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Master's Thesis

Prosperity in BRICS economies through blockchain technology as online institution

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Abstract

Corruption creates relevant institutional voids in BRICS economies (Brazil, Russia, India, China and South Africa) and their economic growth. In this study, a theoretical and operative analysis is undertaken to solve this problem. Throughout deep study, the analysis explores possible solutions for the main voids that jointly affect these five emerging economies. In particular, it is shown how the disruptive blockchain technology can be considered within the theoretical framework of the New Institutional Economics as online institution. This opens many opportunities for the BRICS, the five largest emerging economies. Indeed, it is revealed how common principal institutional voids can be actually filled by this decentralized technology due to its intrinsic properties. These voids are precisely individualized by the parallel application of the five contexts framework on all the BRICS countries. The results confirm that blockchain technology can offer a stable structure that decreases systemic corruption, stimulating prosperity and economic growth within these economies.

Keywords: blockchain technology; institutions; economic growth; BRICS economies.

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1 Introduction

Our societies are based on human relationships driven by shared *trust* (Govier, 1998). In this work, it will be studied how this could be strengthened in Brazil, Russia, India, China and South Africa (i.e., BRICS economies), where important *institutional voids* are present due to underperforming institutions. In particular, the analysis will expose how these voids can be filled thanks to the application of the *blockchain*, in the role of efficient *online institution*. Due to its intrinsic properties such as immutability, tracking and transparency, this decentralized technology can give BRICS countries opportunities for stability and economic growth.

To give a solid base to start, it is fundamental to understand how trust became always more fragile during the centuries. This is a consequence of an enlarging environment based on innovative technological evolutions (e.g., globalization). Indeed, as reported by a Harvard University socio-economic study (La Porta et al., 1996), trust between people weakens as the surrounding environment expands. So, this portrays the perfect case for our contemporary societies: individuals are always more interconnected but eventually with low levels of faith towards others (Bekkers and Thaens, 2005). For instance, today people can indeed communicate with everyone that has an internet connection. According to Johnson (2022), 4.66 billion people were active internet users in January 2021 with trends of growth, so we potentially could have 4.66 billion new connections (e.g., friends, business/cultural/research relationships, etc.) but this does not mean we trust all of them. In this way, development (e.g., globalization) includes a trade-off: it offers many advantages – such as worldwide communication – but it implicitly provokes the thinning of trust among populations. Thus, the following work concerns enforcing this trust between economic actors (i.e., reduce uncertainty) in such a globalized environment, focusing on precise countries: BRICS economies.

The solution proposed in this document is the innovative technology of the blockchain. This is born as a decentralized distributed ledger to register transactions of information between members within a network, that aims to lower uncertainty about data (Nakamoto, 2008). This technology can increase *trust*, specifically meant as the positive individual expectations about other people's actions and intentions (Möllering, 2001). The point of view of this analysis will have a business focus, even though trust can be studied from other different interesting perspectives, such as sociological and cultural angles. Furthermore, the concept of *institutions* is fundamental in this study, and following the Nobel prize Douglass North (1990) they are meant as "*rules of the game*". These main concepts of blockchain, institutions and institutional voids will be put together to develop chapter 3, the first theoretical part of the work. This is

followed by chapter 4, which encloses the practical analysis of this work. In this section, all the main concepts will be in relation with opportunities of *economic growth* in BRICS systems. More precisely, it will be analysed how the blockchain as technological institution can reduce their institutional distance and stimulate economic growth.

To enrich the preliminary background of this work, a brief evolution of commerce is presented now. From an historical lens, trust and reliability led cultures through their evolutions during the centuries. As these two grew between people, commercial relationships became always more globalized (Szabo, 2002). The actual increase in trades' geographical coverage was the result of two elements: the profits connected with large-scale commerce and – subsequently – a stronger payment system based on currencies. In this way, societies developed their internal and external economic relations, turning from *barter economies* to more complex *currency systems*. This thriving socio-economic progress is remarkable. Indeed, the former economic type relies principally on fixed-value barterable objects, and it is based on what in literature is defined as “*double coincidence of wants*”, which implies that exchanges are settled just when parties have mutually beneficial gains through the trade of specific items (Szabo, 2002). The latter gave individuals the opportunity to start exchanging goods and services even without a double coincidence of wants (Jevons, 1875). In fact, with these new mechanisms, people relied on a more flexible way of exchange, based on standard tenders instead on specific objects, starting to give power to *money*. Such economic revolution revealed the humankind obsession with this medium of exchange that it has entered in our everyday life. As stated by Simmel (1900), who interpreted the impact of money on our societies, it is interesting the importance given to the money because it leans on the quantification of qualitative aspects of our lives¹. Societies immediately understood the power of *debt*, perceived as creator of value for our societies (Kiyosaki and Lechter, 1997; Xiao and Yao, 2022). The underlying theoretical logic of this mechanism is that financial availability derived from loans let debtors access new life's standards that they would not have been able to enjoy (Modigliani, 1986)². On this wave, the first banks were born with the aim to account finances and then creating the foundations of financial markets, where people in surplus could offer credits to meet the needs of those in deficit (Hoggson, 1926). Thus, given their administrative and societal functions (i.e., accounting and enhancing personal opportunities), banks received always more power, and they started to be considered as solid financial authorities (i.e., institutions) (Monvoisin and

¹ For details, refers to “*The philosophy of money*”, by Georg Simmel, 1900.

² As stated in literature, overborrowing is a dangerous choice because when people do not have control of their finance, they may face drastical financial pressures (Xiao and Yao, 2022).

Sandrine, 2012). Through the years, institutional frameworks became more efficient, and they could face two transaction cost problems related to large-scale commerce: agency problems and negotiations with countries with different (formal and informal) institutions (North, 1991). But, the process of development can be slow due to many unexpected events, so for instance it happens that countries can experience periods of stagflations³. Indeed, nowadays, not all institutional authorities offer proper operative functionalities to people, and this leads to underperforming systems characterized by institutional voids (Khanna and Palepu, 1997). BRICS countries are a perfect example of this phenomenon since today they still all present inefficiencies in their internal institutions.

Maintaining an economic perspective, different scholars have studied institutions and have included them in their theories. In particular, one of the first academics to study institutions as solution to reduce uncertainty in an economic environment is Douglass North. Given the degree of relevance of his works, this thesis is based on his economic point of view. This is included in the larger school of thought of the New Institutional Economics (i.e., NIE). To be more accurate, the initial analysis of this study has the purpose to guide the reader through a new knowledge regarding institutions today. Indeed, the first goal is to develop North's economic theory in the New Institutional Economics, in relation with the blockchain technology. After this section, it will be clear how the blockchain can be included as third pillar – besides *formal* and *informal* institutions – in the NIE theory. This choice is motivated by the crucial relevance that this distributed technology is claiming today and – probably – will continue to have in the future, creating a disruption on our everyday life. Thus, it is useful to delineate a more complete theoretical framework around it, considering it as a technological institution. So, after a structural explanation of chapter 3, the reader will be able to answer the following theoretical research question:

RQ1: What institutional conditions of the New Institutional Economics theory are found in the blockchain technology?

After this first conceptual analysis that will be useful as logical background throughout the project, a practical application is presented in chapter 4. This section of the research will consider possible solutions in countries where still today institutions are not that efficient and

³ This is a situation when the levels of inflations are high, and countries experience high unemployment rates and slow progress in economic growth. Events such as COVID-19 and Ukrainian-Russian war can be taken as example for causes of such events (World bank, 2022).

effective: BRICS countries, the five principal *emerging economies* in the world. This sample of analysis is chosen on the back of two precise criteria. The first considers the *Corruption Perceptions Index* (i.e., CPI), because all the five countries are “*perceived as more corrupted*” (i.e., $CPI < 50$)⁴, so with medium-high levels of corruption that represent important institutional voids (i.e., absence/low operating of local institutions). The second reason of this practical choice is motivated by their financial availabilities and visions towards innovation, concretized with their common Action plan 2021-2024 (BRICS, 2021). Thus, the representative group embodies a perfect sample of analysis given the institutional inefficiencies caused by the internal corruption and the shared propensity to be more innovative. So, it is stimulating to analyze possible scenarios of *economic growth* in BRICS economies arisen from filled local institutional voids thanks to the blockchain technology as institution. In the end, the practical section in chapter 4 helps the reader to answer the second research question:

RQ2: How can the blockchain technology as an online institution stimulate economic growth in BRICS’ economies?

The reason behind this complex bilateral research is the opportunity to explain and analyse a healthy development (social, economic, cultural) for countries where today the institutional systems do not operate fairly and equally. It is fundamental to always keep in mind how such technological revolution would not be immediately fully applicable. Indeed, time for adaptation of the technology in the countries is needed and, overall, at first glance people will likely face difficulties starting to use such technology. Anyway, after the theory development, the purpose of such study is to stimulate self-thought and future research on these new mechanisms, that one day could be hopefully feasible in our realities.

The paper is structured in the following way. In chapter 2, the main concepts regarding the literature background are introduced and exposed. In particular, they are organised in connection with the main themes of blockchain, institutions, BRICS and corruption levels. Chapters 3 and 4 represent the main methodology section of this thesis. Chapter 3 adapts the New Institutional Economics to nowadays world, building a theoretical development that includes the blockchain as online institution, besides the traditional formal and informal institutions. In chapter 4, the analysis will focus on some possible cases of application of the

⁴ Lower the indicator, higher the corruption level within the country (Transparency International, 2010). Read section 2.3 to better understand the measurement used in this aggregate index.

blockchain in the BRICS representative group. In particular, it will be reported how the blockchain as online institution can fill relevant institutional inefficiencies in these countries and stimulate prosperity. In the end, chapter 5 reports the results connected with the theoretical and operative sections developed in the body. The choice of such peculiar qualitative research is justified by the early stage on the general adoption of this technology, which is not commonly applied yet. Then, a study based on surveys would be too generic for this kind of analysis⁵. Moreover, a quantitative research based on regression analysis would not be properly used since datasets are not appropriately implemented yet.

⁵ Since the aim is to analyse the benefits of this technology in BRICS economies, a survey would be insufficient to claim a significant number of answers. Indeed, the results from this research can be reachable just from this kind of methodology or a regression analysis. A survey would be relevant just after people started to operate blockchain in their everyday lives.

2 Literature review

2.1 Blockchain technology

The blockchain has its roots in the technological field, but it clearly can have even an economic purpose (European Parliament, 2020). Following this vision, it was firstly introduced in 2008, during the start of the global financial crisis, as a system to ensure transactions of Bitcoin, the first decentralized digital currency, with no need of trusting the counterparty (Nakamoto, 2008). This kind of technology is conceived as a shared ledger to guarantee and register cryptographically protected transactions of information – and subsequently assets and multiple digital currencies – in a decentralized way. Thus, the blockchain ensures a peer-to-peer network (P2P), that leads to the opportunity to every node to keep a private copy of the complete ledger (i.e., *distributed ledger*) without the need to rely on actual central institutions. Cryptography is crucial for the principal properties of such technology, such as immutability, transparency and security. It is important to state how there are multiple active blockchains, but the most popular Bitcoin and Ethereum. These decentralized mechanisms lead to a world without any central authorities (e.g., notaries, banks), conceived as institutions to verify and track records of valuable information. Today, they can be overcome by blockchain technology, and this is the main reason why this technology is becoming so popular all around the world (Kommadi, 2002). In fact, since this system is based on technical computational power, it solves the problem of uniformity of information with absence of central authorities (Nakamoto, 2008). Better explained, the Bitcoin white paper (2008) introduces how it is actually possible that nodes can completely trust the ledger with the highest work put into it, because it is verified. This process of enabling the verification of the highest worked ledger is defined as Proof of Work (PoW). This is a complex process that requires high computational energy for the nodes to find a precise code to verify blocks in the blockchain⁶. So, the principle behind the system is that more the effort (i.e., computational power) put into a blockchain system, more reliable the verifiability of the information is. Nodes that offer their energy to verify and create blocks for the PoW are called *miners*, and they are rewarded with *block rewards*. Such gains are issued because of their expenses for validation of data. In the case of the Bitcoin

⁶ Cryptography provides high levels of security. The cryptographic function SHA256 guarantees how the hash of every block in the chain will start with a series of zeros, given all the transactions and information within the block. To find the exact number that through the SHA256 function guarantees the block's hash with a precise amount of zero, is called Proof of Work (PoW).

blockchain, every miner that solves the cryptographical problem through his own computational resources to create a block is rewarded with a – decreasing – portion of new Bitcoin every time. In this way, miners are the channel to introduce always new cryptocurrency in the economy (Velde, 2013). Moreover, immutability of information is guaranteed thanks to timestamped blocks connected in a chronological way with the hash of previous blocks of information. To sum up, the whole mechanism described until now is highly secure given the amount of computational power put into it. Indeed, in the case that someone would want to include a block with false fraudulent information (e.g., receiving cryptocurrencies from another peer), the thief must have a computational power higher than the 50% (i.e., *51% attack*) of all the other peers in the network (Shi, 2016; Frankenfield, 2022). This is practically impossible due to the enlarging amount of users, and it has never happened until today. For this principle, the blockchain can follow the Metcalfe’s law, for which more the users, higher the value of the network (Alabi, 2017).

From a more technical view, cryptography is fundamental to overcome the problem of fraudulent and fake information within a public ledger. Every member of a blockchain (i.e., node), has two lines of code, which are a *secret private key* and a *known public key*⁷. Thanks to these codes every transaction can be verified by each node involved in it. For instance, considering two people – *A* and *B* – who need to exchange money on the blockchain: *A* will write that *A* will receive an amount from *B*. To be executed, this exchange must be confirmed by *B* with both the private and public keys. Moreover, as a ledger, the blockchain will prevent users to possible overspendings, so it actually guarantees that every node in the network cannot write transactions after a certain limit. In this way, problems concerning possible indebtedness are minimized⁸. In the end, for this work’s sake, it is relevant to remember that this decentralized technology can guarantee many advantages such as improved security levels, transparency, privacy, lower costs, traceability, immutability and speed.

⁷ The process implies a virtual signature, which is written as a binary code (0,1) that varies for every transaction. Indeed, it can be considered as a function of what the transaction is (i.e., message) and the private key. To verify that the (256 bit) digital signature for the transaction is valid, it must be used the public key.

$$\text{Signature} = f(\text{message}, \text{private key}) \quad \text{Verification} = f(\text{message}, \text{signature}, \text{public key})$$

This procedure guarantees that other people cannot just copy and paste a digital signature to approve false transactions, because it will depend even on the precise message regarding the transaction.

Even if people know the message and the public key of a user, this complex process gives security to every transaction. Indeed, it is quite impossible to find a signature without the private key: the possibility to find the private key is 1 out of 2^{256} .

⁸ Theoretically, if everyone in the world would use the blockchain as a distributed ledger, there would be the possibility to never use again fiat money.

2.2 New Institutional Economics

The whole theoretical development in this research will be based on the vision of the New Institutional Economics (i.e., NIE), an economic perspective dating back to 1975 (Williamson, 1975)⁹. Such contribution concerns particularly how the blockchain technology can implement the institutional model of this school of thought. The choice of this specific economic perspective is due to its broad and realistic vision of the systems, due to the incorporation of institutions within economic theory (North, 1986; 1990). Indeed, in comparison with the (traditional) Old Institutional Economics (i.e., OIE), NIE scholars embraced social, political and commercial shades into their vision, always maintaining an economic perspective (Klein, 1998). Furthermore, they abandoned the traditional method based on holism, that was particularly characterizing the Old Institutional Economics. Thus, the difference from the traditional view mainly relies on the *deductive* modus operandi of the NIE, that eschews that *inductive* predomination of the old institutionalism (Klein, 1998). Then, other dissimilarities clearly denote the distance in these two approaches. Precisely, while the OIE was focusing just on the study regarding the effects of formal arrangements of governments on societies (i.e., formal institutions), the New Institutionalism enriched this perspective including behavioural sciences (i.e., informal institutions) (Abrutyn and Turner, 2011). So, the underlying development in the institutional theory brought the view from the main concept of *individual collective actions* – belonging to the OIE – to *independent individual actions* – related to the NIE¹⁰. This switch explains how the new institutionalism considers economic actors in a system as independent, rational and with cognitive limits (i.e., bounded rationality) (Klein, 1998). In addition, another progressive difference derives from the fact that the first institutionalism's perspective was only focused on processes of description of normative arrangements, that implied no theory advancements. On the other hand, the new vision brought a different concept of analysis that implied explanations of phenomena and theory building (with its base that relies on neoclassical theory) (Rutherford, 1995). For this reason, one of the most renowned NIE scholars Ronald Coase (1984, p. 230), stated how “*without a theory they [American institutionalists] had nothing to pass on except a mass of*

⁹ Following to Hall and Taylor (1996), within the New Institutionalism, besides the New Institutional Economics, there are three other different approaches. These are defined as historical institutionalism, rational choice institutionalism and sociological institutionalism. On average, it could be seen how the scholarly focus of the New Institutionalism is closer to behavioural and sociological sciences, considering the individuals as independent and rational bounded.

¹⁰ In “*Institutions, institutional change and economic performance*”, North argues how institutions evolve and they are changed by societies, so it is important to give attention to the *individual*.

*descriptive material waiting for a theory, or a fire*¹¹. Besides Ronald Coase, other famous scholars that contributed to the NIE vision are the Nobel laureates Douglass North, Elinor Ostrom and Oliver Williamson. In this research, the works (books, papers, articles) of the economist North are particularly analysed since his studies are a landmark regarding institutional analysis. In one of his first books (Davis and North, 1971), North introduces the concept of *institutional environment*, conceived as the behavioural guidelines to follow, a framework to act with confidence, even called the *rules of the game* in a society. More formally, institutions are defined by North as “[...] *the humanly devised constraints that shape human interactions*“ (1990), with the aim to lower uncertainties. Indeed, according to his vision, institutions are necessary to lower costs and facilitate human – social, political, economic – exchanges, making these more immediate. In other words, institutions reduce the so-called *transaction costs*, that directly represent the “*price to use the price mechanism*” (Coase, 1937) – the cost to exchange goods and services. But this was a price definition developed in the first half of the twentieth century. With the New Institutional Economics (second half XX century), the concept of *cost* was enriched in comparison with OIE, which did not analyse it (North, 1986). Indeed, Williamson (1973) considered in the definition not just the mere cost of transacting but introduced even knowledge from behavioural sciences such as costs connected to human conducts and emotions. Years later, North (1990) further developed the concept and stated how transacting costs are the result of four different elements: *measurement, enforcement, ideological attitudes and perceptions*, and *size of market*¹². It is clear how economists introduced always more attitudinal and psychological elements in their assessments, due to their – *human* – perspective of actors (e.g., bounded rationality). So, given the assumptions of limited rationality, transaction costs and the above-mentioned literature, institutions are fundamental in societies. In fact, they can efficiently reduce transaction costs shaping economic behaviours, increasing trust and so, lowering uncertainties in environments (North, 1986).

Following the literature (Davis and North, 1971; North, 1990), institutions are divided into two precise categories: formal and informal constraints. The former contains official written rules and regulations that are implemented and changed by authorities (e.g., political, economic, governmental rules). The latter comprehends principally the culture, ideologies and values of a society that are unwritten codes, created and followed by individuals (e.g., codes of

¹¹ As North (1986, p. 235) reports: “[...] *the old institutional economics [...] died for lack of a theoretical focus*”.

¹² Refers to North (1990), “*Institutions, institutional change and economic performance*” for more details.

conduct, customs, social conventions)¹³ (North, 1990; Bentkowska, 2021). In those cases when institutional infrastructures do not properly operate or are absent, there is the presence of so-called *institutional voids* (Khanna and Palepu, 1997; 2010). It is studied and reported how these voids are particularly remarkable in emerging economies, mainly due to their information problems (i.e., high information costs), distorted regulations and disorganized judicial systems (Khanna and Palepu, 1997, p. 42; 2010; Doh et al., 2003). This clearly explains why the focus of this research is on emerging economies, such as BRICS countries. At the same time, the choice of these precise realities relies even on their levels of internal corruption. The underlying assumption concerning the second practical section of chapter 4, regards the strong connection between the level of institutional void and local (governmental and social) corruption. As stated by Doh et al. (2017), corruption is a consequence of these institutional voids since they lead to higher levels of individual opportunistic behaviours. At the same time, this creates a vicious circle since corruption weakens even more institutions, in particular the formal institutions such as regulations and rules (Doh et al., 2003)¹⁴.

2.3 Prosperity in BRICS' economies

During the practical part in chapter 4, the theory developed in chapter 3 will be applied in our real world. In particular, it will be studied how feasible the application of the blockchain is in nowadays countries. More in detail, the focus of the study for a possible implementation of the blockchain for filling institutional voids is applied to the so-defined BRICS countries: Brazil, Russia, India, China, and South Africa¹⁵. “*BRICS*” is an acronym that groups these five largest and fastest emerging economies in the global economy, given their performances (Armijo, 2007). They jointly cover a vast geographical area that represents more than 25% of the world's land area (i.e., 39,746,220 km²), and their populations together encompass more than 40% of the global population (i.e., 3.21 billion) (Lowe, 2016; United Nations, 2019). From this data, it is evident how this representative group have a significant impact on global relations and economies. The BRICS countries have some common features but mostly

¹³ Formal institutions can increase and improve effectiveness of informal institutions. Informal constraints are slow to change and derive partially from the culture heritage (North, 1990). This means that they are so “*important in themselves*”, and this is the reason why the same formal regulations applied in different societies do not have the same results.

¹⁴ It is studied how corruption is a disadvantageous factor for many reasons (Doh et al., 2003). It implies indirect costs given government instability, such as reduced investments, distorted public expenditures, instability and more (p. 117).

¹⁵ The acronym was coined by Jim O’Neill in 2001, in his report “*Building Better Global Economic BRICs*”, where he referred just to Brazil, Russia, India and China, since South Africa was not that powerful yet.

differences and nuances. These emerging nations share the fact that they significantly influence the global economy, taking into account the implications derived from their economic (and political) performances. Moreover, they are all developing countries with a relevant potential of growth in the future (Malik, 2013). On the other hand, it must be said that they significantly differ in many aspects, such as internal political and economic structures (Radulescu et al., 2014; Armijo, 2007)¹⁶. Thus, they are not conceived in the same group because of their societies or their cultural and economic structures, but only because of their parallel development as emerging market economies during the previous decades (O'Neill, 2001).

Regarding this thesis, the reason behind the choice of these specific countries relies principally on two common criteria: the *potential innovation's advancement* and the actual *level of corruption* (Lowe, 2016; Radulescu et al., 2014). The former criterion is based on the fact that BRICS countries are a representative group based on their great economic performances. The future potential growth, given their previous expansion (Streltsov et al., 2021), creates a perfect opportunity of study for the application of new avant-garde technologies such as the blockchain. Indeed, the idea in chapter 4 is that BRICS economies can efficiently apply blockchain technology in their internal processes thanks to their own growing financial powers and opportunities of development. Moreover, according to their Action plan 2021-2024 firmed in India, BRICS nations encourage *innovation* from a Scientific, Technological, and Innovational view (i.e., STI) to build their future and to thrive a sustainable economic growth (BRICS, 2021). Based on this recent common plan, this proposal would suite perfectly their near-future aims connected to technological progress. Besides this potential innovation, the second criterium chosen to select BRICS economies as samples is related to their internal perceived level of corruption. Given this reason, the Corruption Perceived Index (i.e., CPI) is crucial in this study since it helps to have a clear classification of countries considering the corruption level for each country (Transparency International, 2021). As stated in section 2.2, there would be the assumption that corruption within these countries creates a vicious internal circle with institutional voids. The goal is to improve a system so they can face and solve it with decentralization systems.

¹⁶ From a political point of view, the structures of these countries differ substantially. Indeed, according to Armijo, 2007, India and South Africa are parliamentary democratic republics and Brazil is a presidential democracy. On the other hand, Russia is a semi-federal democracy that is going towards authoritarianism (mostly in this recent period). China is a communist authoritarian republic, likely the most oppressing one. Economically speaking, they differ from each other considering their production structures, exchange rates regimes etc. The most influential country among BRICS is China (Radulescu et al., 2014). They differ substantially even from a cultural and sociological point of view.

The CPI is an aggregate indicator based on a worldwide assessment on 180 countries, which are all ranked between 0 (i.e., *highly corrupt*) and 100 (i.e., *very clean*) (Transparency International, 2010). The rate for each country is formulated considering results from surveys, feedbacks of businesspeople and experts¹⁷. The combination of sources studied to develop such an index makes the CPI a quite reliable source and this is why it is used as yardstick to select the countries for this research. Considering the index, BRICS countries all have an evaluation lower than 50, that means that they are all “*perceived as more corrupt*” (Transparency International, 2022). In a decrescent order, China is ranked as the least corrupted of the group with a CPI equal to 45, then there is South Africa (44), India (40), Brazil (38) and, in the end, the most corrupted is Russia with 29. So, the actual levels of fraud of these countries – embedded with their propensity for technological innovation – creates a perfect condition for the implementation of the blockchain technology as online institution. Indeed, in such cases, opportunism can easily overwhelm rules, institutions do not properly work, and the consequence is the presence of institutional voids and markets inefficiencies (Doh et al., 2017). The aim of this research is to demonstrate the institutionalism of this technology, that can fill – as much as possible – these actual institutional voids in BRICS economies. Such countries empowered with blockchain can potentially increase their wealth and progress levels. Thus, if technological innovation within these nations can lower the corruption, there would be direct positive effects in markets and institutional systems (Doh et al., 2003). These benefits would be directly reflected on the populations and the countries in general, due to lower transaction costs and uncertainty. For this reason, it will be exposed in chapter 4 how filling these voids, the blockchain could stimulate *economic growth* and wellness.

¹⁷ To read the methodology behind the CPI refers to Transparency International (2021). “Corruption Perception Index”. *Transparency International*, p. 15.

3 Blockchain as Online institution

The adoption of the New Institutional Economics' thought is central for the theoretical development proposed in this document. Indeed, the conceptual framework around the used notion of *institution* relies on the vision of this school of thought. The main work where this thesis has based the most is “*Institutions, institutional change and economic performance*” by Douglass North (1990)¹⁸. The reason of this choice regards the relevance of this book. So, thanks to its contents, this document will be the main guide for the primary goal of this chapter: referring to the NIE theory including the theoretical development of the blockchain technology¹⁹. More in detail, the structure of this chapter is divided between an *operative* and *notional* part, since both blockchain and institutions will be analysed from these two points of view. The former analysis reveals how both traditional institutions and the blockchain lowers uncertainty and transaction costs. The latter part of the chapter gives a notional parallelism between the institutional framework and the decentralized technology. The solution of this theoretical analysis is used as background for the next chapter since new aspects are disclosed regarding this interesting and novel connection.

At the end of his work (1990, p. 125), North describes how some *innovations* (i.e., new techniques, methods and tools) have been essential for the renowned creation and expansion of the long-trade commerce in early modern Europe. These innovations concern methods to better manage usury law, introduction of bills of exchange, printed priced, written features of products and then, quantification of uncertainty into risk (i.e., likelihood of an event). Such modernization implied a remarkable reduction of transaction costs and favoured the trades, due to an increase of capital mobility, a lower information costs and the spread of the risk. In such way, these solutions mitigated the principal transaction cost problems posed in this historical period (XV – XVIII century), that were agency problems and contract fulfilments and enforcements²⁰. On the back of this innovative progress of the past, North (1990) argues how “*modern technology may exacerbate many of the problems of human conflict*”. Actually, as it

¹⁸ This is one of the last books that North wrote, and it represents a landmark among its works. The document is the main source for the theoretical development in this thesis due to the fact that it contains an analytical framework that studies all the main elements of this research together: *institutions* (and *institutional change*), *innovation* and *economic growth*.

¹⁹ It is in the 25 most cited book in social sciences (Seligson and McCants, 2018).

²⁰ North underlines a divergence, since not all the economies in Europe developed in the same way: some of them failed. He describes how Spain stagnated for a long time and based its exchanges on opportunism, which is a system that does not encourage political stability neither modern technology. On the other hand, he described the Netherlands and England as leader countries for institutional change, due to their impersonal exchange systems (p. 117, 130).

will be reported in chapter 4, this is confirmed and exposed since today decentralization can solve many issues in actual malfunctioning systems. Now on, the analysis aims to create a strong connection between blockchain technology and institutions from a practical and notional perspectives.

From the *operative* perspective, blockchain technology implies the same advantages guaranteed by formal and informal institutions. In particular, the beneficial effects that such authorities grant concern the systemic *reduction of uncertainty* and *lower transaction costs*.

Informal and formal institutions guarantee decrease of uncertainty (i.e., risk) given their property of defining the “*set of choices of individuals*” (North, 1990, p. 4). Indeed, these are fundamental to create a – legal and social – framework within which people can act actively and can have expectations regarding others’ behaviours during exchanges. Thus, reductions in information asymmetry between actors in a system bring to lower uncertainty (Moura et al., 2021). Even though informal constraints are unwritten, unconsciously designed and non-specified, they are essential and inevitable for societies since they deline moral, ethical and social attitudes. Conventions, values, routines, customs, traditions are all considered as informal institutions. Furthermore, they are significant because they have a solid connection with the culture of a society and its values. On the other hand, formal institutions are meant as written rules enforced by official authorities such as law, constitutions, rights and regulations²¹. These institutions confer legitimacy to actors in a system due to the fact that they create a legislative framework of action (Peng et al., 2009). This set of choices that delines individuals’ behaviour creates stability in economies, with a consequential decrease of uncertainty. So, less risk in societies is assured by the presence of traditional institutions. In the same way, the reduction of uncertainty concerning human interactions can be achieved even with results connected to blockchain implementations²². As reported in chapter 2, decentralization permits users to access a distributed shared information cryptographically registered on an immutable ledger (Yang et al., 2020). Many advantages coming from the adoption of such cutting-edge ledger help to reduce uncertainty (i.e., risk) in exchanges. The first feature of blockchain that strengthens stability in systems is its property of being distributed. Indeed, such feature implies remarkable levels of *transparency*. This means that every user in the network can access to the same information as the others, since the absence of hierarchical settings (i.e., peer-to-peer or

²¹ For a detailed framework regarding formal institutions refer to Ostrom (1986).

²² Throughout this thesis, the term “*blockchain*” will refer just to “open *public blockchains*”. This is a public ledger where all the users can access to information regarding transactions. Contrarily, a private blockchain does not give access to information to those users not included in the network. Thus, the principle of decentralization is not followed, since just precise members could enter the network (Yang et al., 2020).

P2P network). In general, transparency is the best regulator for the market. Indeed, let's consider an example of financial and managerial transparency for companies. This trait would help stakeholders and shareholders to always have a clear overall vision regarding the business. In this case, transparency would reward those economic actors with the most honest and unequivocal management, creating a competition for the best levels of information's clarity. In such a market, uncertainty would easily decline, creating a more powerful, healthy and crystalline economic environment. The results clearly remark excellent outcomes and satisfaction, due to high reliability levels. Going further with the analysis, another important feature of blockchain regards professional levels of *traceability*. This trait enables peers of the network to granularly check precise information regarding transactions, processes and systems (Pant et al., 2015). In the same way as decentralization, even such a feature is fundamental to guarantee transparency within a shared structure, with a consequential decrease of uncertainty and risk²³ (Sunny et al., 2020). Traceability through blockchain technology (and IoT technology) is already implemented today in many supply chains of different industries (e.g., pharmaceutical, food, clothing industries) in order to offer a broader and truthful vision of data to stakeholders. Moreover, another advantage of traceability is even in terms of costs. This is because companies' information does not have to be checked by third parties to be trusted, or at least there are minimum controls. Then, from an end-user point of view, traceability through blockchain can help customers for precise pieces of information about products and services they want to purchase (Hellani et al., 2021). Blockchain technology implies even other advantages beyond transparency and traceability, such as *immutability*. This special feature of the system assures that all the material registered in this decentralized ledger remains permanently unaltered (Landerreche and Stevens, 2018). Such a quality eliminates doubts regarding data, and it can turn audit processes into more efficient and reliable procedures. For instance, a company can avoid spending important amounts of money to certificate that some information were not altered when it needs to present it to stakeholders. This clearly benefits growth and progress from an economic (less costs) and a human (more trust) perspective. So, to sum up, transparency, traceability and immutability are fundamental properties of the blockchain that encourage trust in human – economic and general – interactions. In this way, the risk and uncertainty regarding exchanges are minimized due to qualities automatically granted by such technology. In the same way, formal and informal institutions guarantee identical outcomes (i.e., low uncertainty) considering their features (North, 1990). Although

²³ Transparency is kept in a system through traceability, that relies on tracking and tracing (Sunny et al., 2020).

this first result makes institutions and blockchain technology closer, there is more to be analysed. Indeed, increased levels of trust is not the only aspect that merges the blockchain technology with the NIE institutional framework.

As formal and informal constraints, the blockchain involves an efficient decrease in transaction costs given its intrinsic technological qualities (Kfoury, 2021). Transaction costs are meant as measurable costs (i.e., costs to do exchanges) and even costs that are difficult to measure (i.e., time to gain information) (Wallis and North, 1986). According to North (1990), the costliness of information is the main factor composing the transaction costs, and it is mitigated by the structure of – formal and informal – institutions. Indeed, he supports the idea that in environments where it is costly to transact (i.e., high information cost), institutions matter (Coase, 1937). In detail, in his work (1990), North argues how the cost of transactions in a system depends on the exchanging structure developed by institutions and the technology employed. Thus, this shows how, already in the 90s, scholars have recognized the academic importance of the quality of technological progress besides the institutional framework. At the same time, it is stated how the levels of heterogeneity within every society are fundamental (North, 1990) – as in the BRICS economies. In practice, it is costly to transact for developed countries with structured institutions. The reason is that cooperation in complex societies is challenging (e.g., high levels of opportunism) and not always immediate due to high information asymmetry (so, remarkable transaction costs). Moreover, human attitude recedes from cooperation when a “game” is not repeated and there is an enlarging number of players (i.e., variety of exchanges), which is a scenario that perfectly reflects the actual global environment. Indeed, every day we conduct many different types of transactions (i.e., different “games”), the number of players has soared (i.e., actors in the economy), and the cost of information is expensive. In such world, the blockchain technology could simplify many processes, creating an efficient and effective structure for exchanges, as North describes for formal and informal constraints. Due to its principle of decentralization, the application of this technology can let actors avoid relying on third parties and middlemen for transactions. The advantage given by the cost reduction is clear, and it is related to the fact that individuals do not have to employ third parties to set rules for economic exchanging. Indeed, the current economic systems expect external parties (i.e., lawyers, notaries, banks) to cover the role of “rulers” and “referees”. Such phenomenon relies on the fact that distrustful actors do not completely trust each other, due to the above-mentioned heterogeneity in societies. Thus, third parties usually create stability in exchanges due to their authoritarian role, involving securities for parties that expect that their exchanges will be settled, and clauses respected. Although this

strategy was effective until today, it is expensive and time wasting. Indeed, the blockchain can overcome the limits of such a structure due to its features. With such a progress, mutual untrusting individuals do not need an external ruler since they would just rely on this decentralized system. Indeed, features as transparency, immutability, traceability lead to high levels of trust in such distributed structure, even if there is no physical central authority to coordinate the cashflows. Moreover, immutability and transparency make all audit processes easier, cheaper and faster. The principal reason is that actors do not rely on traditional paper-based processes and do not have to employ time to find information and check its truthfulness²⁴. But it is important to mention how such technological structure implies even more benefits for users. The blockchain technology grants performing performances due to its speed and efficiency since it is an online system. This would convince even more people to abandon services that rely on middlemen (e.g., banks, vendors, third parties' providers), saving time. Furthermore, given the avoidance of middlemen in exchanges, users would reduce transaction costs due to the cut of fees, necessary for external services (e.g., bank's fee to process transactions)²⁵. Actors could even save costs due to the security's enhancement in the system. Indeed, every information can be updated just with the consensus of the network, and once registered it is unalterable. This trait creates a cloud environment where people can easily check for truthful and unchanged information. So far, decentralization guarantees speed, efficiency, security, auditability and traceability and, consequentially, the reduction of transaction costs in exchanges.

Smart contracts, an evolution of the blockchain, are the perfect example that merges these two main implications about reduction of uncertainty and transaction costs, increasing trust in exchanges. According to Zheng et al. (2020), smart contracts are online transaction protocols that ensure the correct executions of contractual terms between the parties in an agreement. These blockchain-based contracts are lines of code that automatically enforce clauses just when precise written conditions are met (i.e., “*if this, then that*” principle). For this reason, they guarantee solid trust between actors without relying on external third parties. For instance, a buyer and a supplier that do not know each other can arrange a business exchange just relying smart contracts. Sending the product catalogue via blockchain, the buyer can easily check the

²⁴ Since the blockchain is a ledger, the reliability of the information is secure once it is registered. There could be the problem when there is the possibility that the information registered at the beginning is not correct since it cannot be changed successively.

²⁵ The cost of transactions in blockchains depends on which blockchain is used (i.e., gas fee). In this phrase, the cost of transactions is meant as the reduction of costs that imply a relationship with a middleman such a bank. For instance, with blockchain people can access to banking without paying a monthly maintenance, service fees, out-of-network fees, early closing fees.

descriptive (unalterable) information regarding the product and the reliability and authenticity of the supplier. The exchange is completely executed just once the carrier dispatches the product to the buyer, since the smart contract will automatically provide the payment to the supplier. This whole process is finalized without the intervention of third parties, like banks. It implies leaner, faster and cheaper operations, where reciprocal trust is not requested. Through this brief practical example, it is clear how such application leads to elevated volumes of exchange in the markets due to poor transaction costs, strong reliability and remarkable efficiency in matter of time (Sun et al., 2020). Moreover, from this perspective, blockchain-based agreements can solve the issues raised by North (1990) regarding third-party enforcement. Indeed, these smart contracts would represent the “*coercive state*” that enables exchanges, controlling property rights in an equal way and effectively enforcing agreements. Moreover, since these would be lines of code, smart contracts would not act in an opportunistic way, given the absence of that wealth-maximizing behavioural assumption. Such a development could even lead to an *institutional equilibrium*, meant as a situation where the “players” do not take advantage to modify agreements given the costs to alter the “game” (Platje 2008; North , 1990, p. 86). To conclude this operative section, blockchain’s outcomes are the same as the institutions. These results make these two worlds even closer. In the following part of the chapter, this parallelism is strengthened even from a notional angle.

Starting from the most shared definition of what an institution is, we can already find similarities with the blockchain technology. Indeed, North’s description of institutions (1990) as set of rules and constraints for human behaviours already finds points in common with such technology. The blockchain innovation creates a different set of rules for human behaviour, considering its practical applications. As reported in the previous example of smart contracts’ exchange between the supplier and the seller, people can act differently thanks to the usage of such disruptive technology. In the particular case of this commercial relationship, it means that informal rules, such as the scruple to trade when actors do not know each other (i.e., information asymmetry) can be relaxed. Thus, the effect of decentralization in exchanges can influence individuals’ behaviours. As mentioned above, this is a remarkable step for commerce, due to a possible increasing transactions’ volume. Assuming that blockchain will have many new applications in the near future with the same – elevated – frequency that happened until today, such a progression would lead to always different human behaviours in the future. The evolution in informal rules due to the blockchain can even imply the constant reference to information in this decentralised structure before attending any economic, social, commercial and financial exchanges. In this way, it can be assumed that the blockchain can be a landmark

for many of the activities that human beings conduct during their lives. The change in behaviours reflects the opportunity of such technology to create new habits. On the other hand, from a more bureaucratic angle, due to its economical relevance, governments actually started to recognize the potential and power of such technology (Dewey, 2022; Zhao et al., 2021). Such practical importance made countries' administrations adjust and create regulations around the blockchain. A famous example of this regards the case of El Salvador, the first country in the world to adopt bitcoin as legal tender (Roy, 2021)²⁶. This pioneering choice reflects the will and curiosity of many countries towards this innovation. Many more examples are reported in chapter 4. Indeed, other countries have already started to adopt or test blockchain for different applications²⁷. This evolution represents the change and the adaptation of what North defines as formal constraints. In this way, it is evident how the blockchain structure does not directly imply implementations in rules and regulations, but it is a clear consequence of it. In fact, due to its disruptive innovation, it forces governments to design a connection with this, establishing a new developed legal framework. For this reason, such analysis is essential to demonstrate how the blockchain stimulates new rules regarding human behaviours²⁸. Furthermore, it is possible to identify more common qualities between blockchain, formal and informal constraints. Continuing with the theoretical analysis, both blockchain and institutions change during time. From North's perspective (1990), institutions constantly develop and this due to changes in human action (Coccia, 2018). Indeed, from this point of view, the main drivers of progress in institutions are informal rules (Roland, 2004; North 1990). In the same way, blockchain technology is continuously adapted for new efficient applications, trying to overcome possible limitations. Since its launch in 2008 (Nakamoto, 2008), many different implementations structured this technology to solve issues in various industries. Indeed, per se, the blockchain has evolved through different steps in a brief period of history: 14 years. It was initially conceived as an online structure to empower transactions (i.e., cryptocurrencies), then Ethereum blockchain enabled the drafting of smart contracts, that lately evolved in the so-called decentralized applications (i.e., DApps). One of the latest evolutions is related to the

²⁶ The original text is reported on the El Salvador's President's, Nayib Bukele, *Twitter account*. More detailed information can be found in Banco de España, 2021.

²⁷ For instance, one recent case regards the Nigeria Stock Exchange (NGX) Ltd. (*Bloomberg*, 2022). Even the UK has announced to start to test the blockchain technology in traditional market activities (*Voi*, 2022).

²⁸ It is clear how the blockchain cannot officially create proper rules yet, but in this work, governments' legal arrangements around the application of such technology are considered as a creation of new regulative frameworks. These are different from other frameworks of rules since in this case governments are forced to do so, given the power and distribution of such a decentralised structure.

creation of the Decentralized Autonomous Organisations (i.e., DAOs) (Moeller, 2022)²⁹. Thanks to these evolutionary steps, both the blockchain and traditional institutions can progressively evolve, maintaining their role of transaction-costs-minimizing authorities in our societies. This evolution makes their structure stable and efficient, considering the always different challenges of the time and the “new information” for actors (Wegerich, 2001). According to Ostrom et al. (1994) and North (1990), even if institution change, the process of evolution does not imply a fully transformation in the structure. Indeed, the different levels of rules follow a hierarchical system that does not let the change affect the whole. Such a classification creates increasing costs and difficulties to transform rules that are more deeply essential in the system³⁰. In the same way, the blockchain technology is affected by many changes in its marginal structure, but it always keeps its core principles (e.g., smart contracts, cryptocurrencies, NFTs). Adaptation for institutions and blockchain is essential to face the future, but it does not imply that these systems must fully change their basic features.

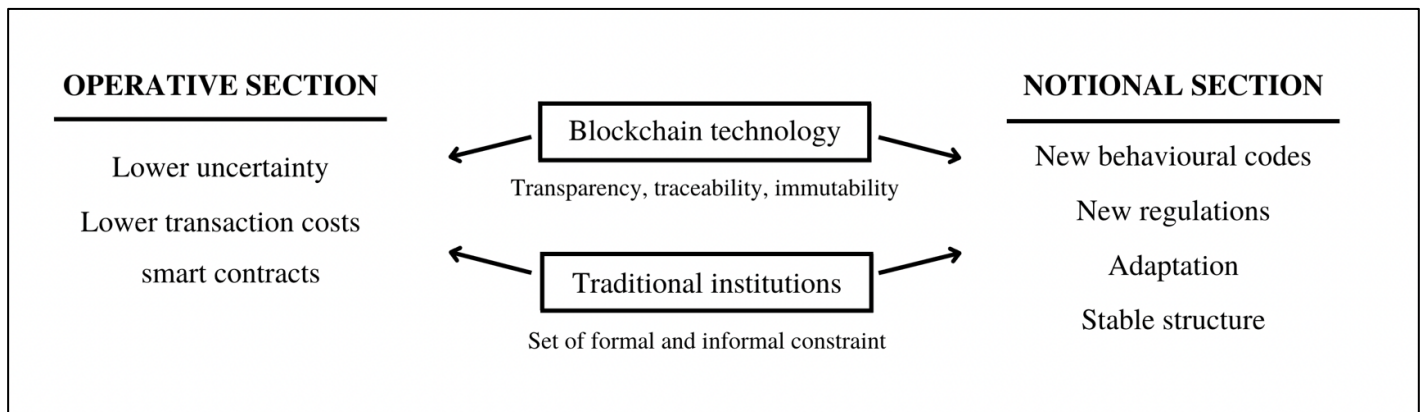
Until now, the analysis shows how traditional institutions (i.e., formal and informal institutions) and blockchain technology have cardinal elements in common. In particular, the first operative section of the chapter highlights the traditional institutions’ and blockchain’s traits that reduce both uncertainty (i.e., risk) and transaction costs. For the institutions, the literature is used to explain their mechanisms, while for the blockchain are reported its precise technological properties. These are transparency given by decentralization, traceability and immutability. The two crucial outcomes lead to increasing trust among economic actors, and a soaring volume of transactions in the markets, which together stimulate economic growth, stability and prosperity. In detail, smart contracts – a blockchain variation – are presented as the perfect solution that merges these two main results. The second notional section of this chapter underlines common features in literal definitions of blockchain and institutions. Indeed, both of them create new human behaviours in systems, due to their structures. Moreover, it is showed how the blockchain implicitly induces an environment with new formal rules necessary for its application. The clear result defines new regulations regarding the codes of conducts of individuals and novel laws. This detail is necessary just to explain that such technology incites adjustments of the surrounding environment. Furthermore, another shared trait is the

²⁹ For a better definition of smart contracts, DApps and DAOs refer to Chohan (2017), Cai et al. (2018) and Kolvart et al. (2016).

³⁰ In detail, Ostrom et al. (1994) recognize three different degrees of rules: operational, collective, and constitutional choice.

continuous (gradual) adaptation to environments, to better face new challenges. In this way, both institutions and the blockchain guarantee a stable structure to individuals' everyday life. Table 1 sums up all the main points analysed in this chapter.

Table 1: graphical results of chapter 3



Given the – *operative* and *notional* – analysis carried out in this chapter, it is marked how traditional institutions and blockchain are in unison. The intrinsic properties of the blockchain create a strong connection with those eminent institutions studied by North, Ostrom, Williamson and the other scholars of the New Institutional Economics. Thanks to this study, now this decentralized technology is counted within the NIE theoretical framework as a new third pillar. Thus, besides those formal and informal institutions, now we find a new “*Online*” or “*Technological*” institution: the blockchain.

4 Application in BRICS economies

After the analysis in chapter 3, the blockchain technology is introduced in the NIE theoretical framework as third institutional pillar. This is crucial for the rest of this research that aims to demonstrate how this technology can stimulate economic growth. The study will include the process that explains how, thanks to its intrinsic capabilities, such decentralized technology can fill the so-called institutional voids. According to Khanna and Palepu (2010), these voids derive from “*the absence or underdevelopment of specialised intermediaries such as database vendors, and quality certification firms, regulatory corporations, and control-enforcing mechanisms*”. Such inefficiency’s phenomenon is particularly evident in developing countries (Khanna and Palepu, 1997). For this reason, to have a productive result this study is focusing on precise emerging countries called BRICS economies (i.e., Brazil, Russia, India, China, South Africa). As reported in section 2.3, the motivation behind the choice of this specific sample relies on two criteria that jointly characterize all these five nations. The first one is related to the progressive vision of every country to develop important structures that incentive – scientific and technological – innovation, cooperation and opportunities of growth (BRICS, 2021). This is actually officialised with the BRICS’ *Action plan 2021-2024*, during the summit held in India in 2021. The second common criterion concerns the medium-high levels of corruption in each of these five countries. To measure these levels, throughout the research it will be used the Corruption Perceived Index, which proposes a scale between 0 and 100 that reveals the level of corruption within countries. According to this Corruption Perceived Index (i.e., CPI), all BRICS economies are “*perceived as more corrupt*” (i.e., $CPI < 50$) (Transparency International, 2022). This level of inefficiency within these systems is constantly assumed to represent a loss of institutional presence and effectiveness. Therefore, the inclination of these countries to develop innovative technological systems and their underperforming internal institutions (i.e., institutional voids) represent a perfect ecosystem to study possible systemic implementations based on a technology such as the blockchain.

Throughout this chapter, the analysis guides the reader to better understand how the blockchain can fill these voids as a technological institution, creating prosperity and stability. Even though there is notable heterogeneity in various fields between the BRICS (Popescu, 2013), it is possible to find shared institutional issues that commonly affect these countries. For this reason, the *five contexts framework* designed by Khanna, Palepu and Shina (2005) is used to analyse the institutional contexts for such developing markets. It is fascinating to say that originally this framework was designed to help businesspeople from developed countries to

have a practical tool to use when they intended to enter emerging economies. Indeed, the framework helps to create an institutional map for these nations and spot the relative voids. In this study, this reveals fruitful results for BRICS. As the authors stated, it “*places a superstructure of key markets on a base of sociopolitical choice*“ (Khanna et al., 2005, p. 66). To better expose the framework, the five contexts are the following:

- *Political and social systems*: this section is the base for the whole framework. It is useful to report insights regarding the political and social environments within a country. This helps to better understand the power centers, and if these are decentralised and autonomous. Moreover, it is important to understand the internal level of trust of the autochthon people towards firms and their governments.
- *Openness*: this aspect concerns both the openness of an emerging country about foreign direct investments (i.e., FDI) within its economy and the propensity to be socially and culturally open. Both the socio-political systems and the openness together shape and influence the next three principal markets.
- *Product market*: this is strictly connected to the difficulty to collect data about consumers and products. Usually there is important information asymmetry between consumers and sellers in emerging countries. This creates high transaction costs in such developing economies, that involve an important disparity from developed markets.
- *Labour market*: thanks to this section, it is possible to analyse the quality of the local employment market. For instance, this looks at the degree of difficulty to hire skilled workers, mainly due to the important lack of recruiting agencies and all lacking solutions for employers and employees. In the article of Khanna et al. (2005), it is stated how in developing countries it is hard to find well-trained people due to voids in intermediaries that operate in such markets but now it is different. As it will be described there are still some institutional voids.
- *Capital market*: this part concerns the study of those markets where investors can allocate their capital and assets. This section focuses on the levels of individuals’ trust in the financial systems and their propensity to approach such markets. This shows possible missing elements that stop countries to achieve great levels of economic growth and prosperity.

After this introduction, it is fundamental to state how the two articles used for the five contexts framework are dated back to 1997 and 2005. Given the 17 years of these papers, the differences from those years to our days will be taken into account. In the end, this analysis will take just the framework used in those papers but not considering the results. Furthermore, such study will focus on the most relevant voids that jointly affect all the five emerging economies in the sample. In this way, a more efficient analysis can be proposed, due to the focus on the most drastic lacks in such systems. Through this granular study, the institutional inefficiencies of BRICS countries are highlighted and connected to solutions connected to blockchain's application. In the following part of the chapter, every section of the five contexts framework is exposed with the relative voids spotted. Subsequently, a technological solution is proposed. The analysis will describe how the blockchain can fill these voids, taking over the place of the actual underperforming institutions.

4.1 Political and social systems

This section uses the first context in the framework that concerns the political and social systems, and it is directed to BRICS economies. These are countries where the application of regulations can present lacks due to inefficient institutional administrations. In this subsection, it will be reported how the legal systems and the contract enforcements cannot have results as efficient as they should because of heavy corruption. This creates important institutional voids that directly have consequences for all these societies (Ahmad et al., 2012).

Every country within the representative BRICS group is connected to political scandals related to corruption. This is due to the fact that this phenomenon is deeply rooted in all these developing cultures. Such important drawback of malfunctioning institutions implies weak legal frameworks that do not always guarantee the enforcement of regulations and contracts. This scenario characterized by corruption do not accelerate economic growth within societies but it creates just more inequalities and exclusion (BRICS, 2021; Ahmad et al., 2012; Gomes, 2017). Moreover, as stated by Enste and Heldman (2017), investments, FDI and capital inflows are strongly affected by the corruption's degree. So, despite the fact that fraud and dishonesty cause relevant – social, economic and cultural – damages to BRICS countries, they are still fueled by parts of their populations. Indeed, as reported by the Transparency International's annual article (2021), all the five BRICS economies are strictly related to internal medium-high levels of corruption. This social phenomenon is remarkable and frequently underlined by scandals in these countries. For instance, famous operations related to corruption in emerging

economies are the “*Operation Car Wash*” in Brazil³¹ and the “*The Laundromat*” scam in Russia³². Given many demonstrations and citizens’ discontent mostly in the past years, these countries are highly motivated to jointly fight such phenomenon with various anti-corruption regulations and laws (Kurakin and Sukharenko, 2018). Though the results are not the same for all of them yet. In practice, during the last 10 years, it can be seen an important progress in the Corruption Perception Index just for China and India. Indeed, considering the last report of 2021, the former increased its CPI from 39 to 45 and India moved from a CPI of 36 to 40. This represents important progress since they moved respectively to the 66th and 85th position, given all the 180 countries of the CPI sample. It is unnecessary to state how these two nations must put a more consistent effort in such anti-corruption activities, even though they increased their positions in the CPI scale, because they are still perceived corrupted on average. On the other hand, for the other countries of the BRICS, there were not any particular changes in their CPI levels. Considering South Africa, Brazil and Russia, no important progressive results are achieved during the last 10 years. Always referring to the last Transparency International’s report (2021), both Russia and South Africa increased their CPI just by 1 point, receiving respectively a CPI of 29 and 44 in 2021. Mostly for Russia, this plague has great importance on its business sides. The worst result in terms of change in the corruption’s score comes from Brazil, which moved from a CPI of 43 to 38. This is the only nation in BRICS group that decreased its position of 5 points in the last decade.

This introduction and classification is needed to propose a clear overview about the inefficiency’s levels of each of the five countries regarding the internal corruption and fraud. It is now clear how, for all the five BRICS countries, there are several issues regarding law enforcement authorities (i.e., police), tax authorities and legal systems due to an important institutional distance coming from the presence of public and private corruption (i.e., grand and petty corruption) (Sahu and Gahlot, 2014). Principally, corruption in these countries is caused and protracted by a kind of public tolerance, mostly during the past decades. Moreover, it was mostly powered by precedent lacks of political incentives to defeat it, the so-called juridical dependence, and the important personal gains coming from these practices

³¹ This is an investigative operation started in 2014 by the Federal Police of Brazil’s Curitiba. The aim was to understand the pattern of a large money laundering scheme. It was discovered that important Brazilian politicians, administrative members of the state-owned firm Petrobras other businessmen, governors and Presidents of the Chamber of deputies. It is considered the biggest corruption investigation in the history of Brazil. For more detail: <https://www.theguardian.com/world/2017/jun/01/brazil-operation-car-wash-is-this-the-biggest-corruption-scandal-in-history>.

³²This scandal regards an immense fraud financial scheme that implied a money laundering of \$20 billion. The aim was to move out of Russia financial system the money through clean bank accounts. For more information regarding the scandal: <https://kyc-chain.com/the-russian-laundromat/>.

(Gontmakher, 2022). The cost of such dishonest activities in these systems heavily impacts BRICS societies and cultures³³. Indeed, according to the International Monetary Fund (i.e., IMF) (2019), in general corruption undermines socio-political stability, creating an underperforming environment with administrative distance. For instance, the impacts of fraudulent activities are directly measurable on citizens' welfare, since they decrease progress and sustainment in public health, educational systems and effective infrastructures. The trend of prominent opportunism coming from the corruption in these societies is easily practicable even due to significant opacity in the actual institutional systems. As stated above, even though many laws and regulation were issued and promoted to face such plague, not many results were achieved – mostly in Brazil (Kurakin and Sukharenko, 2018). The only efficient results were achieved by China, with its anti-corruption plan – even thanks to its commercial openness.

Decreasing and limiting this cultural, social and politic issue is possible thanks to the chance of enhancing a blockchain system within each BRICS country. Indeed, given all its intrinsic properties, such technology can extremely benefit in this kind of environments. In particular, it would reduce the institutional distance in BRICS economies, filling those voids created by the actual institutions. From an operative point of view, transparency, data tracking and immutability would create an online environment where access to information is facilitated and with low transaction costs. Such development would definitely accelerate processes of auditing within institutional structures and solve many problems. For instance, the famous phenomenon of corruption connected to tax avoidance would be easily overcome. This would come from the opportunity of special authorities to check in a decentralized ledger if citizens have paid their obligations. Since this solution could even be influenced by individual opportunism, there can be another autonomous solution. Another way could be connected with auto-enforcing smart contracts that would create a way to incentivize people to pay taxes with their wages even before receiving the money. The blockchain's function of decentralized ledger can enforce auditing mechanisms, giving the opportunity for everyone to easily control all the processes for public and private sectors. Another important possible application could solve the problem of unlawful changes in juridical cases, a phenomenon is particularly present in India (Outlook Journal, 2022). Regarding the issues related to laws and regulations enforcements, the application of blockchain would create an equal, transparent and fairer environment. Indeed, this possible application would solve many disputes related to modified

³³ Indeed, doing something in the “*Brazilian way*” (i.e., *jeitinho brasileiro*) is a saying that means something is done by finding a way to avoid regulations.

archived information that would be slowed down or unlawfully changed by corrupted authorities. Considering this possibility, a decentralized system applied in public courts would clearly have benefits for all those fair people that work against corruption. In fact, granting data immutability, the blockchain could guarantee data integrity during time. This means that implications from a judge's decision cannot be canceled or manipulated in retrospect. Moreover, its distributed feature can lead to access to documentations for all those people with particular interests in juridical cases. So, the intrinsic features that offer immutability and transparency to all the peers in the network are essential to fight law enforcement scenarios and corruption in the regulative system. But it can actually solve many more scenarios of actual corruption. Furthermore, immutability is fundamental in environments where numerous practices rely on traditional paper-based documents that could be easily manipulated. But even though today everything is working online, there is still a simplicity to change data that imply many issues. So, for these reasons, the blockchain technology as a technological institution can support – formal and informal – institutions to fight local corruption, incentivizing social welfare, stability and economic growth.

4.2 Openness

It is crucial to define the availability of a country to be open towards internationalization. This is even more relevant when we refer to the five largest emerging economies in the world. Indeed, their propensity to receive culturally, economically, politically and socially new stimuli leads to important international balances. This can be better explained showing that jointly considered, BRICS economies have a combined GDP which is almost one quarter (i.e., 24%) of the world's GDP (O'Neill, 2022). In this way, openness leads to higher levels of cooperation with foreign countries, that can create more opportunities of – social, political, economic – growth and development. For instance, China has a high level of international cooperation (i.e., openness) to face its internal corruption (Kurakin and Sukharenko, 2018). According to the quantitative research conducted by Nguyen and Duong (2021), such openness regards even the national trade, which positively affects the levels of economic growth and development. In the particular case of China, some important results are shown with the increased CPI's level in the last years (i.e., less perceived corruption) but even by its economic power. Indeed, today China is the second commercial power after the United States³⁴, even due to its levels of

³⁴ Measured by nominal GDP.

cooperation and propensity to other developed countries (World Bank, 2022). In any case, it is important to underline how underperforming institutions and important levels of corruption within BRICS economies influence their reputations, since such disadvantages directly affect the FDI inflows (Jadhav and Katti, 2012). According to Rodrik et al. (2004), good levels of governance within a country encourage foreign businesses to enter new markets. In nations with institutional voids created by inefficient authorities, companies face expensive transaction costs for doing business and having information. So, corrupted economies can have their internal (opportunistic) advantages but they do not attract foreign investments in their economic environments. Maintaining China's market as example, its levels of cooperation with foreign partners helped the country to decrease corruption's levels during the last years. So, this approach pushed for increasing the chances of collaboration with foreign companies and receiving foreign direct investments within its economy. Ranjal and Agrawal (2011) has analyzed the FDI inflows in BRICS economies between 1985 and 2009. The results show that the principal elements that encouraged investors to choose these economies were the cost of labor, the important market sizes, trade openness and prospects of growth. Even though these determinants helped to attract more investments, it must be said that the general levels of FDI were low considering the levels of other countries. This can be even justified by the level of FDI restrictiveness of BRICS nations. For this, the OECD index of restrictiveness³⁵ can be used, since it is based on limits to foreign ownership, approval procedures, constraints on personnel and limits on operations (OECD, 2022). According to the Table 2 in the appendix, even though China – with India – has high advantages from foreign cooperation, its level of closure towards FDI is the second higher (i.e., 0.21) in the BRICS economies, only surpassed by Russia (i.e., 0.26).

So far, it is clear how political, social and economic availability towards other countries have important advantages for nations. But possible new – political and business – relationships are based on the quality of internal institutions. For BRICS economies, this is a relevant issue since they all suffer from internal inefficiencies, as corruption. This strongly discourage foreign investors to allocate their resources in these environments. The example of China, though, is important given its peculiarity. Despite the internal corruption and the levels of restrictiveness,

³⁵ This index goes from 0 (i.e., open) to 1 (i.e., closed) (OECD, 2022). According to the index in 2020, the BRICS economies are classified in the following way:

- South Africa: 0.06.
- Brazil: 0.08.
- India: 0.21.
- China: 0.21.
- Russia: 0.26.

those international – economic, political – relationships of the last decade, increasingly helped the country to overcome these issues (Ranjal and Agrawal, 2011). So, it is clear how stability and effectiveness of the law presented by institutional quality are essential to attract FDIs. These aspects could be improved in other BRICS nations always referring to the importance of a possible internal development and usage of the blockchain technology. As in the previous subsection, it can be proposed a realistic example, based on the common issues affecting the BRICS economies under the openness angle.

For the purpose of such example, it must be assumed that a foreign company overcomes BRICS regulative barriers to invest within these economies. This usually happen, but the level that a foreign company encounter is justified by the OECD index of restrictiveness for each of these countries³⁶. In such scenario, the application of the blockchain as technological institution can importantly increase the results. Indeed, filling those lacks caused by underperforming local authorities, it lowers uncertainty and transaction costs for foreign companies. Let's consider a foreign firm (i.e., A) that wants to invest resources in one of the BRICS markets, like South Africa, and it has passed all the bureaucratic and administrative barriers. According to Khanna et al. (2005; 2015) an efficient strategy would be creating a joint venture with an influential local company. Assuming that company A finds a local firm (i.e., B) as good business partner, they can enhance their arrangements with smart contracts, that run on blockchain. These technological solutions are fundamental to guarantee parties results planned beforehand. For instance, when A would feel uncomfortable due to possible malicious action of B due to some corrupted members, any actual risk is minimized due to the existence of an immutable smart contract that will lead to a certain outcome, decided before the relationship started. In the other hand, whether B would fear that A would act dominantly in the markets, given its – administrative, economic, strategic, operational – power, the smart contracts designed would conceive just a precise result given the actions of the parties. In other words, thanks to their mechanisms, smart contracts applicable in FDI contexts, can be an essential tool to increase relationships among different firms and creating trust. In this way, both A and B will proceed with the deal through the creation and design of smart contracts to empower their respective wills to continue their businesses. In such scenario, the corruption can heavily harm possible foreign cooperation that could offer the developing country some good progresses (e.g., the above-mentioned case of China). But, given its immutability, transparency and

³⁶ For instance, a company that want to enter the South African market will find less FDI barriers than entering the Russian or Chinese markets.

efficiency, the blockchain as technological institution would create a stable and predictable environment, where parties can act trusting each others. In those cases when, moved by opportunistic behaviors, A or B will not respect a clause of the agreement, there could be the opportunity to impose an automatic penalty. This method will lead to a transparent operative agreement between the parties, increasing even more possible collaborations. Moreover, if BRICS economies would adopt such process, they will increase the FDI's levels in their economies, with consequent economic growth and development.

4.3 Product, labor and capital markets

As stated before, the last section of the five contexts framework regards the analysis of the product, labor and capital markets. The institutional voids present in these markets in BRICS economies will be underlined and solve with the application of the distributed ledger technology in the role of online institution. These three types of markets all rely on socio-political environments and openness that, as the first two steps of the framework, create a base of such analysis. In this specific way, it is possible to have a clear overview of the contexts we are referring to, that will be used as structure for the following insights.

The first market to be taken into analysis is the *product market*. According to laws from the European Union (2021), such type of market represents the venue where all services and products are interchanged between economic actors, considering their intrinsic characteristics and qualities. The exchanges in such a market are made on the basis of personal gains and interests. Referring to the distinction taken by Khanna and Palepu (2010), the focus in this analysis is on the “light infrastructures” in the product market³⁷. In particular, intellectual property rights (i.e., IPRs)³⁸ are studied to deline the important voids caused in BRICS economies today by inefficient institutions. The choice of this specific aspect in the product markets is justified by its unprecedented challenges these days (Wang et al., 2019). Indeed, all the BRICS countries encounter important worrying voids for IPRs, that clearly affect their relative product markets. According to the International IP Index of the U.S. Chamber of Commerce (2022)³⁹, among all the countries of the sample, almost all the BRICS economies

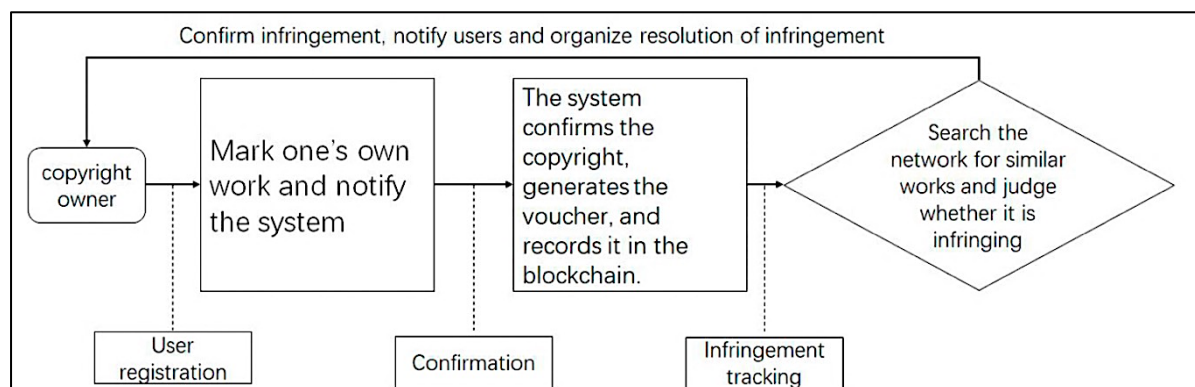
³⁷ The authors suggest a differentiation of heavy and light infrastructures in the product market. The former implies actual material infrastructures like roads and ports, that provide a logistical flow. The latter concerns more information and data, such as agencies for market information.

³⁸ There are different categories such as patents, copyrights, trademarks, design rights (U.S. Chamber of Commerce, 2022).

³⁹ This index varies from 0 to 100, and it classifies 53 economies considering their IPRs qualities. It is published every year from the U.S. Chamber of Commerce.

relies under the lower-middle quality for laws regarding IP. In fact, as reported in Table 3 in the appendix, China leads the representative group with a score of 55.86%, being in the upper-middle quality group. Then, this is followed in a decreasing order by Russia (46.64%), Brazil (42.02%), India (38.64%) and, the latest, South Africa (37.28%). Such institutional voids in IP rights jeopardize innovation, creativity and growth of such countries, creating important barriers for internal and external actors. Moreover, as stated in the report (2022, p. 61), all BRICS economies poorly improved their positions in the index classification, which are all between 0.06% and 1%, with even a loss of quality in the Brazilian regulation (i.e., -0.30%). This means the governments of these nations actually are trying to improve their IP laws, but with slow results. A reason can be found on the relevant levels of corruption in public institutions and governments. Lacks in regulations and IP protection, unsustainable goals and strategic civil code's amendments create paramount instability when it comes to talk about IP in BRICS countries (Kogan, 2006; The Economist, 2022; Zubascu, 2020; Lengare, 2020; DTI, 2018). Solving such common institutional void can be crucial for these economies and their social, economic and cultural environments. Thus, this represents a perfect suitable opportunity to improve such economic and regulative systems with a technology such as the blockchain. Due to its properties, an online distributed ledger can enhance intellectual property rights' confirmation, management and protection. Indeed, from this perspective, decentralization will transform the process of IPRs registration easier, faster and cheaper than centralized actual systems. This can efficiently help all those businesses that could leverage the first-mover advantage, that actually find slowdowns in modern agencies and regulative bodies. As an efficient decentralized ledger, the blockchain can help even authors to exchange rights with ease and find plagiarism on other works. Indeed, more individuals will use the network, more valuable it becomes (i.e., Metcalfe's law). Taking an easy example, considering that all musicians register their works on the blockchain, this would increase the opportunity to check easily for plagiarism, saving time and money. This would increase trust in this system without the presence of third parties, so in an autonomous and decentralized way. A simple process on blockchain for IPRs is represented in Figure 1.

Figure 1: simplified blockchain-based protection process



Source: Wang et al., 2019

Moreover, the application of smart contracts in such realities can improve even better the rewarding process for those who register their contents as IP. Indeed, taking a blockchain-based artwork as example, a smart contract could guarantee a minimum reward for the author given every click online on the content. Such mechanism helps independent authors, businessmen and creators mostly in their early stages. For an extended graphical structure about the blockchain process on IPRs, check the World Intellectual Property Organization (i.e., WIPO) project in Figure 2 in the appendix. To conclude this part, after this study, it is delined how the blockchain can offer an operative solution in a context where today there are still important slowdowns, limitations and barriers.

The second market taken into analysis is the *labor market*, even defined as job market. As known, in this type of market demand and supply of workforce meet each other, filling the needs of employees and employers. According to the International Labor Organization (i.e., ILO), during the last years, such a market had successful results in all the BRICS economies. Indeed, for the representative group, the unemployment rate during the 2021 has decreased of 5.3%, and it is expected to continue to be lower during 2022 (ILO, 2022). In comparison with the other two markets in the framework (i.e., product and capital markets), this one has importantly less institutional voids. Indeed, during the last years, all the five nations of the BRICS had successful results and strategies' effectiveness in this type of market. According to an ILO report (2018), the trend is to reduce young unemployment in these countries, which seems the only relevant problem in the short-term, with young NEET (i.e., **Not in Education**) and gender gap. It must be underlined that these positive results come from active programmes in these countries to better improve the job markets, like the MNREGA **0** employment programme in India. So, after this research, it is possible to spot an institutional void common to all the five largest emerging economies. Indeed, it was found out that – mostly in India and

China – there are important frauds regarding fake *resumes* of potential candidates. According to some journal articles (HireRight, 2015; Shira et al., 2016), this phenomenon was mostly spread in the recent years. This is given by the fact that, even though unemployment rates dropped in the last decade (O’Neill, 2022), there are still relevant inefficiencies in the labor market in BRICS economies. Given the high levels of competition in these nations, potential employees fake their resumes with skills, experiences, positions and job durations they never had to increase their chances to get a job. Obviously, this creates important discrepancies with the actual experience of the candidates and what they present to companies and employers. Such phenomenon puts light on an important void in the job market, which can be represented by the absence of national institutions (e.g., agencies or physical/digital infrastructures) that could verify information regarding possible employees. This is not a fundamental lack in these economies since the phenomenon did not spread too much yet, but still represents an important drawback that causes uncertainty and riskiness for companies. For this reason, given such voids in BRICS economies, it is possible to propose a solution connected with the blockchain’s structure. On the back of an important technological innovation in these countries, the blockchain as technological institution could lead to important improvements in the labor markets, creating lower levels of uncertainty, transaction costs and riskiness. Indeed, the main benefit can come from its property of being a decentralized ledger. Due to the chronological timestamp on every block of information recorded in the ledger, the blockchain can guarantee that all the information of a possible resume will be registered in a chronological order with a digital sign from the institutions. In this way, for instance, future workers cannot counterfeit their positions with other experiences if they are not officialized by the relative authority. Indeed, it would be even more efficient when every company, school, organization can officially sign a piece of information on the blockchain, guaranteeing that the candidate has actually had a precise role during a definite period of time. The immutability property of such technology will certainly lead to higher level of trust between actors since it would not let people change information at a later time. In this way, based on its technological features, the blockchain would create a stable structure in the labor market in such countries, filling the actual institutional void of authorities that should grant so. The results of such application can lead to lower transaction costs for employers and increasing level of trust in the job markets, improving stability in these developing countries. Such innovation would affect even international companies that want to operate and invest in these realities. Indeed, usually they hire skilled local people, and with such of stability given by the blockchain as granting

institution, the risk of hiring unskilled people is lower. This can incentivize FDI as described in the openness in section 4.2.

The last market included in the framework is the *capital market*. This creates the opportunity of a marketplace that lets capital providers in surplus and actors in deficit meet. The former are usually institutions like banks and investors that look for allocate their investments, while the latter are individuals, governments and companies that need finances (Hayes, 2021). In this kind of market, actors exchange instruments such as stocks, bonds, currencies and securities. In this last section, the analysis refers directly to capital and financial markets in BRICS economies. In particular, the focus regards the financial inclusion of the populations of these developing countries, proposing insights and possible solutions for all their unbanked. Indeed, the unbanking phenomenon is highly recorded in emerging countries and, for this analysis, it is chosen as main void to be filled in this context. To better explain, people are defined “*unbanked*” when they do not have accounts in banks or any banking institutions (Downey, 2022)⁴⁰. To give some data related to such phenomenon, today around 1.7 billion people are unbanked in the world (World bank, 2017). According to the Federal Deposit Insurance Corporation (i.e., FDIC) (2019), the rate of people without a bank account is mostly high in households with lower, volatile incomes and low levels of education. As reported by the World Bank Group (2017), the principal motivations behind such phenomenon rely on the costs associated with owning a bank account (i.e., high transaction costs), the scarcity of money given by each country’s economic conditions and the personal preference to use cash given this context⁴¹. Indeed, referring to the poverty levels, the situation can be even further motivated by the notable levels of inequalities. In particular, it is possible to measure the level of wealth inequality within every BRICS country referring to the Gini coefficient. Using such a measurement, all these five nations register high levels of wealth inequalities in their economies, having results between 35.7 and 63 (World bank, 2020)⁴². Thus, from this piece of information, it is clear that BRICS economies register poverty in their societies that lead to important wealth inequalities, that are part of the cause of unbanking phenomenon (World Bank Group, 2017). Additional data from Statista (2022) shows how BRICS economies

⁴⁰ The analysis will not take into account the “*underbanked*” people, so all those who are not financially served in an equal way. Indeed, the focus would be on “*unbanked*” populations because of its level of inequality and disruption. Moreover, for underbanked actors, the solutions coming from the application of the blockchain would be almost the same. So, for these reasons, the work will refer just to the unbanked citizens.

⁴¹ It is essential to say that the use of cash is incentivized just because it is costly and challenging to open bank accounts in such countries.

⁴² Higher the coefficient, more present the inequality is in the country. In the database of the World bank (2020), some years are missing for the countries.

are not in the first part of the classification for unbanked people in their systems. Indeed, the shares of people without an access to financial institutions are between the 20% and 31%⁴³. In comparison with other countries in the study such as Morocco, Vietnam and Egypt, these results are relevant since they represent increasing improvements in BRICS economies during the last few years. Indeed, according to Raccanello (2018), Brazil, Russia, India, China and South Africa have all promoted financial education programmes (i.e., National Strategy for Financial Education, NSFE), and actually they gained some good results from them. But, from the point of view of this analysis, a different operative structure based on decentralization can let these nations achieve even better direct and indirect outcomes. Indeed, increasing financial inclusion is a direct implication of this plan and it would indirectly lead to economic growth in BRICS countries, improving the actual quality of life for local poor people (Cull et al., 2014). In such context, a financial system that relies on blockchain technology can be more efficient and effective than many institutional actors. From a technical point of view, having a bank account implies various and relevant cost of transactions connected with the creation of the account, its usability and the connected financial services. Using a blockchain-based structure to create financial inclusions means lower risks, reduced costs and powerful efficiency. Opening a bank account today is costly and even challenging for unbanked poor people, and this certainly does not incentivize people to take this path. Moreover, banks do not facilitate the process since they need – frequently fixed – fees to transfer money, usually a minimum limit to complete the transactions and few days to process the orders. All these drawbacks could not influence too much a citizen from a developed country, but they are predominant obstacles for poor citizens in emerging economies. This is one of the reasons behind the high levels of inequality and unbanking phenomenon in BRICS economies. Thus, creating a financial market that is structured on the blockchain can achieve important goals for these people and their countries. On the back of its technological properties, unbanked people could start to use blockchain-based softwares to really own⁴⁴ and transfer their savings. Then, the access of such

⁴³ Precisely, the percentage of populations without a bank account are:

- South Africa, 31%
- Brazil, 30%
- Russia, 24%
- India, 20%
- China, 20%

⁴⁴ In a bank people do not actually “own” their money since the bank can even block the savings in specific contexts. During the Ukrainian-Russian war, many bank accounts were blocked and their owners must have to rely on cryptocurrencies. Moreover, it is even true that if a person wants to transfer a high amount of money, they must comply with many documents, papers and confirmations from the bank while with a decentralized system this would take seconds with a cost of cents.

systems would be much easier, faster and less costly than going to a bank and create a deposit account. Transactions in this kind of technological environment would be faster and cheaper: for instance, the Bitcoin Lightning Network can process up to one million transactions per second⁴⁵, and it applies micro fees (i.e., 4 cents) given the amount of money to be transferred. Furthermore, people do not have to open a bank account while using blockchain, since it can work just with a smartphone and a digital wallet (e.g., MetaMask). Many countries has already recognized the big potential of such technology applied in the financial markets. For example, as mentioned before, El Salvador has already introduced the bitcoin as official legal tender in its financial systems. Then, other countries as Jamaica and Nigeria are going to launch their respective blockchain-based financial structures, connected respectively with the central bank using the Central Bank Digital Currencies (i.e., CBDC) and with the national bourse, to grow their markets (Onu, 2022; Singh, 2022). Other countries as Central African Republic trusts this new technology and is the second country to adopt bitcoin as legal tender too (BBC, 2022). The United Kingdom's treasury has announced how it will regulate cryptocurrencies to make the UK a crypto hub in the near future (Hern, 2022). Even Russia has developed a blockchain-based platform with the potential to replace the Society for Worldwide Interbank Financial Telecommunication (i.e., SWIFT) (Pessarlay, 2022). All these recent cases of actual application and usage of such decentralized technology underline how nations all around the world are starting to believe and create structures with it, even if they do so for different purposes. Such technological developments clearly increase the financial inclusion in countries where not everyone has the opportunity to deal with institutions. This is a fundamental step for the implementation of a global financial system where people own their own money due to decentralization. Such revolution create the opportunity to access credit for all those people who are unbanked today and create environments where doing business is not a privilege. In this way, blockchain fills a huge inclusion's void in BRICS markets, improving growth and quality of life. This type of technological-institutional approach can help developing countries to *leapfrog* developed countries, creating a more innovative technological structures based on decentralized technology.

⁴⁵ According to Craig (2021), Visa processes 1,700 transaction per second (i.e., tps) while Mastercard handles 5,000 transactions per second.

5 Results and interpretations

The methodological chapters of this study respectively give a precise theoretical and practical development framework for the cutting-edge blockchain technology.

Chapter 3 focuses on the construction of a new theoretical framework around this decentralized technology, introducing it as third pillar in the NIE theory as *online institution*. The goal was to find common conditions among NIE institutional theory and the blockchain. The results are interesting and successful since they are useful to describe a new theoretical framework. In particular, chapter 3 leads an analysis from an operative and notional point of view, comparing the so-called formal and informal institutions studied by North, Ostrom and Williamson and the disruptive and modern blockchain technology. Thank to this study, a parallelism is created between these two worlds. It was found out how both traditional institutions and blockchain have the same results from an operative angle, since both have intrinsic properties to lower uncertainty (i.e., risk) and transaction costs in societies. Smart contracts are proposed as perfect instrument that merges these two benefits. Even the notional analysis proposes some interest findings regarding the connection between traditional institutions and the blockchain. Indeed, many aspects are commonly in parallel in these two worlds. Indeed, both create a set of – regulative and behavioral – constraints and adapt to changing environments to guarantee a stable structure to societies.

The findings in chapter 4 are completely shifted from a theoretical perspective to a more adaptive solutions for nowadays realities. The chapter reveals how the blockchain can fill relevant institutions voids in the five largest emerging economies. The analysis precisely spots main institutional voids that are common to all the five BRICS nations. In detail, the study consider the BRICS countries as possible fertile environments for the application of the blockchain as online institution. The reason relies on their medium-high levels of CPI and their propensity to technological innovation (i.e., Action plan 2021-2024). The five contexts framework designed by Khanna, Palepu and Sinha (2005) is used as tool to spot the main institutional voids present in BRICS countries. After an overview from a socio-political and openness point of view, it is shown how actually it is possible the application of such technology as institution in these countries, creating successful results. Then, a study of the product, labor and capital markets delines the possible main voids in the BRICS and, for every of this, proposes a blockchain-based solution. The results from the analysis of the BRICS underlines that relevant institutional voids can be actually filled with a new, stable and decentralized institutions such as the blockchain technology. It is important to state how

this study proposes an *average effect* because of the BRICS countries heterogeneity described in section 2.3.

The potential results of such application are stimulating for these countries and their populations. The actual conditions of corruption, uncertainty in economic exchanges and the high levels of transaction costs are all minimized. The blockchain as online institution has the opportunity to put these countries in the direction of their Action plan 2021-2024. Furthermore, it would increase stability and prosperity in BRICS economies, stimulating important economic growth during the time.

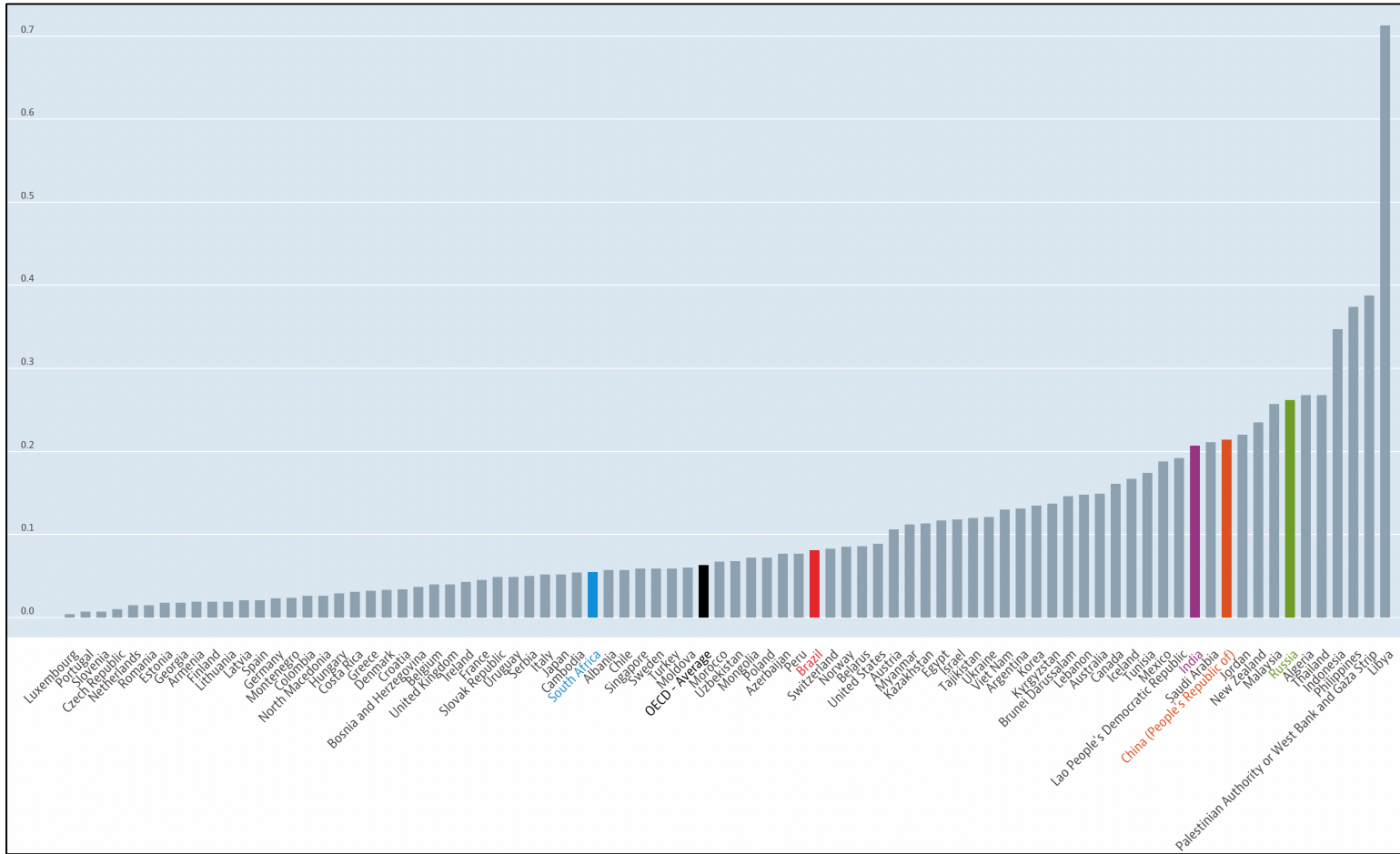
6 Conclusion

The research underlines important findings for the scholars and governments. A new landmark can be introduced in the famous NIE framework with the formal and informal institutions. Then, since governments in emerging economies have the potential to increase their wealth conditions and leapfrog developed countries, they should focus on this new type of decentralized technology. The results are not precisely defined but the average effects are supposed to be successful.

After this research, few suggestions are given for new future enhancements for this study. It can be considered an analysis from another theoretical point of view for institutions, such as the new organizational institutionalism and the comparative institutionalism (Hotho and Pedersen, 2012) since this work uses the prospective of the NIE. Then, the insights about the average effects on BRICS nations cannot be sufficient when there will be more available data in the future. So, it can be interesting to conduct precise research on every single economy of this representative group and their data. This can be offer even more detailed results and solutions, considering specific use cases. Moreover, future analysis can include countries with even higher CPI levels (e.g., Iraq, Haiti, Madagascar) and not just BRICS. Moreover, since this study focused on common important institutional voids, it can be interesting an analysis of other marginal institutional voids affecting such economies. In the end, as soon as some database and detailed reliable information would be available from the application of the blockchain technology, regression analysis and quantitative research can be undertaken to verify a precise connection of these results with economic growth in BRICS economies.

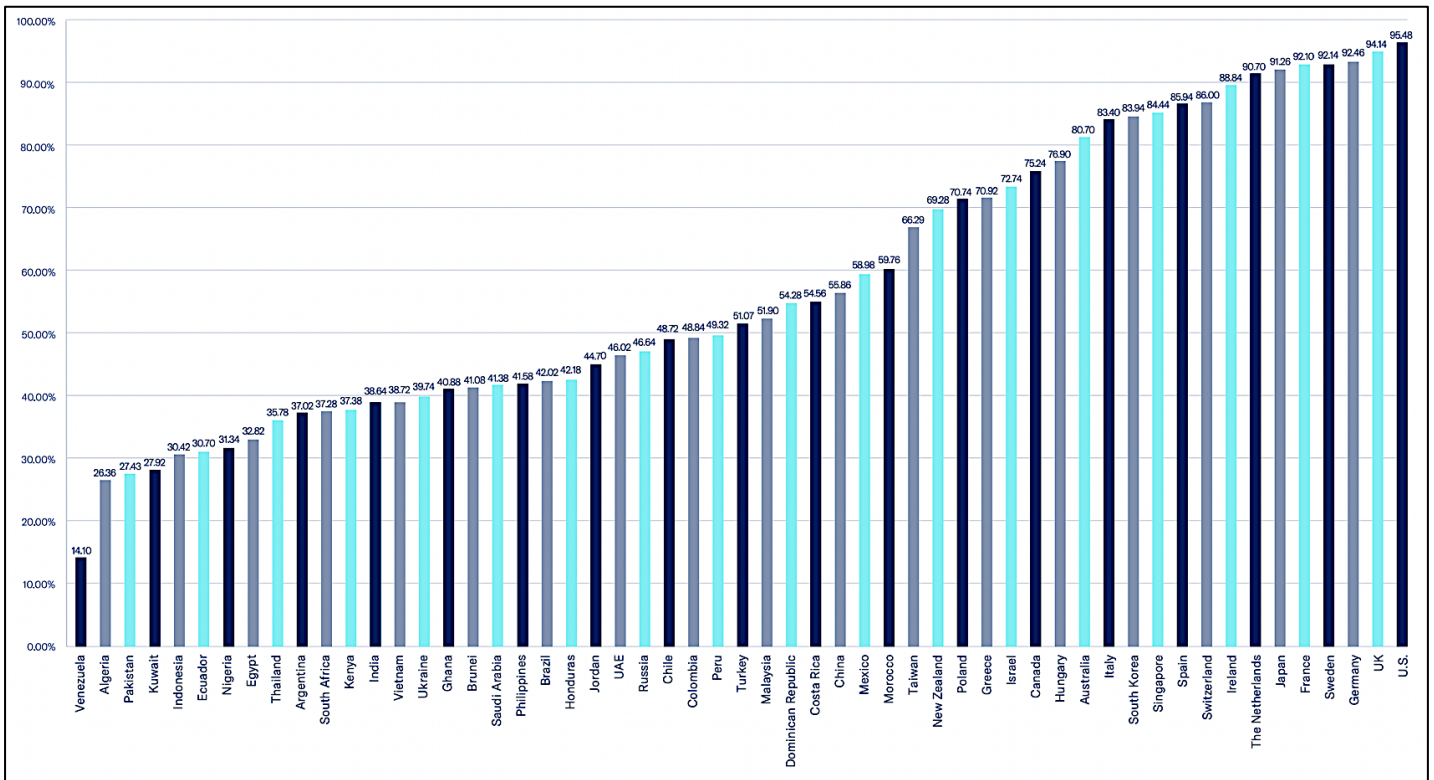
7 Appendices

Table 2: FDI restrictiveness



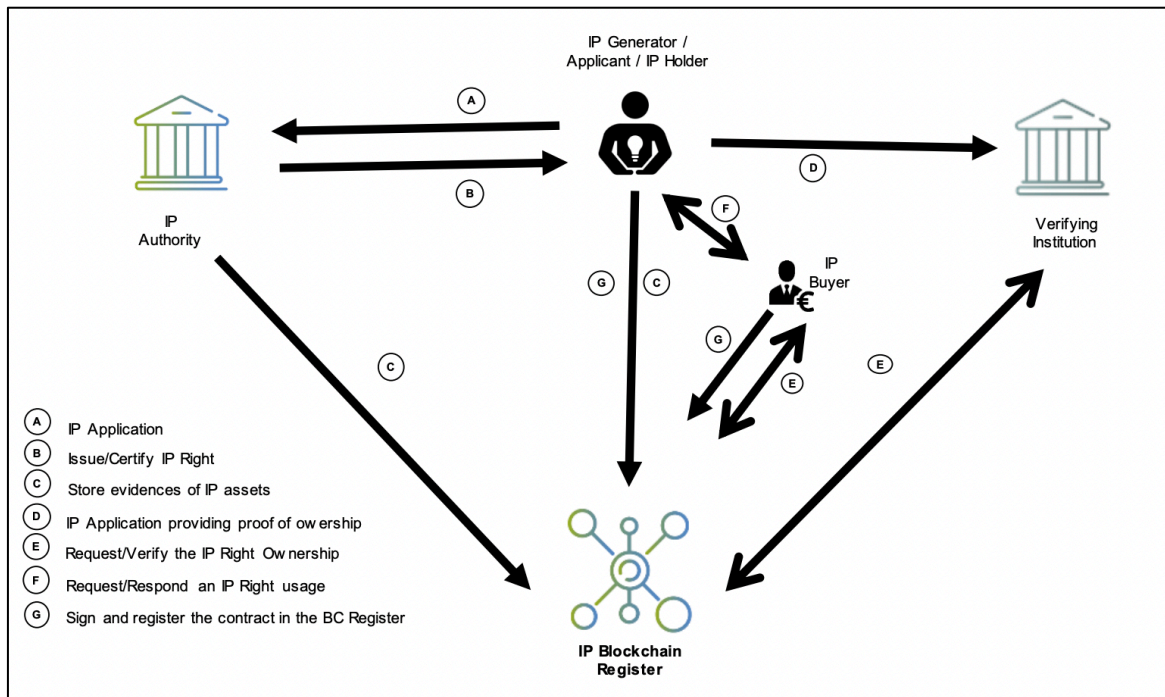
From OECD (2022)

Table 3: overall % score IP Index



Source: U.S. Chamber of Commerce, 2022

Figure 2: extended process of blockchain application in IPs



Source: WIPO, 2021

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