Arts Research Center in New York, announced that it was to be translated into English for the first time in 2008 to mark the 500th anniversary of its completion. A facsimile edition was published by the Aboca Museum, Sansepolcro in 2009.

6. Interestingly, Pacioli’s Summa, in particular Des Scripturis, was examined more recently by mathematical historians, such as Heeffer (2009, 2011), to evaluate whether commerce, bookkeeping and mathematics were inextricably intertwined. In those examinations, issues were raised of proportion as they relate to barter transactions, of which a fifteenth-century example by della Francesca looms large (Heeffer 2011).

7. Aho (2005) notes others who have made this link, such as Swetz (1989, 11–13) and Carruthers and Espeland (1991). Crosby (1997) and Pisano (2013) have explored the Arabic influence on these algebraic developments.

8. While we noted earlier that Clark (1738) is now acknowledged (Edwards 2014) as being the earliest known author to have expressed the balance-sheet form of the accounting equation in symbolic algebraic terms, we also concur with Edwards that ‘someone else’ is likely to be unearthed as the pioneer. We speculate above that it may be someone during the High Renaissance. This notwithstanding Sangster’s (2010, footnote 19) constraining thought on this: ‘Algebraic symbolism (i.e., the use of variable names such as ‘x’ and ‘y’ and symbols such as ‘+’; ‘−’, and ‘=’) did not exist in any consistent form until the seventeenth century (Boas 1966); …’

9. This observation is contestable. As noted previously, Sangster (2015) critically observes that Soll (2014a, 2014b) fails to distinguish the Venetian DEB form from that in place in Holland at the beginning of the seventeenth century.
10. ‘Squaring the circle’ refers to the problem of seeking to show a square fitting perfectly into the ultimate in geometric creation – a circle of the same area.
11. ‘Cartoon’ refers to the initial drawings for the final painting.
13. The UK Limited Liability Act 1855 made limited liability more easily available but it could, of course, previously be conferred by statute or royal charter. Arnold and McCartney (2008) make the point that investors in the English canal companies of the early 1800s benefited from limited liability.
14. The previous sections referred to a contestable view about the economic significance of the DEB methods that emerged in the Renaissance, and to some alternative views about the emergence of DEB. Those arguments need not be recycled.
15. This point is well illustrated in the 2012 Federal Court of Australia judgements in respect of several Australian councils being misled as they invested in what they thought (based on ‘AAA’ ratings) were investments of high quality. Those matters are also discussed in Clarke, Dean, and Egan (2014).

Disclosure statement

No potential conflict of interest was reported by the authors.

References


Pacioli, L. 1508. \textit{De viribus quantitatis} (‘The power of numbers’) – unpublished until it was generally reported that a facsimile edition was published in 2009 by Sansepolcro: Aboca Museum.

References


