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>THESIS

MAFALDA MARIA SEQUEIRA ROLDÃO

Blockchain-based Decentralisation Under EU Competition Law

Dissertation aiming to obtain the degree

Master's degree in Law,

specialisation in Business and Technology Law

Supervisors:

Dr. Fabrizio Esposito, Professor at NOVA School of Law

Dr. Lúcio Feteira, Professor at NOVA School of Law

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Mafalda Sequeira Roldão

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Acknowledgments

I would like to thank my family for supporting everything I do, and for their patience in continuously listening to my monologues about my thesis.

To all my Professors, especially Professor Fabrizio Esposito and Professor Lúcio Feteira, thank you for your immense support, contagious love for research, and the opportunity to learn from you.

A special thank you to all the supervisors and co-workers at the Portuguese Competition Authority. You were undoubtedly an inspiration while writing this thesis.

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Abstract

Blockchain proposes to disrupt how business is conducted and how people organise. In this thesis, we evaluate whether European Competition Law can be applied to Blockchain, especially public permissionless blockchain-enabled entities, considering the Theory of the Firm and the term “undertaking”. We conclude by proposing the Competition Law approach as a possible valuable tool for Blockchain sandbox legislation.

Resumo

Blockchain propõe revolucionar como negócios são feitos e como as pessoas se organizam. Nesta tese avaliar-se-á se o Direito da Concorrência Europeu está apto a ser aplicável a Blockchain, especialmente a public permissionless blockchain-enabled entities, considerando a Teoria da Firma e o conceito de “empresa”. Concluímos com a proposta de adotar a abordagem do Direito da Concorrência como possível ferramenta de legislação sandbox para Blockchain.

Keywords: Decentralisation; Blockchain; DLT; Theory of the firm; Undertaking; Competition Law; Institutional Technology

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LIST OF ABBREVIATIONS

AG - Advocate General

COALA – Coalition of Automated Legal Applications

DAO – Decentralised Autonomous Organisation

ECJ - European Court of Justice

GC - General Court

NRAs – National regulatory authorities

OJ - Official Journal of the European Communities

PoS – Proof of Stake

PoW – Proof of Work

TFUE - Treaty on the Functioning of the European Union

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I. INTRODUCTION

Human history is largely intertwined with the ability of humans to organise, which has been dominated by centralised organisations, whether with formal or informal hierarchies . Throughout the late 20th century, information ledgers were digitalised; however, they remained centralised . Blockchain proposes itself as a disruptive innovation that exemplifies Schumpeter's creative destruction .

Blockchain caught the market's attention – Blockchain startup companies raised up to $2.6 billion in venture capital in the first quarter of 2021 alone . Various industries have adopted it to the point that the real challenge is finding one that is immune to the market's enthusiasm. To name a few: logistics, energy and utilities, education, mobility, healthcare, finance, and insurance.

There are two ways in which we can portray Blockchain, simply as i) a general-purpose technology / technological output (to provide new services or lower the cost of existing services) and as ii) a disruptor of organisational design by giving the chance to a new approach to governance , and allowing self-organisation rather than top-down planning. The latter approach has the potential to impact our understanding of hierarchies and, therefore, our knowledge of how to regulate and perceive them. As Dave Clark put it, "reject kings, presidents and voting. We believe in rough consensus and running code" . Although non-hierarchy and structurelessness are among blockchain's core ideas, in practice, an individual (or a group of individuals) makes decisions .

It is helpful to differentiate between i) entities that use Blockchain as a tool and ii) Blockchain-enabled entities. Blockchain as a tool means the "real" world organisations remain the same, but there is a "tokenisation" of processes, contracts, products and/or services. Whilst in blockchain-enabled entities, there is a "substitution (reallocation) of economic governance from firms, markets, and relational contracts into blockchains" and an "integration of economic governance into activities not currently within the modern institutional economy" . Only the latter may not be within the current meaning of "undertaking" and/or "firm", since the first would be legally considered centralised .

Some authors believe that blockchain-enabled entities could compete with traditional institutions (market, firms, networks, relational contracting, and government) rather than changing them . Others leave the door open by considering that they have the potential to substitute as well as complement conventional organisations .

In this dissertation, we do not aim to predict whether Blockchain-enabled entities will develop to considerably integrate the market; we strive to acknowledge Blockchain's potential and a priori analyse whether Competition Law would be apt to "catch" these entities in case of suspicion of a competition infringement. The study of how Blockchain works, from a technological and economic perspective, greatly informs how governance might be impacted. Therefore, the Competition Law approach to defining "undertaking", by being closely related to economic impact, presents itself as a potential tool to create a structured sandbox regulation to understand Blockchain.

Firstly, we will define the legal scope of this dissertation, specifically focusing on the notion "undertaking" in European Competition Law. After, we will present Blockchain, its characteristics, potential, and governance. Lastly, we will study whether Blockchain poses a threat to the application of Competition Law, in particular, by analysing whether Competition Law would be applicable if a Blockchain-enabled entities were to infringe competition rules.

The mere creation or use of Blockchain will not trigger antitrust liability , even when done by a dominant firm . However, the risk of anti-competitive outcomes related to Blockchain has already been vastly studied . We will use their findings as examples to sustain the goal of the dissertation. To name a few, members performing transaction validations may collude to raise transaction fees; a dominant validator can support an attack to the Blockchain protocol; groups of validators or users may collude to exclude other participants; possible use of Blockchain for cartel management (especially when parties do not trust each other but look to cooperate to increase prices by using the data stored within the ledger) and lastly, the hypothetical possibility of a (type of) Blockchain becoming a dominant/standard technology capable of excluding other competing Blockchains (lack of interoperability between Blockchains might worsen this outcome) .

II. LEGAL SCOPE

There have been some initiatives aiming to legally rationalise and recognise entities born on Blockchain. This thesis does not aim to study those "legal wrappers", since most of them were forcefully attributed to conform to existing legal forms in the name of supposed "legal security", thereby essentially maintaining traditional notions. Although we recognise that legally recognising a Blockchain-enabled entity may have economic advantages, such as enabling access to real-world businesses, for example, access to fiat money , and may contribute to the limitation of liability of its users . In the view of this dissertation, Blockchain institutions, which are in fact decentralised, shall not be turned into legal traditional-like corporations simply because we currently do not have the proper framework.

"Legal wrappers" mainly take form as i) Limited Liability Companies , ii) Foundations and iii) Associations . Either for-profit or non-profit. More innovative approaches include the COALA Model Law , which was adapted by the Utah DAO in March 2023 .

As we will further explore, Competition Law analysis goes beyond that formal legal recognition.

1. Law and Technology

The Law and Technology field of study focuses on how the law should govern the interplay between technology and society . The study of its theory is relatively recent .

It is common to associate technology with social change. However, even if closely related, Law and Technology differentiates itself from the study of social change and the law. The latter focuses on what people think and do, while technological change considers what people are technically capable of doing . To understand the range of Law and Technology application, it is helpful to understand what technology is – "any tool or technique, any product or process, any physical equipment or method of doing or making, by which human capability is extended" .

Although legal problems particularly stemming from technological change are relatively rare and quite specific , regulation can play either a deterring or an encouraging role depending on the instruments used . Ultimately, the lack of appropriate regulation may kill the potential of a technology altogether .

Sandbox regulations create a framework for businesses to test products and services without the risk of being non-compliant with existing laws. The sandbox creates a framework of safeguards to prevent already known risks while preserving the flexibility that technology needs to flourish. The goal of sandbox regulation is to connect market players and regulators to better understand the technology and to identify the best way to protect society from its risks, while supporting promising innovation initiatives. The collaboration between said parties becomes crucial, especially in technologies like Blockchain, where it is technically possible for it to evolve outside legal frameworks. Code is not law , but it could be (compliance by design).

In the European Union, a sandbox approach for Blockchain has been adopted, with the goal of supporting 20 projects annually between 2023 and 2026 .

This dissertation, besides questioning whether Competition Law is ready to be applied to Blockchain-enabled entities, also aims to contribute to the sandbox line of thought by suggesting that European Competition Law analysis may be a virtuous tool for Blockchain sandbox regulation to effectively delimit the boundaries of a firm (even outside the Competition Law scope).

2. European Competition Law

European Competition Law aims to regulate competition in a free-market economy to ensure that the internal market competition is not distorted , based on the belief that a "proactive" competition policy leads to i) macroeconomic and ii) microeconomic benefits .

Macroeconomic effects are related to factors such as growth, inflation, consumption, jobs and investment. However, it is hard to measure and isolate the macroeconomic contribution of Competition Policy from other Public Policies (such as commercial, monetary, etc). Therefore, there is a lack of concrete evidence despite the attempts to prove otherwise .

Microeconomic effects relate to the welfare of individual economic agents, such as undertakings and consumers. Competition Law rules are a means to minimise "market failures" .

The first regulations on anticompetitive conduct date back a few years BC , in India and Rome , forbidding certain agreements between undertakings, output-limiting conduct, boycotts, and activities of private and public monopolies . In the Middle Ages, legal rules were created to protect markets and fairs, which then became Common Law precedent in the United Kingdom. Later, said Common Law inspired the Sherman Act (1890) in the United States .

After the Sherman Act, it took 50 years for competition rules to be adopted in Europe through the Treaty of Paris (1951) and later, and more directly, through the Treaty of Rome (1957) . The Treaty of Rome introduced a sophisticated competition law regime, including provisions on: anticompetitive agreements between competitors, abuses of dominance and rules governing state aid . It was a time of technological revolution – which resulted in the establishment of a large market that gave incentives for firms to exploit.

Article 3(1)(b) of the Treaty on the Functioning of the European Union (TFUE) determines that the "establishing of the competition rules necessary for the functioning of the internal market" is an exclusive competence of the Union. Which means that it is the European Union's competence when trade is affected between Member States or there are EU dimension mergers. If it does not affect the internal market, it is of national concern .

European Competition Law prohibits i) anticompetitive agreements (Article 101 TFUE) and ii) anticompetitive monopolistic practices (Article 102 TFUE), by one or multiple undertakings , in one or several markets. Anticompetitive agreements include, for example, pricing policies, limitations of production, and partitioning markets. Anticompetitive practices might entail price discrimination, exclusive supply clauses, tie-in sales, aggressive new product launch prices, certain types of price discounts and rebates. Mergers and acquisitions are supervised ex ante to prevent big concentration of market power.

To apply these prohibitions, we need to single out the undertaking or undertakings involved. In Competition Law, the term "undertaking" can refer to a single legally recognised entity or include multiple legally recognised entities. As we will further analyse in the next chapter, the "undertaking" is deeply connected with the Theory of the

Firm introduced by Coase – the "firm" as an economic agent (or a single economic unit) that can make decisions as to the exercise of the market power that it holds .

III. THE UNDERTAKING IN EUROPEAN COMPETITION LAW

Before explaining the theory of the firm and its jurisprudential practice in Competition Law, it is important to state why defining a firm/undertaking is important for Competition Law. Defining the firm is essential because it gives us the ability to i) understand if Competition Law should apply, ii) assess practices, iii) assign liability , and iv) define market power .

Regarding the ii) assessing practices, it is important to understand if, in terms of collusion, the two legal entities are part of the same economic unit. If so, they shall not be considered collusive, since they cannot be held responsible for colluding with themselves . The same logic is applied relating to monopolisation and abuse of dominant position, as well as when defining market power under Article 102.

1. Theory of the firm

The Court of Justice has made clear in Shell that "undertakings" are economic units rather than legal units , and Wouter Wills has underlined that the concept of undertaking takes as its starting point Ronald Coase's pathbreaking article .

The theory of the firm was introduced by Ronald Coase in his article "The nature of the firm" , which later became a fundamental pillar of Competition Law and Antitrust . Yet it is important to note that it has not always been that way; the Sherman Act and the European Treaties precede the influence of the article . The concept of "firm" is generally used in Economics, while the concept of "undertaking" is the European Law's equivalent.

In Economic theory, it is acknowledged that in the market, the allocation of factors of production is determined by the price mechanism . However, according to Coase, firms do not work the same way: market structures are controlled by price; firms are controlled by the "entrepreneur's" hierarchical control (vertical control or direct managerial control), which establishes command-and-control over resources . In other words, "a firm is characterised as a single decision-taker and pursues a single goal (of profit maximisation)" .

Coase argues that “entrepreneurs” reduce cost in transactions by internalising it, especially when dealing with “asset specificity and frequency of dealings” , such as negotiating and drafting contracts, researching possible partners, etc.. ; furthermore, the value of internalising the costs is potentiated by the uncertainty of the market.

Therefore, Coase concludes that i) by organising in firms, the economic agents are more efficient than economic individuals who compete; ii) firms extend into where they can minimise costs ; iii) uncertainty of markets potentiate the creation of firms, especially if long-term contracting is ideal .

Although it is not linear that both Williamson and Coase follow the same line of thought , the study of Williamson significantly contributes to the understanding of Coase’s Theory. Williamson (1985) operationalised “Coasean” theory through transaction cost analysis, by arguing that a hierarchical organisation is a method for controlling opportunism while in the presence of bounded rationality and asset specificity.

Bounded rationality considers the limited information and capacity one has. Introduced by Herbert Simon, the term recalls the need to acknowledge “the access to information and the computational capacities that are actually possessed by organisms, including man, in the kind of environments in which such organisms exist” . One may add that rationality is affected by fundamental uncertainty (indeterminacy of the future) .

By controlling opportunism, there is a rise in transaction cost efficiency of hierarchies and relational contracting over markets . Williamson adds that organisations are sometimes more efficient than markets because they have more efficient ways to solve disputes , such as the Incentive Theory (the impact of authority, ownership, and employee compensation) .

A firm is viewed as a “nexus of contracts”, however, as a nexus of incomplete contracts . Incomplete contracting models usually invoke transaction costs arising from: i) uncertainty, or unforeseen contingencies; ii) costs of writing contracts; iii) costs of enforcing contracts .

Hence, firms are created when there is a cost to use the price mechanism present in the Market. These costs, which have been immortalised as transaction costs, relate to the tasks of discovering what the relevant prices are and the costs of contracting with a variety of entities that would have been involved in a purely price-oriented production process .

2. The undertaking

European Union’s Competition rules primarily apply to “undertakings”: directly, through Article 101 and Article 102 and, indirectly, through Article 107 to Article 109 TFUE. The concept of “undertaking” is crucial, since only agreements and concerted practices between undertakings, and decisions made by associations of undertakings, are foreseen in Article 101. Likewise, Article 102 only applies to abuses perpetrated by dominant undertakings. Whilst the EU Merger Regulation , deals with shifts in the competition structure after mergers and acquisitions between undertakings.

Despite the relevance of the concept “undertaking”, it is not defined by any European legislation (not in the Rome Treaty, nor in secondary legislation) . This was a deliberate regulatory decision, since it was previously defined under Article 89 Paris Treaty , Article 196 b) EURATOM , Article 1 Protocol 22 Porto Treaty . As a general concept, it has the advantage of making regulation flexible and thus able to remain unchanged over time and along development .

According to Alison Jones, there is currently no consistency between the notion of “undertaking” under Article 101 and the notion of “sole control” under the EUMR , while defending that both should be in line with the economic notion of the firm – “the existence of authority or the power to exercise control over people and physical assets” .

The EU judiciary takes on the role of further clarifying the content and limits of such concept , and assesses if “its application is definite and foreseeable” . Nonetheless, the firm’s structure underwent minimal transformation over the years; it grew in complexity but has not changed in nature. As a result, litigation mostly involves other issues .

Thus far, there are two paths which we can follow to define “undertaking”: the i) institutional notion and the ii) functional notion.

At first, the jurisprudence tackled the concept of “undertaking” through an institutional approach. The i) institutional notion refers to a unitary organisation , which might include assets and personal elements (workers and managers) and a common goal . As seen, for example, in the Mannesmann Case where it was held that an undertaking is “an unitary organisation of individuals and tangible and intangible assets connected to a legally independent subject, and pursuing on an ongoing basis a specific economic goal” . The main shortcoming is that it can be easily confused with national law concepts, such as “company” or others , and it may not be able to catch “disguised” economic institutions.

The extent of the concept was progressively clarified by the Court of Justice, which brought it to the functional approach. The ii) functional notion considers any entity engaged in economic activity, despite the way in which it is financed and its legal status . As an example, under this approach, the Court defined an undertaking as “every entity engaged in an economic activity regardless of the legal status of the entity and the way in which it is financed” and “economic units which consist of a unitary organisation of personal, tangible and intangible elements, which pursue a specific economic aim on a long-term basis and can contribute to the commission of an infringement of the kind referred to in that provision”. It is therefore a “complex concept involving human and physical components joined in the pursuit of a single economic activity” .

Regarding the shift from an institutional notion to a functional notion, it seems that the only change made was the switch from “economic goal” to “economic activity” (which is also not defined in legislation); however, “economic activity” was already previously defined by the jurisprudence of the Court . For the purpose of this thesis, it is also important to preliminarily note that both approaches maintain the importance of a unitary entity. It is preferable to choose a functional notion, since it will overcome legal personality limits and encompass the totality of resources associated with a common finality, by establishing a common centre of control over those assets .

It is, thus, settled in jurisprudence that the concept of undertaking encompasses every entity engaged in an i) economic activity, ii) regardless of its legal status and iii) the way in which it is financed .

2.1 Economic activity

The CJUE follows the functional approach, which transfers the question from “who” is an undertaking to “what is economic activity” . Such analysis might vary depending on the conduct examined and the specific facts of the case in question.

Economic activity is any activity consisting of “offering goods or services on a given market . We must also consider that “the nature of the purchasing activity must therefore be determined according to whether or not the subsequent use of the purchased goods amounts to an economic activity” . The understanding of such a concept is still reigned by uncertainty (in law and in economics) .

It is likely that an entity may be considered an “undertaking” regarding some activities but not qualified as such for other activities . So, it is also possible to coexist within one entity, both economic and non-economic activities . For example, a public hospital is not, at first sight, an undertaking considering its public health activity; however, it can be regarded as one when considering the monetisation of its laboratories’ intellectual property rights .

It is also important to note that the General Court (GC) held that a “dormant” undertaking with no turnover, assets, or employees did not offer an economic activity . Nevertheless, an entity that only acts as a “facilitator” to a cartel can be an undertaking, even if it does not have an economic activity . The question remains whether those criteria are cumulative (no turnover, assets, or employees) or should be used as such.

The potentially limitless scope of the concept of economic activity/undertaking has prompted criticism from legal scholars ; however, some limits have already been advanced. To better understand this concept, it is essential to briefly explain the existing boundaries of “economic activity”: a) State and (some) public entities; b) solidarity; c) consumers; and d) workers.

a) Public Entities:

The State or the Organs of the Member States (for example, public authorities, the health service, municipalities, communes) and entities entrusted by the Member States with regulatory or other roles are able to alter competition . Nonetheless, we must exclude the consideration of an economic activity when the State or other public entities i) exercise public authority, ii) carry out activities that the market could not provide (in principle,

there is no economic activity), iii) buy goods to satisfy their needs, without the goal of reintroducing them in the market .

Regarding the i) exercise of public authority, the Court held, for instance, that entities enjoying and exercising prerogatives that "are typically" of governmental organisations, could not be designated an undertaking. A "typical" activity of a public authority can be, for example, air traffic control and marine anti-pollution monitoring since they constitute a "general interest mission" that is part of the essential functions of the State .

Therefore, we need to consider i) "its nature, its aim and the rules to which it is subject" and ii) whether it is "connected with the exercise of powers of a public authority" .

Regarding ii) activities that the market could not provide, it has been considered to include, for example, the activity of offering a compulsory social security system scheme .

It is also excluded when the State or other public entities iii) buy goods to satisfy its own needs, without the goal of reintroducing them in the market, like in the FENIN case where it was decided that "an organisation which purchases goods – even in great quantity – not for the purpose of offering goods and services as part of an economic activity, but in order to use them in the context of a different activity, such as one of a purely social nature, does not act as an undertaking simply because it is a purchaser in a given market" .

It might be harder to understand if it is an economic activity in "mixed markets", where public bodies and private firms are present on a Market , since both carry out the same activity.

As stated before, the same entity may be considered an undertaking depending on the activity it performs (whether economic or non-economic), which is particularly relevant in cases involving State or State-related entities . For example, a State school might not be considered as being engaged in an economic activity when providing free educational services, yet, it is probable to be an undertaking when renting out its facilities . As held in Case MOTOE in the context of public power and economic activity, each activity exercised by a given entity must be carried out separately .

b) Solidarity

Regarding solidarity, we need to analyse whether entities with the aim of exclusively focusing on social activities do so as undertakings or not . Given its importance, these

activities must not be competitive or exclusive. If they were to be considered as an economic activity, the entities involved in such endeavours would be considered undertakings, which could deprive them of public subsidies under 107 TFUE or even be incapable of providing services under Article 102 TFUE .

Such entities can be public or private, but in both scenarios, these entities need to pursue solidarity, non-profit initiatives, and initiatives in which the beneficiaries receive the service for free or through a payment that is below its true cost – we can see such activities in areas like social security , public security, health, and education .

The Court, in the Cases Poucet and Pistre , regarding social security, stated that to have a case of "national solidarity", i) the contribution for social security of the ones with more capital shall benefit the least well-off, and ii) active workers finance social security benefits for pensioners. It might also help to consider the activity as solidarity if the contributions and benefits are defined by law and not subject to market pricing .

The Advocate General Francis Jacobs further categorised the criteria that would generally be suggestive of the existence of an economic activity: i) the membership of the insurance scheme is optional; ii) the beneficiary's contributions would finance his own future social security benefits (principle of capitalisation) and no redistribution to other contributors; iii) benefits received by the contributor correlate with the contributions paid, the financial results of the investments made by the managing body and the costs generated by that body .

It is not yet clear whether those requirements are cumulative. In the Albany Case, the Court considered that the fund should be perceived as in competition with insurance companies, because the entity determined the amount of the contributions and benefits, and it followed the capitalisation principle – even if it was a pension fund with a mandatory membership system (exhibiting certain features of "solidarity") .

Therefore, an entity that purchases products (demand-side) not intending to supply goods and services as an economic activity, but to use them in a different activity, said activity shall not be perceived as economic and, hence, not an undertaking under Competition Law.

If all the criteria presented by Advocate General Jacobs in the Albany Case are not met, the Court shall turn to older jurisprudence and consider additional arguments that might suggest that there is, in fact, a national solidarity case, such as the profit motive and the

social character of the functions . Ultimately, the Court has been conducting a case-by-case assessment of what constitutes an “undertaking” .

c) Consumers

A natural person acting as a final consumer, purchasing goods or services, will never constitute an undertaking, since that behaviour is not economic .

d) Workers

Workers are not to be considered as undertakings . An employee is an individual working within a legal person, and, therefore, by being incorporated into the legal person, the employee does not bear financial and commercial risk over the transactions . For clarification, we shall break down the cumulative requirements needed to be considered a worker (which will be very useful in our subsequent analysis): i) control (subordination link); ii) remuneration; and iii) stable, genuine and effective nature of the work .

Individuals acting solely in their capacity as employees are not considered to be undertakings . For example, in the Becu Case the Court held that dock workers, while performing work for and under the direction of their employers, are incorporated in the undertaking that employs them and thus take part of an “economic unit” . The dock workers should not be taken collectively as an undertaking either . Consequently, collective labour agreements are permissible under Article 101 TFUE .

Alternatively, ex-employees who carry on an independent business can be considered an undertaking .

Subcontractors

A subcontracting agreement is defined as an agreement in which a firm (the “contractor”) entrusts to another, called ‘the subcontractor’, the manufacture of goods, the supply of services or the performance of work under the contractor's instructions, to be provided to the contractor or performed on his behalf . Subcontractors are not subject to Article 101 regarding their relationship with the contractor and, therefore, are not considered an undertaking in that context.

Agents

An agency contract is the one in which an agent “is a legal or physical person entrusted with the power to negotiate and/or conclude contracts on behalf of another person (‘the principal’), either in the agent’s own name or in the name of the principal, for the purchase

of goods or services by the principal, or the sale of goods or services supplied by the principal" .

The Court held that in principal and agent relationships, the agent may not be considered an independent trader and should be seen as an auxiliary organ "forming an integral part of the principal's undertaking" given their close economic links. Which means that, like employees , it also i) provides services for and under the direction of the principal, ii) it does not take any (or only a negligible portion) of the responsibility over the commercial and financial risk linked to sales of goods to third parties on behalf of the principal (even if an agent acts for more than one principal) .

Nonetheless, the CJ has held that the previous statement shall only be applied regarding the Market in which the agent offers the principal's goods or services. Which means it shall not be considered as an auxiliary part of the principal's business regarding the Market in which it offers its agency services to potential principals. In that situation, it shall be considered an independent operator and, therefore, an undertaking .

2.2 Regardless of its legal status

As stated before, it is feasible that the same entity may be found to be an "undertaking" for some activities but not qualified as such for other activities . The Commission held that the concept of undertaking is not intertwined with legal personality, which means that its content covers all entities engaged in economic activity, regardless of their legal personality ("a civil company, a commercial company, a public institution, a cooperative, an economic interest group or none of the above") or whether it has one . Nonetheless, it was already stated as necessary the ability to identify a "legal subject" for the decision to be implemented .

2.3 Regardless of the way in which it is financed

The concept "undertaking" covers all entities engaged in economic activities, regardless of how they are financed. As explored before while analysing the "economic activity" concept, public companies or entities financed by the State may fall within the scope of the term "undertaking" .

The idea of economic activity might remind us of profits, yet, such profit-motive or economic purpose is not essential. EU Competition Law does not differentiate between "altruistic entities" and "entities motivated by profit" since in both cases, it is possible

that certain activity may reduce competition. Such an idea has been applied to many cases, football clubs being one of the most interesting takes on Competition Law. Even if, at first sight, Competition Law should not be applied, in the International Olympic Committee's anti-doping Regulation, the Court held that, despite the Regulation being purely sport-related and not an economic activity per se , it had the potential to have anti-competitive consequences given the amount of economic activity based on sports .

We can even have situations where a service or product provided for free is considered an economic activity – for example, the German Federal Employment Office (Bundesanstalt) , an undertaking offering free advertising services to consumers or even a non-profit medical organisation that provides emergency transport and ambulance services . It is very common for products and services to be free in double-sided markets, for example, free morning papers, search engines (Google) or community sites (Facebook, Twitter); however, entities are paid by undertakings on the other side of the market, such as advertising entities .

3. Independence of undertakings

The term undertaking might entail several legal and/or natural persons . We will further explore the possibility of natural persons or several legal/natural persons as undertakings.

3.1 Natural person as an undertaking

Natural persons have repeatedly been held as undertakings in Competition Law. Multiple professions can be considered undertakings , because they are engaged in an economic activity (providing services against remuneration on markets). From artists (like opera singers), lawyers , industrial property agents , architects , accountants , self-employed medical specialists , attestation agents , geologists , employees pursuing their own economic interests, like research for company directors .

Consequently, natural persons may be considered an undertaking if self-employed or if they are from liberal professions . This conclusion shall not be altered by the fact it is an i) intellectual activity; ii) requires authorisation; iii) can be pursued in the absence of a combination of material, non-material, and human resources; iv) nor the complexity and technical nature of the services provided; v) nor the fact that the profession is regulated .

We can, therefore, conclude that individuals may constitute undertakings when operating as independent economic actors. Nonetheless, it is essential to note that a "natural

person… cannot, in his sole capacity as a member or shareholder, be classified as an undertaking" unless the shareholder actually exercises control by involving itself in the management of the undertaking (we will further explore what control means).

a) Prosumers

A prosumer can be defined as "market participants who both produce and consume their own goods or services" . The concept was popularised within the peer-to-peer (P2P) economy , although it was first coined by Alvin Toffler in 1990 . The P2P economy seems to be replacing or significantly complementing multiple markets .

The European Union's legislation does not define a prosumer as a "professional", hence most Member States continue to apply sector-specific definitions. They also were not considered as workers since, in most cases, they do not have one of the three cumulative requirements – i) under control/subordination; ii) remuneration and iii) stable nature of the work. If prosumers are not considered "undertakings", that means Competition Law does not apply, and, for example, they are free to coordinate their conduct. Interestingly, it has been stated that the minimum efficient size of a firm in a P2P economy can be less than a single person – for example, the occasional renter of a room, the weekend driver, and the part-time online shop owner" .

In a P2P economy, digital platforms enable contact between prosumers and users. Those digital platforms argue that there are two types of economic activities: "a) the digital intermediation performed by the platform that generally does not provide any material services to consumers and b) the supply of the underlying services (home, food ride or other sharing services)". While some platforms only i) provide a place for intermediation and advertisement, others ii) control every single aspect of the service (like Uber).

In the Uber Spain Case, it was claimed that there was unfair competition since Uber did not have administrative authorisation, like the rest of the transport services . Although the Court did not delve into the Competition Law question, it further clarified whether platforms should be regarded as transport services, information society services or a combination of both – it ultimately concluded that Uber exercises "a decisive influence over the conditions under which that service is provided by those drivers." Therefore, the drivers do not act independently from the platform, which might mean they should be considered either workers or subcontractors (it is also a good case to see Competition Law's role as a good first responder in the context of institutional innovation).

Although Uber drivers were qualified as part of the platform (and not as single economic units/undertakings), they might not resemble platforms from other sectors (for example, renting housing), and it seems unlikely that the stable nature and control/subordination are satisfied in most other platforms . To understand if each service provider is a separate undertaking, we need to analyse if each individual can establish its own i) business policy and ii) its prices, iii) carry financial risks, and iv) use their own resources .

In conclusion, the entity that will be considered an undertaking will depend on how the platform works, which means it will depend on casuistic analysis. Prosumers will in most cases be identified as undertakings when providing a service , except if the control exerted by the platform "is so exorbitant as to exclude any initiative and risk-taking by the suppliers" .

3.2 Single economic unit

Under the "single entity doctrine", multiple natural or legal persons may form one economic unit and, therefore, an undertaking, if a control relationship or decisive influence exists between them . Both the U.S. and European Courts have recognised that two legal entities that are part of the same economic unit cannot be held responsible for collusion, as one cannot agree with itself ; therefore, Article 101 TFEU will only apply to entities that can compete . The logic is similar regarding monopolisation and abuse of dominant position, since a company cannot abuse its market power against itself .

Regarding liability , it usually rests with the parent company unless the parent company has no control or decisive influence over the subsidiary's decisions. It is essential to distinguish between ownership and control .

Command-and-control can be defined as "a situation in which managers tell employees everything that they should do, rather than allowing them to decide some things for themselves" ; in other words, "Command-and-control instruments (mechanisms, laws, measures) are elements of policy and management that rely on prescribing rules and standards and using sanctions to enforce compliance with them" . In the same line, Article 3 n.º 2 of the Council Regulation on Control of Concentrations Between Undertakings: "Control shall be constituted by rights, contracts or any other means which, either separately or in combination and having regard to the considerations of fact or law involved, confer the possibility of exercising decisive influence on an undertaking, in particular by: (a) ownership or the right to use all or part of the assets of an undertaking;

(b) rights or contracts which confer decisive influence on the composition, voting or decisions of the organs of an undertaking" .

In the Case Akzo Nobel it is stated that "the actual exercise of decisive influence" defines firm limits in Competition Law and that "it is sufficient for the Commission to prove that the subsidiary is wholly owned by the parent company in order to presume that the parent exercises a decisive influence over the commercial policy of the subsidiary" . Decisive influence can also be seen when the parties do not decide independently in the Market and instead follow instructions from the parent company. In the Case Chemical Industries, the Court has ruled that executing "the instructions given" by another party was vital in analysing the independence of a subsidiary, and that "where a subsidiary does not enjoy real autonomy in determining its course of action in the market," the prohibitions set out in TFEU Article 101 were inapplicable .

Regarding the different types of legal/natural persons that can be perceived as an economic unit, there is no fixed rule – there should be a case-by-case analysis of control and decisive influence. For instance, in Hydrotherm, the Court of Justice found that a natural person, a limited partnership and another undertaking constituted a single economic unit because they were all controlled by the same natural person .

3.3 Relationship between economic unit and economic activity

The relationship between "economic activity" and "economic unit" is not clear. Especially, i) if an entity being involved in "economic activity" is the key element to establishing the scope of an economic unit, ii) if, even though an entity is engaged in economic activity, it might not be considered an undertaking because it takes part of a larger economic unit or iii) if an undertaking as an economic unit can be composed by multiple undertakings.

As previously explained, an undertaking is any entity engaged in economic activity despite the way in which it is financed and despite its legal status. Therefore, the concept of undertaking, as seen before, is not necessarily connected with natural or legal personality. An undertaking might entail a plurality of natural persons and/or legal persons, such as: i) companies and partnerships; ii) associations of undertakings; iii) parents and their subsidiaries; and iv) joint ventures.

As exemplified by Alison Jones, "a company or partnership may be made up of individuals capable of competing with one another, a principal and an agent or members

of the same corporate group (a parent and its subsidiaries) may constitute separate legal entities" . Nevertheless, we must recall that multiple persons who participate in a single economic entity are incapable of infringing Article 101 TFEU between one another. As Viho Case stated "where there is no agreement between economically independent entities, relations within an economic unit cannot amount to an agreement or concerted practice between undertakings which restricts competition" .

It may not always be easy to recognise the boundaries of each undertaking, since the reality of control between undertakings is not always formalised in their legal status – remaining the question of whether the undertakings are acting unilaterally or jointly, or if one or more undertakings exist .

It must be pointed out that it is not sufficient to establish that two companies form an economic unit when the same person or the same family have shares in two commercial companies . Likewise, it is feasible to have several majorities within the group of shareholders' meetings of companies without excluding the possibility of a single economic unit . The mere holding of shares in an undertaking does not, in itself, mean that the entity of the shares is an undertaking; yet, if the shareholder actually exercises control by involving himself directly or indirectly in the management of the undertaking, it must be regarded as part of the economic activity and, therefore, it must be viewed as an undertaking . "As long as there is a unitary organisation of personnel and tangible and intangible elements, which pursues a specific economic aim on a long-term basis and can contribute to a restriction of competition or an abuse of dominance, it qualifies as an undertaking for the purposes of Articles 101 and 102 TFEU" .

It is, consequently, not clear the relationship between the concept "economic activity" and "economic unit". Does the economic activity define the scope of the economic unit? Or is it possible to have a larger economic unit and, within it, an undertaking engaged in economic activity? .

In the Case Confederación Española, the Court refers to a partnership and firms both as an "undertaking", as well as two legally independent undertakings that together constitute one contracting party as an economic unit for the purposes of the agreement . It seems that the undertaking as an economic unit can be composed of various undertakings (natural or legal) .

Besides the above-mentioned group of persons, other less obvious groups can also be considered undertakings, such as P & I clubs , agricultural cooperatives and trade associations .

IV. BLOCKCHAIN

Before further clarifying what Blockchain is, it is vital to understand the difference between Blockchain and Distributed Ledger Technologies (DLT). The terms Blockchain and DLT are often used interchangeably, but while all Blockchains are DLTs, not all DLTs are Blockchains. Non-Blockchain distributed systems do not depend on "the creation of a chain of blocks and instead use alternative crypto-economic mechanisms to reach consensus" – for example, Directly Acyclic Graphs .

1. The technology

Blockchain can be understood as a distributed system, i) for recording data , ii) in a cryptographically secured way, which makes it hard to tamper with the previous ledger ; through (iii) crypto-economic incentives and (iv) a common rule structure that keeps copies of the ledger and adds new entries and/or blocks (protocol and consensus mechanisms).

Data is recorded in a Blockchain through blocks. Each block contains data about what happens in the ledger/chain . The chain (the connection between blocks) connects all the previous transactions and information of past blocks; a continuous chain with ad infinitum (an Infinite memory) collection of data .

The blocks need to be mined by solving mathematical problems presented by the system , then stored and validated by the community of the Blockchain. Such blocks are accessible to all members , and if new data is not verifiable within the existing Blockchain, those blocks will not be integrated . Therefore, it creates a peer-to-peer network that is efficient, permanent, and verifiable .

To briefly understand how transactions are technically made possible: the transaction sender signs the transaction with a private key. This private key creates a public key with a practical non-invertible function . The hash, also referred to as an address, is created from the corresponding public key where the amount of cryptocurrency for the private key is registered. The verification is made possible through "zero-knowledge proof",

which enables verification without knowing the contents of the transaction . Hence, private keys are not the same as personal entities since a personal entity would have a different private key of all the transactions made, rendering the technology pseudo-anonymous .

Users need to trust in i) how decisions are made (rules to decide how to create new blocks (consensus mechanism) and overall protocol , ii) in the transaction (“that the same amount left one account as arrived in another, that the sender agreed to it, and that the funds used are unique and were not double-spent”) and that the iii) conditional contract will be automatically executed (a general scripting language with programmable functionality). Users also expect it to be more resistant to external attacks since there is no infrastructural central point of failure (sensitive central point) .

Some Blockchains, like Ethereum, enable smart contracts. Smart contracts are algorithmic “contracts” in which the contracting parties can define terms and conditions that, through Blockchain, are automatically maintained and resolved on the chain . Blockchain is designed with self-executing code; however, it is not always able to respond to ever-changing circumstances . We will further explain this point in Chapter IV 2.

Even though users depend on each other for the survival of the Blockchain, they do not trust each other and can only recognise one another by their public addresses. Blockchain technology is a step towards progressing from trustworthy third-party verification (for example, an intermediary) to relying on consensus mechanisms and “high-powered crypto-economic incentive protocols to verify the authenticity of a transaction in the database” , and, therefore, towards trustlessness.

Tokens or crypto-assets provide incentives to users, which bind them to the platform and facilitate “community-driven forms of corporate organization and governance” building .

Crypto-assets can be defined as “a digital representation of a value or of a right that is able to be transferred and stored electronically using distributed ledger technology or similar technology” .

Tokens are often free (possibly including targeting “additional token-drops at influential users as they grow”) or can be bought (or earned) with minimal cost at the beginning of the token’s release. The early adopters value a token for its long-term potential . Token

effects explain the idea that free tokens offer a "costless way for new entrants to reimburse users for the value of the network effects they bring to the platform" .

2. Governance and decision-making

To understand how decisions are made within Blockchain, one needs to understand i) if the Blockchain is public or private, permissioned or permissionless; ii) the layers of the Blockchain and iii) the consensus mechanisms (which requires understanding of the different types of users/players within Blockchain space and the difference between on-chain and off-chain governance).

a) Public or private, permissioned or permissionless

It is important to note that "public" and "permissionless" or "private" and "permissioned" are not synonyms , even though it is possible to find literature that groups them together. The distinction is crucial because it clearly shows how involved the users are in the development of the system (whether anyone can be a validator/miner or not).

A Blockchain is private when it requires prior authorisation to access; it is public when there is no authorisation needed.

A Blockchain being permissionless or permissioned refers to the accreditation process to accept a new member / "power that a user can exercise" – therefore, a permissionless Blockchain requires no authorisation for new members or for members to develop the system , whether permissioned Blockchains require it .

Another difference is that permissionless Blockchains don't have their principles determined at the start , it is later built by core software developers, miners, users and token holders .

It follows that public Blockchains can either be permissioned or permissionless, whereas private blockchains can only be permissioned . Permissioned systems are governed by a party or consortium that controls the accreditation process for new members and determines the system's rules . Only public permissionless Blockchains are truly public domain because of their open access, open-source and interoperable protocols without a centrally controlled entity . Considering the above explanation and the research question of this thesis, it is concluded that only Public Permissionless blockchains may present real novelty to Competition Law, since all other blockchains have a central authority.

A Public Permissionless Blockchain is what some call a DAO (Decentralised Autonomous Organisation). In this thesis, we do not use the DAO nomenclature because a lot of players who are not actually DAO use the DAO term; we use Public Permissionless Blockchains of clarity.

b) Layers of Blockchain

Blockchains are built through layers. Layers allow the software to be developed on top of itself, thus providing participants with different applications. Depending on the specific project we are analysing, there will be different layers to consider. Within this multi-layered process, each layer acts and has governance independently from each other; however, they are also interdependent , the actions people take on one layer may have repercussions or be influenced by the layers above it .

We can identify various layers. The layer 0 (Hardware/ Infrastructure Layer) comprises the hardware and network architecture. Examples of projects built on this Layer include Polkadot and Cardano. Layer 1 (Network Layer) is where protocol and consensus mechanisms are present. Examples include Ethereum and Bitcoin. Layer 2 manages the transaction of layer 1, an example in Lightning Network on Bitcoin. Layer 3 (Application Layer), the last layer, is the one that users have access to real-world applications of Blockchain, such as wallet providers, crypto exchanges and payment mechanisms . Layers can be classified in other terms, and more layers can be added depending on the taxonomy. We can also differentiate between the Internet Layer (enhancing the role of internet providers) , the Blockchain Layer (where it is included the technical architecture and the governance processes) , the Application Layer (where the application system might create multiple layers – it is not an "unified whole. It consists of multiple layers, each inheriting from the one below."). Bitcoin, for example, has in itself two highly interdependent layers .

Blockchains may have different layers on top of one another, and it might not be possible to control them or stop the addition of new layers.

c) Consensus mechanisms

Traditional entities organise through a combination of formal and informal hierarchies , which impact how decisions are made and, ultimately, where control stands. Blockchain's governance and control are mirrored in the consensus mechanisms, both on-chain and off-chain.

While there is a perceived absence of hierarchy and structure, which are some of Blockchain's core ideas , in practice, decisions can be made by an individual (if centralised) or a collective of individuals . One should keep in mind that "Blockchain is a space in which different forms of powers are being exercised" , that power can be reflected when Blockchain is not able to respond to ever-changing circumstances .

Governance might entail, for example, i) updating the code, ii) addressing technical bugs, iii) determining the interoperability between the on-chain and off-chain , iv) answering to unplanned events to remain competitive , v) determining wealth distribution on the network . Vitalik Buterin, the Founder of Ethereum, doubts we will ever be able to have a blockchain's governance process sufficiently robust and capable of regularly doing things like adjusting fundamental economic parameters .

On-chain governance means coin holders' votes are adopted automatically through the protocol. To install an endorsed update, Miners have no stake in the process of deciding if certain changes should be adopted (no agency) . Unless we consider that groups of miners /validators and coin holders may increasingly overlap, approximating the respective interests of these groups . Coin holders or users propose new blocks and new transactions .

Off-chain governance has a broader pool of users, and decisions shall be taken into consideration.

Miners/Validators are essential for the implementation of protocol changes; only through the majority of miners (measured by computing power) can a proposal be updated to the protocol. In the limit, they can even exercise a veto over decisions (capable of refusing code), but only when they have most of the hashing power (computing power). A soft fork can be created when such a veto is exercised – which means the new and old versions of the software coexist . Even if it is a very technical role, any participant can choose to be a miner .

Blockchain founders and core developers implement the original rules of a blockchain . Software core developers are central to the preservation of the protocol since they are the only ones able to make proposals .

There are various consensus mechanisms, with different incentives and through different mechanisms. The two most well-known are Proof of Work and Proof of Stake.

Proof of Work is the most common consensus mechanism on public blockchains right now (for example, Bitcoin). Miners compete to solve a cryptographic puzzle; the first one to solve it is granted the right to validate a transaction (and therefore, be paid through a transaction fee and newly minted tokens).

Proof of Stake, token holders vote for the miners who validate blocks (for example, on Ethereum). The miners' prospects to validate blocks increase alongside with how many tokens they own and the duration of possession . Miners here are called validators and are only rewarded with transaction fees .

Proof of activity results from a combination of Proof of Work and Proof of Stake . It includes the need to complete a puzzle by miners, like the Proof of Work, after which a validator with more tokens is chosen to validate the transaction or block. The reward (fee) is split among the miner and validator .

Alongside these consensus mechanisms, many more exist, such as Proof of Burn, Delegated Proof of Stake (DPoS), Proof of Elapsed Time (PoET), Proof of Authority (PoAu), Proof of Importance (PoI), Proof of Reputation (PoR), Proof of Luck (PoLu). Each consensus mechanism results in different processes and, therefore, different power structures .

V. BLOCKCHAIN AND THE THEORY OF THE FIRM

1. Blockchain and efficiency

As mentioned before, Blockchain technology is being used in various industries . Blockchain reduces cost from a total factor productivity , rendering Blockchain to a general-purpose technology . The tokenisation of assets brings great fluidity and creates a hyper-efficient market. To better understand it, it is worthwhile to recognise the importance of network effects and token effects in cryptoeconomics.

Nonetheless, the potential of Blockchain does not end there. Blockchain has governance potential (besides using it as a tool for already existing firms) "likely to radically change how organizations operate" .

2. Blockchain as an Institutional Technology

In the beginning, there was Market (and, therefore, price mechanism). Coase posed the question of "If price mechanism works, why do firms exist?". The answer was

predominantly related with the reduction of transaction costs by having an “entrepreneur” directing resources. Now, another question arises: “If prices mechanisms work; if firms can reduce transaction costs, why should we care about Blockchain?”.

Firms and Markets are traditionally seen as “alternative methods of co-ordinating production” / “organization” . Market capitalist economies, like firms and governments, historically dominated instruments for economic coordination. Distributed technologies, and specifically, Public Permissionless Blockchains, introduce the ability to disrupt existing hierarchies to the point where experts foresee that “traditional roles such as investors, executives, managers and consumers will become blurred” .

Blockchain is a new general-purpose information and computation technology, but it is also a revolutionary new institutional technology for economic coordination , which enables “more “inclusive” and “communal” models of organisation that empower more stakeholders” . Blockchain presents itself as an Institutional Technology, a new perspective on institutional governance. Its novelty is related to the introduction of a new way to achieve consensus since it grants large groups of individuals the opportunity to cooperate in a stable environment (cryptographic stigmergy).

These characteristics have the potential to weaken the assumption of efficiency of hierarchies (that exploit incomplete contracts) over Markets . As well as control opportunism (in the presence of bounded rationality) in the Market. Therefore, Blockchain technology challenges key assumptions underpinning the existence of the firm .

3. Transaction Costs

Transaction costs are the “ultimate unit of economic investigation” . From Coase’s doctrine, we can conclude that the existence of transaction costs validates alternative methods of organisation. Blockchain makes possible the reduction of transaction costs and can achieve that end arguably better than firms .

Transaction cost can be reduced with the use of smart contracts by i) the reduction of complexity of drafting contracts (for example, by creating an open-source contract library), ii) the reduction of search costs, contracting costs and coordination costs , iii) the automation of transactions (which means the execution of transactions happens when certain conditions are met and don’t require human input from the contracting parties after the smart contract is created). This automation creates an iv) indefinitely pure

promise that brings certainty to long-term contracts and v) greatly eliminates the need for trusted intermediaries . Plus, it is believed that the overall cost related to the making and maintenance of smart contracts would vi) “cost a fraction of the price that trusted intermediaries are currently able to charge for their services” .

Regarding trust , it is normally expensive to manufacture it conventionally . It is largely assumed that Blockchain does not require trust (it is trustless) , presenting itself as a solution when “agents do not benefit from the trust that may exist within the firm regarding the proper execution of internal transactions” . However, this trustless narrative is inherently limited because behind the code are always humans who can affect it .

Another significant difference relates to information asymmetries. Blockchain introduces the recording of information with valuable data on past transactions, which is a more informative signal than price (since price is memoryless) .

Blockchain tends to limit uncertainty through transparency, immutability, and smart contracts; long-term contracting could be enabled within Blockchain instead of resorting to the control of the entrepreneur, thereby reducing uncertainty. “It is improbable that the firm would emerge without the existence of uncertainty” . Coase somehow envisioned this – “With uncertainty entirely absent, every individual being in possession of perfect knowledge of the situation, there would be no occasion for anything of the nature of responsible management or control of productive activity. (…) The flow of raw materials and productive services to the consumer would be entirely automatic” .

Therefore, “it returns the transaction to a market-like context but with fewer of the costs of a market” , and at the same time, it broadens the limits of efficient contracting, which, until now, was the “role” of the firm . It has even been argued that the “reduction in transaction costs in downstream markets may facilitate the adoption of new business models” .

Nevertheless, Blockchain technology does not eliminate transaction costs entirely . Smart contracts, even if incredibly innovative, do not completely solve the problem of incomplete contracts, because they are incomplete contracts themselves. Hence, smart contracts may still need legal recognition , third-party arbitration , verification of their features and investment in education on cryptographic tools (which comes with a cost). When drafting contracts, we may encounter costs related to the bargaining of the smart contract, the translation of contracts into code and possible costs related to the

enforcement of the smart contracts. Regarding commitment costs, it encompasses "paying fees to full nodes or information services" to protect against theft of digital assets. Lastly, the energy costs required for Permissionless Blockchains are still high, which calls for further development .

4. A Market, a Firm or something in between

The study of the connection between Competition Law and Blockchain is still in its early days; however, there are already various considerations regarding whether Blockchain should be deemed as a Market, a Firm, or neither a Market nor a Firm.

It is argued that Blockchain creates room for a shift from firms towards markets, since it could potentiate true price-driven exchanges among suppliers and consumers . And, if markets can be more efficient than command economies, the latter would cease to exist .

We can interpret Blockchain as a platform where various economic players meet, as a "three-sided" market (buyers, sellers and miners/validators) or a multi-sided market .

Blockchains may enable firms – "blockchain does not necessarily correspond to a single undertaking, but may bring together different firms and individuals". It has been stated that a group of validators could be considered a "gig-working co-operatives" (like Partners in a law firm), whilst individually following collectively determined norms (protocols) ; others have called it a "commons-based peer production" . Some authors go further, stating that certain mining pools could be considered partnerships , and some Blockchain projects can be viewed as joint ventures . Whereas such arguments are interesting, such analysis is outside the scope of this thesis since, in Competition Law, no legal form is required. Therefore, as stated before, trying to "force" Blockchain potential into already existing corporate figures could only be used as a supporting argument in concrete cases, not as the basis for defending the claim that they could be seen as firms.

Heavily grounded in the innovation Blockchain brings as an institutional technology, some argue that Blockchain should be considered outside the scope of markets and firms – it should be understood as a third way, given that it has systematic advantages over both . "Blockchains compete with firms, markets and economies, as institutional alternatives for coordinating the economic actions of groups of people" . With a similar line of thought, "When coupled with token systems (…) blockchains make possible new institutional orders that operate at a micro-scale, yet with the full coordination properties of what we would otherwise attribute to a self-organizing macroeconomy" .

The study of phenomena outside the dichotomy between Market and State goes past the discussion of using a decentralised technology, such as Blockchain. Polycentric governance was initially studied by the economist Vincent Ostrom, introducing it as "polycentric governance, a diverse array of communities and public and private authorities with overlapping domains of responsibility interact in complex and ever-changing ways, and out of these seemingly uncoordinated processes of mutual adjustment emerges a persistent system of social ordering that can support and sustain capacities for individual liberty, group autonomy, and community self-governance" .

Similarly, and applied to the Blockchain reality, the term plutocratic system relates to the possibility of creating accidental corporate structures (even if not directly "advertised" by their members) or hybrid forms . These accidental structures can be defined as "spontaneous organizations using the price mechanisms of markets, the governance properties of a common, and, to some extent, the constitutional properties of a nation-state" . Or, in other words, some situations "make it closer in essence to the price mechanism, though others make it seem more akin to a firm; this combination of features makes it all the more evident that the cryptographic stigmergy defines a space for coordinated production in between those of the price mechanism and the firm" .

Just because transaction costs are not the same as in a traditional firm or traditional Market, it does not mean that blockchain cannot enable one or the other. The line of thought Coase still applies to Blockchain reality, since it is simply another way in which people organise to reduce transaction costs.

I tend to believe that Blockchain can enable Markets and/or firms, depending on the individual case (the layer or layers under study, or how players interact); and even if we consider a third option, it is arguable that it would still be inside the scope of Competition Law since it is a form of organised individuals with economic activities.

To truly understand if a firm is possible, one shall understand the different power dynamics that can happen within Blockchain; which means, if control or decisive influence might be present.

4.2 Theory of Granularity

Schrepel argues that the Theory of the Firm initiated by Ronald Coase, which is centred around direct top-down control to reduce transaction costs, cannot be transposed to Blockchain . He reaches such a conclusion through considering that Blockchains are made

of horizontal governance mechanisms, unlike the firm, which relies on vertical and pyramidal control .

Schrepel introduces the Theory of Granularity , which aims to analyse the role played by each element of a Blockchain . Through that theory he arrives to a "nucleus" because, as already suggested, "even with horizontal and decentralized governance, a group of participants may achieve a form of direct control over the blockchain by collaborating, and as such, by circumventing (some of) the constraints imposed on them" . He includes in the nucleus all participants who have a personal interest (although momentarily) in continually collaborating with each other. "They do not compete, and although their short-term interests may diverge, they seek to achieve the same long-term goal: ensuring the blockchain survival" . Schrepel concludes that defining this nucleus is central to identifying which participants are collaborating to escape the constraints imposed on them to control the blockchain, and potentially, if these participants are abusing their control for anti-competitive purposes.

If a nucleus is an obvious concentration of power, a Permissionless Blockchain with a concentrated list of validators, for example, starts to resemble a Permissioned Blockchain with a small list of validators.

4.3 Is it possible for control or decisive influence to exist within Blockchain?

Within Blockchain, control can be exercised, however, it is not the traditional hierarchical control. Competition Law frames the firm as an economic agent (or a single economic unit) that is actually capable of making decisions, which means to exercise the market power that it holds. Applying these principles to Blockchain is complex, since a Blockchain may bring together different groups and individuals.

It is important to remember again that only Public Permissionless Blockchains truly bring novelty from an organisational perspective and, consequently, the ones inside the scope of this chapter. In this chapter, we will further analyse the influence that each class of members might have over decisions made within Blockchain, especially if it has the potential to interfere with its economic value (if a control structure can be detected at all) and who governs the market power that the blockchain may have.

Blockchain can be seen as the aggregation of various individual objectives where multiple interests and incentives can compete; and, theoretically speaking, every

participant can influence . Said influence "is proportional to its stake in the platform - e.g. in terms of computing power, storage, labor or capital dedicated to it" .

Zetzsche et al. separate the "DLT hierarchy" in four groups: (i) "the core group that sets-up the code design and (de facto) governs the DLT, for instance by having the technical ability and opinion leadership to prompt a hard fork of the system (under certain conditions); (ii) the owners of additional servers running the distributed ledger code for validation purposes […]; (iii) qualified users of the distributed ledger, such as exchanges, lending institutions, miners etc.; and (iv) third parties affected by the system without directly relying on the technology, for instance, [..] simple users, clients of intermediaries […] etc." .

As we have already seen before, Blockchain governance relies on consensus mechanisms but also power structures (blockchain is also heavily politicised), which do not constitute direct orders over others . Nonetheless, even if no single party has command and control over decisions in Public Permissionless Blockchains, they are frequently depicted "to be more decentralized than they really are" .

Although Blockchains in general are praised for being automated, as exposed before, we may never be able to build a blockchain governance process capable of i) adjusting fundamental economic parameters , ii) amending the protocol, and iii) rewards protocol development .

Given the above limitations, at least the first-generation Blockchains will be de facto centralised in core developers' teams or miners to formulate design choices . However, others argue that the architecture of Blockchain, as soon as it is created and put online, they lose any form of control .

It is argued that Founders and Core Developers perform a "janitorial role" to ensure that the goals of the project are followed, like sending emergency messages to all nodes on the network to ask them to adopt updates . They also carry with them a role as influential advisors given to their central "political" role in the survival of the Blockchain's philosophy, as well as their technical skills, even if the personal incentives of other participants might limit their influence. Therefore, it is also possible that Blockchain is used in ways that are outside the creator's control .

The role of Miners could raise a possible control situation since they have the capability of i) influencing soft forks by releasing a 51% attack , and, out of all the participants, they are the ones that ii) most directly can impact the economic value within Blockchains.

Despite the soft fork, the impact may appear less severe if we consider that even with the modification of the protocol, the Blockchain remains compatible with previous versions and the fact that, for the fork to be effective they must convince the rest of the participants to operate as nodes to run the new version of the software and users to transact on to the new fork.

Their capabilities to impact the economic value within Blockchain derives from their capability to raise fees or increase the gas limits . The power of miners is enhanced if there is a strong community spirit they group in mining pools .

The primary real power of token holders over the Blockchain derives from their decision to use it or not; that decision is fundamental to Blockchain's economic value. Their control is directly associated with their ownership over tokens, which grants them the possibility to vote . They influence i) transaction fees; ii) hard forks on the Blockchain .

Even if theoretically Token Holders can vote, it is believed that i) those powers are limited by how hard it is to exercise coordinated control, since their activities are "highly decentralised and spontaneous in nature" and ii) the fact that presumably they will do what is best for the network since the maintenance of the network would be in their interest (which, in case of mass adoption of Blockchain may lead them to always agree with the advice given by core developers). Existing doctrine excludes users' responsibility .

Yet, those arguments shall not be the reason why their decisions should not be scrutinised by Competition Law Authorities. Their power over decisions is impacted by how much wealth they have connected with the token which might seem big enough not to simply consider them users but a kind of prosumer (that contributes to the evolution of decision making but also might use the Blockchain as a simple user). Also, even though we presume that every token holder will align their interests with the survival of the network, such an idea has not been tested .

Therefore, it is expected that users should check for themselves whether the decision made and/or the protocol complies with Competition Law and, in case of suspicion of infringement, they should vote against the proposal and take action to make

improvements by, for example, communicating it to the developers (which is usually made off-chain, for example, in Discord). However, if the users do not engage in the decision-making process, it is not likely that they would be found responsible under Competition Law; such inference comes from the Eturas Case – "if it cannot be established that a travel agency was aware of that message, its participation in a concertation cannot be inferred from the mere existence of a technical restriction implemented in the system at issue" .

The same principle might also be applicable to miners, according to Ioannis Lianos. Miner's control might take the form of colluding to raise transaction fees, an attack by a dominant validator or a colluding group of miners to exclude other participants .

It is also possible for a person to accumulate more than one class of participants. Some Token Holders/Users might also act as Miners/Validators (since they are paid with tokens) and Founder and Core Developers, which might also raise the question of how realistic it is to have a large pool of roles but a small pool of people who actually exercise their power through voting .

4.4 Commentary

The Theory of Granularity greatly informs how attentive we need to be when classifying the limits of the firm. Defining the limits of firm a priori may go against the flexibility of the term within Competition Law, and such practice, as Coase puts it, is a trend in economic theory .

We propose identifying a possible anti-competitive practice, a particular decision (or a group of decisions) that created an identifiable effect (effects already studied in different instances), for which one finds the need to investigate and try to understand who exactly made the decision. Which means, first looking for a possible breach of Competition Law, then identifying the nucleus of that decision – it might lead us to identify a "nucleus" that goes beyond a pre-defined DAO or layer. Which means, taking into account each decision, while being aware of i) the possible volatility of the members of the groups, ii) the interdependency of layers, iii) the consensus mechanism (including the risk of soft forks and hard forks), iv) outside-of-Blockchain and offline exchanges of information, v) the possible tendency of organising through class and vi) the concentration of wealth.

The nucleus, because of the possible volatility of groups within Blockchain, can be ever-changing, which will render the analysis more demanding for competent Regulatory

Entities (such as the Commission or NRAs) and Judicial Entities. The members who influenced a past decision might not be the same members who are present in the group at the time of evaluation. However, one might also argue that even though there is volatility of the groups, there is a tendency for the nucleus to stay the same.

Plus, given the fact that the interdependency of layers makes it possible to have decisions made without the active consent of the players affected by it, makes it important to not ignore the layers under a Dapp, DAO or other type of conglomerate of people within Blockchain – especially if those decisions have economic effects. So, even considering that Blockchain is predominantly horizontal, some verticality still exists.

Centralisation may occur in various layers , including at the protocol level and network level. It is also possible for the hardware layer to be centralised when nodes are owned by a small group of individuals and stored in close geographic proximity, clustered in data centres. Likewise, mining operations are also often centralised .

The emergence of mining as an economic activity has led to the development of mining pools and an ecosystem of industries that supply goods and services to miners. Mining requires specialised equipment which uses an "application-specific integrated circuits (ASIC), which are chips designed to perform a single function: block mining" and the possible need to resort to miners' insurance . Which means real-world firms might impact Blockchain through the access of hardware and insurance – complementary services can give a de facto monopoly power over a cryptocurrency .

The consensus mechanism is one of the central aspects one needs to pay attention to, since it greatly informs how decisions are made. There is a general presumption that because of tokens and the technical possibility of giving all people the right to vote, that all Blockchains work like that, which couldn't be further from the truth. For example, in Proof of Work, Miners make decisions (pools of miners enhance this problem). However, even if Token Holders do have voting power, most do not vote. Since Miners are remunerated with tokens, it may pose the question of whether, in practice, they do not end up being the ones who make the decisions also.

Particular attention has been given to the centralisation risks of consensus mechanisms in cryptocurrency systems, with the consequence that validations are performed by a few entities and possibly coming under the control of one entity be a source of centralisation. This is obvious in systems based on PoS validation. However, such holdings may also

give power in PoW systems, such as the power to launch certain attacks. PoW puzzles may be less susceptible to centralisation; however it seems hard to avoid the development of specialised hardware and consequent centralisation risk .

Even though Blockchain exists in a Web3 world, outside-of-Blockchain and offline exchanges of information might interfere with the decision-making, even if it was identified that the members are in different countries.

The economic and political importance of forks must not be underestimated since it has significant economic implications (network effects weaken with every fork) – "[i]n the Web 2.0 world, forking is the equivalent of Facebook allowing any competitor to take their entire database and codebase to a competitor" .

As Buterin once stated, it is possible that Blockchain creates a type of classicism where each type of player might be motivated to coordinate. Possible solutions have been proposed, such as " social interventions that try to increase participants' loyalty to the community around the blockchain as a whole and substitute or discourage the possibility of the players on one side of a market becoming directly loyal to each other"; "promoting communication between different "sides of the market" in the same context, so as to reduce the possibility that either validators or developers or miners begin to see themselves as a "class" that must coordinate to defend their interests against other classes"; "designing the protocol in such a way as to reduce the incentive for validators/miners to engage in one-to-one "special relationships", centralised relay networks and other similar super-protocol mechanisms" .

Finally, the concentration of wealth. Since ownership and voting are tightly coupled, this may lead to a feudal structure, in which influence is measured by wealth .

VI. Conclusion

The answer to the question of whether Competition Law can be applied to Public Permissionless Blockchain-enabled entities can be divided into two steps. In a preliminary stance, one should take into consideration if the Theory of the Firm is applicable – since the European Competition Law's term "undertaking" is greatly based on Coase's theory. Secondly, one should analyse if it would go in line with European Competition Law per se, its growing case law, and clarifications from the Commission.

As explained before, it is still not consensual if Blockchain would enable firms, markets, or a third way of organising economic power. I tend to agree with the possibility of Blockchain enabling markets and/or firms, depending on the individual case. By acknowledging the new possible form to organise and through its plutocratic system, it is possible to create accidental corporate structures (even if not directly "advertised" by its members) or a hybrid form – and, therefore, hierarchies, even if not formal or fixed. And, in case a hierarchy cannot be found, what can it be besides a market, if the market is what exists when there is no firm? Even if it is a market with different features, it does not seem justified to exclude the consideration that it is indeed a market.

Schrepel defends that the Theory of the firm cannot be transposed to Blockchain. Yet, Coase arguably foreshadowed platform economies , especially when he observed that "(i)inventions which tend to bring factors of production nearer together, by lessening spatial distribution, tend to increase the size of the firm." I believe the greatest contribution of Coase's Theory is not so much the fixed idea of a "top-down" hierarchy, but the idea of how humans will choose to organize in ways that lower transaction costs, which is arguably one of the most significant advantages of Blockchain – "no matter which proof of work system is implemented, they all follow a maximal growth curve that reflects the nature of the firm as detailed in 1937 by Ronald Coase (1937)" .

It is important to note that European Competition Law predates the influence of the Theory of the Firm . Therefore, even if we consider that the Theory of the Firm does not apply, European Competition Law is still applicable.

For an undertaking to exist under Competition Law it needs to have i) an economic activity, ii) regardless of its legal status and iii) the way in which it is financed. Primavera De Filippi and Aaron Wright have highlighted that "every interaction with a blockchain is ultimately an economic transaction, and every party participating in the network serves as an economic actor" . Others leave open the possibility of some activities within Blockchain not being considered as economic – some examples might entail similar situations already excluded by the Commission and Courts, such as solidarity activities . However, it seems fair to affirm that most activities done within Blockchain consist of some kind of "offering goods or services on a given market" .

Another point to consider is the fact that, up until now, a firm-first analysis approach was justifiable. It was simpler from a legal perspective. Most legal entities that act in the

market have a recognized legal form, but i) they do not need to be a legal form that is traditionally connected with economic activity (for example, they can be an association) and ii) it is possible to consider a firm which includes various presumably autonomous legal entities. This shows that Competition Law analysis goes beyond preliminary consideration of what could be formally an undertaking. Furthermore, we do not need to define the firm and then look for economic activity to justify the existence of the firm. We could observe economic activity (the industry) and then look for the decision-making processes (the consensus mechanisms, on-chain and off-chain) to analyse which (if any) control or decisive influence with economic consequences was taking place. The conclusion of what is an undertaking will highly depend upon the consensus mechanism used, and, therefore, the specificities of the power structure enabled by it. The relevance and impact of each player will be different according to each consensus mechanism.

Lastly, Competition Law has the potential to be a valuable tool for a sandbox regulation, given the flexibility of Competition Law and its case-by-case analysis by design. The study of Blockchain from a Competition Law approach would inform NRAs and the legislator on how the markets and firms work, especially regarding Public Permissioned Blockchain, before jumping into over-regulation or misregulation.

In parallel, Competition Law is a great tool to achieve the goal of decentralised technologies – to fight against the abuse of concentration of power. The first, by analysing the market, the anti-competitive agreements, and decisions that were anti-competitive or have anti-competitive effects made by firms, proposing compromising measures or not accepting mergers and acquisitions. The latter, offers a technical solution for decentralisation of power to exist.

The study of Blockchain and especially the study of Competition Law and Blockchain is still in its infancy. Many questions remain regarding the specific consequences of each consensus mechanism (or if the market will evolve to consider one, or a few, as default consensus mechanisms). I believe that a deeper study on specific cases will better inform if within Blockchain there is market, firms, both, or none – because it seems that the answer ultimately relies on how decisions are made (consensus mechanisms).

Concerning enforcement, especially in Public Permissionless Blockchains, the identity of most members is pseudonymized. Some initiatives have been created to try to solve this concern, like attributing a digital ID that would make the members identifiable by

allowing members to actively register . However, it is still not clear if, even if Competition Law is theoretically applicable if it could be practically enforced.

Lastly, given the suggestion above about an industry-first analysis, a deeper understanding of the dynamic economic power within blockchain might be relevant to competition assessment and market definition.

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LIST OF ABBREVIATIONS

AG - Advocate General

COALA – Coalition of Automated Legal Applications

DAO – Decentralised Autonomous Organisation

ECJ - European Court of Justice

GC - General Court

NRAs – National regulatory authorities

OJ - Official Journal of the European Communities

PoS – Proof of Stake

PoW – Proof of Work

TFUE - Treaty on the Functioning of the European Union

Table of Contents

I. INTRODUCTION

Human history is largely intertwined with the ability of humans to organise, which has been dominated by centralised organisations, whether with formal or informal hierarchies . Throughout the late 20th century, information ledgers were digitalised; however, they remained centralised . Blockchain proposes itself as a disruptive innovation that exemplifies Schumpeter's creative destruction .

Blockchain caught the market's attention – Blockchain startup companies raised up to $2.6 billion in venture capital in the first quarter of 2021 alone . Various industries have adopted it to the point that the real challenge is finding one that is immune to the market's enthusiasm. To name a few: logistics, energy and utilities, education, mobility, healthcare, finance, and insurance.

There are two ways in which we can portray Blockchain, simply as i) a general-purpose technology / technological output (to provide new services or lower the cost of existing services) and as ii) a disruptor of organisational design by giving the chance to a new approach to governance , and allowing self-organisation rather than top-down planning. The latter approach has the potential to impact our understanding of hierarchies and, therefore, our knowledge of how to regulate and perceive them. As Dave Clark put it,

“reject kings, presidents and voting. We believe in rough consensus and running code” . Although non-hierarchy and structurelessness are among blockchain’s core ideas, in practice, an individual (or a group of individuals) makes decisions .

It is helpful to differentiate between i) entities that use Blockchain as a tool and ii) Blockchain-enabled entities. Blockchain as a tool means the “real” world organisations remain the same, but there is a “tokenisation” of processes, contracts, products and/or services. Whilst in blockchain-enabled entities, there is a “substitution (reallocation) of economic governance from firms, markets, and relational contracts into blockchains” and an “integration of economic governance into activities not currently within the modern institutional economy” . Only the latter may not be within the current meaning of “undertaking” and/or “firm”, since the first would be legally considered centralised .

Some authors believe that blockchain-enabled entities could compete with traditional institutions (market, firms, networks, relational contracting, and government) rather than changing them . Others leave the door open by considering that they have the potential to substitute as well as complement conventional organisations .

In this dissertation, we do not aim to predict whether Blockchain-enabled entities will develop to considerably integrate the market; we strive to acknowledge Blockchain’s potential and a priori analyse whether Competition Law would be apt to “catch” these entities in case of suspicion of a competition infringement. The study of how Blockchain works, from a technological and economic perspective, greatly informs how governance might be impacted. Therefore, the Competition Law approach to defining “undertaking”, by being closely related to economic impact, presents itself as a potential tool to create a structured sandbox regulation to understand Blockchain.

Firstly, we will define the legal scope of this dissertation, specifically focusing on the notion “undertaking” in European Competition Law. After, we will present Blockchain, its characteristics, potential, and governance. Lastly, we will study whether Blockchain poses a threat to the application of Competition Law, in particular, by analysing whether Competition Law would be applicable if a Blockchain-enabled entities were to infringe competition rules.

The mere creation or use of Blockchain will not trigger antitrust liability , even when done by a dominant firm . However, the risk of anti-competitive outcomes related to Blockchain has already been vastly studied . We will use their findings as examples to sustain the goal of the dissertation. To name a few, members performing transaction validations may collude to raise transaction fees; a dominant validator can support an attack to the Blockchain protocol; groups of validators or users may collude to exclude other participants; possible use of Blockchain for cartel management (especially when parties do not trust each other but look to cooperate to increase prices by using the data stored within the ledger) and lastly, the hypothetical possibility of a (type of) Blockchain becoming a dominant/standard technology capable of excluding other competing Blockchains (lack of interoperability between Blockchains might worsen this outcome) .

II. LEGAL SCOPE

There have been some initiatives aiming to legally rationalise and recognise entities born on Blockchain. This thesis does not aim to study those "legal wrappers", since most of them were forcefully attributed to conform to existing legal forms in the name of supposed "legal security", thereby essentially maintaining traditional notions. Although we recognise that legally recognising a Blockchain-enabled entity may have economic advantages, such as enabling access to real-world businesses, for example, access to fiat money , and may contribute to the limitation of liability of its users . In the view of this dissertation, Blockchain institutions, which are in fact decentralised, shall not be turned into legal traditional-like corporations simply because we currently do not have the proper framework.

"Legal wrappers" mainly take form as i) Limited Liability Companies , ii) Foundations and iii) Associations . Either for-profit or non-profit. More innovative approaches include the COALA Model Law , which was adapted by the Utah DAO in March 2023 .

As we will further explore, Competition Law analysis goes beyond that formal legal recognition.

1. Law and Technology

The Law and Technology field of study focuses on how the law should govern the interplay between technology and society . The study of its theory is relatively recent .

It is common to associate technology with social change. However, even if closely related, Law and Technology differentiates itself from the study of social change and the law. The latter focuses on what people think and do, while technological change considers what people are technically capable of doing . To understand the range of Law and Technology application, it is helpful to understand what technology is – "any tool or technique, any product or process, any physical equipment or method of doing or making, by which human capability is extended" .

Although legal problems particularly stemming from technological change are relatively rare and quite specific , regulation can play either a deterring or an encouraging role depending on the instruments used . Ultimately, the lack of appropriate regulation may kill the potential of a technology altogether .

Sandbox regulations create a framework for businesses to test products and services without the risk of being non-compliant with existing laws. The sandbox creates a framework of safeguards to prevent already known risks while preserving the flexibility that technology needs to flourish. The goal of sandbox regulation is to connect market players and regulators to better understand the technology and to identify the best way to protect society from its risks, while supporting promising innovation initiatives. The collaboration between said parties becomes crucial, especially in technologies like Blockchain, where it is technically possible for it to evolve outside legal frameworks. Code is not law , but it could be (compliance by design).

In the European Union, a sandbox approach for Blockchain has been adopted, with the goal of supporting 20 projects annually between 2023 and 2026 .

This dissertation, besides questioning whether Competition Law is ready to be applied to Blockchain-enabled entities, also aims to contribute to the sandbox line of thought by suggesting that European Competition Law analysis may be a virtuous tool for Blockchain sandbox regulation to effectively delimit the boundaries of a firm (even outside the Competition Law scope).

2. European Competition Law

European Competition Law aims to regulate competition in a free-market economy to ensure that the internal market competition is not distorted , based on the belief that a "proactive" competition policy leads to i) macroeconomic and ii) microeconomic benefits .

Macroeconomic effects are related to factors such as growth, inflation, consumption, jobs and investment. However, it is hard to measure and isolate the macroeconomic contribution of Competition Policy from other Public Policies (such as commercial, monetary, etc). Therefore, there is a lack of concrete evidence despite the attempts to prove otherwise .

Microeconomic effects relate to the welfare of individual economic agents, such as undertakings and consumers. Competition Law rules are a means to minimise "market failures" .

The first regulations on anticompetitive conduct date back a few years BC , in India and Rome , forbidding certain agreements between undertakings, output-limiting conduct, boycotts, and activities of private and public monopolies . In the Middle Ages, legal rules were created to protect markets and fairs, which then became Common Law precedent in the United Kingdom. Later, said Common Law inspired the Sherman Act (1890) in the United States .

After the Sherman Act, it took 50 years for competition rules to be adopted in Europe through the Treaty of Paris (1951) and later, and more directly, through the Treaty of Rome (1957) . The Treaty of Rome introduced a sophisticated competition law regime, including provisions on: anticompetitive agreements between competitors, abuses of dominance and rules governing state aid . It was a time of technological revolution – which resulted in the establishment of a large market that gave incentives for firms to exploit.

Article 3(1)(b) of the Treaty on the Functioning of the European Union (TFUE) determines that the "establishing of the competition rules necessary for the functioning of the internal market" is an exclusive competence of the Union. Which means that it is the European Union's competence when trade is affected between Member States or there are EU dimension mergers. If it does not affect the internal market, it is of national concern .

European Competition Law prohibits i) anticompetitive agreements (Article 101 TFUE) and ii) anticompetitive monopolistic practices (Article 102 TFUE), by one or multiple undertakings , in one or several markets. Anticompetitive agreements include, for example, pricing policies, limitations of production, and partitioning markets. Anticompetitive practices might entail price discrimination, exclusive supply clauses, tie-in sales, aggressive new product launch prices, certain types of price discounts and rebates. Mergers and acquisitions are supervised ex ante to prevent big concentration of market power.

To apply these prohibitions, we need to single out the undertaking or undertakings involved. In Competition Law, the term "undertaking" can refer to a single legally recognised entity or include multiple legally recognised entities. As we will further analyse in the next chapter, the "undertaking" is deeply connected with the Theory of the Firm introduced by Coase – the "firm" as an economic agent (or a single economic unit) that can make decisions as to the exercise of the market power that it holds .

III. THE UNDERTAKING IN EUROPEAN COMPETITION LAW

Before explaining the theory of the firm and its jurisprudential practice in Competition Law, it is important to state why defining a firm/undertaking is important for Competition Law. Defining the firm is essential because it gives us the ability to i) understand if Competition Law should apply, ii) assess practices, iii) assign liability , and iv) define market power .

Regarding the ii) assessing practices, it is important to understand if, in terms of collusion, the two legal entities are part of the same economic unit. If so, they shall not be considered collusive, since they cannot be held responsible for colluding with themselves . The same logic is applied relating to monopolisation and abuse of dominant position, as well as when defining market power under Article 102.

1. Theory of the firm

The Court of Justice has made clear in Shell that "undertakings" are economic units rather than legal units , and Wouter Wills has underlined that the concept of undertaking takes as its starting point Ronald Coase's pathbreaking article .

The theory of the firm was introduced by Ronald Coase in his article “The nature of the firm” , which later became a fundamental pillar of Competition Law and Antitrust . Yet it is important to note that it has not always been that way; the Sherman Act and the European Treaties precede the influence of the article . The concept of “firm” is generally used in Economics, while the concept of “undertaking” is the European Law’s equivalent.

In Economic theory, it is acknowledged that in the market, the allocation of factors of production is determined by the price mechanism . However, according to Coase, firms do not work the same way: market structures are controlled by price; firms are controlled by the “entrepreneur’s” hierarchical control (vertical control or direct managerial control), which establishes command-and-control over resources . In other words, “a firm is characterised as a single decision-taker and pursues a single goal (of profit maximisation)” .

Coase argues that “entrepreneurs” reduce cost in transactions by internalising it, especially when dealing with “asset specificity and frequency of dealings” , such as negotiating and drafting contracts, researching possible partners, etc.. ; furthermore, the value of internalising the costs is potentiated by the uncertainty of the market.

Therefore, Coase concludes that i) by organising in firms, the economic agents are more efficient than economic individuals who compete; ii) firms extend into where they can minimise costs ; iii) uncertainty of markets potentiate the creation of firms, especially if long-term contracting is ideal .

Although it is not linear that both Williamson and Coase follow the same line of thought , the study of Williamson significantly contributes to the understanding of Coase’s Theory. Williamson (1985) operationalised “Coasean” theory through transaction cost analysis, by arguing that a hierarchical organisation is a method for controlling opportunism while in the presence of bounded rationality and asset specificity.

Bounded rationality considers the limited information and capacity one has. Introduced by Herbert Simon, the term recalls the need to acknowledge “the access to information

and the computational capacities that are actually possessed by organisms, including man, in the kind of environments in which such organisms exist" . One may add that rationality is affected by fundamental uncertainty (indeterminacy of the future) .

By controlling opportunism, there is a rise in transaction cost efficiency of hierarchies and relational contracting over markets . Williamson adds that organisations are sometimes more efficient than markets because they have more efficient ways to solve disputes , such as the Incentive Theory (the impact of authority, ownership, and employee compensation) .

A firm is viewed as a "nexus of contracts", however, as a nexus of incomplete contracts . Incomplete contracting models usually invoke transaction costs arising from: i) uncertainty, or unforeseen contingencies; ii) costs of writing contracts; iii) costs of enforcing contracts .

Hence, firms are created when there is a cost to use the price mechanism present in the Market. These costs, which have been immortalised as transaction costs, relate to the tasks of discovering what the relevant prices are and the costs of contracting with a variety of entities that would have been involved in a purely price-oriented production process .

2. The undertaking

European Union's Competition rules primarily apply to "undertakings": directly, through Article 101 and Article 102 and, indirectly, through Article 107 to Article 109 TFUE. The concept of "undertaking" is crucial, since only agreements and concerted practices between undertakings, and decisions made by associations of undertakings, are foreseen in Article 101. Likewise, Article 102 only applies to abuses perpetrated by dominant undertakings. Whilst the EU Merger Regulation , deals with shifts in the competition structure after mergers and acquisitions between undertakings.

Despite the relevance of the concept "undertaking", it is not defined by any European legislation (not in the Rome Treaty, nor in secondary legislation) . This was a deliberate regulatory decision, since it was previously defined under Article 89 Paris Treaty , Article 196 b) EURATOM , Article 1 Protocol 22 Porto Treaty . As a general concept, it has the

advantage of making regulation flexible and thus able to remain unchanged over time and along development .

According to Alison Jones, there is currently no consistency between the notion of "undertaking" under Article 101 and the notion of "sole control" under the EUMR , while defending that both should be in line with the economic notion of the firm – "the existence of authority or the power to exercise control over people and physical assets" .

The EU judiciary takes on the role of further clarifying the content and limits of such concept , and assesses if "its application is definite and foreseeable" . Nonetheless, the firm's structure underwent minimal transformation over the years; it grew in complexity but has not changed in nature. As a result, litigation mostly involves other issues .

Thus far, there are two paths which we can follow to define "undertaking": the i) institutional notion and the ii) functional notion.

At first, the jurisprudence tackled the concept of "undertaking" through an institutional approach. The i) institutional notion refers to a unitary organisation , which might include assets and personal elements (workers and managers) and a common goal . As seen, for example, in the Mannesmann Case where it was held that an undertaking is "an unitary organisation of individuals and tangible and intangible assets connected to a legally independent subject, and pursuing on an ongoing basis a specific economic goal" . The main shortcoming is that it can be easily confused with national law concepts, such as "company" or others , and it may not be able to catch "disguised" economic institutions.

The extent of the concept was progressively clarified by the Court of Justice, which brought it to the functional approach. The ii) functional notion considers any entity engaged in economic activity, despite the way in which it is financed and its legal status . As an example, under this approach, the Court defined an undertaking as "every entity engaged in an economic activity regardless of the legal status of the entity and the way in which it is financed" and "economic units which consist of a unitary organisation of personal, tangible and intangible elements, which pursue a specific economic aim on a long-term basis and can contribute to the commission of an infringement of the kind referred to in that provision". It is therefore a "complex concept involving human and physical components joined in the pursuit of a single economic activity" .

Regarding the shift from an institutional notion to a functional notion, it seems that the only change made was the switch from "economic goal" to "economic activity" (which

is also not defined in legislation); however, “economic activity” was already previously defined by the jurisprudence of the Court . For the purpose of this thesis, it is also important to preliminarily note that both approaches maintain the importance of a unitary entity. It is preferable to choose a functional notion, since it will overcome legal personality limits and encompass the totality of resources associated with a common finality, by establishing a common centre of control over those assets .

It is, thus, settled in jurisprudence that the concept of undertaking encompasses every entity engaged in an i) economic activity, ii) regardless of its legal status and iii) the way in which it is financed .

2.1 Economic activity

The CJUE follows the functional approach, which transfers the question from “who” is an undertaking to “what is economic activity” . Such analysis might vary depending on the conduct examined and the specific facts of the case in question.

Economic activity is any activity consisting of “offering goods or services on a given market . We must also consider that “the nature of the purchasing activity must therefore be determined according to whether or not the subsequent use of the purchased goods amounts to an economic activity” . The understanding of such a concept is still reigned by uncertainty (in law and in economics) .

It is likely that an entity may be considered an “undertaking” regarding some activities but not qualified as such for other activities . So, it is also possible to coexist within one entity, both economic and non-economic activities . For example, a public hospital is not, at first sight, an undertaking considering its public health activity; however, it can be regarded as one when considering the monetisation of its laboratories’ intellectual property rights .

It is also important to note that the General Court (GC) held that a “dormant” undertaking with no turnover, assets, or employees did not offer an economic activity . Nevertheless, an entity that only acts as a “facilitator” to a cartel can be an undertaking, even if it does not have an economic activity . The question remains whether those criteria are cumulative (no turnover, assets, or employees) or should be used as such.

The potentially limitless scope of the concept of economic activity/undertaking has prompted criticism from legal scholars ; however, some limits have already been advanced. To better understand this concept, it is essential to briefly explain the existing boundaries of "economic activity": a) State and (some) public entities; b) solidarity; c) consumers; and d) workers.

a) Public Entities:

The State or the Organs of the Member States (for example, public authorities, the health service, municipalities, communes) and entities entrusted by the Member States with regulatory or other roles are able to alter competition . Nonetheless, we must exclude the consideration of an economic activity when the State or other public entities i) exercise public authority, ii) carry out activities that the market could not provide (in principle, there is no economic activity), iii) buy goods to satisfy their needs, without the goal of reintroducing them in the market .

Regarding the i) exercise of public authority, the Court held, for instance, that entities enjoying and exercising prerogatives that "are typically" of governmental organisations, could not be designated an undertaking. A "typical" activity of a public authority can be, for example, air traffic control and marine anti-pollution monitoring since they constitute a "general interest mission" that is part of the essential functions of the State .

Therefore, we need to consider i) "its nature, its aim and the rules to which it is subject" and ii) whether it is "connected with the exercise of powers of a public authority" .

Regarding ii) activities that the market could not provide, it has been considered to include, for example, the activity of offering a compulsory social security system scheme .

It is also excluded when the State or other public entities iii) buy goods to satisfy its own needs, without the goal of reintroducing them in the market, like in the FENIN case where it was decided that "an organisation which purchases goods – even in great quantity – not for the purpose of offering goods and services as part of an economic activity, but in order to use them in the context of a different activity, such as one of a purely social nature, does not act as an undertaking simply because it is a purchaser in a given market" .

It might be harder to understand if it is an economic activity in "mixed markets", where public bodies and private firms are present on a Market , since both carry out the same activity.

As stated before, the same entity may be considered an undertaking depending on the activity it performs (whether economic or non-economic), which is particularly relevant in cases involving State or State-related entities . For example, a State school might not be considered as being engaged in an economic activity when providing free educational services, yet, it is probable to be an undertaking when renting out its facilities . As held in Case MOTOE in the context of public power and economic activity, each activity exercised by a given entity must be carried out separately .

b) Solidarity

Regarding solidarity, we need to analyse whether entities with the aim of exclusively focusing on social activities do so as undertakings or not . Given its importance, these activities must not be competitive or exclusive. If they were to be considered as an economic activity, the entities involved in such endeavours would be considered undertakings, which could deprive them of public subsidies under 107 TFUE or even be incapable of providing services under Article 102 TFUE .

Such entities can be public or private, but in both scenarios, these entities need to pursue solidarity, non-profit initiatives, and initiatives in which the beneficiaries receive the service for free or through a payment that is below its true cost – we can see such activities in areas like social security , public security, health, and education .

The Court, in the Cases Poucet and Pistre , regarding social security, stated that to have a case of "national solidarity", i) the contribution for social security of the ones with more capital shall benefit the least well-off, and ii) active workers finance social security benefits for pensioners. It might also help to consider the activity as solidarity if the contributions and benefits are defined by law and not subject to market pricing .

The Advocate General Francis Jacobs further categorised the criteria that would generally be suggestive of the existence of an economic activity: i) the membership of the insurance scheme is optional; ii) the beneficiary's contributions would finance his own future social security benefits (principle of capitalisation) and no redistribution to other contributors; iii) benefits received by the contributor correlate with the contributions paid, the financial

results of the investments made by the managing body and the costs generated by that body .

It is not yet clear whether those requirements are cumulative. In the Albany Case, the Court considered that the fund should be perceived as in competition with insurance companies, because the entity determined the amount of the contributions and benefits, and it followed the capitalisation principle – even if it was a pension fund with a mandatory membership system (exhibiting certain features of "solidarity") .

Therefore, an entity that purchases products (demand-side) not intending to supply goods and services as an economic activity, but to use them in a different activity, said activity shall not be perceived as economic and, hence, not an undertaking under Competition Law.

If all the criteria presented by Advocate General Jacobs in the Albany Case are not met, the Court shall turn to older jurisprudence and consider additional arguments that might suggest that there is, in fact, a national solidarity case, such as the profit motive and the social character of the functions . Ultimately, the Court has been conducting a case-by-case assessment of what constitutes an "undertaking" .

c) Consumers

A natural person acting as a final consumer, purchasing goods or services, will never constitute an undertaking, since that behaviour is not economic .

d) Workers

Workers are not to be considered as undertakings . An employee is an individual working within a legal person, and, therefore, by being incorporated into the legal person, the employee does not bear financial and commercial risk over the transactions . For clarification, we shall break down the cumulative requirements needed to be considered a worker (which will be very useful in our subsequent analysis): i) control (subordination link); ii) remuneration; and iii) stable, genuine and effective nature of the work .

Individuals acting solely in their capacity as employees are not considered to be undertakings . For example, in the Becu Case the Court held that dock workers, while performing work for and under the direction of their employers, are incorporated in the undertaking that employs them and thus take part of an "economic unit" . The dock

workers should not be taken collectively as an undertaking either . Consequently, collective labour agreements are permissible under Article 101 TFUE .

Alternatively, ex-employees who carry on an independent business can be considered an undertaking .

Subcontractors

A subcontracting agreement is defined as an agreement in which a firm (the "contractor") entrusts to another, called 'the subcontractor', the manufacture of goods, the supply of services or the performance of work under the contractor's instructions, to be provided to the contractor or performed on his behalf . Subcontractors are not subject to Article 101 regarding their relationship with the contractor and, therefore, are not considered an undertaking in that context.

Agents

An agency contract is the one in which an agent "is a legal or physical person entrusted with the power to negotiate and/or conclude contracts on behalf of another person ('the principal'), either in the agent's own name or in the name of the principal, for the purchase of goods or services by the principal, or the sale of goods or services supplied by the principal" .

The Court held that in principal and agent relationships, the agent may not be considered an independent trader and should be seen as an auxiliary organ "forming an integral part of the principal's undertaking" given their close economic links. Which means that, like employees , it also i) provides services for and under the direction of the principal, ii) it does not take any (or only a negligible portion) of the responsibility over the commercial and financial risk linked to sales of goods to third parties on behalf of the principal (even if an agent acts for more than one principal) .

Nonetheless, the CJ has held that the previous statement shall only be applied regarding the Market in which the agent offers the principal's goods or services. Which means it shall not be considered as an auxiliary part of the principal's business regarding the Market in which it offers its agency services to potential principals. In that situation, it shall be considered an independent operator and, therefore, an undertaking .

2.2 Regardless of its legal status

As stated before, it is feasible that the same entity may be found to be an “undertaking” for some activities but not qualified as such for other activities . The Commission held that the concept of undertaking is not intertwined with legal personality, which means that its content covers all entities engaged in economic activity, regardless of their legal personality (“a civil company, a commercial company, a public institution, a cooperative, an economic interest group or none of the above”) or whether it has one . Nonetheless, it was already stated as necessary the ability to identify a “legal subject” for the decision to be implemented .

2.3 Regardless of the way in which it is financed

The concept “undertaking” covers all entities engaged in economic activities, regardless of how they are financed. As explored before while analysing the “economic activity” concept, public companies or entities financed by the State may fall within the scope of the term “undertaking” .

The idea of economic activity might remind us of profits, yet, such profit-motive or economic purpose is not essential. EU Competition Law does not differentiate between “altruistic entities” and “entities motivated by profit” since in both cases, it is possible that certain activity may reduce competition. Such an idea has been applied to many cases, football clubs being one of the most interesting takes on Competition Law. Even if, at first sight, Competition Law should not be applied, in the International Olympic Committee’s anti-doping Regulation, the Court held that, despite the Regulation being purely sport-related and not an economic activity per se , it had the potential to have anti-competitive consequences given the amount of economic activity based on sports .

We can even have situations where a service or product provided for free is considered an economic activity – for example, the German Federal Employment Office (Bundesanstalt) , an undertaking offering free advertising services to consumers or even a non-profit medical organisation that provides emergency transport and ambulance services . It is very common for products and services to be free in double-sided markets, for example, free morning papers, search engines (Google) or community sites (Facebook, Twitter); however, entities are paid by undertakings on the other side of the market, such as advertising entities .

3. Independence of undertakings

The term undertaking might entail several legal and/or natural persons . We will further explore the possibility of natural persons or several legal/natural persons as undertakings.

3.1 Natural person as an undertaking

Natural persons have repeatedly been held as undertakings in Competition Law. Multiple professions can be considered undertakings , because they are engaged in an economic activity (providing services against remuneration on markets). From artists (like opera singers), lawyers , industrial property agents , architects , accountants , self-employed medical specialists , attestation agents , geologists , employees pursuing their own economic interests, like research for company directors .

Consequently, natural persons may be considered an undertaking if self-employed or if they are from liberal professions . This conclusion shall not be altered by the fact it is an i) intellectual activity; ii) requires authorisation; iii) can be pursued in the absence of a combination of material, non-material, and human resources; iv) nor the complexity and technical nature of the services provided; v) nor the fact that the profession is regulated .

We can, therefore, conclude that individuals may constitute undertakings when operating as independent economic actors. Nonetheless, it is essential to note that a "natural person… cannot, in his sole capacity as a member or shareholder, be classified as an undertaking" unless the shareholder actually exercises control by involving itself in the management of the undertaking (we will further explore what control means).

a) Prosumers

A prosumer can be defined as "market participants who both produce and consume their own goods or services" . The concept was popularised within the peer-to-peer (P2P) economy , although it was first coined by Alvin Toffler in 1990 . The P2P economy seems to be replacing or significantly complementing multiple markets .

The European Union's legislation does not define a prosumer as a "professional", hence most Member States continue to apply sector-specific definitions. They also were not considered as workers since, in most cases, they do not have one of the three cumulative requirements – i) under control/subordination; ii) remuneration and iii) stable nature of the work. If prosumers are not considered "undertakings", that means Competition Law does not apply, and, for example, they are free to coordinate their conduct. Interestingly, it has been stated that the minimum efficient size of a firm in a P2P economy can be less

than a single person – for example, the occasional renter of a room, the weekend driver, and the part-time online shop owner" .

In a P2P economy, digital platforms enable contact between prosumers and users. Those digital platforms argue that there are two types of economic activities: "a) the digital intermediation performed by the platform that generally does not provide any material services to consumers and b) the supply of the underlying services (home, food ride or other sharing services)". While some platforms only i) provide a place for intermediation and advertisement, others ii) control every single aspect of the service (like Uber).

In the Uber Spain Case, it was claimed that there was unfair competition since Uber did not have administrative authorisation, like the rest of the transport services . Although the Court did not delve into the Competition Law question, it further clarified whether platforms should be regarded as transport services, information society services or a combination of both – it ultimately concluded that Uber exercises "a decisive influence over the conditions under which that service is provided by those drivers." Therefore, the drivers do not act independently from the platform, which might mean they should be considered either workers or subcontractors (it is also a good case to see Competition Law's role as a good first responder in the context of institutional innovation).

Although Uber drivers were qualified as part of the platform (and not as single economic units/undertakings), they might not resemble platforms from other sectors (for example, renting housing), and it seems unlikely that the stable nature and control/subordination are satisfied in most other platforms . To understand if each service provider is a separate undertaking, we need to analyse if each individual can establish its own i) business policy and ii) its prices, iii) carry financial risks, and iv) use their own resources .

In conclusion, the entity that will be considered an undertaking will depend on how the platform works, which means it will depend on casuistic analysis. Prosumers will in most cases be identified as undertakings when providing a service , except if the control exerted by the platform "is so exorbitant as to exclude any initiative and risk-taking by the suppliers" .

3.2 Single economic unit

Under the "single entity doctrine", multiple natural or legal persons may form one economic unit and, therefore, an undertaking, if a control relationship or decisive influence exists between them . Both the U.S. and European Courts have recognised that

two legal entities that are part of the same economic unit cannot be held responsible for collusion, as one cannot agree with itself ; therefore, Article 101 TFEU will only apply to entities that can compete . The logic is similar regarding monopolisation and abuse of dominant position, since a company cannot abuse its market power against itself .

Regarding liability , it usually rests with the parent company unless the parent company has no control or decisive influence over the subsidiary's decisions. It is essential to distinguish between ownership and control .

Command-and-control can be defined as “a situation in which managers tell employees everything that they should do, rather than allowing them to decide some things for themselves” ; in other words, “Command-and-control instruments (mechanisms, laws, measures) are elements of policy and management that rely on prescribing rules and standards and using sanctions to enforce compliance with them“ . In the same line, Article 3 n.º 2 of the Council Regulation on Control of Concentrations Between Undertakings: “Control shall be constituted by rights, contracts or any other means which, either separately or in combination and having regard to the considerations of fact or law involved, confer the possibility of exercising decisive influence on an undertaking, in particular by: (a) ownership or the right to use all or part of the assets of an undertaking; (b) rights or contracts which confer decisive influence on the composition, voting or decisions of the organs of an undertaking” .

In the Case Akzo Nobel it is stated that “the actual exercise of decisive influence” defines firm limits in Competition Law and that “it is sufficient for the Commission to prove that the subsidiary is wholly owned by the parent company in order to presume that the parent exercises a decisive influence over the commercial policy of the subsidiary” . Decisive influence can also be seen when the parties do not decide independently in the Market and instead follow instructions from the parent company. In the Case Chemical Industries, the Court has ruled that executing “the instructions given” by another party was vital in analysing the independence of a subsidiary, and that “where a subsidiary does not enjoy real autonomy in determining its course of action in the market,” the prohibitions set out in TFEU Article 101 were inapplicable .

Regarding the different types of legal/natural persons that can be perceived as an economic unit, there is no fixed rule – there should be a case-by-case analysis of control and decisive influence. For instance, in Hydrotherm, the Court of Justice found that a

natural person, a limited partnership and another undertaking constituted a single economic unit because they were all controlled by the same natural person .

3.3 Relationship between economic unit and economic activity

The relationship between “economic activity” and “economic unit” is not clear. Especially, i) if an entity being involved in “economic activity” is the key element to establishing the scope of an economic unit, ii) if, even though an entity is engaged in economic activity, it might not be considered an undertaking because it takes part of a larger economic unit or iii) if an undertaking as an economic unit can be composed by multiple undertakings.

As previously explained, an undertaking is any entity engaged in economic activity despite the way in which it is financed and despite its legal status. Therefore, the concept of undertaking, as seen before, is not necessarily connected with natural or legal personality. An undertaking might entail a plurality of natural persons and/or legal persons, such as: i) companies and partnerships; ii) associations of undertakings; iii) parents and their subsidiaries; and iv) joint ventures.

As exemplified by Alison Jones, “a company or partnership may be made up of individuals capable of competing with one another, a principal and an agent or members of the same corporate group (a parent and its subsidiaries) may constitute separate legal entities” . Nevertheless, we must recall that multiple persons who participate in a single economic entity are incapable of infringing Article 101 TFEU between one another. As Viho Case stated “where there is no agreement between economically independent entities, relations within an economic unit cannot amount to an agreement or concerted practice between undertakings which restricts competition” .

It may not always be easy to recognise the boundaries of each undertaking, since the reality of control between undertakings is not always formalised in their legal status – remaining the question of whether the undertakings are acting unilaterally or jointly, or if one or more undertakings exist .

It must be pointed out that it is not sufficient to establish that two companies form an economic unit when the same person or the same family have shares in two commercial companies . Likewise, it is feasible to have several majorities within the group of shareholders’ meetings of companies without excluding the possibility of a single economic unit . The mere holding of shares in an undertaking does not, in itself, mean

that the entity of the shares is an undertaking; yet, if the shareholder actually exercises control by involving himself directly or indirectly in the management of the undertaking, it must be regarded as part of the economic activity and, therefore, it must be viewed as an undertaking . “As long as there is a unitary organisation of personnel and tangible and intangible elements, which pursues a specific economic aim on a long-term basis and can contribute to a restriction of competition or an abuse of dominance, it qualifies as an undertaking for the purposes of Articles 101 and 102 TFEU” .

It is, consequently, not clear the relationship between the concept “economic activity” and “economic unit”. Does the economic activity define the scope of the economic unit? Or is it possible to have a larger economic unit and, within it, an undertaking engaged in economic activity? .

In the Case Confederación Española, the Court refers to a partnership and firms both as an “undertaking”, as well as two legally independent undertakings that together constitute one contracting party as an economic unit for the purposes of the agreement . It seems that the undertaking as an economic unit can be composed of various undertakings (natural or legal) .

Besides the above-mentioned group of persons, other less obvious groups can also be considered undertakings, such as P & I clubs , agricultural cooperatives and trade associations .

IV. BLOCKCHAIN

Before further clarifying what Blockchain is, it is vital to understand the difference between Blockchain and Distributed Ledger Technologies (DLT). The terms Blockchain and DLT are often used interchangeably, but while all Blockchains are DLTs, not all DLTs are Blockchains. Non-Blockchain distributed systems do not depend on “the creation of a chain of blocks and instead use alternative crypto-economic mechanisms to reach consensus” – for example, Directly Acyclic Graphs .

1. The technology

Blockchain can be understood as a distributed system, i) for recording data , ii) in a cryptographically secured way, which makes it hard to tamper with the previous ledger ; through (iii) crypto-economic incentives and (iv) a common rule structure that keeps

copies of the ledger and adds new entries and/or blocks (protocol and consensus mechanisms).

Data is recorded in a Blockchain through blocks. Each block contains data about what happens in the ledger/chain . The chain (the connection between blocks) connects all the previous transactions and information of past blocks; a continuous chain with ad infinitum (an Infinite memory) collection of data .

The blocks need to be mined by solving mathematical problems presented by the system , then stored and validated by the community of the Blockchain. Such blocks are accessible to all members , and if new data is not verifiable within the existing Blockchain, those blocks will not be integrated . Therefore, it creates a peer-to-peer network that is efficient, permanent, and verifiable .

To briefly understand how transactions are technically made possible: the transaction sender signs the transaction with a private key. This private key creates a public key with a practical non-invertible function . The hash, also referred to as an address, is created from the corresponding public key where the amount of cryptocurrency for the private key is registered. The verification is made possible through “zero-knowledge proof”, which enables verification without knowing the contents of the transaction . Hence, private keys are not the same as personal entities since a personal entity would have a different private key of all the transactions made, rendering the technology pseudo-anonymous .

Users need to trust in i) how decisions are made (rules to decide how to create new blocks (consensus mechanism) and overall protocol , ii) in the transaction (“that the same amount left one account as arrived in another, that the sender agreed to it, and that the funds used are unique and were not double-spent”) and that the iii) conditional contract will be automatically executed (a general scripting language with programmable functionality). Users also expect it to be more resistant to external attacks since there is no infrastructural central point of failure (sensitive central point) .

Some Blockchains, like Ethereum, enable smart contracts. Smart contracts are algorithmic “contracts” in which the contracting parties can define terms and conditions that, through Blockchain, are automatically maintained and resolved on the chain . Blockchain is designed with self-executing code; however, it is not always able to respond to ever-changing circumstances . We will further explain this point in Chapter IV 2.

Even though users depend on each other for the survival of the Blockchain, they do not trust each other and can only recognise one another by their public addresses. Blockchain technology is a step towards progressing from trustworthy third-party verification (for example, an intermediary) to relying on consensus mechanisms and "high-powered crypto-economic incentive protocols to verify the authenticity of a transaction in the database" , and, therefore, towards trustlessness.

Tokens or crypto-assets provide incentives to users, which bind them to the platform and facilitate "community-driven forms of corporate organization and governance" building .

Crypto-assets can be defined as "a digital representation of a value or of a right that is able to be transferred and stored electronically using distributed ledger technology or similar technology" .

Tokens are often free (possibly including targeting "additional token-drops at influential users as they grow") or can be bought (or earned) with minimal cost at the beginning of the token's release. The early adopters value a token for its long-term potential . Token effects explain the idea that free tokens offer a "costless way for new entrants to reimburse users for the value of the network effects they bring to the platform" .

2. Governance and decision-making

To understand how decisions are made within Blockchain, one needs to understand i) if the Blockchain is public or private, permissioned or permissionless; ii) the layers of the Blockchain and iii) the consensus mechanisms (which requires understanding of the different types of users/players within Blockchain space and the difference between on-chain and off-chain governance).

a) Public or private, permissioned or permissionless

It is important to note that "public" and "permissionless" or "private" and "permissioned" are not synonyms , even though it is possible to find literature that groups them together. The distinction is crucial because it clearly shows how involved the users are in the development of the system (whether anyone can be a validator/miner or not).

A Blockchain is private when it requires prior authorisation to access; it is public when there is no authorisation needed.

A Blockchain being permissionless or permissioned refers to the accreditation process to accept a new member / “power that a user can exercise” – therefore, a permissionless Blockchain requires no authorisation for new members or for members to develop the system , whether permissioned Blockchains require it .

Another difference is that permissionless Blockchains don’t have their principles determined at the start , it is later built by core software developers, miners, users and token holders .

It follows that public Blockchains can either be permissioned or permissionless, whereas private blockchains can only be permissioned . Permissioned systems are governed by a party or consortium that controls the accreditation process for new members and determines the system’s rules . Only public permissionless Blockchains are truly public domain because of their open access, open-source and interoperable protocols without a centrally controlled entity . Considering the above explanation and the research question of this thesis, it is concluded that only Public Permissionless blockchains may present real novelty to Competition Law, since all other blockchains have a central authority.

A Public Permissionless Blockchain is what some call a DAO (Decentralised Autonomous Organisation). In this thesis, we do not use the DAO nomenclature because a lot of players who are not actually DAO use the DAO term; we use Public Permissionless Blockchains of clarity.

b) Layers of Blockchain

Blockchains are built through layers. Layers allow the software to be developed on top of itself, thus providing participants with different applications. Depending on the specific project we are analysing, there will be different layers to consider. Within this multi-layered process, each layer acts and has governance independently from each other; however, they are also interdependent , the actions people take on one layer may have repercussions or be influenced by the layers above it .

We can identify various layers. The layer 0 (Hardware/ Infrastructure Layer) comprises the hardware and network architecture. Examples of projects built on this Layer include Polkadot and Cardano. Layer 1 (Network Layer) is where protocol and consensus mechanisms are present. Examples include Ethereum and Bitcoin. Layer 2 manages the transaction of layer 1, an example in Lightning Network on Bitcoin. Layer 3 (Application Layer), the last layer, is the one that users have access to real-world applications of

Blockchain, such as wallet providers, crypto exchanges and payment mechanisms . Layers can be classified in other terms, and more layers can be added depending on the taxonomy. We can also differentiate between the Internet Layer (enhancing the role of internet providers) , the Blockchain Layer (where it is included the technical architecture and the governance processes) , the Application Layer (where the application system might create multiple layers – it is not an "unified whole. It consists of multiple layers, each inheriting from the one below."). Bitcoin, for example, has in itself two highly interdependent layers .

Blockchains may have different layers on top of one another, and it might not be possible to control them or stop the addition of new layers.

c) Consensus mechanisms

Traditional entities organise through a combination of formal and informal hierarchies , which impact how decisions are made and, ultimately, where control stands. Blockchain's governance and control are mirrored in the consensus mechanisms, both on-chain and off-chain.

While there is a perceived absence of hierarchy and structure, which are some of Blockchain's core ideas , in practice, decisions can be made by an individual (if centralised) or a collective of individuals . One should keep in mind that "Blockchain is a space in which different forms of powers are being exercised" , that power can be reflected when Blockchain is not able to respond to ever-changing circumstances .

Governance might entail, for example, i) updating the code, ii) addressing technical bugs, iii) determining the interoperability between the on-chain and off-chain , iv) answering to unplanned events to remain competitive , v) determining wealth distribution on the network . Vitalik Buterin, the Founder of Ethereum, doubts we will ever be able to have a blockchain's governance process sufficiently robust and capable of regularly doing things like adjusting fundamental economic parameters .

On-chain governance means coin holders' votes are adopted automatically through the protocol. To install an endorsed update, Miners have no stake in the process of deciding if certain changes should be adopted (no agency) . Unless we consider that groups of miners /validators and coin holders may increasingly overlap, approximating the respective interests of these groups . Coin holders or users propose new blocks and new transactions .

Off-chain governance has a broader pool of users, and decisions shall be taken into consideration.

Miners/Validators are essential for the implementation of protocol changes; only through the majority of miners (measured by computing power) can a proposal be updated to the protocol. In the limit, they can even exercise a veto over decisions (capable of refusing code), but only when they have most of the hashing power (computing power). A soft fork can be created when such a veto is exercised – which means the new and old versions of the software coexist . Even if it is a very technical role, any participant can choose to be a miner .

Blockchain founders and core developers implement the original rules of a blockchain . Software core developers are central to the preservation of the protocol since they are the only ones able to make proposals .

There are various consensus mechanisms, with different incentives and through different mechanisms. The two most well-known are Proof of Work and Proof of Stake.

Proof of Work is the most common consensus mechanism on public blockchains right now (for example, Bitcoin). Miners compete to solve a cryptographic puzzle; the first one to solve it is granted the right to validate a transaction (and therefore, be paid through a transaction fee and newly minted tokens).

Proof of Stake, token holders vote for the miners who validate blocks (for example, on Ethereum). The miners' prospects to validate blocks increase alongside with how many tokens they own and the duration of possession . Miners here are called validators and are only rewarded with transaction fees .

Proof of activity results from a combination of Proof of Work and Proof of Stake . It includes the need to complete a puzzle by miners, like the Proof of Work, after which a validator with more tokens is chosen to validate the transaction or block. The reward (fee) is split among the miner and validator .

Alongside these consensus mechanisms, many more exist, such as Proof of Burn, Delegated Proof of Stake (DPoS), Proof of Elapsed Time (PoET), Proof of Authority (PoAu), Proof of Importance (PoI), Proof of Reputation (PoR), Proof of Luck (PoLu). Each consensus mechanism results in different processes and, therefore, different power structures .

V. BLOCKCHAIN AND THE THEORY OF THE FIRM

1. Blockchain and efficiency

As mentioned before, Blockchain technology is being used in various industries . Blockchain reduces cost from a total factor productivity , rendering Blockchain to a general-purpose technology . The tokenisation of assets brings great fluidity and creates a hyper-efficient market. To better understand it, it is worthwhile to recognise the importance of network effects and token effects in cryptoeconomics.

Nonetheless, the potential of Blockchain does not end there. Blockchain has governance potential (besides using it as a tool for already existing firms) "likely to radically change how organizations operate" .

2. Blockchain as an Institutional Technology

In the beginning, there was Market (and, therefore, price mechanism). Coase posed the question of "If price mechanism works, why do firms exist?". The answer was predominantly related with the reduction of transaction costs by having an "entrepreneur" directing resources. Now, another question arises: "If prices mechanisms work; if firms can reduce transaction costs, why should we care about Blockchain?".

Firms and Markets are traditionally seen as "alternative methods of co-ordinating production" / "organization" . Market capitalist economies, like firms and governments, historically dominated instruments for economic coordination. Distributed technologies, and specifically, Public Permissionless Blockchains, introduce the ability to disrupt existing hierarchies to the point where experts foresee that "traditional roles such as investors, executives, managers and consumers will become blurred" .

Blockchain is a new general-purpose information and computation technology, but it is also a revolutionary new institutional technology for economic coordination , which enables "more "inclusive" and "communal" models of organisation that empower more stakeholders" . Blockchain presents itself as an Institutional Technology, a new perspective on institutional governance. Its novelty is related to the introduction of a new way to achieve consensus since it grants large groups of individuals the opportunity to cooperate in a stable environment (cryptographic stigmergy).

These characteristics have the potential to weaken the assumption of efficiency of hierarchies (that exploit incomplete contracts) over Markets . As well as control opportunism (in the presence of bounded rationality) in the Market. Therefore, Blockchain technology challenges key assumptions underpinning the existence of the firm .

3. Transaction Costs

Transaction costs are the "ultimate unit of economic investigation" . From Coase's doctrine, we can conclude that the existence of transaction costs validates alternative methods of organisation. Blockchain makes possible the reduction of transaction costs and can achieve that end arguably better than firms .

Transaction cost can be reduced with the use of smart contracts by i) the reduction of complexity of drafting contracts (for example, by creating an open-source contract library), ii) the reduction of search costs, contracting costs and coordination costs , iii) the automation of transactions (which means the execution of transactions happens when certain conditions are met and don't require human input from the contracting parties after the smart contract is created). This automation creates an iv) indefinitely pure promise that brings certainty to long-term contracts and v) greatly eliminates the need for trusted intermediaries . Plus, it is believed that the overall cost related to the making and maintenance of smart contracts would vi) "cost a fraction of the price that trusted intermediaries are currently able to charge for their services" .

Regarding trust , it is normally expensive to manufacture it conventionally . It is largely assumed that Blockchain does not require trust (it is trustless) , presenting itself as a solution when "agents do not benefit from the trust that may exist within the firm regarding the proper execution of internal transactions" . However, this trustless narrative is inherently limited because behind the code are always humans who can affect it .

Another significant difference relates to information asymmetries. Blockchain introduces the recording of information with valuable data on past transactions, which is a more informative signal than price (since price is memoryless) .

Blockchain tends to limit uncertainty through transparency, immutability, and smart contracts; long-term contracting could be enabled within Blockchain instead of resorting to the control of the entrepreneur, thereby reducing uncertainty. "It is improbable that the firm would emerge without the existence of uncertainty" . Coase somehow envisioned

this – “With uncertainty entirely absent, every individual being in possession of perfect knowledge of the situation, there would be no occasion for anything of the nature of responsible management or control of productive activity. (…) The flow of raw materials and productive services to the consumer would be entirely automatic” .

Therefore, “it returns the transaction to a market-like context but with fewer of the costs of a market” , and at the same time, it broadens the limits of efficient contracting, which, until now, was the “role” of the firm . It has even been argued that the “reduction in transaction costs in downstream markets may facilitate the adoption of new business models” .

Nevertheless, Blockchain technology does not eliminate transaction costs entirely . Smart contracts, even if incredibly innovative, do not completely solve the problem of incomplete contracts, because they are incomplete contracts themselves. Hence, smart contracts may still need legal recognition , third-party arbitration , verification of their features and investment in education on cryptographic tools (which comes with a cost). When drafting contracts, we may encounter costs related to the bargaining of the smart contract, the translation of contracts into code and possible costs related to the enforcement of the smart contracts. Regarding commitment costs, it encompasses “paying fees to full nodes or information services” to protect against theft of digital assets. Lastly, the energy costs required for Permissionless Blockchains are still high, which calls for further development .

4. A Market, a Firm or something in between

The study of the connection between Competition Law and Blockchain is still in its early days; however, there are already various considerations regarding whether Blockchain should be deemed as a Market, a Firm, or neither a Market nor a Firm.

It is argued that Blockchain creates room for a shift from firms towards markets, since it could potentiate true price-driven exchanges among suppliers and consumers . And, if markets can be more efficient than command economies, the latter would cease to exist .

We can interpret Blockchain as a platform where various economic players meet, as a “three-sided” market (buyers, sellers and miners/validators) or a multi-sided market .

Blockchains may enable firms – “blockchain does not necessarily correspond to a single undertaking, but may bring together different firms and individuals”. It has been stated

that a group of validators could be considered a “gig-working co-operatives” (like Partners in a law firm), whilst individually following collectively determined norms (protocols) ; others have called it a “commons-based peer production” . Some authors go further, stating that certain mining pools could be considered partnerships , and some Blockchain projects can be viewed as joint ventures . Whereas such arguments are interesting, such analysis is outside the scope of this thesis since, in Competition Law, no legal form is required. Therefore, as stated before, trying to “force” Blockchain potential into already existing corporate figures could only be used as a supporting argument in concrete cases, not as the basis for defending the claim that they could be seen as firms.

Heavily grounded in the innovation Blockchain brings as an institutional technology, some argue that Blockchain should be considered outside the scope of markets and firms – it should be understood as a third way, given that it has systematic advantages over both . “Blockchains compete with firms, markets and economies, as institutional alternatives for coordinating the economic actions of groups of people” . With a similar line of thought, “When coupled with token systems (…) blockchains make possible new institutional orders that operate at a micro-scale, yet with the full coordination properties of what we would otherwise attribute to a self-organizing macroeconomy” .

The study of phenomena outside the dichotomy between Market and State goes past the discussion of using a decentralised technology, such as Blockchain. Polycentric governance was initially studied by the economist Vincent Ostrom, introducing it as “polycentric governance, a diverse array of communities and public and private authorities with overlapping domains of responsibility interact in complex and ever-changing ways, and out of these seemingly uncoordinated processes of mutual adjustment emerges a persistent system of social ordering that can support and sustain capacities for individual liberty, group autonomy, and community self-governance” .

Similarly, and applied to the Blockchain reality, the term plutocratic system relates to the possibility of creating accidental corporate structures (even if not directly “advertised” by their members) or hybrid forms . These accidental structures can be defined as “spontaneous organizations using the price mechanisms of markets, the governance properties of a common, and, to some extent, the constitutional properties of a nation-state” . Or, in other words, some situations “make it closer in essence to the price mechanism, though others make it seem more akin to a firm; this combination of features

makes it all the more evident that the cryptographic stigmergy defines a space for coordinated production in between those of the price mechanism and the firm" .

Just because transaction costs are not the same as in a traditional firm or traditional Market, it does not mean that blockchain cannot enable one or the other. The line of thought Coase still applies to Blockchain reality, since it is simply another way in which people organise to reduce transaction costs.

I tend to believe that Blockchain can enable Markets and/or firms, depending on the individual case (the layer or layers under study, or how players interact); and even if we consider a third option, it is arguable that it would still be inside the scope of Competition Law since it is a form of organised individuals with economic activities.

To truly understand if a firm is possible, one shall understand the different power dynamics that can happen within Blockchain; which means, if control or decisive influence might be present.

4.2 Theory of Granularity

Schrepel argues that the Theory of the Firm initiated by Ronald Coase, which is centred around direct top-down control to reduce transaction costs, cannot be transposed to Blockchain . He reaches such a conclusion through considering that Blockchains are made of horizontal governance mechanisms, unlike the firm, which relies on vertical and pyramidal control .

Schrepel introduces the Theory of Granularity , which aims to analyse the role played by each element of a Blockchain . Through that theory he arrives to a "nucleus" because, as already suggested, "even with horizontal and decentralized governance, a group of participants may achieve a form of direct control over the blockchain by collaborating, and as such, by circumventing (some of) the constraints imposed on them" . He includes in the nucleus all participants who have a personal interest (although momentarily) in continually collaborating with each other. "They do not compete, and although their short-term interests may diverge, they seek to achieve the same long-term goal: ensuring the blockchain survival" . Schrepel concludes that defining this nucleus is central to identifying which participants are collaborating to escape the constraints imposed on them to control the blockchain, and potentially, if these participants are abusing their control for anti-competitive purposes.

If a nucleus is an obvious concentration of power, a Permissionless Blockchain with a concentrated list of validators, for example, starts to resemble a Permissioned Blockchain with a small list of validators.

4.3 Is it possible for control or decisive influence to exist within Blockchain?

Within Blockchain, control can be exercised, however, it is not the traditional hierarchical control. Competition Law frames the firm as an economic agent (or a single economic unit) that is actually capable of making decisions, which means to exercise the market power that it holds. Applying these principles to Blockchain is complex, since a Blockchain may bring together different groups and individuals.

It is important to remember again that only Public Permissionless Blockchains truly bring novelty from an organisational perspective and, consequently, the ones inside the scope of this chapter. In this chapter, we will further analyse the influence that each class of members might have over decisions made within Blockchain, especially if it has the potential to interfere with its economic value (if a control structure can be detected at all) and who governs the market power that the blockchain may have.

Blockchain can be seen as the aggregation of various individual objectives where multiple interests and incentives can compete; and, theoretically speaking, every participant can influence . Said influence "is proportional to its stake in the platform - e.g. in terms of computing power, storage, labor or capital dedicated to it" .

Zetzsche et al. separate the "DLT hierarchy" in four groups: (i) "the core group that sets-up the code design and (de facto) governs the DLT, for instance by having the technical ability and opinion leadership to prompt a hard fork of the system (under certain conditions); (ii) the owners of additional servers running the distributed ledger code for validation purposes […]; (iii) qualified users of the distributed ledger, such as exchanges, lending institutions, miners etc.; and (iv) third parties affected by the system without directly relying on the technology, for instance, [..] simple users, clients of intermediaries […] etc." .

As we have already seen before, Blockchain governance relies on consensus mechanisms but also power structures (blockchain is also heavily politicised), which do not constitute direct orders over others . Nonetheless, even if no single party has command and control over decisions in Public Permissionless Blockchains, they are frequently depicted "to be more decentralized than they really are" .

Although Blockchains in general are praised for being automated, as exposed before, we may never be able to build a blockchain governance process capable of i) adjusting fundamental economic parameters , ii) amending the protocol, and iii) rewards protocol development .

Given the above limitations, at least the first-generation Blockchains will be de facto centralised in core developers' teams or miners to formulate design choices . However, others argue that the architecture of Blockchain, as soon as it is created and put online, they lose any form of control .

It is argued that Founders and Core Developers perform a "janitorial role" to ensure that the goals of the project are followed, like sending emergency messages to all nodes on the network to ask them to adopt updates . They also carry with them a role as influential advisors given to their central "political" role in the survival of the Blockchain's philosophy, as well as their technical skills, even if the personal incentives of other participants might limit their influence. Therefore, it is also possible that Blockchain is used in ways that are outside the creator's control .

The role of Miners could raise a possible control situation since they have the capability of i) influencing soft forks by releasing a 51% attack , and, out of all the participants, they are the ones that ii) most directly can impact the economic value within Blockchains.

Despite the soft fork, the impact may appear less severe if we consider that even with the modification of the protocol, the Blockchain remains compatible with previous versions and the fact that, for the fork to be effective they must convince the rest of the participants to operate as nodes to run the new version of the software and users to transact on to the new fork.

Their capabilities to impact the economic value within Blockchain derives from their capability to raise fees or increase the gas limits . The power of miners is enhanced if there is a strong community spirit they group in mining pools .

The primary real power of token holders over the Blockchain derives from their decision to use it or not; that decision is fundamental to Blockchain's economic value. Their control is directly associated with their ownership over tokens, which grants them the possibility to vote . They influence i) transaction fees; ii) hard forks on the Blockchain .

Even if theoretically Token Holders can vote, it is believed that i) those powers are limited by how hard it is to exercise coordinated control, since their activities are "highly decentralised and spontaneous in nature" and ii) the fact that presumably they will do what is best for the network since the maintenance of the network would be in their interest (which, in case of mass adoption of Blockchain may lead them to always agree with the advice given by core developers). Existing doctrine excludes users' responsibility .

Yet, those arguments shall not be the reason why their decisions should not be scrutinised by Competition Law Authorities. Their power over decisions is impacted by how much wealth they have connected with the token which might seem big enough not to simply consider them users but a kind of prosumer (that contributes to the evolution of decision making but also might use the Blockchain as a simple user). Also, even though we presume that every token holder will align their interests with the survival of the network, such an idea has not been tested .

Therefore, it is expected that users should check for themselves whether the decision made and/or the protocol complies with Competition Law and, in case of suspicion of infringement, they should vote against the proposal and take action to make improvements by, for example, communicating it to the developers (which is usually made off-chain, for example, in Discord). However, if the users do not engage in the decision-making process, it is not likely that they would be found responsible under Competition Law; such inference comes from the Eturas Case – "if it cannot be established that a travel agency was aware of that message, its participation in a concertation cannot be inferred from the mere existence of a technical restriction implemented in the system at issue" .

The same principle might also be applicable to miners, according to Ioannis Lianos. Miner's control might take the form of colluding to raise transaction fees, an attack by a dominant validator or a colluding group of miners to exclude other participants .

It is also possible for a person to accumulate more than one class of participants. Some Token Holders/Users might also act as Miners/Validators (since they are paid with tokens) and Founder and Core Developers, which might also raise the question of how realistic it is to have a large pool of roles but a small pool of people who actually exercise their power through voting .

4.4 Commentary

The Theory of Granularity greatly informs how attentive we need to be when classifying the limits of the firm. Defining the limits of firm a priori may go against the flexibility of the term within Competition Law, and such practice, as Coase puts it, is a trend in economic theory .

We propose identifying a possible anti-competitive practice, a particular decision (or a group of decisions) that created an identifiable effect (effects already studied in different instances), for which one finds the need to investigate and try to understand who exactly made the decision. Which means, first looking for a possible breach of Competition Law, then identifying the nucleus of that decision – it might lead us to identify a "nucleus" that goes beyond a pre-defined DAO or layer. Which means, taking into account each decision, while being aware of i) the possible volatility of the members of the groups, ii) the interdependency of layers, iii) the consensus mechanism (including the risk of soft forks and hard forks), iv) outside-of-Blockchain and offline exchanges of information, v) the possible tendency of organising through class and vi) the concentration of wealth.

The nucleus, because of the possible volatility of groups within Blockchain, can be ever-changing, which will render the analysis more demanding for competent Regulatory Entities (such as the Commission or NRAs) and Judicial Entities. The members who influenced a past decision might not be the same members who are present in the group at the time of evaluation. However, one might also argue that even though there is volatility of the groups, there is a tendency for the nucleus to stay the same.

Plus, given the fact that the interdependency of layers makes it possible to have decisions made without the active consent of the players affected by it, makes it important to not ignore the layers under a Dapp, DAO or other type of conglomerate of people within Blockchain – especially if those decisions have economic effects. So, even considering that Blockchain is predominantly horizontal, some verticality still exists.

Centralisation may occur in various layers , including at the protocol level and network level. It is also possible for the hardware layer to be centralised when nodes are owned by a small group of individuals and stored in close geographic proximity, clustered in data centres. Likewise, mining operations are also often centralised .

The emergence of mining as an economic activity has led to the development of mining pools and an ecosystem of industries that supply goods and services to miners. Mining

requires specialised equipment which uses an “application-specific integrated circuits (ASIC), which are chips designed to perform a single function: block mining” and the possible need to resort to miners’ insurance . Which means real-world firms might impact Blockchain through the access of hardware and insurance – complementary services can give a de facto monopoly power over a cryptocurrency .

The consensus mechanism is one of the central aspects one needs to pay attention to, since it greatly informs how decisions are made. There is a general presumption that because of tokens and the technical possibility of giving all people the right to vote, that all Blockchains work like that, which couldn’t be further from the truth. For example, in Proof of Work, Miners make decisions (pools of miners enhance this problem). However, even if Token Holders do have voting power, most do not vote. Since Miners are remunerated with tokens, it may pose the question of whether, in practice, they do not end up being the ones who make the decisions also.

Particular attention has been given to the centralisation risks of consensus mechanisms in cryptocurrency systems, with the consequence that validations are performed by a few entities and possibly coming under the control of one entity be a source of centralisation. This is obvious in systems based on PoS validation. However, such holdings may also give power in PoW systems, such as the power to launch certain attacks. PoW puzzles may be less susceptible to centralisation; however it seems hard to avoid the development of specialised hardware and consequent centralisation risk .

Even though Blockchain exists in a Web3 world, outside-of-Blockchain and offline exchanges of information might interfere with the decision-making, even if it was identified that the members are in different countries.

The economic and political importance of forks must not be underestimated since it has significant economic implications (network effects weaken with every fork) – “[i]n the Web 2.0 world, forking is the equivalent of Facebook allowing any competitor to take their entire database and codebase to a competitor” .

As Buterin once stated, it is possible that Blockchain creates a type of classicism where each type of player might be motivated to coordinate. Possible solutions have been proposed, such as “ social interventions that try to increase participants’ loyalty to the community around the blockchain as a whole and substitute or discourage the possibility of the players on one side of a market becoming directly loyal to each other”; “promoting

communication between different "sides of the market" in the same context, so as to reduce the possibility that either validators or developers or miners begin to see themselves as a "class" that must coordinate to defend their interests against other classes"; "designing the protocol in such a way as to reduce the incentive for validators/miners to engage in one-to-one "special relationships", centralised relay networks and other similar super-protocol mechanisms" .

Finally, the concentration of wealth. Since ownership and voting are tightly coupled, this may lead to a feudal structure, in which influence is measured by wealth .

VI. Conclusion

The answer to the question of whether Competition Law can be applied to Public Permissionless Blockchain-enabled entities can be divided into two steps. In a preliminary stance, one should take into consideration if the Theory of the Firm is applicable – since the European Competition Law's term "undertaking" is greatly based on Coase's theory. Secondly, one should analyse if it would go in line with European Competition Law per se, its growing case law, and clarifications from the Commission.

As explained before, it is still not consensual if Blockchain would enable firms, markets, or a third way of organising economic power. I tend to agree with the possibility of Blockchain enabling markets and/or firms, depending on the individual case. By acknowledging the new possible form to organise and through its plutocratic system, it is possible to create accidental corporate structures (even if not directly "advertised" by its members) or a hybrid form – and, therefore, hierarchies, even if not formal or fixed. And, in case a hierarchy cannot be found, what can it be besides a market, if the market is what exists when there is no firm? Even if it is a market with different features, it does not seem justified to exclude the consideration that it is indeed a market.

Schrepel defends that the Theory of the firm cannot be transposed to Blockchain. Yet, Coase arguably foreshadowed platform economies , especially when he observed that "(i)inventions which tend to bring factors of production nearer together, by lessening spatial distribution, tend to increase the size of the firm." I believe the greatest contribution of Coase's Theory is not so much the fixed idea of a "top-down" hierarchy, but the idea of how humans will choose to organize in ways that lower transaction costs, which is arguably one of the most significant advantages of Blockchain – "no matter

which proof of work system is implemented, they all follow a maximal growth curve that reflects the nature of the firm as detailed in 1937 by Ronald Coase (1937)" .

It is important to note that European Competition Law predates the influence of the Theory of the Firm . Therefore, even if we consider that the Theory of the Firm does not apply, European Competition Law is still applicable.

For an undertaking to exist under Competition Law it needs to have i) an economic activity, ii) regardless of its legal status and iii) the way in which it is financed. Primavera De Filippi and Aaron Wright have highlighted that "every interaction with a blockchain is ultimately an economic transaction, and every party participating in the network serves as an economic actor" . Others leave open the possibility of some activities within Blockchain not being considered as economic – some examples might entail similar situations already excluded by the Commission and Courts, such as solidarity activities . However, it seems fair to affirm that most activities done within Blockchain consist of some kind of "offering goods or services on a given market" .

Another point to consider is the fact that, up until now, a firm-first analysis approach was justifiable. It was simpler from a legal perspective. Most legal entities that act in the market have a recognized legal form, but i) they do not need to be a legal form that is traditionally connected with economic activity (for example, they can be an association) and ii) it is possible to consider a firm which includes various presumably autonomous legal entities. This shows that Competition Law analysis goes beyond preliminary consideration of what could be formally an undertaking. Furthermore, we do not need to define the firm and then look for economic activity to justify the existence of the firm. We could observe economic activity (the industry) and then look for the decision-making processes (the consensus mechanisms, on-chain and off-chain) to analyse which (if any) control or decisive influence with economic consequences was taking place. The conclusion of what is an undertaking will highly depend upon the consensus mechanism used, and, therefore, the specificities of the power structure enabled by it. The relevance and impact of each player will be different according to each consensus mechanism.

Lastly, Competition Law has the potential to be a valuable tool for a sandbox regulation, given the flexibility of Competition Law and its case-by-case analysis by design. The study of Blockchain from a Competition Law approach would inform NRAs and the

legislator on how the markets and firms work, especially regarding Public Permissioned Blockchain, before jumping into over-regulation or misregulation.

In parallel, Competition Law is a great tool to achieve the goal of decentralised technologies – to fight against the abuse of concentration of power. The first, by analysing the market, the anti-competitive agreements, and decisions that were anti-competitive or have anti-competitive effects made by firms, proposing compromising measures or not accepting mergers and acquisitions. The latter, offers a technical solution for decentralisation of power to exist.

The study of Blockchain and especially the study of Competition Law and Blockchain is still in its infancy. Many questions remain regarding the specific consequences of each consensus mechanism (or if the market will evolve to consider one, or a few, as default consensus mechanisms). I believe that a deeper study on specific cases will better inform if within Blockchain there is market, firms, both, or none – because it seems that the answer ultimately relies on how decisions are made (consensus mechanisms).

Concerning enforcement, especially in Public Permissionless Blockchains, the identity of most members is pseudonymized. Some initiatives have been created to try to solve this concern, like attributing a digital ID that would make the members identifiable by allowing members to actively register . However, it is still not clear if, even if Competition Law is theoretically applicable if it could be practically enforced.

Lastly, given the suggestion above about an industry-first analysis, a deeper understanding of the dynamic economic power within blockchain might be relevant to competition assessment and market definition.

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I hereby declare that the work I present is my own work and that all my citations are correctly acknowledged. I am aware that the use of unacknowledged extraneous materials and sources constitutes a serious ethical and disciplinary offence.

I declare that the quotes are properly referenced through OSCOLA referencing style.

Mafalda Sequeira Roldão

Abstract

Blockchain proposes to disrupt how business is conducted and how people organise. In this thesis, we evaluate whether European Competition Law can be applied to Blockchain, especially public permissionless blockchain-enabled entities, considering the Theory of the Firm and the term “undertaking”. We conclude by proposing the Competition Law approach as a possible valuable tool for Blockchain sandbox legislation.

Resumo

Blockchain propõe revolucionar como negócios são feitos e como as pessoas se organizam. Nesta tese avaliar-se-á se o Direito da Concorrência Europeu está apto a ser aplicável a Blockchain, especialmente a *public permissionless blockchain-enabled entities*, considerando a Teoria da Firma e o conceito de “empresa”. Concluímos com a proposta de adotar a abordagem do Direito da Concorrência como possível ferramenta de legislação *sandbox* para Blockchain.

Keywords: Decentralisation; Blockchain; DLT; Theory of the firm; Undertaking; Competition Law; Institutional Technology

LIST OF ABBREVIATIONS

AG - Advocate General

COALA – Coalition of Automated Legal Applications

DAO – Decentralised Autonomous Organisation

ECJ - European Court of Justice

GC - General Court

NRAs – National regulatory authorities

OJ - Official Journal of the European Communities

PoS – Proof of Stake

PoW – Proof of Work

TFUE - Treaty on the Functioning of the European Union

Table of Contents

I. INTRODUCTION

Human history is largely intertwined with the ability of humans to organise, which has been dominated by centralised organisations, whether with formal or informal hierarchies[1]. Throughout the late 20th century, information ledgers were digitalised; however, they remained centralised[2]. Blockchain proposes itself as a disruptive innovation that exemplifies Schumpeter's creative destruction[3].

Blockchain caught the market's attention – Blockchain startup companies raised up to $2.6 billion in venture capital in the first quarter of 2021 alone[4]. Various industries have adopted it to the point that the real challenge is finding one that is immune to the market's enthusiasm. To name a few: logistics, energy and utilities, education, mobility, healthcare, finance, and insurance.

There are two ways in which we can portray Blockchain, simply as *i)* a **general-purpose technology / technological output** (to provide new services or lower the cost of existing services[5]) and as *ii)* a **disruptor of organisational design**[6] by giving the chance to a new approach to governance[7], and allowing self-organisation rather than top-down planning.

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[1] Governments and companies (shareholders, directors, managers, and employees) *in* Mark Fenwick and Erik Vermeulen, 'Technology and Corporate Governance: Blockchain, Crypto, and Artificial Intelligence' (2018) Lex Research Topics in Corporate Law & Economics Working Paper 2018-7, 18 and 22 <Technology and Corporate Governance: Blockchain, Crypto, and Artificial Intelligence by Mark Fenwick, Erik P. M. Vermeulen :: SSRN> accessed 11 May 2023.

[2] Sinclair Davidson and Primavera De Filippi and Jason Potts, 'Disrupting governance: The new institutional economics of distributed ledger technology' (2016), 6 < Disrupting Governance: The New Institutional Economics of Distributed Ledger Technology by Sinclair Davidson, Primavera De Filippi, Jason Potts :: SSRN> accessed 12 May 2023.

[3] Joseph Schumpeter, *Capitalism, socialism and democracy* (first published 1942, Harper Perennial Modern Thought, 2008).

[4] Petroc Taylor, 'Level of blockchain startup venture-capital funding worldwide 2016-2021'(Statista, 23 May 2022) < Global blockchain startup financing history 2021 | Statista> accessed 12 May 2023.

[5] James Caton, 'On V-form Firms: Governance, Cryptocurrency, and Internalization on the Blockchain' (2020) AIER Sound Money Project Working Paper 2021-03, 5 <On V-form Firms: Governance, Cryptocurrency, and Internalization on the Blockchain by James Caton :: SSRN> accessed 12 May 2023.

[6] Fenwick and Vermeulen (n 1) 18.

[7] Davidson and Filippi and Potts (n 2) 24.

The latter approach has the potential to impact our understanding of hierarchies and, therefore, our knowledge of how to regulate and perceive them. As Dave Clark put it, "reject kings, presidents and voting. We believe in rough consensus and running code"[8]. Although non-hierarchy and structurelessness are among blockchain's core ideas, in practice, an individual (or a group of individuals) makes decisions[9].

It is helpful to differentiate between *i)* **entities that use Blockchain as a tool** and *ii)* **Blockchain-enabled entities**. Blockchain as a tool means the "real" world organisations remain the same, but there is a "tokenisation" of processes, contracts, products and/or services. Whilst in blockchain-enabled entities, there is a "substitution (reallocation) of economic governance from firms, markets, and relational contracts into blockchains"[10] and an "integration of economic governance into activities not currently within the modern institutional economy"[11]. Only the latter may not be within the current meaning of "undertaking" and/or "firm", since the first would be legally considered centralised[12].

Some authors believe that blockchain-enabled entities could compete with traditional institutions (market, firms, networks, relational contracting, and government[13]) rather than changing them[14]. Others leave the door open by considering that they have the potential to substitute as well as complement conventional organisations[15].

In this dissertation, we do not aim to predict whether Blockchain-enabled entities will develop to considerably integrate the market; we strive to acknowledge Blockchain's

[8] Dave Clark, IETF Credo (1992) in P. Resnick, 'On consensus and humming in the IETF' (RFC Editor, June 2014) < RFC 7282: On Consensus and Humming in the IETF (rfc-editor.org)> accessed 14 May 2023.
[9] Michèle Finck, *Blockchain Regulation and governance in Europe* (Cambridge University Press, 2018), 183.
[10] Davidson and Filippi and Potts (n 2) 23.
[11] Ibid.
[12] Caton (n 5) 9.
[13] Davidson and Filippi and Potts (n 2) 24.
[14] Ibid 6.
[15] Peder Østbye, 'Exploring DAO Members' Individual Liability' (2022), 1 < Exploring DAO Members' Individual Liability by Peder Østbye :: SSRN > accessed 12 May 2023.

potential and *a priori* analyse whether Competition Law would be apt to "catch" these entities in case of suspicion of a competition infringement. The study of how Blockchain works, from a technological and economic perspective, greatly informs how governance might be impacted. Therefore, the Competition Law approach to defining "undertaking", by being closely related to economic impact, presents itself as a potential tool to create a structured sandbox regulation to understand Blockchain.

Firstly, we will define the legal scope of this dissertation, specifically focusing on the notion "undertaking" in European Competition Law. After, we will present Blockchain, its characteristics, potential, and governance. Lastly, we will study whether Blockchain poses a threat to the application of Competition Law, in particular, by analysing whether Competition Law would be applicable if a Blockchain-enabled entities were to infringe competition rules.

The mere creation or use of Blockchain will not trigger antitrust liability[16], even when done by a dominant firm[17]. However, the risk of anti-competitive outcomes related to Blockchain has already been vastly studied[18]. We will use their findings as examples to sustain the goal of the dissertation. To name a few, members performing transaction validations may collude to raise transaction fees; a dominant validator can support an

[16] "If, for example, leading commodity traders and banks decide to use a blockchain-based application to complete trades and settling transactions, much will *depend on the information shared* through the chain. If the blockchain is used only to match and clear deals and authenticating customers' information, then there is in principle no competition concern". Renato Nazzini, 'The Blockchain (R)evolution and the Role of Antitrust' (2018) King's College London Law School Research Paper 2019-20, 7 < The Blockchain (R)evolution and the Role of Antitrust by Renato Nazzini :: SSRN> accessed 12 May 2023.

[17] Mariateresa Maggiolino, Laura Zoboli, 'Blockchain governance: The missing piece in the competition puzzle' (2021) 43 Computer Law & Security Review, 8 < Computer Law & Security Review | Vol 43, November 2021 | ScienceDirect.com by Elsevier> accessed 10 May 2023.

[18]See, for example, Bruno de Zêzere Barradas, 'Blockchain e concorrência – um novo horizonte de aplicação?' (January-June 2018) Revista de Concorrência e Regulação, 253-256 < CR_33_34_Breves_Bruno_de_Zezere_Barradas.pdf (concorrencia.pt)> accessed 15 May 2023, Chris Pike, 'Blockchain Technology and Competition Policy' (26 April 2018) OECD Competition Papers <Blockchain Technology and Competition Policy - Issues paper by the Secretariat by Chris Pike :: SSRN> accessed 15 May 2023, Thibault Schrepel, *Blockchain + Antitrust. The Decentralization Formula* (Edward Elgar, 2021) <Blockchain + Antitrust – The Decentralization Formula | Elgar Online: The online content platform for Edward Elgar Publishing> accessed 15 May 2023.

attack to the Blockchain protocol; groups of validators[19] or users[20] may collude to exclude other participants; possible use of Blockchain for cartel management (especially when parties do not trust each other but look to cooperate to increase prices by using the data stored within the ledger)[21] and lastly, the hypothetical possibility of a (type of) Blockchain becoming a dominant/standard technology[22] capable of excluding other competing Blockchains[23] (lack of interoperability between Blockchains might worsen this outcome)[24].

II. LEGAL SCOPE

There have been some initiatives aiming to legally rationalise and recognise entities born on Blockchain. This thesis does not aim to study those "legal wrappers", since most of them were forcefully attributed to conform to existing legal forms in the name of supposed "legal security", thereby essentially maintaining traditional notions. Although we recognise that legally recognising a Blockchain-enabled entity may have economic advantages, such as enabling access to real-world businesses, for example, access to fiat

[19] Østbye (n 15) 12.
[20] Thibault Schrepel, 'Collusion by Blockchain and Smart Contracts' (2019) 33(1) Harvard Journal of Law & Technology, 140 <Collusion by Blockchain and Smart Contracts by Thibault Schrepel :: SSRN> accessed 15 May 2023.
[21] Izabella Kaminska, 'Exposing the "If we call it a blockchain perhaps it won't be deemed a cartel?" tactic', (Financial Times, 11 May 2015) <Exposing the "If we call it a blockchain, perhaps it won't be deemed a cartel?" tactic | Financial Times (ft.com)> accessed 11 June 2023, Stephan Breu, 'Blockchains and cybercurrencies challenging antitrust and competition law" (2018) 1(9) Journal of Entrepreneurial and Corporate Law, 60 <Blockchains and Cybercurrencies Challenging Anti Trust and Competition Law by Stephan Breu :: SSRN> accessed 11 June 2023.
[22] For further clarification on standard technologies see Communication from the Commission, 'Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements' (2011) OJ C 11/1, para 257-335; *Samsung – Enforcement of UMTS Standard Essential Patents* (AT.39939) 2891 final [2014], para 59-61; *Motorola – Enforcement of GPRS Standard Essential Patents* (AT.39985) 2892 final [2014], para 281-284; Case C-170/13 *Huawei Technologies Co Ltd v. ZTE Corp* [2015], para 46-47. However, such affirmation is not consensual "even if a blockchain has established itself as a standard technology, it would not be able to alter the functioning of the market as other dominant technologies would do" *in* Maggiolino and Zoboli (n 17) 2.
[23] Maggiolino and Zoboli (n 17) 8.
[24] For more on this subject: Schrepel (n 18); Schrepel (n 20); Nazzini (n 16).

money[25], and may contribute to the limitation of liability of its users[26]. In the view of this dissertation, Blockchain institutions, which are in fact decentralised, shall not be turned into legal traditional-like corporations simply because we currently do not have the proper framework.

"Legal wrappers" mainly take form as *i)* Limited Liability Companies[27], *ii)* Foundations[28] and *iii)* Associations[29]. Either for-profit or non-profit. More innovative approaches include the COALA Model Law[30], which was adapted by the Utah DAO in March 2023[31].

As we will further explore, Competition Law analysis goes beyond that formal legal recognition.

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[25] See more on: Chris Brummer and Rodrigo Seira, 'Legal Wrappers and DAOs' (2022) 6 <Legal Wrappers and DAOs by Chris Brummer, Rodrigo Seira :: SSRN> accessed 9 June 2023.

[26] "every voting participant in a DAO can and should be held individually liable for any illicit activity conducted by the DAO" Case No. 3:22-cv-05416-WHO *CFTC vs Ooki DAO*. (Commodity Futures Trading Commission, 22 September 2022) < CFTC Imposes $250,000 Penalty Against bZeroX, LLC and Its Founders and Charges Successor Ooki DAO for Offering Illegal, Off-Exchange Digital-Asset Trading, Registration Violations, and Failing to Comply with Bank Secrecy Act | CFTC> accessed 9 May 2023, Case No. 3:22-cv-05416-WHO *CFTC vs Ooki DAO*. (Commodity Futures Trading Commission, 8 June 2023) < Statement of CFTC Division of Enforcement Director Ian McGinley on the Ooki DAO Litigation Victory | CFTC>, accessed 5 August 2023.

[27] Wyoming Senate Bill SF0038 <https://lnkd.in/d7kqPWX8>, Tennessee <2024874.pdf>, Vermont <Vermont Laws>, Marshall Islands Decentralized Autonomous Organizations (DAO) Act (non-profit LLC) <https://lnkd.in/d2_kv_VQ>. For an extensive evaluation of each jurisdiction, see: Madalena Oliveira and António Rolo, *Decentralised Autonomous organisations (DAOs) in various jurisdictions: From old rules to innovative approaches* (2023, AAFDL Editora) < Lisbon DAO Observatory (cidp.pt)> accessed 13 June 2023.

[28] Switzerland (Tara Zharum, 'Swiss Foundation as a DAO Legal Wrapper: What you need to know' (Legal Nodes, 4 August 2022) <Swiss Foundation as a DAO Legal Wrapper: What You Need to Know (legalnodes.com)> accessed 9 June 2023) and Cayman Foundation Company (Nestor Dubnevych, 'Cayman Islands Foundation as DAO Legal Wrapper' (Legal Nodes, 28 April 2022) <Cayman Islands Foundation as a DAO Legal Wrapper (legalnodes.com)> accessed 9 June 2023.

[29] Jurisdictions like Liechtenstein, British Virgin Islands, Malta, Guernsey, Switzerland, Ireland and Singapore give the possibility to choose between cooperatives, foundations, associations and private trust companies. Gail Weinstein and others, 'A Primers on DAOs' (Harvard Law School Forum on Corporate Governance, 17 September 2022) < A Primer on DAOs (harvard.edu)> accessed 17 May 2023.

[30] Constance Choi and others, 'Model Law for Decentralized Autonomous Organizations (DAOs)' (COALA, 2021) <https://coala.global/wp-content/uploads/2022/03/DAO-Model-Law.pdf> accessed 17 May 2023.

[31] Robert Lamb, 'Utah passes innovative DAO legislation' (The National Law Review, 2 March 2023) <Utah Innovates Decentralized Autonomous Organizations Legislation (natlawreview.com)> accessed 17 May 2023.

1. Law and Technology

The Law and Technology field of study focuses on how the law should govern the interplay between technology and society[32]. The study of its theory is relatively recent[33].

It is common to associate technology with social change. However, even if closely related, Law and Technology differentiates itself from the study of social change and the law. The latter focuses on what people think and do, while technological change considers what people are technically capable of doing[34]. To understand the range of Law and Technology application, it is helpful to understand what technology is – "any tool or technique, any product or process, any physical equipment or method of doing or making, by which human capability is extended"[35].

Although legal problems particularly stemming from technological change are relatively rare and quite specific[36], regulation can play either a deterring or an encouraging role depending on the instruments used[37]. Ultimately, the lack of appropriate regulation may kill the potential of a technology altogether[38].

Sandbox regulations create a framework for businesses to test products and services without the risk of being non-compliant with existing laws. The sandbox creates a

[32] Maggiolino and Zoboli (n 17) 1.
[33] Lyria Moses, 'Why have a theory of Law and Technological change?' (2007) 8(2) Minnesota Journal of Law, Science & Technology, 590 <"Why Have a Theory of Law and Technological Change?" by Lyria Bennett Moses (umn.edu)> accessed 17 May 2023.
[34] Moses (n 33) 598.
[35] Donald Schön, 'Technology and change' 1 (1967) in Moses (n 33) 592.
[36] Moses (n 33) 596.
[37] Sofia Ranchordás, 'Innovation-Friendly Regulation: The Sunset of Regulation, the Sunrise of Innovation' (2015) 55(2) Jurimetrics 201–224 <Innovation-Friendly Regulation: The Sunset of Regulation, the Sunrise of Innovation by Sofia Ranchordas :: SSRN> accessed 17 May 2023 (on innovation and regulation).
[38] Thibault Schrepel, 'Is Blockchain the Death of Antitrust Law? The Blockchain Antitrust Paradox' (2019) Georgetown Law Technology Review / 3 Geo. L. Tech. Rev. 281 p. 330-331< Is Blockchain the Death of Antitrust Law? The Blockchain Antitrust Paradox by Thibault Schrepel :: SSRN> accessed 15 May 2023.

framework of safeguards to prevent already known risks[39] while preserving the flexibility that technology needs to flourish. The goal of sandbox regulation is to connect market players and regulators to better understand the technology and to identify the best way to protect society from its risks, while supporting promising innovation initiatives. The collaboration between said parties becomes crucial, especially in technologies like Blockchain, where it is technically possible for it to evolve outside legal frameworks.[40] Code is not law[41], but it could be (compliance by design).

In the European Union, a sandbox approach for Blockchain has been adopted, with the goal of supporting 20 projects annually between 2023 and 2026[42].

This dissertation, besides questioning whether Competition Law is ready to be applied to Blockchain-enabled entities, also aims to contribute to the sandbox line of thought by suggesting that European Competition Law analysis may be a virtuous tool for Blockchain sandbox regulation to effectively delimit the boundaries of a firm (even outside the Competition Law scope).

2. European Competition Law

European Competition Law aims to regulate competition in a free-market economy[43] to ensure that the internal market competition is not distorted[44], based on the belief that a

[39] Dirk Zetzsche and others, 'Regulating A Revolution: From Regulatory Sandboxes to Smart Regulation' (2017) Center for Business and Corporate Law (CBC) Working Paper Series 001/2017, 26 <Regulating a Revolution: From Regulatory Sandboxes to Smart Regulation by Dirk A. Zetzsche, Ross P. Buckley, Douglas W. Arner, Janos Nathan Barberis :: SSRN> accessed 17 May 2023.
[40] For more on this topic see: Primavera De Filippi and Samer Hassan, 'Blockchain Technology as a Regulatory Technology: From Code is Law to Law is Code' (2018) 21(12) Special issue on 'Reclaiming the Internet with distributed architectures' <Blockchain Technology as a Regulatory Technology: From Code is Law to Law is Code by Primavera De Filippi, Samer Hassan :: SSRN> accessed 17 May 2023.
[41] In reference to: Lawrence Lessig, *Code. Version 2.0* (Basic Books, 2006).
[42] 'Commission launches European Regulatory Sandbox for Blockchain' (European Commission, 14 February 2023) <Commission launches European Regulatory Sandbox for Blockchain | Shaping Europe's digital future (europa.eu)> accessed 17 May 2023.
[43] Alison Jones, Brenda Sufrin and Niamh Dunne, *EU Competition Law: Text, Cases and Materials* (7th edition, Oxford, 2019), 2.
[44] Article 3(1)g Treaty of Rome and Protocol 27.

"proactive" competition policy leads to *i)* macroeconomic and *ii)* microeconomic benefits[45].

Macroeconomic effects are related to factors such as growth, inflation, consumption, jobs and investment. However, it is hard to measure and isolate the macroeconomic contribution of Competition Policy from other Public Policies[46] (such as commercial, monetary, etc). Therefore, there is a lack of concrete evidence despite the attempts to prove otherwise[47].

Microeconomic effects relate to the welfare of individual economic agents, such as undertakings and consumers. Competition Law rules are a means to minimise "market failures" [48].

The first regulations on anticompetitive conduct date back a few years BC[49], in India and Rome[50], forbidding certain agreements between undertakings, output-limiting conduct, boycotts, and activities of private and public monopolies[51]. In the Middle Ages, legal rules were created to protect markets and fairs, which then became Common Law precedent in the United Kingdom. Later, said Common Law inspired the Sherman Act (1890) in the United States[52].

After the Sherman Act, it took 50 years for competition rules to be adopted in Europe through the Treaty of Paris (1951)[53] and later, and more directly, through the Treaty of

[45] Damien Geradin, Anne Latne-Farrar and Nicolas Petit, *EU Competition Law and Economics* (Oxford, 2012) 5.
[46] *Ibid.* 6.
[47] Andre Sapir and others, 'An Agenda For A Growing Europe' (2003) Report of an Independent High-Level Study Group established on the initiative of the President of the European Commission, 130 <(1) (PDF) An Agenda for a Growing Europe: The Sapir Report (researchgate.net)> accessed 17 May 2023.
[48] Geradin, Latne-Farrar and Petit (n 45) 6.
[49] Before Christ.
[50] For example, Lex Julia de Annona, from around 50 BC and adopted under Ceaser's ruling. Provided sanctions for arrangements intended to raise the price of wheat.
[51] K.P. Ewing, *Competition Rules for the 21st Century: Principles from America's Experience* (The Hague: Kluwer Law International, 2003), 76 *in* Geradin, Latne-Farrar and Petit (n 45) 12.
[52] Miguel Moura e Silva, *Direito da Concorrência* (AAFDL, 2018) 48.
[53] Establishing the European Coal and Steel Community.

Rome (1957)[54]. The Treaty of Rome introduced a sophisticated competition law regime, including provisions on: anticompetitive agreements between competitors, abuses of dominance and rules governing state aid[55]. It was a time of technological revolution – which resulted in the establishment of a large market that gave incentives for firms to exploit.

Article 3(1)(b) of the Treaty on the Functioning of the European Union (TFUE) determines that the "establishing of the competition rules necessary for the functioning of the internal market" is an exclusive competence of the Union. Which means that it is the European Union's competence when trade is affected between Member States or there are EU dimension mergers. If it does not affect the internal market, it is of national concern[56].

European Competition Law prohibits *i)* anticompetitive agreements (Article 101 TFUE) and *ii)* anticompetitive monopolistic practices (Article 102 TFUE), by one or multiple undertakings[57], in one or several markets. Anticompetitive agreements include, for example, pricing policies, limitations of production, and partitioning markets. Anticompetitive practices might entail price discrimination, exclusive supply clauses, tie-in sales, aggressive new product launch prices, certain types of price discounts and rebates. Mergers and acquisitions[58] are supervised *ex ante* to prevent big concentration of market power.

To apply these prohibitions, we need to single out the undertaking or undertakings involved. In Competition Law, the term "undertaking" can refer to a single legally

[54] Establishing the European Community. The fourth preamble, Article 2 and Article 3(1)g are of great importance.
[55] Geradin, Latne-Farrar and Petit (n 45)15.
[56] Jones, Sufrin and Dunne (n 43) 84.
[57] On collective dominance *see* Damien Geradin and others, 'The Concept of Dominance in EC Competition Law' (2005) Research Paper on the Modernization of Article 82 EC College of Europe 21-30< The Concept of Dominance in EC Competition Law by Damien Geradin, Nicolas Petit, Mike Walker, Paul Hofer, Frédéric Louis :: SSRN> accessed 17 May 2023.
[58] Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings (the EC Merger Regulation).

recognised entity or include multiple legally recognised entities. As we will further analyse in the next chapter, the "undertaking" is deeply connected with the Theory of the Firm introduced by Coase – the "firm" as an economic agent (or a single economic unit) that can make decisions as to the exercise of the market power that it holds[59].

III. THE UNDERTAKING IN EUROPEAN COMPETITION LAW

Before explaining the theory of the firm and its jurisprudential practice in Competition Law, it is important to state why defining a firm/undertaking is important for Competition Law. Defining the firm is essential because it gives us the ability to *i)* understand if Competition Law should apply, *ii)* assess practices, *iii)* assign liability[60], and *iv)* define market power[61].

Regarding the *ii)* assessing practices, it is important to understand if, in terms of collusion, the two legal entities are part of the same economic unit. If so, they shall not be considered collusive, since they cannot be held responsible for colluding with themselves[62]. The same logic is applied relating to monopolisation and abuse of dominant position, as well as when defining market power under Article 102.

[59] Maggiolino and Zoboli (n 17) 3.
[60] Thibault Schrepel, 'The Theory of Granularity: a Path for Antitrust in Blockchain Ecosystems' (2020) 14 < The Theory of Granularity: A Path for Antitrust in Blockchain Ecosystems by Thibault Schrepel :: SSRN> accessed 9 June 2023.
[61] Ioannis Lianos, 'Blockchain Competition' (2018) BRICS Competition Law & Policy Centre Research Paper 1/2018, 79 <Blockchain Competition by Ioannis Lianos :: SSRN> accessed 17 May 2023.
[62] See, for example, Case C-73/95 P *Viho Europe BV v Commission of the European Communities* [1996] ECR I-5457; *Hydrotherm Gerätebau GmbH v Compact del Dott. Ing. Mario Andreoli & C. Sas.* [1984] ECR 1984-02999 para 11, 22; Case C-266/93, *Bundeskartellamt v Volkswagen and VAG Leasing GmbH* [1995] ECR I-3477; for a deeper analysis, see Alison Jones, 'The Boundaries of an Undertaking in EU Antitrust and Competition Law' (2012) European Competition Journal 8(2) < The Boundaries of an Undertaking in EU Competition Law by Alison Jones :: SSRN> accessed 17 May 2023.

1. Theory of the firm

The Court of Justice has made clear in Shell that "undertakings" are economic units rather than legal units[63], and Wouter Wills has underlined that the concept of undertaking takes as its starting point Ronald Coase's pathbreaking article[64].

The theory of the firm was introduced by Ronald Coase in his article "The nature of the firm"[65], which later became a fundamental pillar of Competition Law and Antitrust[66]. Yet it is important to note that it has not always been that way; the Sherman Act and the European Treaties precede the influence of the article[67]. The concept of "firm" is generally used in Economics, while the concept of "undertaking" is the European Law's equivalent.

In Economic theory, it is acknowledged that in the market, the allocation of factors of production is determined by the price mechanism[68]. However, according to Coase, firms do not work the same way: market structures are controlled by price; firms are controlled by the "entrepreneur's"[69] hierarchical control (vertical control or direct managerial control[70]), which establishes command-and-control over resources[71]. In other words, "a firm is characterised as a single decision-taker and pursues a single goal (of profit maximisation)"[72].

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[63] "economic units exist thanks to control with the aim to reducing transaction costs" Case T-11/89 *Shell International Chemical Company Ltd v Commission of the European Communities* [1992] ECR 11-757.para 311.
[64] Wouter P.J. Wils, 'The Undertaking as Subject of E.C. Competition Law and the Imputation of Infringements to Natural or Legal Persons', 25 EUR. LAW REV. 99, 102 (2000) *in* Schrepel (n 60) 12.
[65] Ronald Coase, 'The Nature of the Firm' (Economica 4(16) 1937) < The Nature of the Firm by Coase (bu.edu)> accessed 17 May 2023.
[66] Schrepel (n 60) 6.
[67] Ronald Coase, 'The Nature for the Firm: Influence' (1988) Journal of Law, Economics & organization 4(1) 33-47 < The Nature of the Firm: Influence (jstor.org)> accessed 17 May 2023.
[68] Coase (n 65) 387 and 394.
[69] "refer to the person or persons who, in a competitive system, take the place of the price mechanism in the direction of resources" Coase (n 65) 388 and 392.
[70] Jones (n 62) 312.
[71] Coase (n 65) 393.
[72] Jones (n 62) 312.

Coase argues that "entrepreneurs" reduce cost in transactions by internalising it, especially when dealing with "asset specificity and frequency of dealings"[73], such as negotiating and drafting contracts, researching possible partners, etc..[74]; furthermore, the value of internalising the costs is potentiated by the uncertainty of the market.

Therefore, Coase concludes that *i)* by organising in firms, the economic agents are more efficient than economic individuals who compete; *ii)* firms extend into where they can minimise costs[75]; *iii)* uncertainty of markets potentiate the creation of firms, especially if long-term contracting is ideal[76].

Although it is not linear that both Williamson and Coase follow the same line of thought[77], the study of Williamson significantly contributes to the understanding of Coase's Theory. Williamson (1985)[78] operationalised "Coasean" theory through transaction cost analysis, by arguing that a hierarchical organisation is a method for controlling opportunism while in the presence of bounded rationality and asset specificity.

Bounded rationality considers the limited information and capacity one has. Introduced by Herbert Simon, the term recalls the need to acknowledge "the access to information and the computational capacities that are actually possessed by organisms, including man,

[73] Sinclair Davidson, Primavera de Fillippi and Jason Potts, 'Blockchains and the Economic Institutions of Capitalism' (2018) Journal of Institutional Economics 14(4) 648 < Blockchains and the Economic Institutions of Capitalism by Sinclair Davidson, Primavera De Filippi, Jason Potts :: SSRN> accessed 17 May 2023.
[74] Schrepel (n 60) 7.
[75] Coase (n 65) 395.
[76] Coase (n 65) 392.
[77] Per L. Bylund, 'The Firm vs. the Market. Dehomogenizing the Transaction Cost Theories of Coase and Williamson' (2019) <The Firm vs. the Market: Dehomogenizing the Transaction Cost Theories of Coase and Williamson by Per L. Bylund :: SSRN> accessed 17 May 2023.
[78] Alan Stone, 'The Economic Institutions of Capitalism. By Oliver Williamson' (1985) American Political Science Review *80*(4), 1424-1425 <The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. By Oliver E. Williamson. (New York: Free Press, 1985. Pp. 450. $27.95.) | American Political Science Review | Cambridge Core> accessed 17 May 2023.

in the kind of environments in which such organisms exist"[79]. One may add that rationality is affected by fundamental uncertainty (indeterminacy of the future)[80].

By controlling opportunism, there is a rise in transaction cost efficiency of hierarchies and relational contracting over markets[81]. Williamson adds that organisations are sometimes more efficient than markets because they have more efficient ways to solve disputes[82], such as the Incentive Theory (the impact of authority, ownership, and employee compensation) [83].

A firm is viewed as a "nexus of contracts", however, as a nexus of incomplete contracts[84]. Incomplete contracting models[85] usually invoke transaction costs arising from: *i)* uncertainty, or unforeseen contingencies; *ii)* costs of writing contracts; *iii)* costs of enforcing contracts[86].

Hence, firms are created when there is a cost to use the price mechanism present in the Market. These costs, which have been immortalised as transaction costs, relate to the tasks of discovering what the relevant prices are and the costs of contracting with a variety of entities that would have been involved in a purely price-oriented production process[87].

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[79] Herbert Simon, 'A Behavioral Model of Rational Choice' (1955) Quarterly Journal of Economics 69(1) 99–118, 99 <Behavioral Model of Rational Choice | The Quarterly Journal of Economics | Oxford Academic (oup.com)> accessed 17 May 2023.
[80] David Dequech, 'Bounded rationality, Institutions, and Uncertainty' (2001) Journal of Economic Issues 35(4) 911-929, 916 <Bounded Rationality, Institutions, and Uncertainty on JSTOR> accessed 17 May 2023.
[81] Caton (n 5) 16.
[82] 'Oliver Williamson – Facts' (The Nobel Prize, 12 June 2023) <Oliver E. Williamson – Facts - NobelPrize.org> accessed 17 May 2023.
[83] Schrepel (n 60) 9.
[84] Stone (n 78).
[85] Jean Tirole, 'Incomplete contracts: where do we stand?' (1999) Econometrica, 67(4), 741–781.
[86] Caton (n 5) 16.
[87] Prateek Goorha, 'The return of "The Nature of the firm": The role of Blockchain' (2017) The Journal of the British Blockchain Association 1(1), 3 <The Return of 'The Nature of the Firm': The Role of the Blockchain by Prateek Goorha :: SSRN> accessed 19 May 2023.

2. The undertaking

European Union's Competition rules primarily apply to "undertakings": directly, through Article 101 and Article 102 and, indirectly, through Article 107 to Article 109 TFUE. The concept of "undertaking" is crucial, since only agreements and concerted practices between undertakings, and decisions made by associations of undertakings, are foreseen in Article 101. Likewise, Article 102 only applies to abuses perpetrated by dominant *undertakings*. Whilst the EU Merger Regulation[88], deals with shifts in the competition structure after mergers and acquisitions[89] between *undertakings*.

Despite the relevance of the concept "undertaking", it is not defined by any European legislation (not in the Rome Treaty, nor in secondary legislation)[90]. This was a deliberate regulatory decision, since it was previously defined[91] under Article 89 Paris Treaty[92], Article 196 b) EURATOM[93], Article 1 Protocol 22 Porto Treaty[94]. As a general concept, it has the advantage of making regulation flexible and thus able to remain unchanged over time and along development[95].

[88] Council Regulation 139/2004 of 20 January 2004 on the Control of Concentrations Between Undertakings [2004] OJ L24/1.
[89] "the acquisition, by one or more persons already controlling at least one undertaking, or by one or more undertakings, whether by purchase of securities or assets, by contract or by any other means, of direct or indirect control of the whole or parts of one or more other undertakings" Article 3(1) of Council Regulation 139/2004 of 20 January 2004 on the Control of Concentrations Between Undertakings [2004] OJ L24/1
[90] Geradin, Latne-Farrar and Petit (n 45) 40; Jones (n 62) 302; Richard Whish and David Bailey, *Competition Law* (Oxford University Press, 8th edition, 2021) 85.
[91] Moura e Silva (n 52) 243.
[92] Established the European Coal and Steel Community (ECSC) in 1951.
[93] Established the European Atomic Energy Community (EAEC or Euratom) in 1957.
[94] "any entity carrying out activities of a commercial or economic nature"
[95] Katarína Kalesná, 'What Has Changed in European Concept of Undertaking? From "FENIN" to "EASY PAY"' (2021) Slovak Yearbook of European Union Law 1 81–88, 81 < What Has Changed in European Concept of Undertaking? From „FENIN" to „EASY PAY" | Slovak Yearbook of European Union Law (uniba.sk)> accessed 17 May 2023.

According to Alison Jones, there is currently no consistency between the notion of "undertaking" under Article 101 and the notion of "sole control" under the EUMR[96], while defending that both should be in line with the economic notion of the firm – "the existence of authority or the power to exercise control over people and physical assets"[97].

The EU judiciary takes on the role of further clarifying the content and limits of such concept[98], and assesses if "its application is definite and foreseeable"[99]. Nonetheless, the firm's structure underwent minimal transformation over the years; it grew in complexity but has not changed in nature. As a result, litigation mostly involves other issues[100].

Thus far, there are two paths which we can follow to define "undertaking": the *i)* institutional notion and the *ii)* functional notion.

At first, the jurisprudence tackled the concept of "undertaking" through an institutional approach. The *i*) **institutional notion** refers to a unitary organisation[101], which might include assets and personal elements (workers and managers) and a common goal[102]. As seen, for example, in the Mannesmann Case where it was held that an undertaking is "an unitary organisation of individuals and tangible and intangible assets connected to a legally independent subject, and pursuing on an ongoing basis a specific economic goal"[103]. The main shortcoming is that it can be easily confused with national law concepts, such as "company" or others[104], and it may not be able to catch "disguised" economic institutions.

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[96] Jones (n 62) 304.
[97] WPJ Wils, 'The Undertaking as Subject of EC Competition Law and the Imputation of Infringements to Natural or Legal Persons' (2000) 25 European Law Review 99 in Jones (n 62) 311.
[98] Geradin, Latne-Farrar and Petit (n 45) 40; Moura e Silva (n 52) 243. Jones (n 62) 302.

[99] Case T-99/04 *AC-Treuhand v Commission* [2008] ECR II-1501, para 14: "the gradual clarification of the notion of "agreement" and "undertaking" by the [EU] judicature is of decisive importance in assessing whether their application in practice is definite and foreseeable".
[100] Schrepel (n 60) 10.
[101] Joined cases 17/61 and 20/61, *Klöckner-Werke AG and Hoesch AG v High Authority of the European Coal and Steel Community*. [1962], *Shell* Case (n 63).
[102] Moura e Silva (n 52) 244.
[103] Case 19/61 *Mannesmann AG v High Authority of the European Coal and Steel Community* [1962].
[104] Moura e Silva (n 52) 243.

The extent of the concept was progressively clarified by the Court of Justice, which brought it to the functional approach. The *ii*) **functional notion** considers any entity engaged in economic activity, despite the way in which it is financed and its legal status[105]. As an example, under this approach, the Court defined an undertaking as "every entity engaged in an economic activity regardless of the legal status of the entity and the way in which it is financed"[106] and "economic units which consist of a unitary organisation of personal, tangible and intangible elements, which pursue a specific economic aim on a long-term basis and can contribute to the commission of an infringement of the kind referred to in that provision".[107] It is therefore a "complex concept involving human and physical components joined in the pursuit of a single economic activity"[108].

Regarding the shift from an institutional notion to a functional notion, it seems that the only change made was the switch from "economic goal" to "economic activity" (which is also not defined in legislation[109]); however, "economic activity" was already previously defined by the jurisprudence of the Court[110]. For the purpose of this thesis, it is also important to preliminarily note that both approaches maintain the importance of a unitary entity. It is preferable to choose a functional notion, since it will overcome legal personality limits and encompass the totality of resources associated with a common finality, by establishing a common centre of control over those assets[111].

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[105] Case C-41/90 *Höfner and Elser v Macrotron GmbH* [1991] ECR I-1979, para 21; Case C-244/94 *Deferation Française des Societes d'Assurances (FFSA) and Others v Ministère de l'Agriculture et de la Pêche* [1995] ECR I-4013, para 14; Case C-55/96 *Job Centre coop arl* [1997] ECR I-7119, para 21; Case C-35/96 *Commission v Italian Republic* [1998] ECR I-3851, para 49; Case T-513/93 *Consiglio Nazionale degli Spedizionieri Doganali v Commission* [2000] ECR II-1807, para 36; Case C-280/06 *Ente tabacchi italiani* [2007] ECR I-10893, para 38; Case T-386/06 *Pegler* [2011] II-1267, para 42ff.
[106] *Höfner* Case (n 105) para 21.
[107] *Shell* Case (n 63) paragraph 311, and Case T-352/94 *Mooch Domsjö v Commission* [19981 ECR 11-1989, paragraph 87.
[108] Case T-6/89 *Enichem v Commission* [1991] ECR II-1623, paras 233–35.
[109] Geradin, Latne-Farrar and Petit (n 45) 40.
[110] Case 118/85 *Commission v Italy*, [1987] ECR I-2599, para 7, Case C-35/96 *Commission v Italy (CNSD)* [1998] ECR I-385, para 36.
[111] Moura e Silva (n 52) 244.

It is, thus, settled in jurisprudence that the concept of undertaking encompasses every entity engaged in an *i)* economic activity, *ii)* regardless of its legal status and *iii)* the way in which it is financed[112].

2.1 Economic activity

The CJUE follows the functional approach, which transfers the question from "who" is an undertaking to "what is economic activity"[113]. Such analysis might vary depending on the conduct examined and the specific facts of the case in question.

Economic activity is any activity consisting of "offering goods or services on a given market[114]. We must also consider that "the nature of the purchasing activity must therefore be determined according to whether or not the subsequent use of the purchased goods amounts to an economic activity"[115]. The understanding of such a concept is still reigned by uncertainty (in law and in economics)[116].

It is likely that an entity may be considered an "undertaking" regarding some activities but not qualified as such for other activities[117]. So, it is also possible to coexist within one

[112] *Höfner* Case (n 105), para 21, *Fédération Française* Case (n 105), para 14; *Job Centre* Case (n105), para 21; Case C-138/11 *Compass Datenbank v. Republik Őstereich* [2012], para 35, Case C-309/99 *Wouters* [2002] ECR I -1577, para 46, *Hydrotherm* Case (n 62) para 1.
[113] Okeoghene Odudu, 'The Meaning of Undertaking within 81 EC' Cambridge Yearbook of European Legal Studies, (edited by John Bell and Claire Kilpatrick, 2005), 212–213 *in* Lianos (n 61) 78.
[114] *Commission v. Italy (CNSD)* Case (n 110), para 7 and 36; Case C-118/85 *Commission v Italy* (n 110), para 7; Joined Cases C-180-184/98 *Pavel Pavlov v Stichting Pensioenfonds Medische Specialisten* [2000] ECR I-6451, para 75; *Consiglio Nazionale* Case (n 105) para 36; Case C-82/01 P *Aéroports de Paris v Commission* [2002] ECR I-9297, para 79; Case C-49/07 *Motosykletistiki Omospondia Ellados NPID (MOTOE) v Elliniko Dimosio* [2008] ECR I-4863, para 2; Case T-319/99 *FENIN v Commission* [2003] ECR II-357, para 36; Case C-437/09 *AG2R Prévoyance* [2011] ECR I-973, para 42.
[115] Fenin Case (n 114) para 26.
[116] J.M. Coutinho de Abreu, *Definição de empresa pública* (Coimbra, 1990) 106-120 *in* Manuel Lopes Porto, José Luís da Cruz Vilaça, Carolina Cunha, Miguel Gorjão-Henriques, Gonçalo Anastácio, "Lei da Concorrência. Comentário Conimbricense." (Almedina, 2nd edition, 2017) 120.
[117] "(…) has to be established *in concreto* with regard to the specific activity under scrutiny" Opinion of the Advocate General F. Jacobs in the Albany Case, para 207, Lianos (n 61) 78, Case G-67/96 *Albany International v Sticjting Bedriifspensionnenfonds Textielindustrie* (1999) ECR I-5751, Jonathan Faull and Ali Nikpay, *The EU Law of Competition* (Oxford : Oxford University Press, 3rd edition, 2014) 190; Whish and Bailey (n 90) 87.

entity, both economic and non-economic activities[118]. For example, a public hospital is not, at first sight, an undertaking considering its public health activity; however, it can be regarded as one when considering the monetisation of its laboratories' intellectual property rights[119].

It is also important to note that the General Court (GC) held that a "dormant" undertaking with no turnover, assets, or employees did not offer an economic activity[120]. Nevertheless, an entity that only acts as a "facilitator" to a cartel can be an undertaking, even if it does not have an economic activity[121]. The question remains whether those criteria are cumulative (no turnover, assets, or employees) or should be used as such.

The potentially limitless scope of the concept of economic activity/undertaking has prompted criticism from legal scholars[122]; however, some limits have already been advanced. To better understand this concept, it is essential to briefly explain the existing boundaries of "economic activity": *a*) State and (some) public entities; *b*) solidarity; *c*) consumers; and d) workers.

a) Public Entities:

The State or the Organs of the Member States (for example, public authorities, the health service, municipalities, communes) and entities entrusted by the Member States with regulatory or other roles are able to alter competition[123]. Nonetheless, we must exclude the consideration of an economic activity when the State or other public entities *i)* exercise public authority, *ii*) carry out activities that the market could not provide (in principle, there is no economic activity), *iii*) buy goods to satisfy their needs, without the goal of reintroducing them in the market[124].

[118] See Opinion of AG Jacobs *Albany* Case (n 117) para 207, Geradin, Latne-Farrar and Petit (n 45) 41.
[119] Geradin, Latne-Farrar and Petit (n 45) 41.
[120] Case *Pegler* (n 105) para 43-49.
[121] Commission decision of 10 December 2003, para 331-349, upheld on appeal *Treuhand* Case (n 99).
[122] Geradin, Latne-Farrar and Petit (n 45) 42.
[123] Whish and Bailey (n 90) 85-86.
[124] Porto and others (n 116) 121.

Regarding the *i*) exercise of public authority, the Court held, for instance, that entities enjoying and exercising prerogatives that "are typically"[125] of governmental organisations, could not be designated an undertaking.[126] A "typical" activity of a public authority can be, for example, air traffic control[127] and marine anti-pollution monitoring[128] since they constitute a "general interest mission" that is part of the essential functions of the State[129].

Therefore, we need to consider *i*) "its nature, its aim and the rules to which it is subject" and *ii*) whether it is "connected with the exercise of powers of a public authority"[130].

Regarding *ii*) activities that the market could not provide, it has been considered to include, for example, the activity of offering a compulsory social security system scheme[131].

It is also excluded when the State or other public entities *iii*) buy goods to satisfy its own needs, without the goal of reintroducing them in the market, like in the FENIN case where it was decided that "an organisation which purchases goods – even in great quantity – not for the purpose of offering goods and services as part of an economic activity, but in order to use them in the context of a different activity, such as one of a purely social nature, does not act as an undertaking simply because it is a purchaser in a given market"[132].

[125] Case C-364/92, SAT Fluggesellschaft mbH v Eurocontrol [1994] ECR I-43, para 30.
[126] Geradin, Latne-Farrar and Petit (n 45) 42.
[127] *SAT v Eurocontrol* Case (n 125) para 30. Case T-155/04 *SELEX Sistemi Integrati SpA v Commission*, [2006] ECR II-4787, para 77.
[128] Case C-343/95 *Diego Cali & Figli Srl v Servizi ecologici porto di Genova SpA (SEPG)* [1997] ECR I-1547, para 22-23.
[129] Geradin, Latne-Farrar and Petit (n 45) 42.
[130] *Wouters* Case (n 112) para 57.
[131] Cases C-160/91 *Poucet* [1993] ECR I -637 (based on the principle of solidarity and, therefore, it is not an undertaking) and Case C-218/00 *Cisal di Battistello Venanzio & C Sas v Istituto nazionale per l'assicurazione contro gli infortune sul lavaro (INAIL)* [2002] ECR I-691; on the contrary, Case C-67/96 *Albany* [1999] ECR I-5863 (based on principle of capitalisation is an undertaking) and Case C-180/98 *Pavlov* [2000] ECR I -06451.
[132] Fenin Case (n 114) para 37 and confirmed by the appeal Case C-205/03P [2006] ECR I -6295.

It might be harder to understand if it is an economic activity in "mixed markets", where public bodies and private firms are present on a Market[133], since both carry out the same activity.

As stated before, the same entity may be considered an undertaking depending on the activity it performs (whether economic or non-economic), which is particularly relevant in cases involving State or State-related entities[134]. For example, a State school might not be considered as being engaged in an economic activity when providing free educational services, yet, it is probable to be an undertaking when renting out its facilities[135]. As held in Case MOTOE in the context of public power and economic activity, each activity exercised by a given entity must be carried out separately[136].

b) Solidarity

Regarding solidarity, we need to analyse whether entities with the aim of exclusively focusing on social activities do so as undertakings or not[137]. Given its importance, these activities must not be competitive or exclusive. If they were to be considered as an economic activity, the entities involved in such endeavours would be considered undertakings, which could deprive them of public subsidies under 107 TFUE or even be incapable of providing services under Article 102 TFUE[138].

Such entities can be public or private, but in both scenarios, these entities need to pursue solidarity, non-profit initiatives, and initiatives in which the beneficiaries receive the

[133] Whish and Bailey (n 90) 86.
[134] *Aéroports de Paris* Case (n 114) para 72; *MOTOE* Case (n 114), para 25; Compass Datenbank Case (n 112) para 37.
[135] Faull and Nikpay (n 117) 190-191.
[136] "The clarification as an activity falling within the exercise of public power or as an economic activity must be carried out separately for each activity exercised by a given entity" in *MOTOE* Case (n 114) para 25.
[137] Winterstein 'Nailing the Jellyfish: Social Security and Competition Law' (1999) 20 ECLR 324, 327-331 *in* Whish and Bailey (n 90) 90.
[138] Geradin, Latne-Farrar and Petit (n 45) 42.

service for free or through a payment that is below its true cost[139] – we can see such activities in areas like social security[140], public security, health, and education[141].

The Court, in the Cases Poucet and Pistre[142], regarding social security, stated that to have a case of "national solidarity", *i)* the contribution for social security of the ones with more capital shall benefit the least well-off, and *ii)* active workers finance social security benefits for pensioners. It might also help to consider the activity as solidarity if the contributions and benefits are defined by law and not subject to market pricing[143].

The Advocate General Francis Jacobs further categorised the criteria that would generally be suggestive of the existence of an economic activity: *i)* the membership of the insurance scheme is optional; *ii)* the beneficiary's contributions would finance his own future social security benefits (principle of capitalisation) and no redistribution to other contributors; *iii)* benefits received by the contributor correlate with the contributions paid, the financial results of the investments made by the managing body and the costs generated by that body[144].

It is not yet clear whether those requirements are cumulative. In the Albany Case, the Court considered that the fund should be perceived as in competition with insurance companies, because the entity determined the amount of the contributions and benefits, and it followed the capitalisation principle – even if it was a pension fund with a mandatory membership system (exhibiting certain features of "solidarity")[145].

Therefore, an entity that purchases products (demand-side) not intending to supply goods and services as an economic activity, but to use them in a different activity, said activity

[139] Porto and others (n 116) 12.
[140] Poucet Case (n 131).
[141] Case C-263/86 *Belgian State v René Humbel and Marie-Thérèse Edel* [1988] ECR I-5365 (education).
[142] Poucet Case (n 131).16-19.
[143] *Battistello Venanzio v INAIL* Case (n 131) para 38 and para 43-46 (since it had a national solidarity objective and the contribution and the benefits were defined by law)
[144] Opinion of the Advocate General F. Jacobs in the Albany Case (n 117) para 338, 342, 346.
[145] *Albany* Case (n 131) para 81 and 84.

shall not be perceived as economic[146] and, hence, not an undertaking under Competition Law.

If all the criteria presented by Advocate General Jacobs in the Albany Case are not met, the Court shall turn to older jurisprudence and consider additional arguments that might suggest that there is, in fact, a national solidarity case, such as the profit motive and the social character of the functions[147]. Ultimately, the Court has been conducting a case-by-case assessment of what constitutes an "undertaking"[148].

c) Consumers

A natural person acting as a final consumer, purchasing goods or services, will never constitute an undertaking, since that behaviour is not economic[149].

d) Workers

Workers are not to be considered as undertakings[150]. An employee is an individual working within a legal person, and, therefore, by being incorporated into the legal person, the employee does not bear financial and commercial risk over the transactions[151]. For clarification, we shall break down the cumulative requirements needed to be considered a worker (which will be very useful in our subsequent analysis): *i)* control (subordination link); *ii*) remuneration; and *iii*) stable, genuine and effective nature of the work[152].

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[146] FENIN Case T-319/99 (n 114) para 37; and confirmed by the appeal Case C-205/03P [2006] ECR I -6295 para 25.
[147] Geradin, Latne-Farrar and Petit (n 45) 44.
[148] Ibid.
[149] See Joined Cases C-180-184/98 Pavlov (n 114) para 79-81. The main exception to this is FENIN Case T-319/99 (n 114) para 35-37
[150] Joined Cases C-180-184/98 *Pavel Pavlov v Stichting Pensioenfonds Medische Specialisten* [2000] ECR I-6451Opinion of AG Jacobs.
[151] Jones (n 62) 306; Whish and Bailey (n 90) 93.
[152] European Commission, 'A European agenda for the collaborative economy' (Communication) COM(2016)356 final, 12-13< EUR-Lex - 52016DC0356 - EN - EUR-Lex (europa.eu)> accessed 28 May 2023. European Commission, 'Reaffirming the free movement of workers: rights and major developments ', COM(2010) 373 final, 4-6 < EUR-Lex - 52010DC0373 - EN - EUR-Lex (europa.eu)> accessed 28 May 2023.

Individuals acting solely in their capacity as employees are not considered to be undertakings[153]. For example, in the Becu Case the Court held that dock workers, while performing work for and under the direction of their employers, are incorporated in the undertaking that employs them and thus take part of an "economic unit"[154]. The dock workers should not be taken collectively as an undertaking either[155]. Consequently, collective labour agreements are permissible under Article 101 TFUE[156].

Alternatively, ex-employees who carry on an independent business can be considered an undertaking[157].

Subcontractors

A subcontracting agreement is defined as an agreement in which a firm (the "contractor") entrusts to another, called 'the subcontractor', the manufacture of goods, the supply of services or the performance of work under the contractor's instructions, to be provided to the contractor or performed on his behalf[158]. Subcontractors are not subject to Article 101 regarding their relationship with the contractor and, therefore, are not considered an undertaking in that context.

Agents

An agency contract is the one in which an agent "is a legal or physical person entrusted with the power to negotiate and/or conclude contracts on behalf of another person ('the principal'), either in the agent's own name or in the name of the principal, for the purchase

[153] For example, Joined Cases 40/73, etc *Coöperatieve Vereniging Suiker Unie UA and Others v Commission* [1975] ECR 1663.
[154] Case C-22/98 *Criminal Proceedings against Becu* [1999] ECR I-5665, para 26. (labour is not the same as provision of goods and services), *Albany* Case, Opinion AG Jacobs (n 117). *Pavlov* Case (n 114).
[155] Becu Case (n 154) para 27; Whish and Bailey (n 90) 93
[156] Albany Case (131) para 60.
[157] For example, *Reuter/BASF* (Case IV/28.996) [1976] OJ L 254/40.
[158] Commission notice of 18 December 1978 concerning its assessment of certain subcontracting agreements in relation to Article 85 (1) of the EEC Treaty, 1, and confirmed on Communication from the Approval of the content of a draft for a Communication from the Commission – Commission Notice: Guidelines on vertical restraints, 2021/C 359/02, 26.

of goods or services by the principal, or the sale of goods or services supplied by the principal"[159].

The Court held that in principal and agent relationships, the agent may not be considered an independent trader and should be seen as an auxiliary organ "forming an integral part of the principal's undertaking" [160] given their close economic links. Which means that, like employees[161], it also *i)* provides services for and under the direction of the principal, *ii)* it does not take any (or only a negligible portion) of the responsibility over the commercial and financial risk linked to sales of goods to third parties on behalf of the principal (even if an agent acts for more than one principal) [162] [163] [164].

Nonetheless, the CJ has held that the previous statement shall only be applied regarding the Market in which the agent offers the principal's goods or services. Which means it shall not be considered as an auxiliary part of the principal's business regarding the Market in which it offers its agency services to potential principals. In that situation, it shall be considered an independent operator and, therefore, an undertaking[165] [166].

[159] Communication from the Approval of the content of a draft for a Communication from the Commission – Commission Notice: Guidelines on vertical restraints, 2021/C 359/02, 21, and EC Guidelines on Vertical Restraints [2010] OJ C130, para 12.
[160] Bundeskartellamt v Volkswagen Case (n 62) paras 18–19, Case C-279/06 *CEPSA Estaciones de Servicio SA v LV Tobar e Hijos SL.* [2008] ECR I-6681, para 35. Contrasting with , Cases 46 and 58/64, *Établissements Consten S.à.R.L. and Grundig-Verkaufs-GmbH v Commission* [1966] ECR 299 (the ECJ rejected the argument that a vertical agreement did not constitute an agreement between undertakings since the supplier and distributor were i) not on an equal footing and ii) were not competitors "These situations are distinct in law and, moreover, need to be assessed differently, since two marketing organisations, one of which is integrated into the manufacturer's undertaking while the other is not, may not necessarily have the same efficiency", 340).
[161] Jones (n 62) 307.
[162] *CEPSA* Case (n 160), para 36.
[163] Jones (n 62) 306.
[164] *Bundeskartellamt v Volkswagen* Case (n 62) para 19; Case T-325/01 *DaimlerChrysler AG v Commission* [2005] ECR II-3319, para 87.
[165] *CEPSA* Case (n 160) para 41.
[166] Jones (n 62) 307.

2.2 Regardless of its legal status

As stated before, it is feasible that the same entity may be found to be an "undertaking" for some activities but not qualified as such for other activities[167]. The Commission held that the concept of undertaking is not intertwined with legal personality, which means that its content covers all entities engaged in economic activity, regardless of their legal personality ("a civil company, a commercial company, a public institution, a cooperative, an economic interest group or none of the above"[168]) or whether it has one[169]. Nonetheless, it was already stated as necessary the ability to identify a "legal subject" for the decision to be implemented[170].

2.3 Regardless of the way in which it is financed

The concept "undertaking" covers all entities engaged in economic activities, regardless of how they are financed. As explored before while analysing the "economic activity" concept, public companies or entities financed by the State may fall within the scope of the term "undertaking" [171].

The idea of economic activity might remind us of profits, yet, such profit-motive[172] or economic purpose[173] is not essential. EU Competition Law does not differentiate between "altruistic entities" and "entities motivated by profit" since in both cases, it is possible that certain activity may reduce competition.[174] Such an idea has been applied to many

[167] Lianos (n 61) 78.
[168] Geradin, Latne-Farrar and Petit (n 45) 40.
[169] For example, *Pre-insulated Pipe Cartel* (Case IV/35.691/E-4) Commission Decision 1999/60/EC [1999] OJ L24/1, para 154 "The subject of the competition rules in the Treaty is the "undertaking`, a concept not necessarily identical with the notion of corporate legal personality in national commercial company or fiscal law").
[170] "it is always necessary to identify, for the purpose of execution of the decision, an entity possessing legal personality" PVC Decision Committee of December 21, 1988 (89/190/EEC), OJ L 74 17th March 1989.
[171] Manuel Pita, 'As empresas públicas e o direito comunitário da concorrência' (1987) XXIX Revista de Direito e de Estudos Sociais, 564.
[172] PVC Decision Committee (n 170), Joined Cases 209/78 etc *Heintz van Landewyck SARL and others v Commission* [1980] ECR 3125, para 88.
[173] Case C-222/04 *Cassa di Risparmio di Firenze* [2006] ECR I-289, para 123.
[174] Lianos (n 61) 78.

cases, football clubs[175] being one of the most interesting takes on Competition Law. Even if, at first sight, Competition Law should not be applied, in the International Olympic Committee's anti-doping Regulation, the Court held that, despite the Regulation being purely sport-related and not an economic activity *per se*[176], it had the potential to have anti-competitive consequences given the amount of economic activity based on sports[177].

We can even have situations where a service or product provided for free is considered an economic activity – for example, the German Federal Employment Office (*Bundesanstalt*)[178], an undertaking offering free advertising services to consumers[179] or even a non-profit medical organisation that provides emergency transport and ambulance services[180]. It is very common for products and services to be free in double-sided markets, for example, free morning papers, search engines (Google) or community sites (Facebook, Twitter); however, entities are paid by undertakings on the other side of the market, such as advertising entities[181].

3. Independence of undertakings

The term undertaking might entail several legal and/or natural persons[182]. We will further explore the possibility of natural persons or several legal/natural persons as undertakings.

[175] Case T-193/02 *Piau* [2005] ECR II-209, para 69-72. It was held that FIFA was an association of undertakings, even if it had amateur club alongside professional ones. Case C-519/04 P *Meca-Medina and Igor* Majeen *v Commission* [2006] ECR I-6991, para 38. International Olympic Committee as an undertaking and an association of undertakings.
[176] *David Meca-Medina and Igor Majeen v Commission* Case (n 175) para 27.
[177] Geradin, Latne-Farrar and Petit (n 45) 41.
[178] *Höfner* Case (n 105).
[179] Case 352/85 *Vond van Adverteerders* [1988] ECR 2085.
[180] C-475/99 *Firma Ambulanz Glöckner v Landkreis Südwestpfalz* [2001] ECR I-08089, para 9-22.
[181] Geradin, Latne-Farrar and Petit (n 45) 42.
[182] Hydrotherm Case (n 62) para 11; Case C-97/08 P *Akzo Nobel v Commission* [2009] ECR I-8237, para 55; Case C-90/09 P *General Química* [2011] OJ C80/2, para 35; Case T-321/05 *AstraZeneca* [2010] ECR II-2805, paras 818-820.

3.1 Natural person as an undertaking

Natural persons have repeatedly been held as undertakings in Competition Law.[183] Multiple professions can be considered undertakings[184], because they are engaged in an economic activity (providing services against remuneration on markets[185]). From artists[186] (like opera singers[187]), lawyers[188], industrial property agents[189], architects[190], accountants[191], self-employed medical specialists[192], attestation agents[193], geologists[194], employees pursuing their own economic interests, like research[195] for company directors[196].

Consequently, natural persons may be considered an undertaking if self-employed or if they are from liberal professions[197]. This conclusion shall not be altered by the fact it is an *i)* intellectual activity; *ii)* requires authorisation; *iii)* can be pursued in the absence of

[183] Case *AOIP v Beyard* OJ [1976] L 6/8 (a patent license between an individual and a company) Reuter/BASF (n 157); *RAI v UNITEL* OJ [1987] L 157/39 (opera singers were undertakings); Vaessen BV v Moris OJ (1979) L 19/32; Case 35/83 *BAT v Commission* [1985] ECR 363; Case 42/84 *Remia BV and Verenigde Bedrijven Nutricia NV v Commission* [1985] ECR 2545.
[184] Whish and Bailey (n 90) 92; Faull and Nikpay (n 117) 190.
[185] "Indeed, the Court confirmed in Wouters (n 112), para 48, that lawyers offer, for a fee, services in the form of legal assistance and representation of clients in legal proceedings. Similar reasoning applies for other professions, such as customs agents in the two CNSD (T- 513/93 and C-35/96) cases and medical specialist doctors in Pavlov op cit note 22" *in* Commission Communication to report on competition in professional services, COM (2004) 83 final 09.02.2004, 18.
[186] "when they exploit commercially their artistic performances" *RAI/UNITEL*, (n 183), 39
[187] Ibid.
[188] *Wouters* Case (n 112) para 48-49.
[189] Commission Decision of 30 January 1995, IV/33.686, COAPI, OJ L 122 of 2 June 1995, 37.
[190] Commission Decision of 24 June 2004, COMP/38.549, PO/Belgian architects fee system, 36–7.
[191] Case C-1/12 *Ordem dos Técnicos Oficiais de Contas v Autoridade da Concorrência* [2013] para 37-38.
[192] Joined Cases *Pavlov* (n 114), para 77.
[193] Case C-327/12 *Ministero dello Sviluppo económico v SOA Nazionale Costruttori* [2012], para 27-35.
[194] Case C-136/12 *Consiglio nazionale dei geologi* [2013], para 14.
[195] Decision Reuter/BASF (n 157) para 40.
[196] *Remia BV* Case (n 183), para 50.
[197] Commission Communication to report on competition in professional services, COM (2004) 83 final 09.02.2004, p.18.

a combination of material, non-material, and human resources; *iv)* nor the complexity and technical nature of the services provided; *v)* nor the fact that the profession is regulated[198].

We can, therefore, conclude that individuals may constitute undertakings when operating as independent economic actors.[199] Nonetheless, it is essential to note that a "natural person… cannot, in his sole capacity as a member or shareholder, be classified as an undertaking"[200] unless the shareholder actually exercises control by involving itself in the management of the undertaking[201] (we will further explore what control means).

a) Prosumers

A prosumer can be defined as "market participants who both produce and consume their own goods or services"[202]. The concept was popularised within the peer-to-peer (P2P) economy[203], although it was first coined by Alvin Toffler in 1990[204]. The P2P economy seems to be replacing or significantly complementing multiple markets[205].

The European Union's legislation does not define a prosumer as a "professional", hence most Member States continue to apply sector-specific definitions. They also were not considered as workers since, in most cases, they do not have one of the three cumulative requirements[206] – *i)* under control/subordination; *ii)* remuneration and *iii)* stable nature of

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[198], Commission v. Italy (CNSD) Case (n 110), para 38. *Wouters* Case (n 112), para 49; *Pavlov* Joined (n 114), para 77.
[199] Jones (n 62) 305-306.
[200] Case C-189/02P *Dansk Rørindustri A/S v Commission* [2002] ECR II-1681, para 111.
[201] *Cassa di Risparmio Di Firenze* Case (n 173), para 111-113.
[202] Lucila de Almeida and others, 'Peer-to-peer Trading and Energy Community in the Electricity Market – Analysing the literature on Law and Regulation and Looking Ahead to Future Challenges', (2021) EUI Working Papers RSC 2021/35, 2 <https://cadmus.eui.eu/bitstream/handle/1814/70457/RSC%202021_35rev.pdf?sequence=4&isAllowed=y > accessed 23 May 2023
[203] Known as well as "sharing economy", "collaborative economy" and "gig economy".
[204] Alvin Toffler, *The Third Wave* (Bantam Books, 1st edition 1980) <The Third Wave : Alvin Toffler : Free Download, Borrow, and Streaming : Internet Archive> accessed 23 May 2023.
[205] George Ritzer, 'Prosumer Capitalism' (2015) 56 The Sociological Quarterly 413 *in* Sofia Ranchordás, 'Peers or Professionals? The P2P-Economy and Competition Law' (2017) University of Groningen Faculty of Law Research Paper Series 4/2018, 2 <Peers or Professionals? The P2P-Economy and Competition Law by Sofia Ranchordas :: SSRN> accessed 23 May 2023.
[206] European Commission, 'A European agenda for the collaborative economy" (Communication) COM(2016)356 final, 12-13. See also European Commission, 'Reaffirming the free movement of

the work. If prosumers are not considered "undertakings", that means Competition Law does not apply, and, for example, they are free to coordinate their conduct. Interestingly, it has been stated that the minimum efficient size of a firm in a P2P economy can be less than a single person – for example, the occasional renter of a room, the weekend driver, and the part-time online shop owner"[207].

In a P2P economy, digital platforms enable contact between prosumers and users. Those digital platforms argue that there are two types of economic activities: "a) the digital intermediation performed by the platform that generally does not provide any material services to consumers and b) the supply of the underlying services (home, food ride or other sharing services)".[208] While some platforms only *i)* provide a place for intermediation and advertisement, others *ii)* control every single aspect of the service (like Uber[209]).

In the Uber Spain Case, it was claimed that there was unfair competition since Uber did not have administrative authorisation, like the rest of the transport services[210]. Although the Court did not delve into the Competition Law question, it further clarified whether platforms should be regarded as transport services, information society services or a combination of both – it ultimately concluded that Uber exercises "a decisive influence over the conditions under which that service is provided by those drivers."[211] Therefore, the drivers do not act independently from the platform, which might mean they should be

workers: rights and major developments', COM(2010) 373 final, 4-6< EUR-Lex - 52010DC0373 - EN - EUR-Lex (europa.eu)> accessed 25 May 2023.

[207] D. Stallibrass and J. Fingleton, 'Regulation, Innovation, and Growth: Why Peer-to-Peer Businesses Should Be Supported' (2016) 7 Journal of European Competition Law & Practice 414, 414 *in* Friso Bostoen, 'Competition Law in the Peer-to-peer economy' (2019), 9 < Competition Law in the Peer-to-Peer Economy by Friso Bostoen :: SSRN> accessed 23 May 2023.

[208] Vassilis Hatzopoulos, 'The Collaborative Economy and EU Law', Hart, (2018)) 104 in Ranchordás (n 205) 16.

[209] Case C-434/15 *Asociación Profesional Elite Taxi v Uber Spain* [2017].

[210] Ibid para 26.

[211] Ibid para 39-40 and Case C-434/15 *Asociación Profesional Elite Taxi v Uber Spain* [2017],Opinion of AG SZPUNAR, para 52.

considered either workers or subcontractors[212] (it is also a good case to see Competition Law's role as a good first responder in the context of institutional innovation).

Although Uber drivers were qualified as part of the platform (and not as single economic units/undertakings), they might not resemble platforms from other sectors (for example, renting housing), and it seems unlikely that the *stable nature* and *control/subordination* are satisfied in most other platforms[213]. To understand if each service provider is a separate undertaking, we need to analyse if each individual can establish its own *i)* business policy and *ii)* its prices, *iii)* carry financial risks, and *iv)* use their own resources[214].

In conclusion, the entity that will be considered an undertaking will depend on how the platform works, which means it will depend on casuistic analysis.[215] Prosumers will in most cases be identified as undertakings when providing a service[216], except if the control exerted by the platform "is so exorbitant as to exclude any initiative and risk-taking by the suppliers"[217].

3.2 Single economic unit

Under the "single entity doctrine", multiple natural or legal persons[218] may form one economic unit[219] and, therefore, an undertaking, if a control relationship or decisive

[212] Case C-434/15 *Asociación Profesional Elite Taxi v Uber Spain* [2017],Opinion of AG SZPUNAR, para 54.
[213] Victoria Daskanova, 'Regulating the new self-employed in the Uber economy: what role for EU competition law?' (2017) Stockholm University Research Paper 38, 11-14 and 15-16 < Regulating the New Self-Employed in the Uber Economy: What Role for EU Competition Law? by Victoria Daskalova :: SSRN> *in* Bostoen (n 207) 11*;* Vassilis Hatzopoulos, "The Collaborative Economy and EU Law", Hart, (2018), p. 105 *in* Ranchordás (n 205) 17.
[214] Case C-107/82 *AEG-Telefunken v Commission* [1983].
[215] Bostoen (n 207) 10.
[216] Almeida and others (n 202) 14 and 24; Bostoen (n 207) 12.
[217] Vassilis Hatzopoulos, The Collaborative Economy and EU Law (Hart 2018) 105 *in* Ranchordás (n 205) 17.
[218] C-48/69 *Imperial Chemical Industries Ltd. v Commission* [1972] ECR 619 the Court for the first time applied the "economic entity" test. The actions of the subsidiary were attributed to their parent company since it succeeded in determining the relationship of control.
[219] "Concerned practices between undertakings do not cover agreements or harmonized practices between undertakings belonging to the same group if the undertakings form an economic unit." Joined

influence exists between them[220]. Both the U.S. and European Courts have recognised that two legal entities that are part of the same economic unit cannot be held responsible for collusion, as one cannot agree with itself[221]; therefore, Article 101 TFEU will only apply to entities that can compete[222]. The logic is similar regarding monopolisation and abuse of dominant position, since a company cannot abuse its market power against itself[223].

Regarding liability[224], it usually rests with the parent company unless the parent company has no control or decisive influence over the subsidiary's decisions. **It is essential to distinguish between ownership and control**[225].

Command-and-control can be defined as "a situation in which managers tell employees everything that they should do, rather than allowing them to decide some things for themselves"[226]; in other words, "Command-and-control instruments (mechanisms, laws, measures) are elements of policy and management that rely on prescribing rules and standards and using sanctions to enforce compliance with them"[227]. In the same line, Article 3 n.º 2 of the Council Regulation on Control of Concentrations Between

cases T-68/89, T-77/89 and T-78/89 *Società Italiana Vetro SpA, Fabbrica Pisana SpA and PPG Vernante Pennitalia SpA v Commission of the European Communities* [1992] para 357.

[220] Hydrotherm Gerätebau Case (n 62), *Akzo Nobel* Case (n 182); *Joined Cases C-628/10 P and C-14/11 P Alliance One International and Standard Commercial Tobacco v Commission and Commission v Alliance One International and Others*, 46-47 (liability of a parent company for the conduct of its wholly–owned subsidiary or on which it exercises a decisive influence); Art. 3(2) & 3(3) of Council Regulation (EC) No. 139/2004 on the Control of Concentrations Between Undertakings, OJ 2004 L 24/1 (in the context of merger control).

[221] Schrepel (n 20) 129.

[222] Joined cases *Società Italiana Vetro SpA, Fabbrica Pisana SpA and PPG Vernante Pennitalia SpA v Commission* (n 219) para 357; Case C-15/74 *Centrafarm BV and Adriaan de Peijper v Sterling Drug Inc.*, [1974] para 41.

[223] Schrepel (n 20) 129.

[224] For a deeper analysis, see Jones (n 62).

[225] On this distinction, see, for example, Spencer Waller, 'Corporate Governance and Competition Policy' (2011) George Mason Law Review 18(4) < Corporate Governance and Competition Policy by Spencer Weber Waller :: SSRN> accessed 23 May 2023.

[226] 'Command and Control' (Cambridge English Dictionary) < COMMAND AND CONTROL definition | Cambridge English Dictionary> accessed 23 May 2023.

[227]'Command-and-control' (EEA Glossary) <https://www.eea.europa.eu/help/glossary/eea-glossary/command-and-control > accessed 23 May 2023.

Undertakings: "Control shall be constituted by rights, contracts or any other means which, either separately or in combination and having regard to the considerations of fact or law involved, confer the possibility of exercising decisive influence on an undertaking, in particular by: (a) ownership or the right to use all or part of the assets of an undertaking; (b) rights or contracts which confer decisive influence on the composition, voting or decisions of the organs of an undertaking"[228].

In the Case Akzo Nobel it is stated that "the actual exercise of decisive influence"[229] defines firm limits in Competition Law and that "it is sufficient for the Commission to prove that the subsidiary is wholly owned by the parent company in order to presume that the parent exercises a decisive influence over the commercial policy of the subsidiary"[230]. Decisive influence can also be seen when the parties do not decide independently in the Market and instead follow instructions from the parent company.[231] In the Case Chemical Industries, the Court has ruled that executing "the instructions given" by another party was vital in analysing the independence of a subsidiary, and that "where a subsidiary does not enjoy real autonomy in determining its course of action in the market," the prohibitions set out in TFEU Article 101 were inapplicable[232].

Regarding the different types of legal/natural persons that can be perceived as an economic unit, there is no fixed rule – there should be a case-by-case analysis of control and decisive influence. For instance, in Hydrotherm, the Court of Justice found that a

[228] Regulation (EC) 139/2004.
[229] C-516/15 P *Akzo Nobel and Others v Commission* [2017] para 55.
[230] Ibid, para 61. (analysing shares holding or other factual elements, such as who is supporting financial risks as one of them), *Wouters* Case (n 112) para 48.
[231] C-516/15 P *Akzo Nobel and Others v Commission* [2017] Joined Cases C-231/11 P to C-233/11 P, *European Commission v Siemens AG Österreich and Others and Siemens Transmission & Distribution Ltd and Others v European Commission* [2014] para 43; Joined Cases C-247/11 P and C-253/11 P, *Areva and Others v European Commission* [2014] para 125.
[232] *Imperial Chemical* Case (n 218) para 133-134. *Viho* Case (n 62) para 47, "real autonomy in determining their course of action in the market, but carry out the instructions issued to them by the parent company controlling them."

natural person, a limited partnership and another undertaking constituted a single economic unit because they were all controlled by the same natural person[233].

3.3 Relationship between economic unit and economic activity

The relationship between "economic activity" and "economic unit" is not clear.[234] Especially, *i)* if an entity being involved in "economic activity" is the key element to establishing the scope of an economic unit, *ii)* if, even though an entity is engaged in economic activity, it might not be considered an undertaking because it takes part of a larger economic unit[235] or *iii)* if an undertaking as an economic unit can be composed by multiple undertakings.

As previously explained, an undertaking is any entity engaged in economic activity despite the way in which it is financed and despite its legal status.[236] Therefore, the concept of undertaking, as seen before, is not necessarily connected with natural or legal personality.[237] An undertaking might entail a plurality of natural persons and/or legal persons, such as: *i*) companies and partnerships; *ii*) associations of undertakings; *iii*) parents and their subsidiaries; and *iv*) joint ventures.

As exemplified by Alison Jones, "a company or partnership may be made up of individuals capable of competing with one another, a principal and an agent or members of the same corporate group (a parent and its subsidiaries) may constitute separate legal entities"[238]. Nevertheless, we must recall that multiple persons who participate in a single economic entity are incapable of infringing Article 101 TFEU between one another. As *Viho* Case stated "where there is no agreement between economically independent

[233] *Hydrotherm Gerätebau* Case (n 62) para 12. Other example is Case C-680/20 Unilever Italia Mkt. Operations Srl v Autorità Garante della Concorrenza e del Mercato [2020].
[234] Jones (n 62) 303.
[235] Ibid.
[236] *Höfner* Case (n 105), para 21; Def*eration Française des Societes d'Assurances (FFSA)* Case (n 105), para 14; *Job Centre* Case (n 105) para 21; *Commission v Italian Republic* Case (n 105), para 49.
[237] *Pre-insulated Pipe Cartel* Case (n 169) para 154.
[238] Jones (n 62) 303; O. Odudu and D. Bailey, 'The Single Economic Entity Doctrine in EU Competition Law' (2014) 51 Common Market Law Review, 1721-1723 *in* Bostoen (n 207) 9.

entities, relations within an economic unit cannot amount to an agreement or concerted practice between undertakings which restricts competition"[239].

It may not always be easy to recognise the boundaries of each undertaking, since the reality of control between undertakings is not always formalised in their legal status – remaining the question of whether the undertakings are acting unilaterally or jointly, or if one or more undertakings exist[240].

It must be pointed out that it is not sufficient to establish that two companies form an economic unit when the same person or the same family have shares in two commercial companies[241]. Likewise, it is feasible to have several majorities within the group of shareholders' meetings of companies without excluding the possibility of a single economic unit[242]. The mere holding of shares in an undertaking does not, in itself, mean that the entity of the shares is an undertaking; yet, if the shareholder actually exercises control by involving himself directly or indirectly in the management of the undertaking, it must be regarded as part of the economic activity and, therefore, it must be viewed as an undertaking[243]. "As long as there is a unitary organisation of personnel and tangible and intangible elements, which pursues a specific economic aim on a long-term basis and can contribute to a restriction of competition or an abuse of dominance, it qualifies as an undertaking for the purposes of Articles 101 and 102 TFEU"[244].

It is, consequently, not clear the relationship between the concept "economic activity" and "economic unit". Does the economic activity define the scope of the economic unit?

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[239] *Viho* Case ("where there is no agreement between economically independent entities, relations within an economic unit cannot amount to an agreement or concerted practice between undertakings which restricts competition"), and para 18.
[240] Jones (n 62) 303.
[241] Case C-196/99 *P Aristrain* [2003] ECR I-11005, para 99. In Michael J. Frese, *Sanctions in EU Competition Law: Principles and Practice* (1st edition, Hart Publishing, 2014), 64.
[242] Case C-407/08 P *Knauf Gips* [2010] ECR I-6375, para 73. *Ibid*.
[243] *Cassa di Risparmio Di Firenze* Case (n 173), para 111-113.
[244] Case T-9/99 *HFB* [2002] ECR II-1487, para 54 in Frese (241) 64.

Or is it possible to have a larger economic unit and, within it, an undertaking engaged in economic activity?[245].

In the Case Confederación Española, the Court refers to a partnership and firms both as an "undertaking", as well as two legally independent undertakings that together constitute one contracting party as an economic unit for the purposes of the agreement[246]. It seems that the undertaking as an economic unit can be composed of various undertakings (natural or legal)[247].

Besides the above-mentioned group of persons, other less obvious groups can also be considered undertakings, such as P & I clubs[248] , agricultural cooperatives[249] and trade associations[250].

IV. BLOCKCHAIN

Before further clarifying what Blockchain is, it is vital to understand the difference between Blockchain and Distributed Ledger Technologies (DLT). The terms Blockchain and DLT are often used interchangeably, but while all Blockchains are DLTs, not all DLTs are Blockchains.[251] Non-Blockchain distributed systems do not depend on "the

[245] Jones (n 62) 303.
[246] Case C-217/05 *Confederación Española de Empresarios de Estaciones de Servicio v Compañia Española de Petróleos SA* [2006] ECR I-11987, para 12.
[247] Case T-102/92 *Viho Europe BV v Commission* [1995] ECR II-117, paras 47–53.
[248] P & I Clubs OJ [1985] L 376/2, P& I Clubs OJ [1999] L 125/12, para 50-51.
[249] Case 61/80 *Cooperatuve Stremsek-wn Kleurselfabirek v Commission* [1981] ECR 851.
[250] Case 71/74 *FRUBO v Commission* [1975] ECR 563, Case 96/82 *IAZ International Belgium NV v Commission* [1983] ECR 3369.

[251] David Shrier, *Basic Blockchain: What it is and how it will transform the way we work and live* (Hachette UK, 2020) 22 *in* Chris Pike and Gabriele Carovano 'Reasons to be cheerful: the benevolent market power of decentralized blockchains' (2020) 1 < Reasons to Be Cheerful: The Benevolent Market Power of Decentralised Blockchains by Chris Pike, Gabriele Carovano :: SSRN> accessed 15 May 2023.

creation of a chain of blocks and instead use alternative crypto-economic mechanisms to reach consensus"[252] – for example, Directly Acyclic Graphs[253].

1. The technology

Blockchain can be understood as a distributed system, *i)* for recording data[254], *ii)* in a cryptographically secured way, which makes it hard to tamper with the previous ledger[255]; through *(iii)* crypto-economic incentives[256] and *(iv)* a common rule structure[257] that keeps copies of the ledger and adds new entries and/or blocks[258] (protocol and consensus mechanisms).

Data is recorded in a Blockchain through blocks. Each block contains data about what happens in the ledger/chain[259]. The chain (the connection between blocks) connects all

[252] Chris Pike and Gabriele Carovano 'Reasons to be cheerful: the benevolent market power of decentralized blockchains' (2020) 1 < Reasons to Be Cheerful: The Benevolent Market Power of Decentralised Blockchains by Chris Pike, Gabriele Carovano :: SSRN> accessed 15 May 2023.

[253] "Directed Acyclic Graphs (DAGs) consensus mechanisms, instead of bundling data together into blocks that are then confirmed one after another, require newly added data to reference and validate past data. Usually each new transaction would have to reference and validate two transactions that came before. In doing so, the network comes to form a graph of converging and confirmed transactions. If a node incorrectly validates a past transaction, that node's transaction would fail to be confirmed by other participants". In Pike and Carovano (n 252) 1.

[254] Max Raskin, "The law and legality of smart contracts", *1 Georgetown Law Technology Review 304 (2017),* 317 <The Law and Legality of Smart Contracts by Max Raskin :: SSRN> accessed 23 May 2023.

[255] Davidson and Filippi and Potts (n 2) 6; Maggiolino and Zoboli (n 17) 6: "the system is designed to resist illegitimate manipulation of records, because compromising parts of a ledger entails a high risk of making it incompatible with the system at large – which would negate the utility of the tampering itself."

[256] Davidson and Filippi and Potts (n 2) 6.

[257] Caton (n 5) 9.

[258] Christopher Millard, 'Blockchain and law: Incompatible codes?' (2018) 34 Computer Law & Security Review, 3 < Blockchain and Law: Incompatible Codes? by Christopher Millard :: SSRN> accessed 23 May 2023. Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets, and amending Regulations (EU) No 1093/2010 and (EU) No 1095/2010 and Directives 2013/36/EU and (EU) 2019/1937, defines it as "rules and procedures by which an agreement is reached, among DLT network nodes, that a transaction is validated" Article 3 (1(3))

[259] For example, I create a NFT and want to sell it. Owning the NFT would be a block, as well as there would be blocks of all the steps of the transaction. All the data relating to ownership and transactions would accompany the NFT.

the previous transactions and information of past blocks; a continuous chain[260] with *ad infinitum* (an Infinite memory[261]) collection of data[262].

The blocks need to be mined by solving mathematical problems presented by the system[263], then stored[264] and validated[265] by the community of the Blockchain. Such blocks are accessible to all members[266], and if new data is not verifiable within the existing Blockchain, those blocks will not be integrated[267]. Therefore, it creates a peer-to-peer network[268] that is efficient, permanent, and verifiable[269].

To briefly understand how transactions are technically made possible: the transaction sender signs the transaction with a private key. This private key creates a public key with a practical non-invertible function[270]. The hash, also referred to as an address, is created from the corresponding public key[271] where the amount of cryptocurrency for the private key is registered. The verification is made possible through "zero-knowledge proof", which enables verification without knowing the contents of the transaction[272]. Hence, private keys are not the same as personal entities since a personal entity would have a different private key of all the transactions made, rendering the technology pseudo-anonymous[273].

[260] Davidson and Filippi and Potts (n 2) 7.
[261] Goorha (n 87) 4.
[262] The degree of access to this information will change if the blockchain is public or private / permissioned or permissionless. We will further explain the difference.
[263] Breu (n 21) 58.
[264] A full node is a node that stores all the information within Blockchain.
[265] On how validation occurs on Bitcoin, as an example Rainer Böhme and others, 'Bitcoin: Economics, Technology, and Governance' (2014, last revised on May 2015) 29(2) Journal of Economic Perspectives <Bitcoin: Economics, Technology, and Governance (ssrn.com)> accessed 23 May 2023.
[266] Maggiolino and Zoboli (n 17) 5.
[267] Breu (n 21) 58, Maggiolino and Zoboli (n 17) 6.
[268] Raskin (n 254) 317.
[269] Breu (n 21) 58.
[270] Which means it is exceptionally difficult to reverse engineer.
[271] Through a similar process as the public key (practical non-invertible function).
[272] Pike and Carovano (n 252) 2.
[273] Østbye (n 15) 3.

Users need to trust in *i)* how decisions are made (rules to decide how to create new blocks[274] (consensus mechanism) and overall protocol[275], *ii)* in the transaction ("that the same amount left one account as arrived in another, that the sender agreed to it, and that the funds used are unique and were not double-spent"[276]) and that the *iii)* conditional contract will be automatically executed[277] (a general scripting language with programmable functionality[278]). Users also expect it to be more resistant to external attacks since there is no infrastructural central point of failure (sensitive central point)[279].

Some Blockchains, like Ethereum, enable smart contracts. Smart contracts are algorithmic "contracts" in which the contracting parties can define terms and conditions that, through Blockchain, are automatically maintained and resolved on the chain[280]. Blockchain is designed with self-executing code; however, it is not always able to respond to ever-changing circumstances[281]. We will further explain this point in Chapter IV 2.

Even though users depend on each other for the survival of the Blockchain, they do not trust each other and can only recognise one another by their public addresses. Blockchain technology is a step towards progressing from trustworthy third-party verification[282] (for example, an intermediary) to relying on consensus mechanisms and "high-powered

[274] Daniel Ferreira, Jin lin, Radoslawa Nilokowa, 'Corporate Capture of Blockchain Governance' (2019) European Corporate Governance Institute, Finance Working Paper 593/2019, 2 < Corporate Capture of Blockchain Governance by Daniel Ferreira, Jin Li, Radoslawa Nikolowa :: SSRN > accessed 24 May 2023.
[275] Finck (n 9)183.
[276] Chris Pike and Antonio Capobianco, 'Antitrust and the Trust Machine' (2019) 5(3) Competition Law and Policy Debate, 48 < Antitrust and the Trust Machine by Chris Pike, Antonio Capobianco :: SSRN> accessed 13 June 2023
[277] Ibid.
[278] Davidson, Filippi and Potts (n 2) 7.
[279] Vitalik Buterin, 'The Meaning of Decentralization' (Medium, 6 February 2017) <The Meaning of Decentralization. "Decentralization" is one of the words… | by Vitalik Buterin | Medium> accessed 23 May 2023
[280] Chris Berg, Sinclair Davidson and Jason Potts, 'Proof of work as a three-sided market' (2020) 3 Frontiers in Blockchains, 4 < Frontiers | Proof of Work as a Three-Sided Market (frontiersin.org)> accessed 23 May 2023.
[281] Finck (n 9) 187.
[282] Davidson and Filippi and Potts (n 2) 8, Pike and Carovano (n 252) 2.

crypto-economic incentive protocols to verify the authenticity of a transaction in the database"[283], and, therefore, towards trustlessness.

Tokens or crypto-assets provide incentives to users, which bind them to the platform[284] and facilitate "community-driven forms of corporate organization and governance" building[285].

Crypto-assets can be defined as "a digital representation of a value or of a right that is able to be transferred and stored electronically using distributed ledger technology or similar technology"[286].

Tokens are often free (possibly including targeting "additional token-drops at influential users as they grow"[287]) or can be bought (or earned) with minimal cost at the beginning of the token's release. The early adopters value a token for its long-term potential[288]. Token effects explain the idea that free tokens offer a "costless way for new entrants to reimburse users for the value of the network effects they bring to the platform"[289].

2. Governance and decision-making

To understand how decisions are made within Blockchain, one needs to understand *i)* if the Blockchain is public or private, permissioned or permissionless; *ii)* the layers of the Blockchain and *iii)* the consensus mechanisms (which requires understanding of the

[283] Davidson and Filippi and Potts (n 2) 8.
[284] Fenwick and Vermeulen (n 1) 22.
[285] Fenwick and Vermeulen (n 1) 5. See more on its advantages on Mark Fenwick, Joseph McCahery and Erik Vermeulen, 'The end of "Corporate" Governance: Hello "Platform" Governance' (2018) European Corporate Governance Institute – Law Working Paper 430/2018 <The End of 'Corporate' Governance: Hello 'Platform' Governance by Mark Fenwick, Joseph A. McCahery, Erik P. M. Vermeulen :: SSRN> accessed 16 May 2023
[286] Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets, and amending Regulations (EU) No 1093/2010 and (EU) No 1095/2010 and Directives 2013/36/EU and (EU) 2019/1937, Article 3 (1(5)).
[287] Pike and Carovano (n 252) 4.
[288] *Ibid*.
[289] Catalini, C. & Tucker, C. E. 'Antitrust and Costless Verification: An Optimistic and a Pessimistic View of the Implications of Blockchain Technology' (2018). MIT Sloan Research Paper No. 5523-18 *in* Pike and Carovano (n 252) 4.

different types of users/players within Blockchain space and the difference between on-chain and off-chain governance).

a) Public or private, permissioned or permissionless

It is important to note that "public" and "permissionless" or "private" and "permissioned" are not synonyms[290], even though it is possible to find literature that groups them together. The distinction is crucial because it clearly shows how involved the users are in the development of the system (whether anyone can be a validator/miner or not).

A Blockchain is **private** when it requires prior authorisation to access; it is **public** when there is no authorisation needed.

A Blockchain being **permissionless** or **permissioned** refers to the accreditation process to accept a new member[291] / "power that a user can exercise"[292] – therefore, a permissionless Blockchain requires no authorisation for new members or for members to develop the system[293], whether permissioned Blockchains require it[294].

Another difference is that permissionless Blockchains don't have their principles determined at the start[295], it is later built by core software developers, miners, users and token holders[296].

It follows that public Blockchains can either be permissioned or permissionless, whereas private blockchains can only be permissioned[297]. Permissioned systems are governed by a party or consortium that controls the accreditation process for new members and determines the system's rules[298]. Only public permissionless Blockchains are truly public

[290] Pike and Carovano (n 252) 1.
[291] Finck (n 9) 195.
[292] Pike and Carovano (n 252) 1.
[293] Østbye (n 15) 3.
[294] Pike and Carovano (n 252) 2
[295] Finck (n 9) 197.
[296] Finck (n 9) 185.
[297] Schrepel (n 60) 4.
[298] Such Blockchain "is often designed for a specific purpose" – governance by design. Finck (n 9) 195.

domain[299] because of their open access, open-source and interoperable protocols without a centrally controlled entity[300]. Considering the above explanation and the research question of this thesis, it is concluded that **only Public Permissionless blockchains may present real novelty to Competition Law, since all other blockchains have a central authority.**

A Public Permissionless Blockchain is what some call a DAO (Decentralised Autonomous Organisation[301]). In this thesis, we do not use the DAO nomenclature because a lot of players who are not actually DAO use the DAO term; we use Public Permissionless Blockchains of clarity.

b) Layers of Blockchain

Blockchains are built through layers. Layers allow the software to be developed on top of itself, thus providing participants with different applications. Depending on the specific project we are analysing, there will be different layers to consider. Within this multi-layered process, each layer acts and has governance independently from each other; however, they are also interdependent[302], the actions people take on one layer may have repercussions or be influenced by the layers above it[303].

We can identify various layers. The layer 0 (Hardware/ Infrastructure Layer) comprises the hardware and network architecture. Examples of projects built on this Layer include Polkadot and Cardano. Layer 1 (Network Layer) is where protocol and consensus

[299] "a truly public space" in Helen Eenmaa & Maria José Schmidt-Kessen, 'Creating Markets in No-Trust Environments: The Law and Economics of Smart Contracts' (2019) 35(1) Computer Law & Security Review: The International Technology Law and Practice, 7 < Creating Markets in No-Trust Environments: The Law and Economics of Smart Contracts by Helen Eenmaa, Maria José Schmidt-Kessen :: SSRN > accessed 24 May 2023

[300] Finck (n 9) 195, Goorha (n 87) 4.

[301] Not to be confused with The DAO, a project launched in 2016 in Germany and failed. In Fenwick and Vermeulen (n 1)17. For a brief explanation of what it was see, for example, David Siegel 'Understanding The DAO Attack' (CoinDesk, Updated 13 January 2023) <The DAO Attack: Understanding What Happened – CoinDesk> 10 June 2023.

[302] Finck (n 9) 185 and 195.

[303] Finck (n 9) 197, Vitalik Buterin, 'Notes on Blockchain Governance' (Vitalik.ca, 17 December 2017) < Notes on Blockchain Governance (vitalik.ca) > accessed 23 May 2023.

mechanisms are present. Examples include Ethereum and Bitcoin. Layer 2[304] manages the transaction of layer 1, an example in Lightning Network on Bitcoin. Layer 3 (Application Layer), the last layer, is the one that users have access to real-world applications of Blockchain, such as wallet providers, crypto exchanges and payment mechanisms[305]. Layers can be classified in other terms, and more layers can be added depending on the taxonomy. We can also differentiate between the Internet Layer (enhancing the role of internet providers)[306], the Blockchain Layer (where it is included the technical architecture and the governance processes)[307], the Application Layer (where the application system might create multiple layers – it is not an "unified whole. It consists of multiple layers, each inheriting from the one below."[308]). Bitcoin, for example, has in itself two highly interdependent layers[309].

Blockchains may have different layers on top of one another, and it might not be possible to control them or stop the addition of new layers.

c) Consensus mechanisms

Traditional entities organise through a combination of formal and informal hierarchies[310], which impact how decisions are made and, ultimately, where control stands. Blockchain's

[304] The "ultimate deciding layer," Vitalik Buterin, 'Notes on Blockchain Governance' (Vitalik.ca, 17 December 2017) < Notes on Blockchain Governance (vitalik.ca) > accessed 23 May 2023.
[305] Blockchain Council, 'A Beginner's Guide to Understanding The Layers of Blockchain Technology' (Blockchain Council, 21 May 2022) <A Beginner's Guide to Understanding the Layers of Blockchain Technology - Blockchain Council (blockchain-council.org); A beginner's guide to understanding the layers of blockchain technology (cointelegraph.com)> accessed 23 May 2023.
[306] Primavera de Filippi and Greg Mcmullen, 'Governance of blockchain systems: Governance of and by Distributed Infrastructure' (2018) Blockchain Research Institute and COALA, 9-13 <Governance of blockchain systems: Governance of and by Distributed Infrastructure (hal.science)> 24 May 2023.
[307] Primavera de Filippi and Greg Mcmullen (n 306) 14.
[308] Primavera de Filippi and Greg Mcmullen (n 306) 15.
[309] Primavera De Filippi and Benjamin Lovelick, 'The Invisible Politics of Bitcoin: Governance Crisis of a Decentralized Infrastructure' (2016) 5(4) Internet Policy Review, 13 < The Invisible Politics of Bitcoin: Governance Crisis of a Decentralized Infrastructure by Primavera De Filippi, Benjamin Loveluck :: SSRN> accessed 23 May 2023.
[310] Fenwick and Vermeulen (n 1) 8.

governance and control are mirrored in the consensus mechanisms, both on-chain and off-chain.

While there is a perceived absence of hierarchy and structure, which are some of Blockchain's core ideas[311], in practice, decisions can be made by an individual (if centralised) or a collective of individuals[312]. One should keep in mind that "Blockchain is a space in which different forms of powers are being exercised"[313], that power can be reflected when Blockchain is not able to respond to ever-changing circumstances[314].

Governance might entail, for example, *i)* updating the code, *ii)* addressing technical bugs, *iii)* determining the interoperability between the on-chain and off-chain[315], *iv)* answering to unplanned events to remain competitive[316], *v)* determining wealth distribution on the network[317]. Vitalik Buterin, the Founder of Ethereum, doubts we will ever be able to have a blockchain's governance process sufficiently robust and capable of regularly doing things like adjusting fundamental economic parameters[318].

On-chain governance means coin holders' votes are adopted automatically through the protocol. To install an endorsed update, Miners have no stake in the process of deciding if certain changes should be adopted (no agency)[319]. Unless we consider that groups of miners /validators and coin holders may increasingly overlap, approximating the

[311] Finck (n 9) 183.
[312] Vili Lehdonvirta, 'The Blockchain Paradox: Why Distributed Ledger Technologies May Do Little to Transform the Economy' (Oxford Internet Institute, 21 November 2016) accessed 3 April 2018 in Finck (n 9) 183-184.
[313] Schrepel (n 60) 28.
[314] Finck (n 9) 187.
[315] Finck (n 9) 206.
[316] Østbye (n 15) 3.
[317] Finck (n 9) 187.
[318] Vitalik Buterin (Medium, 16 April 2018) <To be clear I'm not necessarily wedded to a finite supply cap. | by Vitalik Buterin | Medium> accessed 23 May 2023. Finck (n 9) 206.
[319] Finck (n 9) 192 and 201.

respective interests of these groups[320]. Coin holders or users propose new blocks and new transactions[321].

Off-chain governance has a broader pool of users, and decisions shall be taken into consideration.

Miners/Validators are essential for the implementation of protocol changes; only through the majority of miners (measured by computing power) can a proposal be updated to the protocol. In the limit, they can even exercise a veto over decisions (capable of refusing code), but only when they have most of the hashing power (computing power). A soft fork can be created when such a veto is exercised – which means the new and old versions of the software coexist[322]. Even if it is a very technical role, any participant can choose to be a miner[323].

Blockchain founders and core developers implement the original rules of a blockchain[324]. Software core developers are central to the preservation of the protocol since they are the only ones able to make proposals[325].

There are various consensus mechanisms, with different incentives and through different mechanisms. The two most well-known are Proof of Work and Proof of Stake.

Proof of Work is the most common consensus mechanism on public blockchains right now (for example, Bitcoin[326]). Miners compete to solve a cryptographic puzzle; the first

[320] Finck (n 9) 204.
[321] Jean Bacon, Johan David Michels, Christopher Millard & Jatinder Singh, Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers, XXV(1) RICH. J.L. & TECH. 34 (2018), 34 in Schrepel (n 60) 32.
[322] Finck (n 9) 201.
[323] Bacon, Michels, Millard and Singh (n 321) 34 in Schrepel (n 60) 32.
[324] Schrepel (n 18) 113.
[325] Finck (n 9) 20.
[326] Arshdeep Singh and others, 'A survey and taxonomy of consensus protocols for blockhain' (2022) 127 Journal of Systems Architecture, 5 <A survey and taxonomy of consensus protocols for blockchains - ScienceDirect> accessed 24 May 2023, Satoshi Nakamoto 'Bitcoin Whitepaper' (208) < bitcoin.pdf> accessed 15 August 2023.

one to solve it is granted the right to validate a transaction (and therefore, be paid through a transaction fee and newly minted tokens[327]).

Proof of Stake, token holders vote for the miners who validate blocks[328] (for example, on Ethereum[329]). The miners' prospects to validate blocks increase alongside with how many tokens they own and the duration of possession[330]. Miners here are called validators[331] and are only rewarded with transaction fees[332].

Proof of activity results from a combination of Proof of Work and Proof of Stake[333]. It includes the need to complete a puzzle by miners, like the Proof of Work, after which a validator with more tokens is chosen to validate the transaction or block. The reward (fee) is split among the miner and validator[334].

Alongside these consensus mechanisms, many more exist, such as Proof of Burn, Delegated Proof of Stake (DPoS), Proof of Elapsed Time (PoET), Proof of Authority (PoAu), Proof of Importance (PoI), Proof of Reputation (PoR), Proof of Luck (PoLu). **Each consensus mechanism results in different processes and, therefore, different power structures**[335].

[327] Schrepel (n 18) 33.
[328] Katie Roman, 'Understanding EOS and Delegated Proof of Stake' Steemit, March 5, 2018, <https://perma.cc/T72P-RU3C> in Schrepel (n 18) 34.
[329] Ethereum transitioned from Proof-of-Work to Proof-of-Stake .
[330] Schrepel (n 18) 34. On the probability of validating being directly proportional to ownership of tokens see, for example, in Singh and others (n 326) 5.
[331] Singh and others (n 326) 5.
[332] Schrepel (n 18) 34.
[333] Iddo Bentov et al., "Proof of Activity: Extending Bitcoin's Proof of Work Via Proof of Stake," Performance Evaluation Review (2014): 2. In Schrepel (n 18) 34.
[334] Schrepel (n 18) 34.
[335] For more consensus mechanisms and how they work, see: Singh and others (326), Sarag Bouraga, 'A taxonomy of blockchain consensus protocols: A survey and classification framework' (2020) 168 Expert Systems with Applications < A taxonomy of blockchain consensus protocols: A survey and classification framework - ScienceDirect> 25 May 2023

V. BLOCKCHAIN AND THE THEORY OF THE FIRM

1. Blockchain and efficiency

As mentioned before, Blockchain technology is being used in various industries[336]. Blockchain reduces cost from a total factor productivity[337], rendering Blockchain to a general-purpose technology[338]. The tokenisation of assets brings great fluidity and creates a hyper-efficient market.[339] To better understand it, it is worthwhile to recognise the importance of network effects[340] and token effects[341] in cryptoeconomics.

Nonetheless, the potential of Blockchain does not end there. Blockchain has governance potential (besides using it as a tool for already existing firms) "likely to radically change how organizations operate" [342].

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[336] For example: Payments, Data management for users and the public sector, Healthcare, Supply chains. Respectively, see, for example: Mafalda Roldão, 'Future of payments' (Whatnext.law, 15 September 2021) <Future of payments – WhatNext.Law> accessed 13 June 2023, Mafalda Roldão, 'Owning our (Digital) Idenity' (Whatnext.law, 19 January 2023) < Owning our (Digital) Identity – WhatNext.Law> accessed 13 June 2023, Jamie Berryhill, Théo Bourgery, Angela Hanson, 'Blockchains Unchained: Blockchain Technology and its use in the Public Sector' (2018) OECD Working Paper on Public Governance 28 < Blockchains Unchained : Blockchain Technology and its Use in the Public Sector | OECD Working Papers on Public Governance | OECD iLibrary (oecd-ilibrary.org)> accessed 13 June 2023, Cornelius Agbo, Qusay Mahmoud, J. Mikael Eklund, 'Blockchain technology in Healthcare: A systematic Review' (2019) 7(2) Healthcare Journal <Healthcare | Free Full-Text | Blockchain Technology in Healthcare: A Systematic Review (mdpi.com)> accessed 13 June 2023, Bertrand Copigneaux and other, 'Blockchain for supply chains and international trade' (2020) European Parliamentary Research Service < EPRS_STU(2020)641544_EN.pdf (europa.eu)> accessed 13 June 2023.

[337] "aggregate measure of technological change is thus referred to as multi-factor or totalfactor productivity" in Caton (n 5) 4.

[338] Davidson, Filippi and Potts (n 73) 647.

[339] ConsenSysMedia, Joe Lubin - Nature Of The Firm, v2.0 Keynote from EtherealNY #Blockchain Conference 2018, YOUTUBE.COM (May 13, 2018), https://www.youtube.com/watch?v=SQbcGhnv4jw in Schrepel (n 60) 18.

[340] "phenomenon whereby the value to the user or consumer of a product or service increases as its user base grows" in Cathy Barrera, 'The Blockchain Effect: Network Effects without Market Power Costs' (Medium, 29 March 2018) < The Blockchain Effect: Network Effects without Market Power Costs | by Cathy Barrera, PhD | MIT Cryptoeconomics Lab | Medium> accessed 12 June 2023.

[341] "offering of free tokens offers a costless way for new entrants to reimburse users for the value of the network effects they bring to the platform" in Pike and Carovano (n 252) 4.

[342] IBM Institute for Business Value, 'Forward Together: Three ways blockchain Explorers chart a new direction' (2017) Global C-suite Study 19th Edition, 5 <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=GBE03835USEN> accessed 25 May 2023.

2. Blockchain as an Institutional Technology

In the beginning, there was Market (and, therefore, price mechanism). Coase posed the question of "If price mechanism works, why do firms exist?". The answer was predominantly related with the reduction of transaction costs by having an "entrepreneur" directing resources. Now, another question arises: "If prices mechanisms work; if firms can reduce transaction costs, why should we care about Blockchain?".

Firms and Markets are traditionally seen as "alternative methods of co-ordinating production"[343]/ "organization"[344]. Market capitalist economies, like firms and governments, historically dominated instruments for economic coordination. Distributed technologies, and specifically, Public Permissionless Blockchains, introduce the ability to disrupt existing hierarchies[345] to the point where experts foresee that "traditional roles such as investors, executives, managers and consumers will become blurred"[346].

Blockchain is a new general-purpose information and computation technology, but it is also a revolutionary new institutional technology for economic coordination[347], which enables "more "inclusive" and "communal" models of organisation that empower more stakeholders"[348]. Blockchain presents itself as an Institutional Technology, a new perspective on institutional governance. [349] Its novelty is related to the introduction of a new way to achieve consensus[350] since it grants large groups of individuals the opportunity to cooperate in a stable environment (cryptographic stigmergy[351]).

[343] Coase (n 65) 388.
[344] Coase (n 65) 393.
[345] Berg, Davidson and Potts (n 280) 2.
[346] Going to the length of comparing it to the invention of joint stock (*in* Davidson, Filippi and Potts (n 2) 24) or the concept of a multinational firm (Caton (n 5) 1).
[347] Davidson and Filippi and Potts (n 2) 2.
[348] Fenwick and Vermeulen (n 1) 19.
[349] Caton (n 5) 4 and 15.
[350] Caton (n 5) 4.
[351] "Stigmergy is the idea that a large group of individuals can interact through identifiable changes in their environment" Goorha (n 87) 3.

These characteristics have the potential to weaken the assumption of efficiency of hierarchies (that exploit incomplete contracts) over Markets[352]. As well as control opportunism (in the presence of bounded rationality[353]) in the Market. Therefore, Blockchain technology challenges key assumptions underpinning the existence of the firm[354].

3. Transaction Costs

Transaction costs are the "ultimate unit of economic investigation"[355]. From Coase's doctrine, we can conclude that the existence of transaction costs validates alternative methods of organisation. Blockchain makes possible the reduction of transaction costs[356] and can achieve that end arguably better than firms[357].

Transaction cost can be reduced with the use of smart contracts by *i)* the reduction of complexity of drafting contracts (for example, by creating an open-source contract library[358]), *ii)* the reduction of search costs, contracting costs and coordination costs[359], *iii)* the automation of transactions (which means the execution of transactions happens when certain conditions are met[360] and don't require human input from the contracting parties after the smart contract is created). This automation creates an *iv)* indefinitely pure promise that brings certainty to long-term contracts and *v)* greatly eliminates the need for trusted intermediaries[361]. Plus, it is believed that the overall cost related to the making

[352] Caton (n 5) 16.
[353] Which means human rationality has limits. Berg, Davidson and Potts (n 280) 2.
[354] Goorha (n 87) 5
[355] JOHN R. COMMONS, 'INSTITUTIONAL ECONOMICS' 6 (Madison: University of Wisconsin Press, 1934) in Schrepel (n 60) 21.
[356] Caton (n 5) 14.
[357] Goorha (n 87) 4.
[358] Davidson and Filippi and Potts (n 2) 16.
[359] Patrick Waelbroeck, 'An Economic Analysis of Blockchains', 6893 CESIFO WORKING PAPER 1, 14 (2018), Schrepel (n 60) 18.
[360] Schrepel (n 60) 16-17.
[361] Pike and Carovano (n 252) 4.

and maintenance of smart contracts would *vi)* "cost a fraction of the price that trusted intermediaries are currently able to charge for their services"[362].

Regarding trust[363], it is normally expensive to manufacture it conventionally[364]. It is largely assumed that Blockchain does not require trust (it is trustless)[365], presenting itself as a solution when "agents do not benefit from the trust that may exist within the firm regarding the proper execution of internal transactions"[366]. However, this trustless narrative is inherently limited because behind the code are always humans who can affect it[367].

Another significant difference relates to information asymmetries. Blockchain introduces the recording of information with valuable data on past transactions, which is a more informative signal than price (since price is memoryless)[368].

Blockchain tends to limit uncertainty through transparency, immutability, and smart contracts; long-term contracting could be enabled within Blockchain instead of resorting to the control of the entrepreneur, thereby reducing uncertainty. "It is improbable that the firm would emerge without the existence of uncertainty"[369]. Coase somehow envisioned this – "With uncertainty entirely absent, every individual being in possession of perfect knowledge of the situation, there would be no occasion for anything of the nature of responsible management or control of productive activity. (…) The flow of raw materials and productive services to the consumer would be entirely automatic"[370].

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[362] *Ibid*.
[363] "[t]rust is sometimes treated as an antonym for opportunism." Williamson, O. (1993) Opportunism and its critics. Manage. Decis. Econ. 14, 97–107. doi: 10.1002/mde.4090140203 in Berg, Davidson and Potts (n 280) 3.
[364] Davidson and Filippi and Potts (n 2) 9.
[365] Pike and Carovano (n 252) 4; Maggiolino and Zoboli (n 17) 2.
[366] Schrepel (n 60) 17.
[367] Finck (n 9) 199.
[368] Goorha (n 87) 4.
[369] Coase (n 65) 292.
[370] Professor Kight, Risk, uncertainty and profits, p 267 *in* Coase (n 65) 399.

Therefore, "it returns the transaction to a market-like context but with fewer of the costs of a market"[371], and at the same time, it broadens the limits of efficient contracting, which, until now, was the "role" of the firm[372]. It has even been argued that the "reduction in transaction costs in downstream markets may facilitate the adoption of new business models"[373].

Nevertheless, Blockchain technology does not eliminate transaction costs entirely[374]. Smart contracts, even if incredibly innovative, do not completely solve the problem of incomplete contracts, because they are incomplete contracts themselves. Hence, smart contracts may still need legal recognition[375], third-party arbitration[376], verification of their features and investment in education on cryptographic tools (which comes with a cost).[377] When drafting contracts, we may encounter costs related to the bargaining of the smart contract, the translation of contracts into code[378] and possible costs related to the enforcement of the smart contracts.[379] Regarding commitment costs, it encompasses "paying fees to full nodes[380] or information services" [381] to protect against theft of digital

[371] Caton (n 5) 16.
[372] Schrepel (n 60) 18.
[373] Pike and Carovano (n 252) 4.
[374] Schrepel (n 60) 22.
[375] Goorha (n 87) 5.
[376] Blockchain initiatives are already being created to suppress this possible contract failure. For example, Kleros.
[377] Schrepel (n 60) 22. To better understand smart contracts and its challenges: Alexander Savelyev, 'Contract Law 2.0: "Smart" Contracts as the Beginning of the end of Classic Contract Law' (2016) National Research university Higher School of Economics Working Paper WP BRP 71/LAW/2016 < Contract Law 2.0: «Smart» Contracts As the Beginning of the End of Classic Contract Law by Alexander Savelyev :: SSRN> 25 May 2023, Raskin (n 254) and Filippi and Hassan (n 40).
[378] There are limitations to this translation: difficulty of turning natural language into code and consequent limitation of the scope, if there is an error in the wording of the contract, it may not function as it should and imperfect performance always leads to breach.
[379] Davidson and Filippi and Potts (n 2) 16.
[380] Members that have the copy of the whole Blockchain.
[381] Schrepel (n 60) 22.

assets. Lastly, the energy costs required for Permissionless Blockchains are still high, which calls for further development[382].

4. A Market, a Firm or something in between

The study of the connection between Competition Law and Blockchain is still in its early days; however, there are already various considerations regarding whether Blockchain should be deemed as a Market, a Firm, or neither a Market nor a Firm.

It is argued that Blockchain creates room for a shift from firms towards markets, since it could potentiate true price-driven exchanges among suppliers and consumers[383]. And, if markets can be more efficient than command economies, the latter would cease to exist[384].

We can interpret Blockchain as a platform where various economic players meet, as a "three-sided" market (buyers, sellers and miners/validators)[385] or a multi-sided market[386].

Blockchains may enable firms – "blockchain does not necessarily correspond to a single undertaking, but may bring together different firms and individuals". [387] It has been stated that a group of validators could be considered a "gig-working co-operatives" (like Partners in a law firm), whilst individually following collectively determined norms (protocols)[388]; others have called it a "commons-based peer production"[389]. Some authors

[382] Vincent, J. (2019). Bitcoin consumes more energy than Switzerland, according to new estimate, available at: https://www.theverge.com/2019/7/4/20682109/bitcoin-energy-consumption-annual-calculation-cambridge-index-cbeci-country-comparison in Pike and Carovano (n 252) 4.
[383] Goorha (n 87) 5.
[384] With a similar line of thought: Yochai Benkler and Helen Nissenbaum 'Commons-based Peer production and virtue' (2006) 14(4) The Journal of Political Philosophy 394-419, 405 <Commons-based Peer Production and Virtue* - Benkler - 2006 - Journal of Political Philosophy - Wiley Online Library> accessed 25 May 2023. Catherine Mulligan, 'Blockchain will kill the traditional firm' (Imperial College Business School, 16 October 2017) < Blockchain will kill the traditional firm | Imperial College Business School> accessed 25 May 2023.
[385] Regarding proof-of-work Blockchains. In Berg, Davidson and Potts (n 280) 4.
[386] Juri Mattila, 'Blockchain Systems as Multi-sided platforms' (Industrial Engineering and Management thesis, Aalto University 2021) < Blockchain Systems as Multi-sided Platforms (aalto.fi)> 24 May 2023.
[387] Maggiolino and Zoboli (n 17) 4.
[388] Pike (n 18) 47.
[389] Benkler and Nissenbaum (n 384) 369.

go further, stating that certain mining pools could be considered partnerships[390], and some Blockchain projects can be viewed as joint ventures[391]. Whereas such arguments are interesting, such analysis is outside the scope of this thesis since, in Competition Law, no legal form is required. Therefore, as stated before, trying to "force" Blockchain potential into already existing corporate figures could only be used as a supporting argument in concrete cases, not as the basis for defending the claim that they could be seen as firms.

Heavily grounded in the innovation Blockchain brings as an institutional technology, some argue that Blockchain should be considered outside the scope of markets and firms – it should be understood as a third way, given that it has systematic advantages over both[392]. "Blockchains compete with firms, markets and economies, as institutional alternatives for coordinating the economic actions of groups of people"[393]. With a similar line of thought, "When coupled with token systems (…) blockchains make possible new institutional orders that operate at a micro-scale, yet with the full coordination properties of what we would otherwise attribute to a self-organizing macroeconomy"[394].

The study of phenomena outside the dichotomy between Market and State goes past the discussion of using a decentralised technology, such as Blockchain. Polycentric governance was initially studied by the economist Vincent Ostrom, introducing it as "polycentric governance, a diverse array of communities and public and private authorities with overlapping domains of responsibility interact in complex and ever-changing ways, and out of these seemingly uncoordinated processes of mutual adjustment

[390] Amy Castor, 'Vermont lawyer warns of legal complications ahead for cryptocurrency miners' (Bitcoin magazine, 21 February 2018) <Vermont Lawyer Warns of Legal Complications Ahead for Cryptocurrency Miners - Bitcoin Magazine: Bitcoin News, Articles, Charts, and Guides> accessed 25 May 2023.
[391] Dirk Zetzsche, Ross Buckley and Douglas Arner, 'The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain' (2017, last revised July 2018) 14 European Banking Institute Working Paper Series, 28 and 36-37 < The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain by Dirk A. Zetzsche, Ross P. Buckley, Douglas W. Arner :: SSRN> accessed 25 May 2023.
[392] Schrepel (n 60) 16-18.
[393] Davidson and Filippi and Potts (n 2) 3.
[394] Caton (n 5) 15.

emerges a persistent system of social ordering that can support and sustain capacities for individual liberty, group autonomy, and community self-governance"[395].

Similarly, and applied to the Blockchain reality, the term plutocratic system relates to the possibility of creating accidental corporate structures[396] (even if not directly "advertised" by their members) or hybrid forms[397]. These accidental structures can be defined as "spontaneous organizations using the price mechanisms of markets, the governance properties of a common, and, to some extent, the constitutional properties of a nation-state"[398]. Or, in other words, some situations "make it closer in essence to the price mechanism, though others make it seem more akin to a firm; this combination of features makes it all the more evident that the cryptographic stigmergy defines a space for coordinated production in between those of the price mechanism and the firm"[399].

Just because transaction costs are not the same as in a traditional firm or traditional Market, it does not mean that blockchain cannot enable one or the other. The line of thought Coase still applies to Blockchain reality, since it is simply another way in which people organise to reduce transaction costs.

I tend to believe that Blockchain can enable Markets and/or firms, depending on the individual case (the layer or layers under study, or how players interact); and even if we consider a third option, it is arguable that it would still be inside the scope of Competition Law since it is a form of organised individuals with economic activities.

[395] Michael D. McGinnis, 'Polycentric Governance in Theory and Practice: Dimensions of Aspiration and Practical Limitations' (2016), 2 < delivery.php (ssrn.com)> accessed 5 December 2023
[396] Finck (n 9) 206.
[397] Roman Beck, 'Beyond Bitcoin: The rise of blockchain world' (2018) 21(2) Computer, 57 <*IEEE Xplore Full-Text PDF:*> accessed 25 May 2023.
[398] Schrepel (n 60) 24.
[399] Goorha (n 87) 4.

To truly understand if a firm is possible, one shall understand the different power dynamics that can happen within Blockchain; which means, if control or decisive influence might be present.

4.2 Theory of Granularity

Schrepel argues that the Theory of the Firm initiated by Ronald Coase, which is centred around direct top-down control to reduce transaction costs, cannot be transposed to Blockchain[400]. He reaches such a conclusion through considering that Blockchains are made of horizontal governance mechanisms, unlike the firm, which relies on vertical and pyramidal control[401].

Schrepel introduces the Theory of Granularity[402], which aims to analyse the role played by each element of a Blockchain[403]. Through that theory he arrives to a "nucleus" because, as already suggested, "even with horizontal and decentralized governance, a group of participants may achieve a form of direct control over the blockchain by collaborating, and as such, by circumventing (some of) the constraints imposed on them"[404]. He includes in the nucleus all participants who have a *personal interest* (although momentarily) in continually collaborating with each other. "They do not compete, and although their short-term interests may diverge, they seek to achieve the same long-term goal: ensuring the blockchain survival"[405]. Schrepel concludes that defining this nucleus is central to identifying which participants are collaborating to escape the constraints imposed on them to control the blockchain, and potentially, if these participants are abusing their control for anti-competitive purposes.

[400] Schrepel (n 60) 25.
[401] *Ibid* 36.
[402] Within the study of Blockchain. "the notion of granularity defines the size of the smallest element in a system" In *Ibid* 28.
[403] *Ibid* 28.
[404] *Ibid* 36.
[405] Schrepel (n 60) 36.

If a nucleus is an obvious concentration of power, a Permissionless Blockchain with a concentrated list of validators, for example, starts to resemble a Permissioned Blockchain with a small list of validators.

4.3 Is it possible for control or decisive influence to exist within Blockchain?

Within Blockchain, control can be exercised, however, it is not the traditional hierarchical control. Competition Law frames the firm as an economic agent (or a single economic unit) that is actually capable of making decisions, which means to exercise the market power that it holds. Applying these principles to Blockchain is complex, since a Blockchain may bring together different groups and individuals.

It is important to remember again that only Public Permissionless Blockchains truly bring novelty from an organisational perspective and, consequently, the ones inside the scope of this chapter. In this chapter, we will further analyse the influence that each class of members might have over decisions made within Blockchain, especially if it has the potential to interfere with its economic value (if a control structure can be detected at all[406]) and who governs the market power that the blockchain may have.

Blockchain can be seen as the aggregation of various individual objectives[407] where multiple interests and incentives[408] can compete; and, theoretically speaking, every participant can influence[409]. Said influence "is proportional to its stake in the platform - e.g. in terms of computing power, storage, labor or capital dedicated to it"[410].

Zetzsche et al. separate the "DLT hierarchy" in four groups: (i) "the core group that sets-up the code design and (de facto) governs the DLT, for instance by having the technical ability and opinion leadership to prompt a hard fork of the system (under certain

[406] Maggiolino and Zoboli (n 17) 4.
[407] FRIEDRICH HAYEK, LAW, LEGISLATION AND LIBERTY 109 (Routledge 1973) in Schrepel (n 60) 28.
[408] Finck (n 9) 185.
[409] "(…) might mirror rent-seeking and interest group influence studied in the political economics literature" in Østbye (n 15) 6.
[410] Christian Catalini & Joshua S Gans, Some Simple Economics of the Blockchain, 5191-16 MIT SLOAN RESEARCH PAPER (2019)16 in Schrepel (n 60) 28.

conditions); (ii) the owners of additional servers running the distributed ledger code for validation purposes […]; (iii) qualified users of the distributed ledger, such as exchanges, lending institutions, miners etc.; and (iv) third parties affected by the system without directly relying on the technology, for instance, [..] simple users, clients of intermediaries […] etc."[411].

As we have already seen before, Blockchain governance relies on consensus mechanisms but also power structures (blockchain is also heavily politicised[412]), which do not constitute direct orders over others[413]. Nonetheless, even if no single party has command and control over decisions in Public Permissionless Blockchains, they are frequently depicted "to be more decentralized than they really are"[414].

Although Blockchains in general are praised for being automated, as exposed before, we may never be able to build a blockchain governance process capable of *i)* adjusting fundamental economic parameters[415], *ii)* amending the protocol, and *iii)* rewards protocol development[416].

Given the above limitations, at least the first-generation Blockchains will be *de facto* centralised in core developers' teams or miners to formulate design choices[417]. However, others argue that the architecture of Blockchain, as soon as it is created and put online, they lose any form of control[418].

It is argued that Founders and Core Developers perform a "janitorial role"[419] to ensure that the goals of the project are followed, like sending emergency messages to all nodes

[411] Zetzsche, Buckley and Arner (n 391) 21-22.
[412] Finck (n 9) 199.
[413] Schrepel (n 60) 25
[414] Finck (n 9) 199 and 205. In other words, it remains rather centralised and controlled by a few parties. See: 'Dissecting the DAO: Web3 Ownership is surprisingly concentrated' (Chainalysis, 27 June 2022) <Dissecting the DAO: Web3 Ownership is Surprisingly Concentrated (chainalysis.com)> accessed 28 May 2018
[415] Buterin (318).
[416] Buterin (303).
[417] Buterin (303).
[418] Filippi and Mcmullen (n 306) 21.
[419] Schrepel (n 60) 30.

on the network to ask them to adopt updates[420]. They also carry with them a role as influential advisors given to their central "political" role in the survival of the Blockchain's philosophy, as well as their technical skills, even if the personal incentives of other participants might limit their influence.[421] Therefore, it is also possible that Blockchain is used in ways that are outside the creator's control[422].

The role of Miners could raise a possible control situation since they have the capability of *i)* influencing soft forks by releasing a 51% attack[423], and, out of all the participants, they are the ones that *ii)* most directly can impact the economic value within Blockchains.

Despite the soft fork, the impact may appear less severe if we consider that even with the modification of the protocol, the Blockchain remains compatible with previous versions and the fact that, for the fork to be effective they must convince the rest of the participants to operate as nodes to run the new version of the software[424] and users to transact on to the new fork.

Their capabilities to impact the economic value within Blockchain derives from their capability to raise fees or increase the gas limits[425]. The power of miners is enhanced if there is a strong community spirit[426] they group in mining pools[427].

The primary real power of token holders over the Blockchain derives from their decision to use it or not; that decision is fundamental to Blockchain's economic value. Their

[420] As an example, the Bitcoin core. (Bitcoin Core) < Bitcoin Core :: About> accessed 24 May 2023.
[421] Schrepel (n 60) 31
[422] Sebastian Louven and David Saive, 'Antitrust by Design – the prohibition of anti-competitive coordination and the consensus mechanism of the blockchain' (2018) ZRI Working Paper, Carl von Ossietzky University Oldenburg, 9 <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3259142> accessed 25 May 2023.
[423] See Filippi and Loveluck (n 309) 10–11.
[424] There is the possibility that not all nodes will agree to fork. Bacon, Michels, Millard and Singh (n 321) 37 in Schrepel (n 60) 33.
[425] 'Ethereum Average Gas limit Chart' (Etherscan) <Ethereum Average Gas Limit Chart | Etherscan> in Vitalik Buterin, 'Coordination, Good and Bad' (Vitalik.ca, 11 September 2020) <Coordination, Good and Bad (vitalik.ca)> accessed 25 May 2023.
[426] Buterin (n 279).
[427] Schrepel (n 60) 33.

control is directly associated with their ownership over tokens, which grants them the possibility to vote[428]. They influence *i)* transaction fees; *ii)* hard forks on the Blockchain[429].

Even if theoretically Token Holders can vote, it is believed that *i)* those powers are limited by how hard it is to exercise coordinated control, since their activities are "highly decentralised and spontaneous in nature"[430] and *ii)* the fact that presumably they will do what is best for the network since the maintenance of the network would be in their interest (which, in case of mass adoption of Blockchain may lead them to always agree with the advice given by core developers). Existing doctrine excludes users' responsibility[431].

Yet, those arguments shall not be the reason why their decisions should not be scrutinised by Competition Law Authorities. Their power over decisions is impacted by how much wealth they have connected with the token[432] which might seem big enough not to simply consider them users but a kind of prosumer (that contributes to the evolution of decision making but also might use the Blockchain as a simple user). Also, even though we presume that every token holder will align their interests with the survival of the network, such an idea has not been tested[433].

Therefore, it is expected that users should check for themselves whether the decision made and/or the protocol complies with Competition Law and, in case of suspicion of infringement, they should vote against the proposal and take action to make improvements by, for example, communicating it to the developers[434] (which is usually

[428] Oliver E. Williamson, The Theory of the Firm as Governance Structure: From Choice to Contract, 16(3) J. ECON. PERSPECT 180 (2002), 180 in Schrepel (n 60) 38.
[429] Schrepel (n 60) 32.
[430] Schrepel (n 60) 32, Buterin (303) (states how users' influence might be limited by their lack of technical knowledge).
[431] Lianos (n 61) 89.
[432] Finck (n 9) 193.
[433] *Ibid.*
[434] Louven and Saive (n 422) 9.

made off-chain, for example, in Discord[435]). However, if the users do not engage in the decision-making process, it is not likely that they would be found responsible under Competition Law; such inference comes from the Eturas Case – "if it cannot be established that a travel agency was aware of that message, its participation in a concertation cannot be inferred from the mere existence of a technical restriction implemented in the system at issue"[436].

The same principle might also be applicable to miners, according to Ioannis Lianos.[437] Miner's control might take the form of colluding to raise transaction fees, an attack by a dominant validator or a colluding group of miners to exclude other participants[438].

It is also possible for a person to accumulate more than one class of participants. Some Token Holders/Users might also act as Miners/Validators (since they are paid with tokens) and Founder and Core Developers, which might also raise the question of how realistic it is to have a large pool of roles but a small pool of people who actually exercise their power through voting[439].

4.4 Commentary

The Theory of Granularity greatly informs how attentive we need to be when classifying the limits of the firm. Defining the limits of firm *a priori* may go against the flexibility of the term within Competition Law, and such practice, as Coase[440] puts it, is a trend in economic theory[441].

We propose identifying a possible anti-competitive practice, a particular decision (or a group of decisions) that created an identifiable effect (effects already studied in different

[435] A centralised website where blockchain communities discuss proposals, evolution, and technical aspects (Discord) <DISCORD | Seu Lugar para Papear e Ficar De Boa> accessed 25 May 2023. Although other safer tools are being built like Commonwealth <Commonwealth> or Matrix <Matrix.org>.
[436] C-74/14, *Eturas UAB and Others v Lietuvos Respublikos konkurencijos taryba* [2016] para 45 and 46.
[437] Lianos (n 61) 69.
[438] Østbye (n 15) 12.
[439] For example, The DAO Carbonvote only had a voter participation rate of 4.5%. Buterin (n 303).
[440] Coase (n 65) 386.
[441] N. Kaldor, 'The equilibrium of the firm', Economic Journal, March, 1934 6, *in* Coase (n 65) 386.

instances), for which one finds the need to investigate and try to understand who exactly made the decision. Which means, first looking for a possible breach of Competition Law, then identifying the nucleus of that decision – it might lead us to identify a "nucleus" that goes beyond a pre-defined DAO or layer. Which means, taking into account each decision, while being aware of *i)* the possible volatility of the members of the groups, *ii)* the interdependency of layers, *iii)* the consensus mechanism (including the risk of soft forks and hard forks), *iv)* outside-of-Blockchain and offline exchanges of information, *v)* the possible tendency of organising through class and *vi)* the concentration of wealth.

The nucleus, because of the possible volatility of groups within Blockchain, can be ever-changing, which will render the analysis more demanding for competent Regulatory Entities (such as the Commission or NRAs) and Judicial Entities. The members who influenced a past decision might not be the same members who are present in the group at the time of evaluation. However, one might also argue that even though there is volatility of the groups, there is a tendency for the nucleus to stay the same.

Plus, given the fact that the interdependency of layers makes it possible to have decisions made without the active consent of the players affected by it, makes it important to not ignore the layers under a Dapp, DAO or other type of conglomerate of people within Blockchain – especially if those decisions have economic effects.[442] So, even considering that Blockchain is predominantly horizontal, some verticality still exists.

Centralisation may occur in various layers[443], including at the protocol level and network level.[444] It is also possible for the hardware layer to be centralised when nodes are owned

[442] "There is a large chance that we never will come up with a blockchain governance process that is sufficiently robust that it will be capable of regularly doing things like adjusting fundamental economic parameters" in Buterin (n 318).
[443] "the blockchain economy at present continues to be characterized by a high degree of centralized decision-making" in Roman Beck, Christoph Müller-Bloch, John King, 'Governance in the Blockchain Economy: A framework and Research Agenda' (2018) 19 Journal of the Association for Information Systems, 28 < [PDF] Governance in the Blockchain Economy: A Framework and Research Agenda | Semantic Scholar> accessed 25 May 2023.
[444] Østbye (n 15) 5.

by a small group of individuals and stored in close geographic proximity, clustered in data centres.[445] Likewise, mining operations are also often centralised[446].

The emergence of mining as an economic activity has led to the development of mining pools[447] and an ecosystem of industries that supply goods and services to miners. Mining requires specialised equipment which uses an "application-specific integrated circuits (ASIC), which are chips designed to perform a single function: block mining" and the possible need to resort to miners' insurance[448]. Which means real-world firms might impact Blockchain through the access of hardware and insurance – complementary services can give a *de facto* monopoly power over a cryptocurrency[449].

The consensus mechanism is one of the central aspects one needs to pay attention to, since it greatly informs how decisions are made. There is a general presumption that because of tokens and the technical possibility of giving all people the right to vote, that all Blockchains work like that, which couldn't be further from the truth. For example, in Proof of Work, Miners make decisions (pools of miners enhance this problem). However, even if Token Holders do have voting power, most do not vote. Since Miners are remunerated with tokens, it may pose the question of whether, in practice, they do not end up being the ones who make the decisions also.

Particular attention has been given to the centralisation risks of consensus mechanisms in cryptocurrency systems, with the consequence that validations are performed by a few

[445] Gencer et al., 'Decentralization in Bitcoin and Ethereum' (2018) Financial Cryptography and Data Security, 8 < [1801.03998] Decentralization in Bitcoin and Ethereum Networks (arxiv.org)> accessed 25 May 2023.
[446] "(…) in Bitcoin, the weekly mining power of a single entity has never exceeded 21% of the overall power. In contrast, the top Ethereum miner has never had less than 21% of the mining power. Moreover, the top four Bitcoin miners have more than 53% of the average mining power. On average, 61% of the weekly power was shared by only three Ethereum miners. These observations suggest a slightly more centralized mining process in Ethereum." *Ibid* 10.
[447] Matteo Romiti, Aljosha Judmayer, Alexei Zamyatin, Bernhard Haslhofer, 'A Deep Dive into Bitcoin Mining Pools: An Empirical Analysis of Mining Shares' (2019) <[1905.05999] A Deep Dive into Bitcoin Mining Pools: An Empirical Analysis of Mining Shares (arxiv.org) > accessed 25 May 2023.
[448] Ferreira, Li and Nikolowa (n 274) 3.
[449] Østbye (n 15) 5.

entities and possibly coming under the control of one entity[450] be a source of centralisation. This is obvious in systems based on PoS validation. However, such holdings may also give power in PoW systems, such as the power to launch certain attacks.[451] PoW puzzles may be less susceptible to centralisation; however it seems hard to avoid the development of specialised hardware and consequent centralisation risk[452].

Even though Blockchain exists in a Web3 world, outside-of-Blockchain and offline exchanges of information might interfere with the decision-making, even if it was identified that the members are in different countries.

The economic and political importance of forks must not be underestimated since it has significant economic implications (network effects weaken with every fork) – "[i]n the Web 2.0 world, forking is the equivalent of Facebook allowing any competitor to take their entire database and codebase to a competitor" [453].

As Buterin once stated, it is possible that Blockchain creates a type of classicism where each type of player might be motivated to coordinate. Possible solutions have been proposed, such as " social interventions that try to increase participants' loyalty to the community around the blockchain as a whole and substitute or discourage the possibility of the players on one side of a market becoming directly loyal to each other"; "promoting communication between different "sides of the market" in the same context, so as to reduce the possibility that either validators or developers or miners begin to see themselves as a "class" that must coordinate to defend their interests against other classes"; "designing the protocol in such a way as to reduce the incentive for validators/miners to engage in one-to-one "special relationships", centralised relay networks and other similar super-protocol mechanisms"[454].

[450] Østbye (n 15) 5.
[451] Østbye (n 15) 6.
[452] Rajendra Sai, A., Buckley, J., Fitzgerald, B., & Le Gear, A. (2020). Taxonomy of Centralization in Public Blockchain Systems: A Systematic Literature Review. arXiv e-prints, arXiv-2009 in Østbye (n 15) 6.
[453] Ehrsam, 'Blockchain Governance' in Finck (n 9) 203.
[454] Buterin (279).

Finally, the concentration of wealth. Since ownership and voting are tightly coupled, this may lead to a feudal structure, in which influence is measured by wealth[455].

VI. Conclusion

The answer to the question of whether Competition Law can be applied to Public Permissionless Blockchain-enabled entities can be divided into two steps. In a preliminary stance, one should take into consideration if the Theory of the Firm is applicable – since the European Competition Law's term "undertaking" is greatly based on Coase's theory. Secondly, one should analyse if it would go in line with European Competition Law *per se*, its growing case law, and clarifications from the Commission.

As explained before, it is still not consensual if Blockchain would enable firms, markets, or a third way of organising economic power. I tend to agree with the possibility of Blockchain enabling markets and/or firms, depending on the individual case. By acknowledging the new possible form to organise and through its plutocratic system, it is possible to create accidental corporate structures[456] (even if not directly "advertised" by its members) or a hybrid form[457] – and, therefore, hierarchies, even if not formal or fixed. And, in case a hierarchy cannot be found, what can it be besides a market, if the market is what exists when there is no firm? Even if it is a market with different features, it does not seem justified to exclude the consideration that it is indeed a market.

Schrepel defends that the Theory of the firm cannot be transposed to Blockchain.[458] Yet, Coase arguably foreshadowed platform economies[459], especially when he observed that "(i)inventions which tend to bring factors of production nearer together, by lessening spatial distribution, tend to increase the size of the firm."[460] I believe the greatest

[455] Olga Kharif, 'The Bitcoin Whales: 1,000 People Who Own 40 Percent of the Market' Bloomberg (8 December 2017) The Bitcoin Whales: 1,000 People Who Own 40 Percent of the Market - Bloomberg accessed 4 April 2018 in Finck (n 9) 204.
[456] Finck (n 9) 206.
[457] Beck (397) 57.
[458] Schrepel (n 60) 25
[459] Goorha (n 87) 5.
[460] Coase (n 65) 401.

contribution of Coase's Theory is not so much the fixed idea of a "top-down" hierarchy, but the idea of how humans will choose to organize in ways that lower transaction costs, which is arguably one of the most significant advantages of Blockchain – "no matter which proof of work system is implemented, they all follow a maximal growth curve that reflects the nature of the firm as detailed in 1937 by Ronald Coase (1937)"[461].

It is important to note that European Competition Law predates the influence of the Theory of the Firm[462]. Therefore, even if we consider that the Theory of the Firm does not apply, European Competition Law is still applicable.

For an undertaking to exist under Competition Law it needs to have *i)* an economic activity, *ii)* regardless of its legal status and *iii)* the way in which it is financed.[463] Primavera De Filippi and Aaron Wright have highlighted that "every interaction with a blockchain is ultimately an economic transaction, and every party participating in the network serves as an economic actor"[464]. Others leave open the possibility of some activities within Blockchain not being considered as economic[465] – some examples might entail similar situations already excluded by the Commission and Courts, such as solidarity activities[466]. However, it seems fair to affirm that most activities done within Blockchain consist of some kind of "offering goods or services on a given market"[467].

Another point to consider is the fact that, up until now, a firm-first analysis approach was justifiable. It was simpler from a legal perspective. Most legal entities that act in the

[461] Craig Wright, 'Proof of Work as it relates to the theory of the firm' (June 2017) 1 < *delivery.php (ssrn.com)> accessed 15 August 2023.
[462] Coase (n 67) 33-47.
[463] *Höfner* Case (n 105), para 21, *Fédération Française* Case (n 105), para 14; *Job Centre* Case (n105), para 21, *Compass Datenbank v. Republik Őstereich* Case (n 112) para 35, *Wouters* Case (n 112) para 46, *Hydrotherm* Case (n 62) para 1.
[464] Primavera De Filippi and Aaron Wright, Blockchain and the Law (Harvard University Press 2018) 185 in Michele Fink (n 9) 186, Lianos (n 61) 8.
[465] Lianos (n 61) 78.
[466] Or other exceptions analysed in Chapter III.2.1 a), b), c), d).
[467] Case T-319/99 *Federación Nacional de Empresas de Instumentación Científica, Médica, Técnica y Dental (FENIN) v Commission* [2003] ECR II-357, para 36 "The concept of economic activity is assessed from the supply-side viewpoint and not, as in the FENIN case, from the viewpoint of demand (purchases)" *in* Geradin, Latne-Farrar and Petit (n 45) 40.

market have a recognized legal form, but *i)* they do not need to be a legal form that is traditionally connected with economic activity (for example, they can be an association) and *ii)* it is possible to consider a firm which includes various presumably autonomous legal entities. This shows that Competition Law analysis goes beyond preliminary consideration of what could be formally an undertaking. Furthermore, we do not need to define the firm and then look for economic activity to justify the existence of the firm. We could observe economic activity (the industry) and then look for the decision-making processes (the consensus mechanisms, on-chain and off-chain) to analyse which (if any) control or decisive influence with economic consequences was taking place. The conclusion of what is an undertaking will highly depend upon the consensus mechanism used, and, therefore, the specificities of the power structure enabled by it. The relevance and impact of each player will be different according to each consensus mechanism.

Lastly, Competition Law has the potential to be a valuable tool for a sandbox regulation, given the flexibility of Competition Law and its case-by-case analysis by design. The study of Blockchain from a Competition Law approach would inform NRAs and the legislator on how the markets and firms work, especially regarding Public Permissioned Blockchain, before jumping into over-regulation or misregulation.

In parallel, Competition Law is a great tool to achieve the goal of decentralised technologies – to fight against the abuse of concentration of power. The first, by analysing the market, the anti-competitive agreements, and decisions that were anti-competitive or have anti-competitive effects made by firms, proposing compromising measures or not accepting mergers and acquisitions. The latter, offers a technical solution for decentralisation of power to exist.

The study of Blockchain and especially the study of Competition Law and Blockchain is still in its infancy. Many questions remain regarding the specific consequences of each consensus mechanism (or if the market will evolve to consider one, or a few, as default consensus mechanisms). I believe that a deeper study on specific cases will better inform

if within Blockchain there is market, firms, both, or none – because it seems that the answer ultimately relies on how decisions are made (consensus mechanisms).

Concerning enforcement, especially in Public Permissionless Blockchains, the identity of most members is pseudonymized. Some initiatives have been created to try to solve this concern, like attributing a digital ID that would make the members identifiable by allowing members to actively register[468]. However, it is still not clear if, even if Competition Law is theoretically applicable if it could be practically enforced.

Lastly, given the suggestion above about an industry-first analysis, a deeper understanding of the dynamic economic power within blockchain might be relevant to competition assessment and market definition.

[468] Brad Finney, 'Blockchain and Antitrust: New Tech Meets Old Regs' (2018) The Tennessee Journal of Business Law, 716 < "Blockchain and Antitrust: New Tech Meets Old Regs" by Brad Finney (utk.edu)> accessed 25 May 2023.

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