

ACCOUNTING FOR PANDEMICS AND ECONOMIC CRISES MANAGEMENT: MORAL HAZARD, BLOCKCHAIN, AND SMART-CONTRACTS

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Abstract

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During economic crises, sovereign states and central banks support the general economy and firms with a range of emergency measures, such as the allocation of subsidies to enterprises and citizens. The sudden availability of money without the need for any consideration by the recipient leads the way to inappropriate conduct known as moral hazards, such as diversion or improper use of the financial resources received. The moral hazard arises from the individual tendency to rational behavior when in the presence of information asymmetry, inadequate controls, or favorable contractual positions. To reduce moral hazard, and to preserve the intentionality of the states, information asymmetry must be reduced. Avoiding moral hazard is particularly important in cases such as the COVID-19 pandemic, but also during economic crises and other emergency situations. This paper conceptualizes a relevant topic for the economy and accounting fields of study because information tends to be naturally asymmetrical. Traditional accounting is limited by the fact that some accounting practices or techniques can be used to reduce the effect of the pandemics on the economic performance of organizations. In our study we propose a way to reduce the natural subjectivity in accounting and reporting, using blockchain and smart contracts technologies, as a solution to information asymmetry during crises (such as economic ones or pandemics).

Keywords: Accounting, Pandemic, Economic, Crises, Moral Hazard, Blockchain

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1. INTRODUCTION

The last thirty years of our planet history, in a context of continuous climate change, have been strongly marked by intercontinental economic and

financial crises, such as the Mexican financial crisis of 1994, the collapse of the currencies that marked the Asian financial crisis in 1997-1998, the Argentina and Turkey crisis toward the end of 2000 (Desai, 2003) and the subprime crisis of 2008.

During these years, the economy and enterprises have been raddled by financial distress, and it required countries and governing bodies to issue assorted rescue measures on a large scale, including loans and/or subsidies to firms and citizens.

The typical feature of these crises is not only its global reach but also the heterogeneity with which it affected different countries, both among advanced economies as well as among emerging market economies (Fratzscher, 2012). The effects of these crises naturally spread to the banking system as well, modifying the banks' ability to sustain lending in the wake of financial shocks, to a greater or lesser degree depending on their relationship with the market, the quantity, and quality of their capital and the assistance programs of governments (Kapan & Minoiu, 2018).

Among the various global economic crises, the current economic crisis, which has now become the new norm for the entire planet, has been further worsened by the first true global pandemic of the digital age, caused by the SARS-CoV2 virus and the so-called COVID-19 disease. This type of economic-social situations, which are becoming cyclical normality due to future pandemics or environmental or economic phenomena of high impact, cause a total worldwide blockage of production and economic activity, with the need for the reaction of society as a whole, and the public sector, in particular, to provide relief tools for the survival of companies, small entrepreneurs and nonprofit organizations.

In the particular case of the current health crisis, almost the entire economic system has been forced to reduce to a minimum, if not to suspend totally, its activities and, therefore, trade and financial exchanges, for more or less long periods, dictated by the health needs of the country that orders the "lockdown". All firms, considered as instruments of the human operating in the economic activity (Ferrero, 1968), aimed at satisfying human needs (Zappa, 1950), must be able to sustain and carry out the production and consumption of wealth (Zappa, 1957). To prevent collapse, and to guarantee the survival of the economy in general and of firms in particular, in the light of this externally imposed blocking, the economic system must be supported by central banks, money emitters, sovereign states, through the increase of their debt for the financing and emergency support of the national economy, with the emission of non-repayable grants, unemployment benefits, welfare enhancement, and guaranteed financing.

In these situations, therefore, the IMF, the central banks, and the sovereign states respond to the crisis by providing programs of large-scale lending packages, in combination with the implementation of macroeconomic and structural reform. These programs are intended to offer bridging finance to the debtor and to help catalyze private sector capital flows, but official lending on this scale may also generate a moral hazard risk. Under this light, it is the behavior of the official financial institutions that engender moral hazard, and so do more harm than good (Haldane & Kruger, 2001) and therefore it can be stated that moral hazard is an important element of many financial crises (Dow, 2000).

The provision of these sources of financing, whether non-repayable or with extremely long maturities or external guarantees, generates the issuance of new money mainly through institutions outside the company, without any economic return for the cash flow. Thus, the intervention tends to provide beneficiaries with the availability of money that is not offset by any consideration from the recipient. This can lead to misbehaving such as the incorrect use of money, such as improper use, or in general different from the purposes intended by the issuing body or the handling of such sums for longer than is necessary. In this way, the *do ut des* principle, on which the market-based economy is based, is no longer applied.

These undesirable behaviors represent a moral hazard and arise in the presence of information asymmetry. For this reason, there is a need for careful monitoring by multiple actors to avoid the emergence of moral hazard situations (Pauly, 1968; Hölmstrom, 1979), in which the beneficiaries use the money acquired for purposes other than those set by the lender (over-insurance), or do not access the available instruments because they underestimate liquidity risks (under-insurance).

Because of the wide economic scale of crises, the cyclicity of these phenomena, and the large number of firms involved, the topic of research is certainly relevant. More in general, this article aims at exploring whether accounting information acquired without the mediation of a person and subjectivity is capable of reducing information asymmetry and then the related moral hazard issues.

This article is conceptual and explorative and inspects whether recent information technologies and in particular blockchain and smart-contracts, can help reduce this type of phenomenon. The research question of this article is: *Is it possible to find a technical solution to the problem of moral hazard in case of extraordinary loans to support the economy in crisis occurrence?*

This possible solution is looked for among the applications of new technology available to accounting, with a particular focus on blockchain and smart-contracts to reduce the information asymmetry between the emitter(s) and recipients. The approach of this work is theoretical and proposals, suggesting a new direction of solutions to the problem under investigation.

The paper is structured as follows. In Section 2, the literature on moral-hazard is analyzed, shifting its framework, which is originally, of the insurance world, to the economic one. In particular, it is highlighted that the moral-hazard is generated by the tendency of the actors, in the presence of information asymmetry, to adopt economically rational behaviors. Section 3 frames the problem of information asymmetry and contractual problems between debtors and money lenders under the light of rational management theory. Section 4 introduces the concepts of blockchain and smart-contracts and proposes a technical solution based on these technologies. Section 5 concludes.

2. LITERATURE REVIEW ON MORAL HAZARD

Moral hazard is a type of risk related to behavior, whose original identification is linked to the insurance world, and can be defined as the intangible loss-producing propensities of the individual assured (Grubel, 1971). Every insurance contract possesses some degree of moral hazard and its effects are sometimes hard to detect even though anecdotal evidence of the importance of moral hazard is widespread (Haldane & Kruger, 2001). It is already clear that the case of moral hazard in insurance is a very general one, arising whenever behavior is unobservable, but its consequences are observable (Mirrlees, 1999). Just to give some examples of this kind of behavior, not arising from the insurance world, it is possible to think of the possibility that individual traders will take actions, specifically, excessive risk-taking, at the expense of the firm as a whole, the possibility that bank management will not act in the shareholders' interests or the recurrent problem of excessive risk-taking in bank loan portfolios, that is often a moral hazard problem (Dow, 2000).

Dow identifies four particular situations that lead to moral hazard. The first is the case of excessive risk-taking or fraudulent behavior by individuals or groups of individuals who have a disproportionate amount of discretion together with a failure of management control that fails to detect them. The second case stems from an aggressive profit tendency, i.e. the focus on profitability is so strong to take excessive risks to enhance short-term profitability. The third case represents the classic problem of moral hazard, where a passive attitude together with the presence of strong incentives may encourage risky or suboptimal actions. Incentives that are too advantageous lead the individual, or group of individuals, to try hard to make large profits but without giving enough weight to the consequences of failure. Also in this case a lack of control contributes to the occurrence of unwanted behavior. The last case occurs in the presence of a collective overexposure when a large group of individuals is collectively exposed to the same risk and no one has the incentive to correct the problem (Dow, 2000).

From the economist's point of view, one of the most interesting aspects of the moral hazard phenomenon is its ultimate cause. The search for additional services in the presence of insurance if no constraints are imposed, the tendency to exaggerate the size of losses, the tendency to seek services or benefits at a lower price where liable, are actually expected actions (Grubel, 1971). In other words, if the "moral" aspect is disregarded, it must be observed that this behavior is the result of economically rational behavior (Pauly, 1968). From a management point of view, however, the situation is complicated by the presence of expected behavior, as we have seen, widespread and rooted in individuals whose measurement can only take place after the behavior has taken place. In other words, at present, there appear to exist no systematic measures of moral hazard. The measurement can be made through multiple regression techniques based on the measurements of the phenomenon from data available.

In the specific case of recent policy measures to facilitate international financial rescues, a large amount of literature has wondered if these programs have influenced debtors' reliance on official sector resources. Authors have tried to identify the extent of the phenomenon for which certain debtors tend to consider exceptional funding as "part of the furniture", leading to an increase in purchases classifiable as a moral hazard (Haldane & Kruger, 2001).

In response to the crisis, new regulations were imposed on, and on, sovereign States and banks (Mirza, Rahat, Naqvi, & Rizvi, 2020), as the creation of a banking union in the Eurozone or new directives on capital regulation. The goal of these new regulations is to introduce more discipline both for sovereign States and banks, decrease the public support to banks, and strengthen the resiliency of financial institutions or, in other words, to reduce the moral hazard resulting from widespread support to the financial system (Allen, Carletti, Goldstein, & Leonello, 2015). The analysis shows that in a large number of cases the problems related to the moral hazard arose within the financial sector and individual firms, and this led to the discussion of the role of moral hazard in financial crises (Dow, 2000).

In this specific context, moral hazard can be identified on both the creditors' and debtors' side. The moral hazard of creditors, who on the one hand mitigate the control and risk management policies and on the other hand provide loans, encouraging capital flight. On the other hand, the moral hazard of debtors who improperly use resources, require loans beyond their needs, or keep them for too long. In both cases, it goes in the opposite direction to the needs of the provider, who wants the livelihood of the subjects in a context of health and economic-social crisis. For example, there would be a moral hazard for companies if the funds received were used for the remuneration of equity capital or purposes other than the re-establishment of the company and economic activity in a pre-crisis situation; there would be a moral hazard if the company believed that it could sustain itself and subsequently went bankrupt, causing a worsening of the crisis. In these cases, moreover, the principle of "moral hazard" generates the risk that rescue programs encourage engaging in risky transactions, because institutions, firms, and individuals foresee being bailed out (Schoen, 2017). There must be greater clarity in the rescue programs dedicated to financial crises. And the respective responsibilities of the private and official sectors must be more clearly defined. It is essential that the official sector decides how much official finance will be made available and on what conditions (Haldane & Kruger, 2001). The meaning of moral hazard is that attempts to reduce the consequences of bad behavior can encourage such behavior. The general lesson of moral hazard is that less is more (Baker, 1996).

Reducing the a priori information asymmetry, to avoid the consequences of moral hazard, is difficult, since the relationship between action, incentive, and undesirable behavior should be carefully assessed, which can be very complex and with results far from those expected. Moreover, it must be considered that the source of moral hazard is an asymmetry of information among individuals,

resulting because actions cannot be observed and hence immediately contracted upon (Hölmstrom, 1979) and the reduction of information asymmetry leads to lower incentives to moral hazard (Millon & Thakor, 1985; Sufi, 2007).

An example of solutions found in the insurance industry to reduce moral hazard is to link payments in a proportional way to expenditures, with individuals choosing their expenditures to suit themselves. In this sense lending limitations or constraints can help to reduce the phenomenon (Haldane & Kruger, 2001; Mirrlees, 1999). Another possible direction for the resolution of the phenomenon is monitoring the actions and using this information to draw up contracts. Obviously, if in simple situations complete monitoring may be possible; in the more general case a full observation of actions is either impossible or prohibitively costly. The indication, therefore, is that of using estimators of action or casual observations that are extensively used in practice to alleviate moral hazard, as in the supervision of employees or various forms of managerial account (Hölmstrom, 1979).

It can, therefore, be briefly summarised that moral hazard is a behavior that occurs in the presence of contracts that provide incentives in favor of certain actions. These actions are typically determined by an excessive propensity to risk-taking, by an excessive tendency on profitability, or by a passive attitude to underestimate the possible consequences of their actions. The lack or inefficiency of controls also contributes to the occurrence of undesirable behavior.

This type of unwanted behavior is extremely rooted and widespread in individuals since it is rational economic behavior. Moral hazard is a consequence of information asymmetry among the actors, deriving from the fact that the measurement of behaviors is impossible (because of the excessive number of necessary observations) or because it is too expensive. This statement is particularly true in the case of international financial rescue programs, where the number of actors and actions is very high.

The reduction of moral hazard can be pursued in several ways:

- Reduction of information asymmetry from the information issuer by requesting more mandatory information: this solution can transfer information between the actors, leveling out the available knowledge for decision making.
- Reduction of information asymmetry by granting more controlling power or rights: this solution can increase the awareness by the user of the information or by the controller.
- Introduction of limitations and covenants within the contracts between actors that can prevent the onset of moral hazard situations by providing for compensation in case of misbehaviors.

From this point of view, it is interesting to highlight that not always the imposition of information constraints leads to conformity. The response to new regulations, or increased controls or covenants, is modified by several factors that include the scope, the means and goals of the organization, and their compatibility with the institutional pressure, the nature of the demand,

and the internal representation of its effects (Oliver, 1991; Pache & Santos, 2010).

The problem of all of the proposed solutions is that information, in particular economic one, can be gatekept is subjectivized and derives from evaluation and estimation processes. Thus the complexity (and costs) for implementation of mandatory information and the controlling and monitoring activities can be massive and daunting. Moreover, as Gomez-Conde, Malagueño, Lopez-Valeiras, Fabricia, and Lunkes (2020) pointed out, "Empirical evidence has shown that during crisis periods timeliness, aggregation and integration could lead to slower decision making as these dimensions could lead to information overload" (p. 5).

Accounting and reporting serve at least the purpose of rationalizing and processing information in a convenient and transferrable way, at least when it follows generally accepted principles and it is implemented rationally to prevent gatekeeping and omissions.

This property of accounting is given by its capabilities of creating an informed space, that actors inhabit, of awareness of the results of the management and the operations (*territorializing*), of providing an external-communication-function (*mediating*) and the possibility of evaluating the performance of individuals and organizations (*adjudicating*) and of allowing control by the competent authorities (*subjectivizing*) (Miller & Power, 2013). In particular, the mediation of information can reduce information asymmetry, and subjectivizing information can enhance control and monitoring capabilities by information users.

The limits of accounting, that must be kept in mind when reading the information in particular during crises, are that some accounting practices or techniques can be used to reduce the effect of the pandemics on the economic performance of organizations (fair value accounting, big bath accounting, loss avoidance, and income smoothing techniques) (Ozili, 2020).

For this reason, to overcome the obstacle of the complexity of implementation, and to reduce considerably both time and human resource consumption, new technologies can automate part of the process and make information accessible, reducing asymmetry. Moreover, the use of technologies such as blockchain-based accounting and smart contracts can also foster the use of artificial intelligence to prevent or highlight subjectivity, misbehaviors, information asymmetry, and, thus, to reduce moral hazard.

3. ACCOUNTING UNDER RATIONAL MANAGEMENT THEORY AND REDUCTION OF INFORMATION ASYMMETRY

The management of any organization, whether it is private or public, small or big, profit-oriented or not for profit, is conceived through a complex process of continuous implementation of decisions and policies. Each of the single decision is built up through a sub-process, that is known as rational management based on financial statements (Puddu, 2010; Migliavacca, 2020) that can be divided into three separate macro phases - planning, execution, controlling - cyclic and backed by several

documents, in particular budgeting statements and reports, accountancy and final balance statement, that will become the key instrument for economic and financial information (Torri, 1987).

In the first phase, the decision is conceived based on prospective and retrospective data, through financial and non-financial resources allocation forecast. This phase of Planning is aimed to define the vision and the mission of the organization and, more specifically, defining the target and the related budget (Bhushan & Rai, 2007). In the public sector management, in particular, in this phase, the policymakers attempt to enhance the accountability of the decision-makers and operators and lay the foundations for any resource consumption. In particular, none of the resources that are not allotted can be consumed, and each consumption must correspond to an authorization (Potter & Diamond, 1999). To achieve this accountability and the capability of authorization, a perspective financial statement (or budget) must be generated. In this financial statement, any resource allocation is indicated and defines the maximum resources that can be used for organization management.

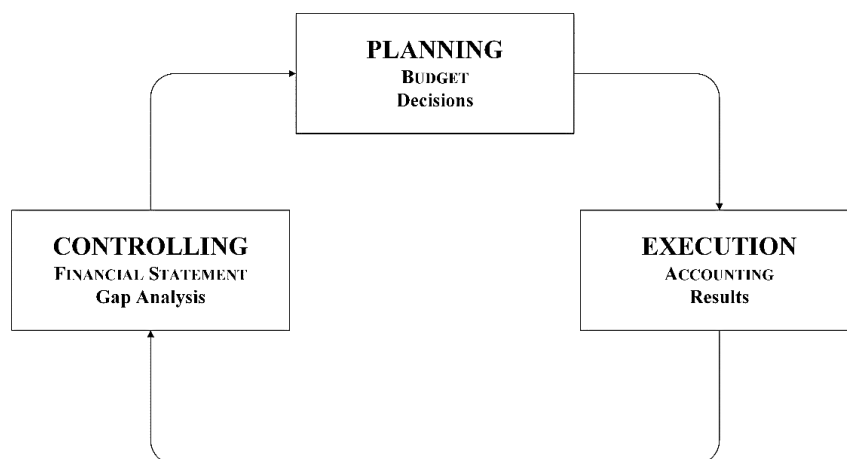
The second macro phase, naturally following the planning one, consists of the execution of the forecasted activities. This phase of execution is grounded on the budget allocations and is composed of a continuous process of unitary decisions that must generate continuous recording for actual resource consumption. The orderly, continuous, and thorough recording is called accounting and permits to generate timely, precise, and effective data prospectuses to enhance further decisions and gap analyses. In particular, several accounting systems have been created and developed for the public sector, and almost all of them lay their foundations on the double-entry accounting system of financial, economic data recorded on an accrual basis (even if

some of the applied systems are still only financial-data-driven and on a cash basis). The use of a shared accounting system can enhance the decision making, the stakeholder-driven disclosure, and the comprehensibility of the organization's activity, namely leading to a lower information asymmetry level and allowing other organizations to generate synergies through linked policies.

The third step of decision making is represented by a phase of controlling. In this phase, any organization must take into consideration what the budget forecasted and conduct gap analyses on the deliverables expected from the budget statement with the actual execution results recorded in accounting. This phase, generally crucial for the private sector and its stakeholders' information requirements, is way less considered in the public sector, despite being it really important for better decision making and proper accountability of the policymakers. The control phase generally exploits financial statements and accounting prospectus to achieve a better comprehension of what caused differences between the forecasted and the actual performance of the organization.

Rational management theory acknowledges the three phases and the related documentation to be produced for accountability and better policymaking in a circular vision and is repeated on the whole at least yearly. This process enhances the potential efficiency and effectiveness of an organization and contributes to the creation of a clearer map of the actual value generation through the organization's activity. Thus, rational management is always focused on people and their requirements (Puddu, 2010) and the value generation can be considered both under the economic/financial dimension and the non-financial one, to maximize all the results and meet all the stakeholders' requirements and needs.

Figure 1. Rational management theory cycle



Source: Puddu (2010).

In the case of financial crisis rescue by providing programs of large-scale lending packages, our research question concerns in particular the possibility of reducing moral hazard on the debtors' side. When rescue programs have already been planned and implemented, unwanted behavior is present in the possibility that the contractors will

take advantage of sums to which they are not entitled and/or improperly use them. For this reason, the question must be looked at during the three planning, execution, and controlling phasis. In line with the literature on moral hazard, the possibilities to reduce the phenomenon are related to the introduction of limits in

the contractual phase, and the implementation of a control system (execution and control). In particular, this last function can be considered as part of the Miller and Power (2013) framework, as the subjectivizing function.

To be able to reduce moral hazard behavior, a system capable of actively operating on contracts is logically necessary, so as to be able to limit and possibly withdraw from the contract promptly and to reduce the information asymmetry because moral hazard arises in conditions of uncertainty. Improving information quality can reduce the costs to retrieve it for the counterpart, and produce a more accurate performance evaluation, and more efficient monitoring to prevent moral hazard situations (Guadalupe & Pérez-González, 2006). By reducing or eliminating the information asymmetry between the various actors involved, operating the appropriate controls, it is possible to make the debtors liable to subjectivizing, and therefore be able to promptly intervene on their work. In this light, it appears how important is the accuracy of the information, because if debtors are required to report, there could always be a risk of data distortion or tampering. In the next section will be shown if and how technology can then overcome the difficulty of operating controls in real-time among a multitude of subjects.

4. BLOCKCHAIN AND AI, A TECHNICAL SOLUTION TO REDUCE MORAL HAZARD

In the case of financial crisis rescue by lending, the two areas on which to intervene to reduce moral hazard are the contractual aspect and the control aspect, to reduce the information asymmetry between debtors and money lenders. In specific, the control aspect is complicated by the fact that such controls must be carried out in real-time, that data entry must not be left to the debtors to avoid tampering or distortion, and that control over multiple subjects can be costly or complex due to the presence of a massive amount of data.

In the area of data processing and management, Information Technology has made a lot of progress, particularly in recent years. The literature has already analyzed the use of new technologies, especially blockchain technology, also in the context of the public sector and in the case of e-government, for instance in the case of management of voting and management of payments, or to reduce the cost of managing tax, often eliminating government intermediation and changing the actors in the management. Information Technology has also made changes at the accounting level to audit and verify scripts through blockchain algorithms designed to identify the application of the law to the records (Secinaro, 2020). In this sense, it is already known that in the future the accountant's skill will improve in areas such as modeling, statistics, and text mining (Vasarhelyi, Kogan, & Tuttle, 2015), while the auditor's role will move from statement-level assurance to data-level assurance (Krahel & Titera, 2015).

The blockchain is technically a list of records, where each new recording is maintained and added

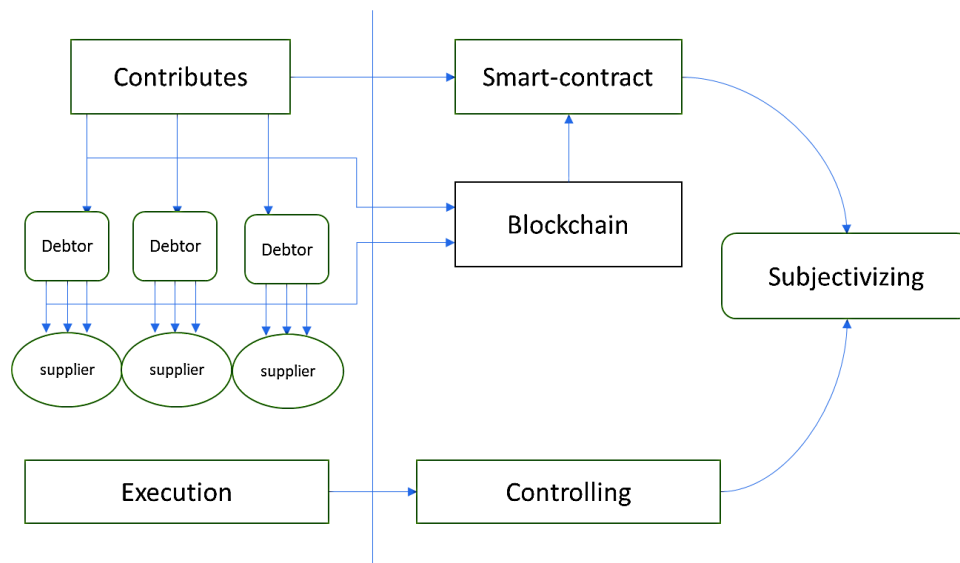
to the previous ones. Once a new record is introduced, it is no possible to delete or modify it. The validation of records is implemented through simultaneous communication of the records to all who have access to the data. The security of the system is based on the use of a cryptographic system to add new registrations to the previous ones in a secure and tamper-proof way (Lynn, Mooney, Rosati, & Cummins, 2019). The blockchain is a distributed ledger, stored on an unbounded number of computers, in which the data cannot be tampered with, altered, or stolen (Coyne & McMickle, 2017). From an operational point of view, it is important to underline that data is updated in real-time and there is no limit to the number of records to be processed. In addition to the above, it should be noted that the potential of the blockchain lies in its ability to record anything, and therefore not only in the recording of payments (Böhme, Christin, Edelman, & Moore, 2015).

Using blockchain technology is therefore possible to implement a storage system with the characteristics of transparency, data is accessible to all those who have the permissions, security, cannot tamper with the data, reliability, the recording system is distributed. In the specific case of records of expenses incurred by debtors by using the money loaned, there may still be a risk of incorrect or distorted communications by debtors. This problem can be solved if the expense statement is automatically collected at the same time as the payment is made. By using blockchain technology to automatically record payments made as a result of loaned amounts, it is, therefore, possible to implement a real-time and wide-ranging control system. If in the past the role of controller, and therefore of guarantor of trust, was attributed to a physical person, now this role could be played by the blockchain.

If, as seen above, the block-chain can perform the control function, it is still necessary to intervene on the contractual side. If the use of the loaned monies is not compliant with the creditor's policy, and therefore in the event of irregular conduct ascertained by the block-chain, the contractual conditions must be applied promptly and automatically, so that the amounts loaned can be returned, the loan is modified in the conditions of disbursement, or further and stricter controls must be activated. This can be achieved by using smart-contracts.

Smart contracts are self-executing contracts, based on computer programs that, within the block-chain, disconnect the contractual parties from third parties (Allam, 2018). Since in these programs the evaluation of the inputs is left to algorithms, deterministic control is obtained, that is to say, that in the presence of the same inputs the same outcomes are obtained (Christidis & Devetsikiotis, 2016).

A combined system of block-chain and smart-contracts could, therefore, perform the dual role of control and automatic execution of contractual rules. Below is proposed an illustrative scheme of the system architecture.

Figure 2. System architectures with blockchain and smart contracts

Source: Our elaboration.

In the case of large contributions, following verification of the debtors' eligibility requirements for access to the funds, the sums are released. Starting from this moment, through the blockchain, smart-contracts are activated, and all money movements are tracked. The tracking of these transitions, in all those countries where electronic payments have already been implemented, is certainly already possible. During the execution phase of the company's activities (execution), the recognition takes place, which is the process of capturing information for inclusion in the statement of financial position (International Accounting Standards Board, 2018). The recognition, as we have seen, takes place automatically through the tracking of money movements, and goes to collect information on the date of spending, how the sums were used, and to who were given. This data gathering takes place without the intervention of debtors, who therefore have no way of hiding or tampering with the data for fraudulent purposes. Simultaneously with the collection of this information the data is stored indelibly and tamper-proof in the blockchain and evaluated using the algorithms of the smart-contract. In this way, control is performed (controlling), by an algorithm and not by a natural person, so that the control is exercised by an entity outside the company. The algorithms, at this point, can assess the presence of gaps between the policy lines of the lenders and the use of the loans, automatically recognizing whether there has been total or partial contractual fulfillment, thus being able to activate accessory clauses such as the payment of interest at a higher rate, or if there is a total breach of contract so that the debtors must return the total amount lent and are subject to further controls and acceptance by the competent authorities.

From the point of view of the rational management theory, controls are then implemented automatically and concomitantly in the execution phase, and the controlling phase is exercised automatically and externally whenever there is a payment. This whole system, therefore, leads to

complete asseveration of control by the competent authorities, thus allowing the subjectivizing of the debtor's actions (Miller & Power, 2013).

5. CONCLUSION

In the concrete hypothesis of a future affected by a growing number of financial crises, due to catastrophic climatic and economic events, health emergencies, wars caused by the exploitation of economic and human resources, the possibility of economic interventions by governments and central banks will be increasingly common. The possibility for firms to have access to economic resources at little or no cost brings with it a high risk of moral hazard (Haldane & Kruger, 2001) with the consequence of distracting this aid from where it was needed.

The possibility to combine blockchain technology, with its capability of interaction among different actors in a trustless, auditable manner, in combination with smart-contracts, brings with it the potential of automating complex multi-step processes (Christidis & Devetsikiotis, 2016). These powerful new possibilities, applied to the control of business processes, can significantly reduce the information asymmetry, through the strengthening of controls, and make loan contracts rapidly expire, mitigating, and in theory reducing, the causes identified for the occurrence of moral hazard phenomena.

This paper is explorative and proposes an answer to urgent problems, having identified from the literature the causes of moral hazard, highlighting a possible solution intervening on these causes, based on a system architecture that has yet to be tested. This type of research is certainly important since opens up pathways of study that have not yet been explored, but at the same time represent the limit of this work.

The possible areas for future research are mainly two. On the one hand, a study should be carried out to measure the impact of improved controls and contractual actions on the reduction

of moral hazard behavior. On the other hand, the technical solution, based on the blockchain, must be implemented and tested. This current, and very broad, field of research, which is part of the much broader real-time accounting, is a science still in the making (Trigo, Belfo, & Estébanez, 2014), which gives ample space for both researchers and practitioners to work.

This article addresses a real problem from a strictly theoretical point of view and the proposed solution to the problem of moral hazard in the case of financial crisis rescue by lending is deliberately general and at a high level. This approach to the problem, although it is functional to identify the problems from an abstract point of view and aimed at addressing a solution, implies some limitations.

The proposed system architecture, which provides a blockchain and the activation of targeted controls based on the activation of smart-contract for the tracking of payments, in this study is not deepened from a technical point of view. Therefore, in the current state of work, it has not been possible to identify any problems with the functioning of the system and, consequently, its effectiveness. The high-level approach used in this study also did not allow assumptions to be made about the cost of implementing and maintaining the system.

An interesting development of this work could be to study the impact of such a control system on the behavior of the actors involved, both through the analysis of specific literature and the structuring of social experiments.

REFERENCES

- Allam, Z (2018). On smart contracts and organisational performance: A review of smart contracts through the blockchain technology. *Review of Economic and Business Studies*, 11(2), 137-156. <https://doi.org/10.1515/rebs-2018-0079>
- Allen, F., Carletti, E., Goldstein, I., & Leonello, A. (2015). Moral hazard and government guarantees in the banking industry. *Journal of Financial Regulation*, 1(1), 30-50. <https://doi.org/10.1093/jfr/fju003>
- Baker, T (1996). On the genealogy of moral hazard. *Texas Law Review*, 75(2), 237-292. Retrieved from https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=1870&context=faculty_scholarship
- Böhme, R., Christin, N., Edelman, B., & Moore, T (2015). Bitcoin: Economics, technology, and governance. *Journal of Economic Perspectives*, 29(2), 213-238. <https://doi.org/10.1257/jep.29.2.213>
- Christidis, K., & Devetsikiotis, M. (2016). Blockchains and smart contracts for the Internet of things. *IEEE Access*, 4, 2292-2303. <https://doi.org/10.1109/ACCESS.2016.2566339>
- Coyne, J. G., & McMickle, P. L. (2017). Can blockchains serve an accounting purpose? *Journal of Emerging Technologies in Accounting*, 14(2), 101-111. <https://doi.org/10.2308/jeta-51910>
- Desai, P. (2003). *Financial crisis, contagion, and containment: From Asia to Argentina*. <https://doi.org/10.1515/9781400865376>
- Dow, J. (2000). What is systemic risk? Moral hazard, initial shocks, and propagation. *Monetary and Economic Studies*, 18(2), 1-24. Retrieved from <https://www.imes.boj.or.jp/research/papers/english/me18-2-1.pdf>
- Ferrero, G. (1968). *Istituzioni di economia d'azienda*. Milano, Italia: Giuffrè.
- Fratzscher, M. (2012). Capital flows, push versus pull factors and the global financial crisis. *Journal of International Economics*, 88(2), 341-356. <https://doi.org/10.1016/j.jinteco.2012.05.003>
- Gomez-Conde, J., Malagueño, R., Lopez-Valeiras, E., Fabricia, R., & Lunkes, R. (2020). *The effect of management control systems in managing the unknown: Does the market appreciate the breadth of vision?* <https://doi.org/10.2139/ssrn.3675688>
- Grubel, H. G. (1971). Risk, uncertainty and moral hazard. *The Journal of Risk and Insurance*, 38(1), 99-106. <https://doi.org/10.2307/251093>
- Guadalupe, M., & Pérez-González, F. (2006). *The impact of product market competition on private benefits of control* (Discussion Paper No. 159). Retrieved from <http://hi-stat.ier.hit-u.ac.jp/research/discussion/2005/pdf/D05-159.pdf>
- Haldane, A., & Kruger, M. (2001). *The resolution of international financial crises: Private Finance and public funds* (Bank of Canada Working Paper No. 2001-20). Retrieved from <https://www.bankofcanada.ca/wp-content/uploads/2010/02/wp01-20.pdf>
- Hölmstrom, B. (1979). Moral Hazard and Observability. *The Bell Journal of Economics*, 10(1), 74-91. <https://doi.org/10.2307/3003320>
- International Accounting Standards Board. (2018). *Definition of material: Amendments to IAS 1 and IAS 8*. Retrieved from https://library.cronerico.uk/cch_uk/iast/ias8-amending-201810
- Kapan, T., & Minoiu, C. (2018). Balance sheet strength and bank lending: Evidence from the global financial crisis. *Journal of Banking & Finance*, 92, 35-50. <https://doi.org/10.1016/j.jbankfin.2018.04.011>
- Krahel, J. P., & Titera, W. R. (2015). Consequences of big data and formalization on accounting and auditing standards. *Accounting Horizons*, 29(2), 409-422. <https://doi.org/10.2308/acch-51065>
- Lynn, T., Mooney, J. G., Rosati, P., & Cummins, M. (2019). *Disrupting finance: FinTech and strategy in the 21st century*. <https://doi.org/10.1007/978-3-030-02330-0>
- Migliavacca, A. (2020). *La gestione dell'aspetto socio-ambientale delle aziende. Un approccio di amministrazione razionale alla luce della crisi ambientale e sanitaria del XXI secolo*. Torino, Italia: Giappichelli.
- Miller, P., & Power, M. (2013). Accounting, organizing, and economizing: Connecting accounting research and organization theory. *Academy of Management Annals*, 7(1), 557-605. <https://doi.org/10.5465/19416520.2013.783668>
- Millon, M. H., & Thakor, A. V. (1985). Moral hazard and information sharing: A model of financial information gathering agencies. *The Journal of Finance*, 40(5), 1403-1422. <https://doi.org/10.1111/j.1540-6261.1985.tb02391.x>
- Mirrlees, J. A. (1999). The theory of moral hazard and unobservable behaviour: Part I. *The Review of Economic Studies*, 66(1), 3-21. <https://doi.org/10.1111/1467-937X.00075>
- Mirza, N., Rahat, B., Naqvi, B., & Rizvi, S. K. A. (2020). Impact of Covid-19 on corporate solvency and possible policy responses in the EU. *The Quarterly Review of Economics and Finance*. <https://doi.org/10.1016/j.qref.2020.09.002>

25. Oliver, C. (1991). Strategic responses to institutional processes. *The Academy of Management Review*, 16(1), 145-179. <https://doi.org/10.2307/258610>
26. Ozili, P. K. (2020). *Accounting and financial reporting during a pandemic*. <https://doi.org/10.2139/ssrn.3613459>
27. Pache, A.-C., & Santos, F. (2010). When worlds collide: the internal dynamics of organizational responses to conflicting institutional demands. *The Academy of Management Review*, 35(3), 455-476. <https://doi.org/10.5465/amr.35.3.zok455>
28. Pauly, M. V. (1968). The economics of moral hazard: Comment. *The American Economic Review*, 58(3), 531-537. Retrieved from <https://www.jstor.org/stable/1813785>
29. Puddu, L. (2010). *Il processo di accumulazione del capitale, l'analisi funzionale del management, l'amministrazione razionale e la classificazione delle aziende: Razionalità della rilevanza e valori etici*. Milano, Italia: EGEA.
30. Schoen, E. J. (2017). The 2007-2009 financial crisis: An erosion of ethics: A case study. *Journal of Business Ethics*, 146(4), 805-830. <https://doi.org/10.1007/s10551-016-3052-7>
31. Secinaro, S. (2020). *Blockchain e accounting*. Giappichelli.
32. Sufi, A. (2007). Information asymmetry and financing arrangements: Evidence from syndicated loans. *The Journal of Finance*, 62(2), 629-668. <https://doi.org/10.1111/j.1540-6261.2007.01219.x>
33. Torri, A. (1987). Il processo di statuizione dei principi contabili in Gran Bretagna e negli Stati Uniti. *Rirea*, 11-12, 556-579.
34. Trigo, A., Belfo, F., & Estébanez, R. P. (2014). Accounting information systems: The challenge of the real-time reporting. *Procedia Technology*, 16, 118-127. <https://doi.org/10.1016/j.protcy.2014.10.075>
35. Vasarhelyi, M. A., Kogan, A., & Tuttle, B. M. (2015). Big data in accounting: An Overview. *Accounting Horizons*, 29(2), 381-396. <https://doi.org/10.2308/acch-51071>
36. Zappa, G. (1950). *Il reddito di impresa: Scritture doppie, conti e bilanci di aziende commerciali*. Milano, Italia: Giuffrè.
37. Zappa, G. (1957). *Le produzioni nell'economia delle imprese*. Milano, Italia: Giuffrè.