Accounting and blockchain technology: from double-entry to triple-entry

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Abstract

Any private and public institution is required to have a bookkeeping for their activity. Among many other duties, transparency in procurement and selling of goods and services, budgeting and presentation of their accounts are mandatory for any business. Actual legislation requires recordings according to the double-entry bookkeeping system. Current practice shows that the actual accounting system despite all legislative rigors, still leaves room for errors, voiced or forced, which in time leads to the development of the phenomenon of financial fraud. From this perspective, the present paper comes to how, moving to the next level of technology, blockchain, and from double-entry to triple entry accounting system, the risk of error and fraud mechanism can be definitely reduced.

Introduction

This research aims to analyze the evolution of the accounting practices starting with the double-entry bookkeeping system, invented in the fifteenth century up to the imminent future implementation that will involve the triple entry linked to the blockchain technology. It is also about to compare and verify how the economic, social and technological context has influenced accounting and how this context has in turn been influenced by accounting.

Since the double-entry bookkeeping system was introduced by Luca Pacioli (Pacioli, L., 1494; Houghton Budd, C., 2016), anyone approaching accounting always struggle to understand why a value should be entered in debit side or credit side for each T-Account. In the end, most people resign themselves to memorize, mechanically, where to enter values (*debit* or *credit*), simply by habit.

The use of the words *debits* and *credit* to identify, respectively, the left and right section of the double-entry, is linked to the naming of the sections according to origin of the system. However, the use of the words *debits* and *credit*, which currently no longer have any intrinsic meaning, is now even misleading. It would probably be more effective to call the two sections of each accounts, *left section* and *right section*, so as to avoid any confusion. In fact, for example, the increase of a payable (that is a debt) is recorded in *credit* (right-hand section) and vice versa the increase of a receivable (that is a credit) is recorded in *debit* (left-hand section).

Although almost all of the international widespread accounting dedicated literature (Sullivan, M.C., Benke Jr., R.L., 1997; Needles, B.E., Powers, M., 2012; Spiceland, D., 2016; Libby, R., 2017; Wild, J., 2017; Weigandt, J.J., Kieso, D.E., Kimmel, P.D., 2017; Warren, C., Reeve, J.M., Duchac, J., 2018; Williams, J., 2018) is based on the explanation and the study of the accounting equation, the analysis of the nature of the accounts represents a prerequisite that cannot be ignored. Undoubtedly, the accounting equation is useful to explain different dynamics of accounting and it especially useful to prepare the financial statement (especially the balance sheet and the income statement) at the end of the period (O'Bryan, D., Berry, K.T., Troutman, C., Quirin, J.J., 2000). The research, however, has revealed that the nature of accounts has many controversial classifications. The one that sometimes is showed in international textbooks is based on the original classification suggested by Luca Pacioli at the end of the sixteenth century. However, advanced and refined studies were carried out by the

Italian Doctrine on the analysis of the nature of the accounts. In Italy, the accounts are analyzed under various aspects and the nature of accounts currently bases the studies of the accounting of each Italian University, but it is unfortunately almost still unknown abroad. The translation and dissemination of these analyzes will undoubtedly offer a more complete view of the accounting process, not only based on the study of the accounting equation, which represents its synthesis and not its origin.

It is not possible to neglect to describe the reasons that led to the origin of the double entry and the consequences generated by its introduction. At the end of the 15th century commercial exchanges in the Mediterranean were very intense, particularly among the Italian maritime republics (including Venice) and Muslim traders in the Middle East. It is also likely that the double-entry bookkeeping system described in the book by Luca Pacioli originated from the possible influence of the practice of Muslim accounting, practiced and implemented by the Venetians (Zaid, O.A., 2000).

The development of industrial companies (starting from the industrial revolution, in the eighteenth century, which allowed mass production) in the whose duration was no longer limited to the conclusion of a single business, then determined the need to distribute dividends at least annually. At that time the need to implement adjusting entries also arose. That need, in turn, has led us to study, above all in Italy, the nature of the accounts, in order to allow to take account of the accrual basis.

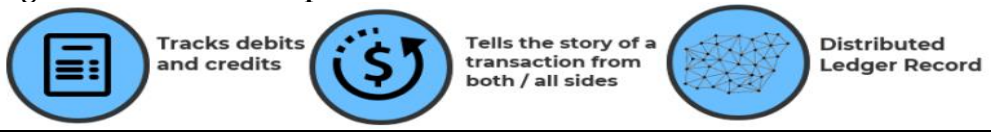
Despite the auditing controls, however, commercial frauds have unfortunately always occurred. The bad accounting practices that lead to an incorrect representation of the financial statements, however, have become more widespread. Nowadays, given the centrality of accounting practices and the financial globalization, it is crucial to find a way to curb the challenge.

The advanced studies (Yuji I., 1986) on the triple entry synthesized from the very beginning on the topic (Simoyama, F.D.O., Grigg, I., Bueno, R. L. P., & Oliveira, L.C.D., 2017), have highlighted how the double entry cannot be considered an absolute system, but it can certainly be improved and evolved.

Nowadays, given the globalization of markets, the difficulties in compliance among different transnational regulations, the number of transactions and the quickness with which they occur, the main weaknesses that characterize accounting are linked to the following aspects: *1)* it is quite impossible for auditors to audit all the accounts rendered, and instead, they are forced to select a small sample for audit based on their level of risk; *2)* obsolescence of information, since the presentation of accounts, through the financial statements, only occurs once a year, *leading to a seasonal demand with significant lag time between auditing and accounting period* (Shim, J.K., Siegel, J.G., Dauber, N., Qureshi, A.A., 2014); and, *3)* lack of cross-checking of transactions recorded in the accounts of two counterparties.

Blockchain is a new technology that was introduced a decade ago, after financial crisis of 2008 (Nakamoto S.,2008), and there is still a long way to being accepted and adopted by everyone. Blockchain can be described as the chronological record of block transactions. To ensure transactions, the cryptography is used, based on a chain of digital signatures. Each block is a group of transactions that are added to the last block by reaching a consensus on its authenticity among users, which is then passed to each network user to update their database. The Blockchain system records all transactions ever made, shared by consensus distributed and shared among each participant's users, and it is very difficult to force it. Since every two-key sign-in and any transactions are cryptographed and simultaneously maintained in distributed ledgers of each Node, which make this almost impossible to be hacked (figure no.1).

Figure no.1: Blockchain process



The invention of the blockchain that already found an application in finance through the cryptocurrencies, by many is currently considered as the solution to implement the triple entry. The move to a financial system with a significant blockchain element offered opportunities and new approaches for accountancy area. Nowadays, blockchain can help accountants to gain clarity over the available resources and obligations of their organizations.

Research Methodology

The present work paper is an exploratory research, based on investigative techniques. It is a fundamental and qualitative research which aims to present what is the current approach of double entry accounting, and a new era: triple-entry ledgers with blockchain.

Literature Review

3.1. The Double Entry bookkeeping system and the different classification of the nature of accounts

In order to deepen the development of accounting techniques, it is necessary first of all to provide a complete and analytical framework of the literature review concerning the nature of the accounts. According to the international classification of the nature of accounts:

Real accounts: are considered all assets of a firm, which are tangible or intangible, *balance sheet account that is carried forward into the next year. It is a proprietary account* (Spellman W.L., 2000). Tangible real accounts are related to things that can be touched and felt physically (tool, building, machinery, stock, land). Intangible real accounts are related to things that cannot be touched and felt physically. (Goodwill, patents, trademarks, software licenses).

DEBIT: what comes in	CREDIT: what goes out

Personal accounts: accounts related to individuals, firms, companies (debtors, creditors, banks, outstanding/prepaid accounts, accounts of credit customers, accounts of goods suppliers, capital, drawings)

Natural personal accounts: related to people (e.g. Mr. X's A/C, Mrs Y's A/C …). Artificial personal accounts: related to entities created by law (corporations, institutions). Representative personal accounts: related to a certain person or a group directly or indirectly (employees, wage-prepaid account)

DEBIT: the receiver	CREDIT: the giver

Nominal accounts: related to expenses, losses, incomes or gains. Existing by name only, they do not exist in physical form, but related to any nominal account money, *income statement account (revenue and expense) that is closed out at the end of the year* (Spellman W.L., 2000).

DEBIT: expenses and losses	CREDIT: incomes and gains

The above-mentioned classification focuses on the material essence of the accounts but has no direct connection with the accounting equation and it is referred to the initial classification provided by Luca Pacioli (Pacioli, L., 1494).

Authoritative scholars in Italy in the twentieth century have largely deepened the study of nature of accounts to be able to create a simple, intuitive and rigorous system to post the accounts in the financial statement. The theoretical construction of Gino Zappa (Dagnino, G.B., Quattrone, P., 2006), father of the modern Italian *business economics*, has defined the *earnings system*, where the original, *numerical accounts*, represented by the changes of money and its equivalents, is distinguished, and the derived aspect, referred to economic measures, *economic accounts*, which are distinguished as *economic accounts of capital*, and *earnings economic accounts*.

The current widespread approach adopted in Italy to identify the nature of the accounts, called *capital and earnings system*, as it is presented by contemporaneous academics (Melis, A., 2007), it outlines the original (financial) and derivative (economic) accounts (Manni, F., 1996; Manni, F., 2008; Manni, F., Faccia A., 2015; Manni, F., Faccia, A., 2019).

Financial accounts include numerical accounts (cash, operating receivables and operating payables), in addition to financial receivables and financial payables. Financial accounts (original aspect: concerns cash inflows & outflows, as well as increases & decreases of receivables and payables):

Certain: current liquidity (cash, bank)

DEBIT: increase of cash	**CREDIT: decrease of cash**

Assimilated: deferred values (receivables from customers, payables to suppliers, settlements receivables and payables), to sum up, operating receivables and payables

DEBIT: increase of credit (or) decrease of debit	**CREDIT: decrease of credit (or) increase of debit**

Assumptive: accrued receivables and payables, and funds

DEBIT: increase of credit (or) decrease of debit	**CREDIT: decrease of credit (or) increase of debit**

Economic accounts, on the other hand, include, in addition to *multi-annual* (that exhaust their usefulness in more than one period) and operating costs and revenues (that exhaust their usefulness in one period), also the equity. Economic accounts (derivative aspect allows to identify the causes of each financial transaction, cost, revenues, and change in equity):

Earnings of the period: costs and revenues of the period

DEBIT: expense (or) revenue reduction	**CREDIT: revenue (or) expense reduction**

Earnings *multi-annual*: economic accounts with two-phase operation (multi-year) – multi-annual: material and intangible assets

DEBIT: durable expense increase (due to purchase, bartering or impairment)	**CREDIT: durable expense reduction (due to disposal, impairment or depreciation)**

Earnings suspended: costs and revenues of deferred allocation (inventories and deferral, prepaid expenses and unearned revenues)

DEBIT: expense paid, but still not accrued	**CREDIT: revenue collected, but still not accrued**

Capital: accounts related to risk capital (equity) risk capital and reserves

DEBIT: capital refund (withdrawal)	**CREDIT: capital contribution**

3.2. The Triple Entry bookkeeping system and use of blockchain technology

Nowadays double-entry bookkeeping it is not an absolute system, but it is logically extendible to triple-bookkeeping by including a set of *force* in its third axis (Yuji, I., 1982). Blockchain, for accounting industry, helps the companies to write their transactions directly into a join bookkeeping, creating an interlocking system of enduring accounting records. Double entry accounting has been used for a very long time now. Triple entry accounting adds a level of clarity and honesty to bookkeeping that double-entry accounting cannot offer. Triple entry accounting has address A, address B, and the third address that is the confirmation receipt. The third public ledger allows for both books to reconcile their ledgers and make sure all three records are in a consensus (Unicorn, 2018). It is showing all transactions and all debits and credits involved can be seen. It is how, the salient feature of double-entry bookkeeping lies in the integration of flow accounts with stock

accounts, its logical extension to triple-entry bookkeeping becomes clear, subsequently an integration of a new set of accounts designed to explain changes in flow accounts (Yuji, I., 1986).

Findings and conclusions

The aim of this research paper is to review the evolution of accounting practices, analyzing the main evolutionary steps that occurred in different historical periods in accordance with social needs. The aim of the research is also to analyze the technical consequences and the advantages determined by the introduction of the evolutions themselves.

The authors have highlighted that at least three periods in which substantial changes have occurred can be identified: *1)* the origin of scientific accounting, determined according to the written accounting reference (Pacioli, L., 1494); *2)* implementation of accounting for enduring businesses, with the introduction of adjusting entries and the study of the nature of the accounts; and, *3)* the possibility of practically implementing the triple entry with the application of blockchain technology.

The origin of scientific accounting: double entry bookkeeping system

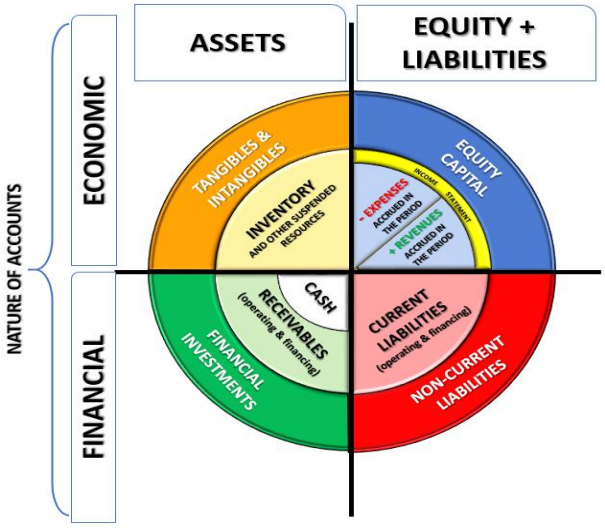
At the end of the 15th century commercial exchanges in the Mediterranean were very intense, particularly among the Italian maritime republics (including Venice) and Muslim traders in the Middle East. It is also likely that the double-entry bookkeeping system described in the book by Luca Pacioli originated from the possible influence of the practice of Muslim accounting, practiced and implemented by the Venetians (Pryor J.H.,1997). Even the name of the "Journal" (in Venice "*Zornal*") has a very strong assonance with the equivalent book used in the Middle East "*Jaridah*" (Zaid, O.A., 2000). Nor can it be ruled out that religion (Spellman W.L., 2000) represented a driving force for innovation. It is necessary to consider that both the Muslim and the Christian religions, in that historical period (the Muslim one still today (Pryor J.H., 1997; Moşteanu, N.R., 2017; Moşteanu, N.R., 2018; Moşteanu, N.R., 2019) forbade, even if to a different extent, the lending of money with interest. However, the merchants' need to find a source of finance has led to the invention of a new legal form of governance that has made it possible to circumvent the ban (sharing profit instead of charging interests): the partnership (Pryor J.H.,1997), in which two types of partners are identified: *a limited partner* (limited liability partner), usually the capitalist who wanted to finance a project without risking all his assets, but who still wanted to get a return on their money; and, *a general partner* (unlimited partner), usually a merchant who wanted to make money and also risked his life by sailing and travelling.

The spread of these new ventures forced the merchants to provide detailed reports, through an advanced accounting practice, to determine the final profit to be shared with the capitalists. The partnership forms took on the name of *Commenda* in Italy and *Mudarabah* or *Qirad* in the Middle East, but the model of governance was substantially the same.

Accounting for enduring business: adjusting entries and nature of accounts

The industrial revolution was a process of economic evolution and industrialization of the society that from an agricultural-craft-commercial system became a modern industrial system characterized by the general use of machines driven by mechanical energy and by the use of new inanimate energy sources (such as for example fossil fuels), all favored by a strong component of technological innovation and accompanied by phenomena of growth, economic development and profound socio-cultural and even political changes. The first industrial revolution mainly involved the textile-metallurgical sector with the introduction of the steam engine in the second half of the 18th century. The second industrial revolution was conventionally started in 1870 with the introduction of electricity, chemicals and oil.

Figure no.2: The three-dimensional views of accounts



The industrial revolution involved a profound and irreversible transformation that starts from the productive system up to involve the economic system as a whole and the entire social system. The appearance of the factory and the machine changes the relationships between the productive sectors. Thus, was born the working class that received, in exchange for its work and time made available for work in the factory, a salary. The industrial capitalist, an entrepreneur who owns the factory and the means of production, also arose, which aims to increase the profit of his business. The life of the companies begins to lengthen, and the owners express the need to have a return at least annually. It is therefore necessary to report annually, conventionally and ideally, the profit (positive or negative) actually accrued over the closing period.

Therefore, the complexity of accounting increases with the introduction of adjusting entries (prepaid cost, unearned revenues, depreciation, amortization, unearned receivables and payables ...), which were previously unknown because it was not necessary to prepare intermediate reports. Previously, in fact, the closing of the balance sheet was essentially carried out at the conclusion of the affair (*commenda* contract), when the merchant returned from the commercial trip and divided the profits with the limited liability partner.

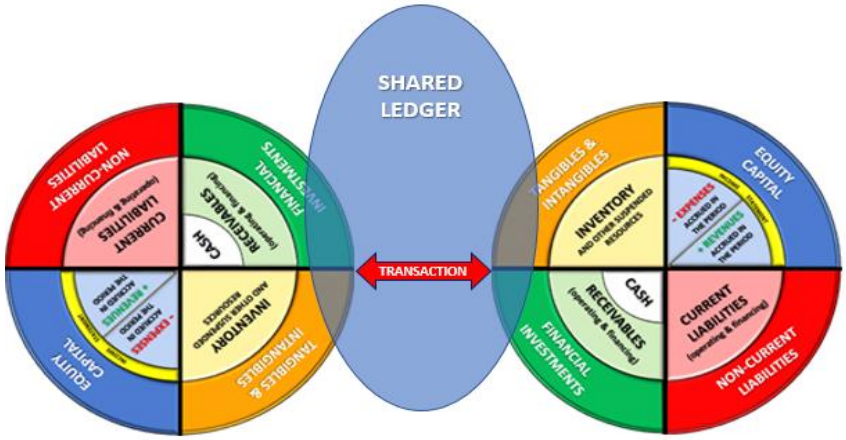
In order to better represent, also visually (figure no. 2), the complexity of the double-entry bookkeeping system, summarized by the accounting equation, the Authors, in this paper, also identify a three-dimensional graphic according to three perspectives: *horizontal axis* –accounting equation / left side - Assets, right side - Equity & Liabilities; *vertical axis* – above - economic accounts, below - financial accounts; *concentric circles* – external circle - long term; inner circle - short term.

Accounting for enduring business: triple entry blockcain

Blockchain technology continues to grow and is being used in more and more business sectors, accounting has been identified as an area that could greatly benefit the distributed registry and other features of the blockchain. The main benefits discussed include reducing the risk of error (especially human error); low risk of fraud (blockchai it is very difficult to penetrate and manipulate); system automation, huge cost savings (by increasing the efficiency and decreasing in errors), increased reliability in financial reports, and reduced workflow.

Nowadays many economists and accountants are saying that *at the end of the road, fully automated audits can be real* (Deloitte, 2016). Triple-entry accounting (figure no. 3) is an extension of the double-entry system that has been in use since the 16th century (Grigg, I., 2005).

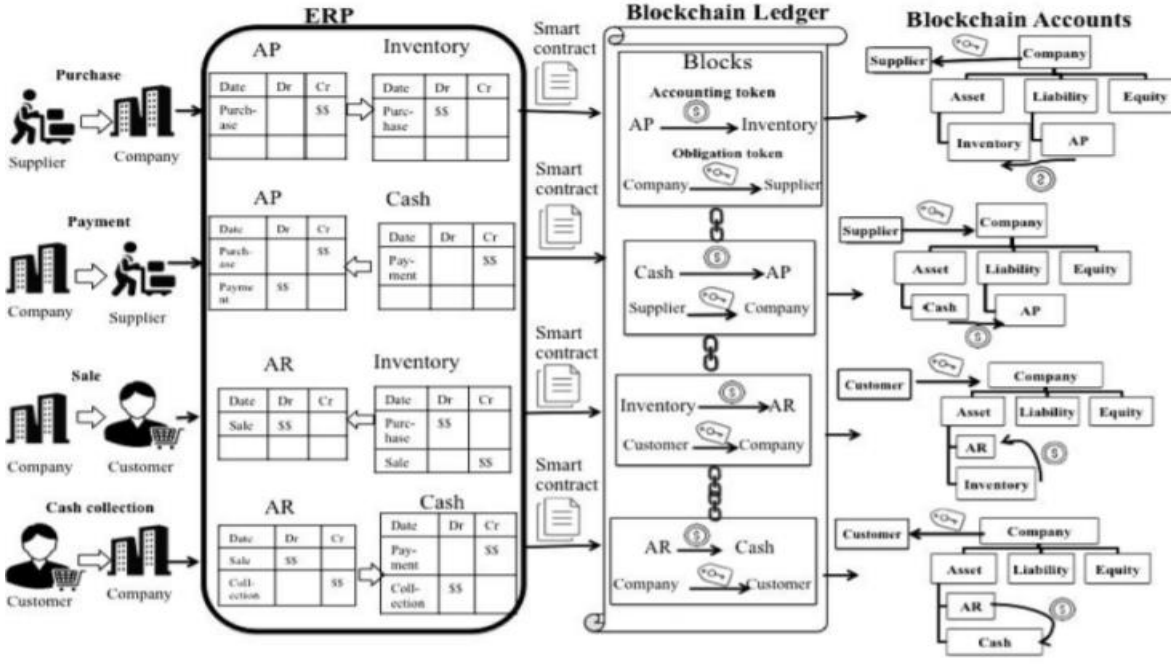
Figure no.3: Triple-entry bookkeeping



Double-entry transaction set up jointly by three parties as a payer, a payee and a payee issuer, as is usually done by banks and their customers. The payer sends units of the beneficiary's money (for example, a check) and the issuer (the bank) is responsible for checking and signing the transaction, for transferring the money and issuing a receipt for both the payer and the payee to update their books. This model offers too much centralized power to the issuer, which would be strong candidate for internal fraud. In order to reduce the issuer's ability to commit fraud, triple-entry accounting through blockchain brings countless advantage that the three parties involved are guaranteed exactly the same information and no party can enter unauthorized information (Simoyama, F.D.O., Grigg, I., Bueno, R. L. P., & Oliveira, L.C.D., 2017).

The basis for triple entries is a unique, cryptographically safe record, called *receipt*, the full probative proof of proof is provided by the digital signatures of the author, the payer and the accepting issuer, making sure that no party can successfully pass unauthorized transaction is valid. This reduces the problem of accounting with that of its presence or other type of receipt, which would be guaranteed by dividing the copies between all parties involved (figure no.4).

Figure no.4. Triple-entry accounting system through block technology



Source: Dai, J., Vasarhelyi, M., 2017

The new blockchain technology, rules and data layers are already implemented in many activities, and the triple-entry with blockchain could be implemented successfully within accounting system. This comes with balance checks, asset levels and inter-organizational confirmations of debts and accounts receivables and would be integrated into the automatic use of smart contracts (Dai, J, & Vasarhelyi, M., 2017).

Furthermore, with the permissioned blockchain, different parties / roles can be given different data views, restricting access to data to some. Triple-entry account systems through blockchain it can be programmed to follow accounting standards and regulations automatically using smart contracts and could even automate tax filings through continuous updates.

Blockchain technology allows for timely examination of potential errors or fraud within accounting entries (e.g., duplicate payments), as well as automation of transaction verification using data from business partners. Moreover, smart contracts encoded with accounting and business rules could enable efficient control of the recording process (Dai, J., Vasarhelyi, M., 2017).

References

Dagnino, G.B., Quattrone, P., 2006. Comparing institutionalisms: Gino Zappa and John R. Commons' accounts of "institution" as a groundwork for a constructivist view. *Journal of Management History*, 12 (1), pp. 36-52.

Dai, J, & Vasarhelyi, M., 2017. Toward Blockchain-Based Accounting and Assurance, *Journal Of Information Systems*, 31, 3, pp. 5-21, *Business Source Complete, EBSCOhost*.

Deloitte, 2016. Blockchain: A game changer for audit processes?, Retrieved from https://www2.deloitte.com/mt/en/pages/audit/articles/mt-blockchain-a-game-changer-foraudit.html

Grigg, I., 2005. Triple Entry Accounting, Retrieved from http://iang.org/papers/triple_entry.html

Houghton Budd, C., 2016. In the shoes of Luca Pacioli – double entry bookkeeping and financial literacy, *International Handbook of Financial Literacy*. pp:621-637.

Libby, R., 2017. Financial Accounting. *McGraw-Hill Higher Education*.

Needles, B.E., Powers, M., 2012. Financial Accounting. *Cengage Learning*.

Manni, F., 2018. Il percorso logico contabile di costruzione del bilancio ordinario di esercizio. *Giappichelli Editore*.

Manni, F., 1996. Lineamenti di ragioneria generale. Il processo logico-contabile di formazione del bilancio ordinario d'esercizio. *Giappichelli Editore*.

Manni, F., Faccia, A., 2015. Introduction to accounting. *Aracne Editrice*.

Manni, F., Faccia, A., 2019. Financial Accounting - Text and cases. *Aracne Editrice*.

Melis, A., 2007. Financial statements and positive accounting theory: The early contribution of Aldo Amaduzzi. *Accounting, Business and Financial History*, 17 (1), pp. 53-62.

Moşteanu, N.R., 2019. Safety finance – a different approach – Conventional versus Islamic. Conference on Advances in Social Science, Management and Human Behaviour, Malaysia.

Moşteanu, N.R., 2018. The benefit of taxation: Zakat versus income tax. 10th European Academic Research Conference on Global Business, Economics, Finance and Social Science, Paris, France.

Moşteanu, N.R., 2017. What is the future of banking industry? Different approach: Islamic vs. Conventional system. *Ecoforum Journal*, Volume 6, Issue 3(13)

Nakamoto, S., 2008. Bitcoin: A peer-to-peer electronic cash system.

O'Bryan, D., Berry, K.T., Troutman, C., Quirin, J.J., 2000. Using the accounting equation analysis to teach the statement of cash flows in the first financial accounting course. *Journal of accounting education*, Vol. 18, Issue 2, Pages 147-155.

Pacioli, L., 1494. Summa de arithmetica, geometria. Proportioni et proportionalita.

Pryor J.H., 1997. The origins of commenda contract. *Speculum*, vol 52, No.1, *The University of Chicago Press*.

Simoyama, F.D.O., Grigg, I., Bueno, R. L. P., & Oliveira, L.C.D., 2017. Triple entry ledgers with blockchain for auditing. *International Journal of Auditing Technology*, *3*(3), 163-183.

Shim, J.K., Siegel, J.G., Dauber, N., Qureshi, A.A., 2014. Dictionary of accounting terms. 6th edition. *Barron's business Guides*.

Spellman W.L., 2000. The influence of Religion on the Globalization of Accounting Standards. *Trinity Christian College*.

Spiceland, D., 2016. Financial Accounting. *McGraw-Hill Higher Education.*

Sullivan, M.C., Benke Jr., R.L., 1997. Comparing introductory financial accounting textbooks. *Journal of accounting education*, Vol. 15, Issue 2, Pages 181-220.

Unicorn, 2018. Can blockchain truly disrupt the accounting industry?, video retrieved from https://blockchain.wtf/2018/08/industry-impacts/finance/accounting/

Warren, C., Reeve, J.M., Duchac, J., 2018. Financial Accounting. *McGraw-Hill Higher Education*.

Weigandt, J.J., Kieso, D.E., Kimmel, P.D., 2017. Financial Accounting. *Wiley*.
Wild, J., 2017. Fundamental Accounting Principles. *McGraw-Hill Higher Education*.
Williams, J., 2018. Financial Accounting. *McGraw-Hill Higher Education*.
Yuji, I., 1982. Triple-Entry Bookkeeping and Income Momentum, *American Accounting Association*.
Yuji I., 1986. A framework for triple-entry bookkeeping. *The Accounting Review*, Vol. LXI, No. 4.
Zaid, O.A., 2000. Were islamic records precursors to accounting books based og the Italian Method?. *Acccounting Historians Journal*.