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Blockchain and online gambling: Legal challenges from the perspective of EU member states

Bachelor's thesis
Programme 18HAJB, specialisation European Union Law

Supervisor: Thomas Hoffmann, PhD

Tallinn 2021

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ABSTRACT

The gambling industry is prone to adopt technological innovations, as shown with the rise of online gambling. However, consumers perceive the online gambling activities provided as being fraudelent. The issue can be countered with blockchain and decentralized applications as it can provide transparency, security and decentralization. Blockchain is Distributive Ledger Technology which eliminates the need for intermediaries and the most popular examples of blockchain are Bitcoin and Ethreum. Blockchain Applications are a combination of blockchain network, smart contracts and user interface, which can be utilized to almost anything. This paper will examine the problems of decentralized applications from the view of online gambling as a refence point. Although, gambling is on the focus, the same principles can be reflected on similar markets, inter alia, for example on insurance markets. Blockchain applications, as effective and secure as they may seem, will cause jurisdictional and enforcement issues for EU member states due to pseudonymous and decentralized nature of blockchain applications. These problems derive from the fragmented gambling regulation established in EU, combined with blockchain characteristics and internet jurisdiction. Plausible solutions for the problem are amendement of existing regulation or creation of new regulation, of which the most efficient one is the creation of new blockchain regulation.

Keywords: Blockchain, Decentralized applications, Gambling, Legal Challenges.

1. INTRODUCTION

Internet enabled revolutionary availability and accessibility to services, goods, information, and communication at a global level. The gambling industry used the opportunity the internet provided, in expanding its market share which developed into and still is, a booming industry. As shown with the rise of internet gambling, the gambling industry is prone to adopt technological innovations. It is then likely that the gambling industry will adopt decentralized blockchain technology sooner than later.[1] This accelerated adoption technological innovations by the gambling community, provides a steady stream of challenges for regulators as, by default, law is slow in its efforts to create secure and comprehensive frameworks to operate and transact in.[2]

Regulation of gambling varies from country to country and nature of the growing online sector of gambling, imposes jurisdictional questions in enforcement of cross-border and global gambling contracts and national regulation. A serious problem for gamblers across the globe is trusting the online gambling sites to act in good faith when providing gambling services. Integrity of the game odds and enforcement of gambling contracts is therefore a common corcern for online gamblers. Deriving from this, gamblers actively search for an answer which is generally the reputation of the gambling provider.[3] In addition to the subjectively perveiced continous charades of online gambling providers, the European Court of Justice stated that online gambling increases the risk of fraud when compared to traditional land-based gambling due to absence of direct contact of the parties.[4]

[1] Gainsbury, S., & Blaszczynski, A. (2017). How blockchain and cryptocurrency technology could revolutionize online gambling. *Gaming Law Review*, 21(7), 482-492. https://doi.org/10.1089/glr2.2017.2174

[2] van der Maas, M., & Nower, L. (2020). CONTRADICTIONS OF RESPONSIBLE GAMBLING POLICIES AND GAMBLING PROVISION IN THE CONTEXT OF RAPID MARKET EXPANSION. *Gaming Law Review*, 24(7), 456–465. https://doi.org/10.1089/glr2.2020.0009

[3] Gainsbury, S., Parke, J., & Suhonen, N. (2013). Consumer attitudes towards Internet gambling: Perceptions of responsible gambling policies, consumer protection, and regulation of online gambling sites. *Computers in Human Behavior*, 29(1), 235–245. https://doi.org/10.1016/j.chb.2012.08.010

[4] Vlaemminck, P. (2020). The Gambling Law Review: Gambling and European Law. In R. Verbeke & L. Dutkiewicz Pharumlegal (Eds.), The Gambling Law Review (5th ed., pp. 12–29). Law Business Research Ltd.

Blockchain and its innovative applications are Distributive Ledger Technology (DLT) which decentralizes operations by eliminating the need for intermediaries. Decentralized gambling applications can help the gambling industry, regulators and gamblers in providing transparency, efficiency and reduce risk.[5] The decentralized nature of blockchain applications, mixed with the complexity of internet jurisdiction and fragmented pieces of national gambling regulation inside the EU, provides tools for uncertainty and creates room for potential misconduct.[6] Also, as regulators are not commenting on blockchain regulation, third part of the trinity of uncertainty unweils itself. As the technology is relatively new and still being developed, the economic impact of decentralized gambling applications on the gambling market cannot be assessed. However, legal challenges that derive from decentralized blockchain and its applications can be and should be assessed before its implementation by the industry and consumers.

Decentralized gambling applications would not impose new gambling activities, meaning that the same national definitions and rules of EU member states will apply to the gambling services displayed via blockchain applications.[7] Decentralized gambling applications will only change the method which through the gambling escalates, switching from internet to blockchain networks. The blockchain networks are provided online as well, however, the blockchain networks introduce new features which make it hard for regulators to identify the service providers and consumers in new decentralized applications.

The research question is the revolutionary technology of decentralized applications pose a more serious threath to the national jurisdictions of EU member states than the challenges that currently pressure the online gambling environment and its regulators. Aim of this paper is to draw attention towards jurisdictional challenges posed by decentralized applications by using the gambling industry as a reference point. Decentralized applications could be used in almost immeasurable ways; thus, a reference point (gambling) defines the thesis as internet gambling faces similar challenges already. Materials used in this paper have been retrieved from online library archives of Tallinn University of technology and have been limited by their association to the matter of gambling and blockchain applications. Other criteria for limitations of materials were to analyze the latest materials as the subject is relatively new and the academic material is scarce. This paper

[5] Gainsbury. (2017). Supra nota 1.
[6] Ellul, J., Galea, J., Ganado, M., Mccarthy, S., & Pace, G. J. (2020). Regulating Blockchain, DLT and Smart Contracts: a technology regulator's perspective. *ERA Forum*, 21(2), 209–220. https://doi.org/10.1007/s12027-020-00617-7
[7] Gainsbury. (2017). Supra nota 1.

shortly views internet gambling as a phenomenon and internet jurisdiction, after which it discusses the technical aspects of blockchain technology and its applications, what are legal implications of smart contracts, and what legal challenges decentralized gambling applications bring to the jurisdiction's of European Union member states.

2. Rise of Internet Gambling

As the usage of the internet got popularized in the 1990s, it was a matter of time for casinos to appear online in addition to the already existing land-based casinos. However, not many land-based casinos dared to start an online casino in the fear that they would lose their ability to offer services in land, due to the vague nature of online gambling resulting from the lack of regulation. The regulation of online gambling was first legalized in Antigua in 1994, where the Intercasino was the first online casino to accept real money as a wager in 1996. In the 1990s, the online gambling activity was primarily situated in the Caribbean, whilst focusing on the North American market[8]. After the Antiguan government legalized online gambling, other Caribbean countries soon followed the example and the European market exploded with the mixture of privately owned and publicly owned (i.e. state owned) casinos. The number of online gambling sites has increased from being only 15 in 1996 to approximately 2400 gambling sites being online in 2011.[9] The fast growth pace of new online casinos met recession in the late 2000s century. However, COVID-19 and self-isolation increased attendance rates of online gambling sites in Sweden.[10] In addition to expected growth due to COVID-19, the online gambling industry is expected to grow due to online gambling getting more convenient and accessible.[11] Increased accessibility of online gambling is caused by overall economic growth of the gambling market and growth in technology as online gambling has been made possible through mobile phones and tablet computers.[12] Familiarity with

[8] Gainsbury, S (2012). *Internet Gambling: Current Research Findings and Implications*. SpringerBriefs in Behavioral Medicine 1. Pages 1-5.

[9] Williams, R; Wood, R; Parke, J (2012). *Routledge International Handbook of Internet Gambling*. Simultaneously published in the USA and Canada by Routledge. Pages 3-27.

[10] See study on Swedish population and increased participation on online casinos. Auer, M., Malischnig, D. & Griffiths, M.D. *Gambling Before and During the COVID-19 Pandemic Among European Regular Sports Bettors: An Empirical Study Using Behavioral Tracking Data*. Int J Ment Health Addiction (2020). https://doi.org/10.1007/s11469-020-00327-8.

[11] Deans, E. G., Thomas, S. L., Daube, M., & Derevensky, J. (2016). "I can sit on the beach and punt through my mobile phone" : The influence of physical and online environments on the gambling risk behaviours of young men. Social Science & Medicine, 166, 110–119. https://doi.org/10.1016/j.socscimed.2016.08.017

[12] European Commission (2012). Staff working document: Online gambling in the Internal Market Accompanying the document Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions Towards a comprehensive framework for online gambling. Accessed: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:52012SC0345

the gambling industry and online payment methods are also expected to increase popularity of online gambling.[13]

Gambling as a field can consist of various types of games and activities, however, the widest definition for gambling is "wagering something of value on an uncertain outcome".[14] This definition reflects the inherent risk that underlies gambling, where a person takes a chance in his luck to win the odds presented in front of him. This definition also makes the distinction between games that are based on chance and from games that also require skill. This paper will view gambling in regards of all gambling activities since all gambling activities are feasible with decentralized gambling applications.

Most popular types of gambling are betting, gaming, and lotteries. Betting refers to "gambling in which players have the opportunity to receive a share of the winnings determined according to the product of the stake placed by the player and the odds indicating the probability of an outcome on the basis of a guess made about the events in or results of a sporting or other competition, including a horse race, or gambling".[15] Gaming can be defined as "roulette, card and dice or other comparable games".[16] A lottery can be defined as "a lottery means an activity in which participants may win a prize of monetary value based in full or in part on chance and in which there is a charge for participation".[17]

Online gambling refers to "Online gambling, internet gambling, e-gaming and remote gambling are interchangeable names for gambling activity taking place over the internet".[18] The distinction of wagers placed over the internet, without direct contact to other people, is what separates traditional or land-based gambling from online or internet gambling.

[13] Williams, Wood, Parke (2012).Supra nota 9. Pages 3-27.
[14] Planzer S. (2014) Introduction. In: Empirical Views on European Gambling Law and Addiction. Studies in European Economic Law and Regulation, vol 1. Springer, Cham. https://doi.org/10.1007/978-3-319-02306-9_1
[15]The Finnish Lotteries Act 1047/2001, Section 3(2). Accessed: https://www.finlex.fi/fi/laki/kaannokset/2001/en20011047.pdf
[16] Ibid. Section 3(6).
[17] Ibid. Section 2.
[18] Williams, Wood, Parke, (2012). Supra nota 9. Preface.

Research on internet gambling has primarily concentrated on behavioral issues, such as problem gambling and on addictive factors of gambling[19], on different public policies[20], harm minimizing instruments for consumer protection and on prevention of crime (i.e. money laundering). As examined by the academic community, decentralized applications (DApps), blockchain technology and smart contracting, introduce future legal challenges. Dapps, blockchain and smart contracts are being innovated and it is becoming apparent that the new technology will eventually be applied to online gambling which effects the already existing and fragmented regime of gambling regulation.

2.1. Gambling regulation in EU

Sovereignties produce laws to protect the well-being of a community, where the significance is not drawn to individuals but rather to the needs of the masses.[21] Therefore, laws of a country can be seen as a produce of a culture, history, and customs which explain the differences between legal systems. The same applies to gambling law in EU since the EU has purposefully averted from regulating gambling and activities associated with gambling. At the European Council meeting of December 1992, the European Council met to discuss issues that the Community is facing. There, the European Council decided on exclusion of harmonization in regards of gambling. For example, the European Union has now intentionally excluded gambling from secondary law of EU, inter alia, from digital services directive (Directive EU 2019/770).[22] The exclusion and the absence of gambling regulation provides the right to dispense laws for member states within almost unlimited capacity.[23] As all member states and the citizens of those member states have a different position on and perception of gambling, national gambling laws differentiate from each other. The freedom to regulate gambling, also applies to online gambling.[24]

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[19] Halme, J (2011). *Overseas Internet poker and problem gambling in Finland 2007: A secondary data analysis of a Finnish population survey*. Nordic Studies on Alcohol and Drugs. Volume 28.
[20] Planzer, Simon; Gray, Heather; Shaffer, Howard. *Associations between national gambling policies and disordered gambling prevalence rates within Europe*. International Journal of Law and Psychiatry. Volume 37(2). Pages 217-229. https://doi.org/10.1016/j.ijlp.2013.11.002.
[21] Lehmann, M. (2020). Regulation, global governance, and private international law: Squaring the triangle. Journal of Private International Law, 16(1), 1–30. https://doi.org/10.1080/17441048.2020.1744255
[22] See Directive (EU) 2019/770 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the supply of digital content and digital services. article 3(5) Scope, which states that the Directive does not apply to gambling.
[23] Maier, B. (2010). How has the law attempted to tackle the borderless nature of the internet? International Journal of Law and Information Technology, 18(2), 142–175. https://doi.org/10.1093/ijlit/eaq001
[24] Vlaemminck, P. (2020). Supra nota 4. 12–29

The dispense of several national laws has resulted in different levels of regulation. Normally, the EU sets the framework for member states to regulate in, where the secondary law poses the minimum level of expected and mandatory regulation required from the member states relating to the subject matter. However, now when that framework and minimum requirements are missing, the member states can arbitrarily choose on how they want to regulate gambling. The respected EU member states have regulated gambling by creating license systems and monopolies. Even though, the free movement of services is present in the internal market of the EU, the freedom to provide gambling services is not due peculiar nature of gambling. Gambling involves so many downsides by increasing risk of fraud, addiction, and social harm (e.g. change in values towards gambling) that prohibiting a service provider to import services and gambling monopolies of some member states can be justified under EU law. [25]

Gambling services are not ordinary services but are services nevertheless within the meaning of article 57 and 56 of the Treaty of the Functioning of the European Union (TFEU) and therefore if and when derogated from the free movement of services, the actions of member states must be justified as the derogation breaches article 56 TFEU.[26] Derogations can be justified under public order, public security, public health and public interest under articles 62 and 52 TFEU and under case law (C-470/11, judgement EU:C:2012:505 and joined cases of Stanleybet International e.a., joined cases C-186/11 and C-209/11). The actions taken by the member states must also be what is necessary in order to attain the objective[27] and must be presented in a systematic and consistent manner[28], whilst being transparent and not discriminatory[29]. These prerequisites altogether are referred as principle of proportionality. The proportionality of derogatory national legislation is assessed objectively, without consideration on actions taken by other jurisdictions. Financial justifications, such as, increasing tax revenue or public winning of the state and discriminatory or non-consistent measures are prohibited by EU case law.[30]

When institutions, such as the EU, do not address a topic which it would normally address, a cloak of temporary uncertainty rises from the lack of regulation. This derives from the fact that law is

[25] Hojnik, J. (2018). Online gambling under EU law: Strolling between controlled expansion and genuine diminution of gambling opportunities. Lexonomica, 10(2), 67–102. https://doi.org/10.18690/lexonomica.10.2.67-102.2018
[26] Ibid.
[27] Stanleybet International e.a., joined cases C-186/11 and C-209/11, par. 27.
[28] Judgment of the European Court of Justice of 28 February 2018 Sporting Odds, C-3/17, EU:C:2018:130, par. 33.
[29] Ibid. par. 44.
[30] Vlaemminck, P. (2020). Supra nota 4. 12–29.

slow to act which gets multiplied as regulating a matter also scales all of the factors that have to be regarded into European legislation, due to a number of reasons, such as, inter alia difference between the member states' legal systems, history, culture and perception of things (i.e. perception on gambling). As regulation is missing, room for misconduct and mistake for criminals and for people operating in good faith, becomes unrestricted. For example, banking and the financial sector is generally a well regulated and comprehensive field for experts, where inter alia taxation of economic instruments, such as, shares are taxed. In the case of gambling, the discretion on how to legislate gambling activities has been passed from EU to the member states. This set-up is working properly when each member state provides a comprehensive and reliable framework for citizens to operate in.

2.2. Jurisdiction and online gambling

The global nature, accessability and reduction of costs related to the activities conducted via internet, enables and encourages entities from different countries to interact and transact with each other. Chances for a contract to be of cross-border nature is higher in the internet than it would be in normal or paper based contracting.[31] This likelihood cross-border contracting is the key contributor to most of the jurisdictional challenges that internet faces. Operators, service providers and actors have to consider a vast amount of national and transnational rules and regulation before and whilst they conduct their business. This consideration for different legal regimes has to be done in a case by case basis as most situations differ from each other.[32]

Difference between public and private international law is distinguished from the interest of the law. For example, if the intended directory of the law is private, it generally regulates matters that concern individuals and their activities, where as, public law concentrates on public matters of the state, such as, prosecuting criminals for their offences.[33] As stated above, the EU refrains from commenting and regulating the matters relating to gambling, however, if the national rules of EU

[31] Wang, F. (2008). *Obstacles and solutions to internet jurisdiction: comparative analysis of the eu and us laws*. Journal of International Commercial Law and Technology, 3(4), 233-241.
[32] Svantesson, D. B. (2018). *European union claims of jurisdiction over the internet*. Journal of Intellectual Property, Information Technology and Electronic Commerce Law, 9(2), 113–125. https://www.jipitec.eu/issues/jipitec-9-2-2018/4722
[33] Hörnle, J. Zammit, B. (2010). *Cross-border Online Gambling Law and Policy*. Northampton, USA: Edward Elgar Publishing Limited. 78-138.

member states are violated, the member states can assert jurisdiction over the case by depending on principles of public international law.

Jurisdiction refers "to the power of a state to regulate conduct under international law in matters not exclusively of domestic concern".[34] Jurisdiction has three distinct section: legislative jurisdiction, judicial jurisdiction and executive jurisdiction, where legislative refers to sovereignty's right to regulate and produce substantive legislation, judicial refers to jurisdiction to summon persons to adjudication and executive refers to sovereignty's jurisdiction to enforce the rules they pose.[35] Six theories of justifications for jurisdiction under public international law are subjective territoriality, objective territoriality, nationality, passive nationality, protective measures and universal jurisdiction. Territoriality refers to the territory where the act unfolds (subjective) or territory where the effects of the act unfold (objective). Nationality refers to the nationality of the actor or to the nationality of the person who has been wronged (passive nationality). Protective measures refer to actions taken against entities that, directly or indirectly, hurt the interests (e.g. economic, legal or social) of a state. Lastly, universality is a principle used to justify states' jurisdiction over the most grave crimes (e.g. the Nuremberg trials against nazi officials).[36]

The landmark case of LICRA v. Yahoo! Inc. established that a state may use its jurisdictional powers on matters which take place over the internet, even though the actor does belong to that jurisdiction. The significance of the landmark case derives from the fact that the internet was considered to be borderless due to its nature, however, the case showed that a state can establish jurisdiction over the internet with principles of traditional jurisdiction.[37] In the case, Yahoo! Inc, which is an internet market place established in the United States of America, auctioned Nazi memorabilia. Yahoo, as being a market place, does not itself sell the products offered over the platform but rather works as a middleman and a platform where people can sell their products to other individuals. Selling artefacts that are related to semitism is, under French Criminal Code, prohibited and therefore LICRA and UEFJ sought cease and desist orders for Yahoo. Among the cease and desist order, LICRA demanded Yahoo to technically block and filter access from French

[34] Kuner, C. (2010). Data Protection Law and International Jurisdiction on the Internet(Part 1*). International Journal of Law and Information Technology*, 18(2), 176–193. https://doi.org/10.1093/ijlit/eaq002
[35] Jiménez, W. G., & Lodder, A. R. (2015). Analyzing approaches to internet jurisdiction based on a model of harbors and the high seas. International Review of Law, Computers & Technology, 29(2–3), 266–282. https://doi.org/10.1080/13600869.2015.1019204
[36] Andria, A. (2001). Internet Jurisdiction Today. Northwestern Journal of International Law and Business, 22(1), 69–90. https://scholarlycommons.law.northwestern.edu/njilb/vol22/iss1/
[37] Idib.

users. The French court justified that they had jurisdiction over Yahoo and its subsidiary Societe Yahoo! France, even though servers are located in USA due to material being available in France.[38]

Like in the Yahoo case, member states of EU can protect their national gambling rules on online as well, by depending on case law and public international. However, with the introduction of blockchain applications, the lack of regulation and harmonization causes legal challenges for all fields of law, including gambling and financial fields. For example, crypto assets which are used in blockchain applications, are not yet regulated by the EU which are used in decentralized gambling applications.

3. Technical aspects of Blockchain technology

Blockchain was first introduced to the world with the rise of Bitcoin in 2008, when an alias called Satoshi Nakamoto released his paper "Bitcoin: A Peer-to-Peer Electronic Cash System". In his paper, Nakamoto described a decentralized mechanism that would store digital currency and eliminate the need for intermediaries and financial institutions when transacting.[39] The physical Bitcoin network was launched a year later in 2009.[40] From its launch to this day, the bitcoin network's total market value has fluctuated significantly from being 16 billion US Dollars in 2017[41] to 1 trillion US Dollars in February 2021.[42] As bitcoin gains more attention, desire to understand blockchain technology becomes more apparent. Interest in blockchain markets in return, increases innovation in applications of blockchain technology.

Nowadays, bitcoin is still the leading blockchain network (when measured by total market value), however, there are other blockchain networks with various application purposes and target

[38] Okoniewski, E. A. (2002). Yahoo!, Inc. v. LICRA: The French Challenge to Free Expression on the Internet. *American University International Law Review*, 18(1), 295–339. https://digitalcommons.wcl.american.edu/auilr/vol18/iss1/6/
[39] Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer electronic cash system. Bitcoin.org. https://bitcoin.org/bitcoin.pdf
[40] Antonopoulos, A. M. (2017). Mastering Bitcoin: Programming the Open Blockchain (2nd ed.). O'Reilly Media. Chapter 1.
[41] Historical Snapshot - 01 January 2017. (2017). CoinMarketCap. https://coinmarketcap.com/historical/20170101/
[42] Partridge, J. (2021, February 19). Bitcoin's market value exceeds $1tn after price soars. The Guardian. https://www.theguardian.com/technology/2021/feb/19/bitcoins-market-value-exceeds-1tn-after-price-soars-to-above-54000

audiences. The idea of the Ethereum blockchain network was released in 2013 by Vitalik Buterin. 2 years after the Buterin released his idea, Ethereum blockchain network was launched.

All blockchain networks differ in their intended purpose.[43] Bitcoin's main purpose is to provide a decentralized platform for a digital money ecosystem,[44] whereas the Ethereum network was founded to utilize the characteristics of blockchain technology to not any specific purpose, but to work as a general computer.[45] Therefore, the two where coded with differing protocols, where Bitcoin's purpose is to only differentiate true transactions from false, Ethereum was coded to work as a general computer with the characteristic of being Turing complete with the ability to execute code.[46]

Blockchain technology has three key characteristics: "decentralization, proof-of-work, and immutability of the network".[47] Blockchain can be defined as a distributive ledger technology that is used for storing and deploying information into an almost impenetrable network of nodes where the added information is validated by proof-of-work consensus.[48] Blockchain is maintained and can be edited by users of the network in a decentralized manner, without the need for a central authority.[49]

A block is added to the blockchain when the intention of two users actualizes as a transaction. Ledger refers to a keeping and management of records.[50] An example of a ledger is real estate register, where ownership of real estate is kept. These records (i.e. blocks) can be recognized from their timestamp and 'Hash',[51] where the block get timestamped upon creation and contains

[43] Werbach, K. (2018). Trust, but verify: Why the blockchain needs the law. Berkeley Technology Law Journal, 33(2), 489–549. https://doi.org/10.15779/Z38H41JM9N
[44] Antonopoulos. (2017). Supra nota 40. Chapter 1.
[45] Antonopoulos, A. M., & D., G. W. P. (2018). Mastering Ethereum: Building Smart Contracts and DApps (1st ed.). O'Reilly Media. Chapter 1.
[46] Ibid.
[47] Fulmer, N. (2019). Exploring the legal issues of blockchain applications. Akron Law Review, 52(1), 162–191. https://ideaexchange.uakron.edu/akronlawreview/vol52/iss1/5
[48] De Filippi, Primavera; Wright, Aaron (2019). *Blockchain and the Law.* Harvard University Press. Cambridge, Massachusetts. Pages 33-59.
[49] ETLA Reports, Lauslahti, K., Mattila, J., & Seppälä, T. (2017). Smart Contracts – How will Blockchain Technology affect Contractual Practices? (No. 68). ETLA. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3154043
[50] Ledger refers to a record of accounts. Werbach. (2018). Supra nota 43.489–549.
[51] Hash defined as a "signature for a text or a data file" in. Peters G.W., Panayi E. (2016). Understanding Modern Banking Ledgers Through Blockchain Technologies: Future of Transaction Processing and Smart Contracts on the Internet of Money. In: Tasca P., Aste T., Pelizzon L., Perony N. (eds) Banking Beyond Banks and Money. New Economic Windows. Springer, Cham. https://doi.org/10.1007/978-3-319-42448-4_13

reference to the previous block (also contained in the hash). The blockchain get longer by each added block, thus the line of reference is easily accessible to all users.[52]

Decentralization of the blockchain refers to the absence of a central authority for management records which is instead distributed across nodes and to the autonomy of the users to transact freely. Blockchain consists of 'nodes'[53] which together create the blockchain network. Each node that possesses a coin or a part of it, stores the coins transactional history. Thus, copies of transactional history of the whole ledger is distributed widely, meaning that there is no need for intermediaries. Each node has a public key that connects the node (i.e. computer) to an address in the blockchain network. Public key is the identifier of the node since intent to transact is shown by providing the public key of one's node.[54] Private key on the other hand is the password of the node. When a transaction is executed, it must be verified with the private key. Nodes can freely transact in the blockchain if they possess the public key, the private key and funds. Decentralization of blockchain decreases transactional costs as the need for intermediaries for ledger management is eliminated since all nodes can act freely.[55] The transaction made in blockchain are speudonymous since even though the public is the identifier of the node, it does not provide identification for the person who operates the node. The public keys are just reference number to connect the funds in question to an account but the account itself does not provide any information on the details of the operator of the account, which makes blockchain also speudonymous.

Blockchain networks, such as Bitcoin and Ethereum, uses coins (coins are cryptocurrency, for example, bitcoin or ether) to incentivize activity.[56] Activities in the blockchain must be validated by proof-of-work consensus, meaning that each transaction and added information to the blockchain must be verified by the majority of other users of the network before new block containing that information is added to the chain of blocks. Validation of new a block (also known as Proof-of-work) is performed by 'miner' who "offers their computers' processing power to solve cryptographic problems that certify the transaction is valid".[57] The miners solve mathematical

[52] Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. (2017). Blockchain. Business & Information Systems Engineering, 59(3), 183–187. https://doi.org/10.1007/s12599-017-0467-3
[53] Node refers to a blockchain client or a computer that is connected to the blockchain network. Fulmer. (2019). Supra Nota 47. 162–191.
[54] Ross, E. (2017). Nobody puts blockchain in a corner: The disruptive role of blockchain technology in the financial services industry and current regulatory issues. Catholic University Journal of Law and Technology, 25(2), article 7. https://scholarship.law.edu/jlt/vol25/iss2/7
[55] Werbach. (2018). Supra nota 43.489–549.
[56] Ibid.
[57] Fulmer. (2019). Supra nota 47. 162–191.

problems called ‘hash functions’. After the miner have solved the equation, it projects the correct answer across all nodes, which in return check the correctness of the solution. Majority of the nodes must check that the solution is correct before a new block to be added. However, as solving hash functions requires immense processing power, incentive is needed on behalf of the miners for them to want to participate in validation of legitimate transaction. Therefore, for each correctly validated block, a miner receives a reward in a form of a coin.[58] The idea behind proof-of-work consensus is that it is hard for the miners to solve hash functions, but easy for the nodes to check its validity.[59] As most of the nodes would not trust other nodes in the absence of central authority, proof-of-work is essential in trust creation.

In addition to trust derived from proof-of-work block validation, immutability of the blockchain increases security and trust in to the blockchain network as a whole and to the trust between nodes. After a block has been validated and added to the blockchain network, it cannot be edited or removed from it. As stated before, blocks are linked to each other through the hash (reference to the previous block). If one would edit or remove even one block, all blocks in the blockchain would have to be edited as the hash of all blocks would otherwise present incorrect information. However, theoretically blockchains can be edited if one possesses fifty one percent of the blockchain resources. Meaning that if one has acquired sufficient resources (possession of nodes) which put together exceed the majority’s resources, blockchain can be edited. If one possesses the majority of the blockchain, they can edit the nodes to correlate to their version of the truth or to their version of what blocks are legitimately validated. The likelihood of these fifty one percent attacks decreases as more blocks are mined into the blockchain since acquiring sufficient resources becomes more complicated as blockchain grows (more bitcoin’s and users, more resources needed for breach).[60] Immutability and growing complexity of hash functions bring monetary value to blockchain systems.[61] Like central banks hold stable assets as assurances for currency, blockchain networks assure the integrity of the chain with a stabilizer (i.e. with growing complexity of hash functions.

[58] Savelyev, A. (2017). Contract law 2.0: ‘Smart’ contracts as the beginning of the end of classic contract law. Information & Communications Technology Law, 26(2), 116–134. https://doi.org/10.1080/13600834.2017.1301036
[59] Politou, E., Casino, F., Alepis, E., & Patsakis, C. (2020). Blockchain Mutability: Challenges and Proposed Solutions. IEEE Transactions on Emerging Topics in Computing, 1–13. https://doi.org/10.1109/tetc.2019.2949510
[60] Ibid.
[61] Savelyev. (2017). Supra nota 58.116–134.

3.1. Smart Contracts and their legal implications

Ethereum's Turing completeness[62] introduces a new blockchain characteristic: smart contract. Smart contracts have gained popularity with the rise of the Ethereum blockchain. The idea of smart contract, however, was first introduced by Nick Szabo in his paper called "Smart Contracts" in 1994. In his publications, Szabo defines a smart contract as "computerized transaction protocol that executes the terms of a contract"[63] and as "a set of promises, specified in digital form, including protocols within which the parties perform on these promises".[64] Szabo's definition of the smart contract was quite simple. In a nutshell, Szabo stated that if a contract is automatically executed, it can be regarded as a smart contract.[65] Nowadays, smart contracts are associated with blockchain networks, particularly with Ethereum blockchain, even though smart contracts could have been deployed in other technologies and not only on blockchain.

Smart contracts work conditionally in 'if this then that' or 'if x then y' manner. For example, a smart contract could be something very simple such as, if one pays 50 euros (condition x), they receive a shirt (result y) or something complicated such as, a lease agreement where party A creates a smart contract wherein he inserts a code for a car lock and adds as a condition that whoever pays 200 euros, will receive the code and rights to use the car for a month.

Oracle in blockchain means a computer program that can gather data from trustworthy sources outside the blockchain. Oracles can be used in smart contracting, where oracles could check whether conditions for the fulfillment of the smart contract has been met. However, the usage of an oracle could jeopardize the tamper proof nature of the blockchain and smart contracts since the condition of the contract would then depend on an outside factor.[66] Without the oracle, the smart contract does not need to consider any outside factors which makes it tamper-proof as it cannot be influenced after creation and deployment. But the data which the oracle gathers, could be

[62] "Turing complete means that any program of any complexity can be computed by Ethereum.". Antonopoulos. (2018). Chapter, Ethereum and Turing Completeness.
[63]Szabo, N. (1994). *Smart Contracts*. https://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html
[64]Szabo, N. (1996). Nick Szabo -- Smart Contracts: Building Blocks for Digital Markets. https://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart_contracts_2.html
[65] Filatova, N. (2020). Smart contracts from the contract law perspective: outlining new regulative strategies. International Journal of Law and Information Technology, 28(3), 217–242. https://doi.org/10.1093/ijlit/eaaa015
[66] Cuccuru, P. (2017). Beyond bitcoin: An early overview on smart contracts. International Journal of Law and Information Technology, 25(3), 179-195. doi: 10.1093/ijlit/eaxOO3

influenced some way, thus opening a security gap to the usage of smart contracts. This security gap of data gathering between the online and off-line worlds is called the 'oracle problem'.[67]

The law community has been intrigued by the word 'contract' in smart contract which has triggered high interest and discussion on whether a smart contract can be considered as a legally binding contract or not. Definitions of smart contracts are mainly provided by academic literature because of the lack of regulation in the matter.[68] As smart contracts are relatively new technology, lack of definition and regulation towards smart contracts, derives from the slow nature of law and regulation.

Smart contract that has been deployed on a decentralized blockchain, capable of executing the code implemented into the smart contract, can be defined as "any digital agreement which is (a) written in computer code (thus, a piece of software), (b) run on blockchain or similar distributed ledger technologies (thus, decentralized) and (c) automatically executed without any need for human intervention (thus, smart)".[69] Smart contracts themselves cannot be considered as contracts but as a tool to be used for contracts enforcement and/or conclusion.[70]

3.2. Decentralized applications (DApps)

Decentralized applications (DApps) are revolutionary technology that utilizes the characteristics of blockchain technology and smart contracts. DApps can be wholly or partly decentralized and consist of interface (a website which can be interacted with), backend program (the code which links all parts of the application together) and data storage.[71] DApps can be defined as "applications whose main logic is programmed in smart contracts that run on blockchain systems"[72] and as a "as a piece of software, which includes a user interface and a decentralized back end that makes use of the Ethereum blockchain and smart contracts".[73]

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[67] Herian, R. (2020). Smart contracts: a remedial analysis. Information & Communications Technology Law, 30(1), 17–34. https://doi.org/10.1080/13600834.2020.1807134
[68] Savelyev. (2017). Supra nota 58.116–134.
[69] Caria, R. (2019). The legal meaning of smart contracts. European Review of Private Law, 26(6), 731–752. https://kluwerlawonline.com/journalarticle/European+Review+of+Private+Law/26.6/ERPL2018052
[70] Cuccuru. (2017). Supra nota 66.179-195.
[71] Antonopoulos. (2018). Supra nota 44. Chapter 12.
[72] Bracamonte, V., & Okada, H. (Eds.). (2017). 2017 IEEE international symposium on technology in society (ISTAS) proceedings: The issue of user trust in decentralized applications running on blockchain platforms. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8318975&tag=1
[73] Sheth, A., & Subramanian, H. (2019). Blockchain and contract theory: modeling smart contracts using insurance markets. Managerial Finance, 46(6), 803–814. https://doi.org/10.1108/mf-10-2018-0510

Most of the applications are centralized, meaning that the frontend (interface, webpage or interface of the app), the backend (program code and the hardware which processes the operations occurring in the interface) and the data storage (storage of e.g. profiles and transactions) are all controlled by the authority or company. Centralized applications rule the markets but are more prone to security threats than partially or wholly decentralized applications because their 'eggs are in one basket'. Even though centralized applications can outsource, for example, their data storing, the possibility of a breach relies on one point of failure.

Applications that utilize the blockchain network, have already been established. These applications are partially decentralized meaning that one of the application elements is decentralized, instantly providing more security and transparency with lower costs than centralized applications offer. As discussed above, the blockchain characteristics of decentralization of nodes, immutability and proof-of-work or proof-of-stake, make decentralized blockchains tamper-proof. For example, a gambling site decentralizing their payment channel: lowers costs since transacting in blockchains is relatively cheap, adds security with public key identification, when compared to the alternative of third party identification methods (such as email or facebook), and provides transparency for regulators (taxation and money-laundering). However, there are security threats in partially decentralized applications within their centralized parts of the application.

A wholly decentralized DApp would have all the elements of the application, decentralized. This would mean that the whole system is spread out the blockchain, build on smart contracts, accessed via an IPRS. A non-comprehensive list of DApps is provided in website called 'Dapp.com' and 'State of the Dapp'. A wholly decentralized application is vastly more secure to cyber-attacks than centralized applications and partially decentralized applications are. However, the idea for the DApp and its elements still are created and developed by a human which leaves room for human error. Thus, DApps can be flawed but the flaws can be patched (i.e. fixed) and as the program is used, the user experience and the software itself evolves.

In conclusion, centralized applications and partially decentralized applications require human government for smooth operation which opens the systems for security issues. Whereas, wholly decentralized applications run smoothly without human intervention. Partially and wholly decentralized applications, both, have legal issues that need to be assessed before they are accepted as technology for wide-spread usage. These issues include, in addition to the already addressed

lack of regulation and common definition for smart contracts, data protection issues arising from transparency of the applications, issues with applicable law and jurisdiction, tax related issues and issues concerning competitiveness of the markets.

4. Challenges posed by decentralized gambling applications

Fragmented pieces of national gambling regulation, jurisdictional challenges posed by the internet, unregulated and uncertain legal position of blockchain are all culminated in decentralized gambling applications. As popularity of DApps and decentralized gambling grows, more of illegal and unlicensed gambling will appear which will in return pose issues with jurisdiction.

Decentralized gambling applications can nullify the measures taken by EU member states due to the nature of blockchain's in regards of pseudonysm and availability as all blockchain's and their applications are currently accessible from in all EU member states.[74]

Consumer protection in gambling is, inter alia, a reason on which the member states justify their national gambling restrictions, systems and measures taken. However, as blockchain applications are pseudonymized, the identification of vulnerable consumers from the pool of users can be hindered even though plausible.[75] Blockchain applications might be accessed by a minor if they possess the right capacity, i.e. are able to buy the crypto-currency or the tokens used in the gambling application, after which they can freely participate in the gambling activities. This problem emerges as some gambling services do not requiring identification from its consumers.[76] Even though, a minor could be identified through tracking the transaction history of the wallet until currency exchange, this would amount into a hugely greater amount of work to what is required by the gambling authorities nowadays. Even the tracking of the wallet history could be ultimately confused by acting through cash systems (e.g. if blockchain coins are traded to cash, instead of wire transfer).[77] The same applies for restricting access for gambling addicts and

[74] Millar, S. I. (2018). *CRYPTOCURRENCY EXPANDS ONLINE GAMBLING*. Gaming Law Review, 22(3), 174. https://doi.org/10.1089/glr2.2018.2232
[75] Filippa (2019). Supra Nota 48. 171-193.
[76] Gainsbury (2017). Supra nota 1. 182-192.
[77] Ibid.

problem gamblers. Since the decentralized gambling applications do not require a consumer to create a 'gambling wallet or account', the consumers cannot be ceased from excess gambling.[78]

As perceived trust of online gambling sites is bad, decentralized applications and their ability to dispose transparency on e.g. gambling odds, can encourage the consumers to participate on illegal gambling on unregulated and unlicensed gambling sites.[79] As the gambling providers can provide statatics and odds of the gambling services to the consumers directly with smart contracts, the consumers might deviate from the regulated sites to unregulated ones which results in issues with enforcement of gambling laws, as it is hard to determine the whereabouts of the operator of a fully decentralized gambling provider due to speudonymity and decentralized nature of blockchain.

Even though, providing gambling activities may be legal in one country, it does not mean that it is legal in another. Therefore, when providing gambling services inside the internal market of EU, the service provider has to consider the rules and regulation of all jurisdictions it wants to provide its services to.[80] With blockchain, this is almost impossible since the blockchain is accessible to all persons in the EU since none of the EU member states has restricted access to blockchain applications. Unlike with the internet, blockchain's ability to filter or to block access for user's of a specific region or country is hindered due to pseudonymization and accessability. The blockchain also does not have, at least not yet, the capability to censor its material for a specific audience. If the content of a blockchain is avaible in a member state, then all of its smart contracts and transactional capacity is offered as well.

Stopping the operation, even though regulatory measures have been established, is not as simple with blockchain as it would be with websites. Blockchain technology is decentralized to a vast amount of nodes which cannot be all 'turned off' at command.[81] Also, immutability of blockchain means that all criminal or otherwise illegal actions taken in the blockchain, stays in the blockchain. For if an illegal gambling service has been created into the blockchain by using smart contracts, the authorities will have difficulties of taking the service down as it would require them to alter with the integrity of the chain of hashes.

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[78] Ibid.
[79] Ibid.
[80] Duh, C. (2002). *Yahoo! Inc. v. LICRA*. Berkeley Technology Law Journal, 17(1), 359–378. https://www.jstor.org/stable/24120111
[81] Yeoh, P. (2017). Regulatory issues in blockchain technology. Journal of Financial Regulation and Compliance, 25(2), 196–208. https://doi.org/10.1108/jfrc-08-2016-0068

Since blockchain networks and applications can, like the websites on the internet, reach a unconsiderable amount of repiciants, the laws and regulation of all of the countries that are affected, might have a claim for jurisdiction under the principles of public international law. However, if an application is fully decentralized (i.e. operated fully in the blockchain network) establishing jurisdiction might be hard or close to impossible. For example, operation of a fully decentralized gambling application, might trigger a justification link for various member states to have a claim over the jurisdiction on a case. The matter of what factors takes precedense when establishing jurisdiction on cases of illegal decentralized gambling applications, has not yet been disclosed by authorities, ruled over by courts or discussed by the legal academic community. However, the question of jurisdiction might be too complex for a court to decide as the hardware, the repiciant of the service, the operator of the service, the impacts of the conduct, and the nationalities of the parties can all be located at different member states. Also, if jurisdiction is established, the member states can only enforce their laws if the perpetrator resides or holds assets in that member state as public law agreements on enforcement of foreign judgements are rare.[82]

4.1. Blockchain regulation

The actions of an individual can be affected in many different ways, where the most efficient one conducted by a state is regulating the matter with laws and regulation.[83] In the case of regulating blockchain, the EU and its member states have three valid options. Firstly, the EU and the member states can institute a total ban. A ban, even though, having an alleviating effect on the legal challenges that lie ahead, would also be near to impossible to enforce due to blockchain decentralized, accessability and censor-resistant nature. Also, providing such a ban on blockchain applications, would only force individuals, who already operate and transact with crypto-currencies, to act in an illegal environment, thus increase the number of illegal activity. Second option is to provide the needed regulation and attention for the matter which would in return create a secure and comprehensive structure for individuals to operate in. Last option is not to regulate the matter. However, lack of regulation could lead to uncertainty. Individuals might accidentally take part in illegal activity without their knowledge which increases criminal opportunities, such

[82] Devaney, M. (2009). Online gambling and international regulation: an outside bet. Information & Communications Technology Law, 18(3), 273–283. https://doi.org/10.1080/13600830903424718
[83]Filippa (2019). Supra nota 48. 171-193.

as, fraud.[84] Even though, limitations of blockchain seems reasonable, future innovation on the field, might adhere to a halt and the full potential of blockhain applications remain unseen.[85] As discussed previously, banning the participation in or providing of decentralized gambling applications, it would be harder if not impossible for the authorities as filtering or to blocking access of its citizens can only be achieved by banning the access to a blockchain network compeletely.

The central banks of some EU countries and the European Central Bank (ECB) do not define crypto-currencies as money or equivalent to money, however the ECB has stated that crypto-currencies can be regarded as an alternative to money.[86] The EU has also announced proposals for regulating crypto assets as securities, but it has not yet been released. Even if the EU would release regulation classifying tokens as securities, utility tokens would be exempt from that classification as they are not used for investment per se. [87] Until a harmonized regulation for crypto assets, such as, utility coins used in decentralized blockchain applications, has been released, the member states are forced to dwell in uncertainty or to regulate the matter themselves. Therefore, the usage of utility coins in decentralized gambling applications pose a serious threat to the jurisdiction of member states as viable cause for prosecution is hard to justify under vague or absent regulation.

Unregulated position of blockchain coins creates a loophole for the service providers. Since the coins are not classified as money or equivalent to money, the gambling activity cannot be considered as gambling per se. Giving Ethereum coins and other blockchain coins the classification of 'money' will relieve the pressure since if blockchain coins can be regarded as money, it can be regulated the same way as online gambling is regulated at the moment.

Despite all the legal challenges that accompany and derive from blockchain, usage of blockchain, under a comprehensive framekwork, is beneficial for all of its users and for regulators. Blockchain applications would bring more transparency for, both, the consumer and the regulator as they can

[84] Ibid.
[85] Yeoh. Supra nota 81. 196–208.
[86] Miseviciute, J. (2018). Blockchain and virtual currency regulation in the EU. Journal of Investment Compliance, 19(3), 33–38. https://doi.org/10.1108/joic-04-2018-0026
[87]A token is an instrument inside a blockchain which can be used as a ticket system for applications built on top of blockchain networks. For example, a blockchain application can trade coins for tokens that are used for transactions inside the application. Utility token can be defined as "Utility tokens confer rights to use or consume certain products developed by the issuing company and deposited on the blockchain." Hacker, P. & Thomale, C. (2018). Crypto-Securities Regulation: ICOs, Token Sales and Cryptocurrencies under EU Financial Law. European Company and Financial Law Review, 15(4), 645-696. https://doi.org/10.1515/ecfr-2018-0021.

transparently view and examine actions, cashflow and architecture of gambling inside blockchain networks. Perhaps, establishing limits to blockchain related jurisdictional problems is impossible. Nevertheless, regulation for crypto-currencies and their classification as securities or as legal tender is needed to protect service providers, consumers and the interests of EU member states.

4.2 Suggestions

The European Commission has stated, that more projects and examples of potential usage of blockchain applications are required so the hype can be distinguished and dissociated from the practical capabilities.[88] Whilst, the European Commission waits for the technology and its applications to develop, the propability and opportunity for crime and illegal action will develop as well. Therefore, I suggest the European Commission and the respected EU member states to amend gambling and new forms of gambling to already existing regulation (here, blockchain based and decentralized gambling), or create new regulation for gambling, amend blockchain to the already existing regulation or create new regulation for blockchain.

The EU has amended legislation in the past, and will continue to do to secure that e.g. directives provide efficient tools for actors in the internal market. Amending the already existing regulation therefore does not constitute immense difficulties. The benefit of amending the current legislation is that EU market operators, consumers and EU member states have habituated themselves with the current legislation and implemented the principles and rules of those directives. However, current directives do not consider or include gambling. The exclusion of gambling could be justified in the past with member states handling the matter by themselves and with national legislation. Now, the decentralization of e.g. gambling presents new challenges and poses threats for the functioning of the internal market, therefore the more blockchain regulation is harmonized, the better. As inclusion of land-based and online gambling to the existing regulation seems unlikely, amendement of blockchain based gambling is out of the question.

Creating new regulation is more burdensome than amending the current legislation. Nevertheless, creating new legislation would give the legislator (here, EU and EU member states) an opportunity to address all aspects and issues that derive from blockchain gambling. As discussed above, the European Council decided not to regulate gambling. Regulating gambling inside blockchain

[88] Miseviciute. (2018). Supra Nota 86. 33-38.

applications, would require the European Council to reverse that decision which also seems highly unlikely. Even though, gambling would be amended to existing regulation or new regulation would be created for decentralized gambling, it would not solve all the problems. The current problems discussed above, can be reflected to other fields as well. For example, concluding contracts without legal capacity is an issue, not only inherited by gambling. Therefore, amending gambling to or creation of new regulation for gambling cannot be considered as a viable solution.

Whereas, including gambling into the existing regulation by implementation or creation of new regulation seems unrelevant, amending blockchain to the existing regulation in the hopes that it would solve problems faced by the decentralized gambling applications, seems even more unlikely and inefficient. As the directives particularly state that they exlude gambling, amending blockchain regulation to the existing regulation would not relieve the situation in any way. If the EU does not change its policy on regulating gambling, the amendement of current regulation does not provide any solutions.

As blockchain can be applied to almost every field inside the internal market, creating new regulation becomes problematic since the new regulation cannot overlap with past directives to eliminate contradictions and conflicts within regulation. Creation of new regulation, thus is not effortless, however it seems to be the only plausible solution presented. The EU or the EU member states must then establish regulation on how crypto-currencies and blockchain characteristics are defined. Also, as jurisdictional issues are apparent, the European Commission has to address the problem inside public international law, or otherwise the age of landmark cases will soon begin. Even though, the European Commission can disregard the jurisdictional issues by accreding it to the European Court of Justice, addressing the problem beforehand seems justified to prevent blockchain from the same shortcoming which internet regulation faced and is still facing.

Even though it seems unlikely at the moment, establishing new blockchain regulation is the most efficient measure that the EU can establish. Regulating blockchain, would also surely assist the member states to solve problems inherent to decentralised gambling applications.

5. CONCLUSION

The fact that the European Union has not addressed matters relating to gambling activities in the past, has not disturbed the EU member states from providing comprehensive regulations. The rise and accelerated development of e-commerce and online activity has materialized into a rise in cross-border transacting.[89] The same phenomenon can be viewed in the industry of gambling from the increasing number of online gambling sites, repicients of those sites and modes of gambling. However, gambling on online poses higher propabilities for criminal activity to take place (e.g. fraud) than traditional gambling would. As the market will eventually meet growing demand, it is apparent that blockchain applications will eventually be implemented by the gambling industry due to the their security, pseudonysm, and transparency.

Providing gambling services through a blockchain applications does not instantly constitute the operation to be of illegal nature. However, as it is not yet being regulated, the risks in the field of blockchain applications has not been mapped out. The EU member states want to protect the its citizens, inter alia, from illegal gambling services, fraud, excess or problem gambling and minors from participating in gambling activities. However, as the power to regulate, has been given by the European authorities to the member states, the member states can decide the level of regulation, referring to whether gambling is illegal or not and what regulatory measures are taken to enforce those rules. The laws of EU member states do and must achieve a sufficient level of consumer protection, however this is not mandatory in the case of gambling even though it has been the path that all member states have taken. The blockchain technology poses serious threats for the member states in achieving that goal. The technology already exists and the pace of its innovation does not show any marks of slowing down, therefore the regulators must to take action sooner than later.

The blockchain technology can ultimately cause issues with identifying underaged gambling, problem gambling and gambling addiction, encourage consumers to deviate to illegal and unlicensed gambling applications, filtering or blocking access to and providing of illegal gambling

[89] Ward, B. T., Sipior, J. C., & Volonino, L. (2016). *Internet Jurisdiction for E-commerce*. Journal of Internet Commerce, 15(1), 1–17. https://doi.org/10.1080/15332861.2015.1109988

activity, and complex jurisdictional challenges as member states are trying to enforce their national gambling laws.

As authorities, such as the EU, leave the matter to developed further, development of illegal and unlicensed gambling industry grows. The best solution for the protection of citizens of EU member states, interests of EU member states and for the European Union, even though it limits blockchain innovation, is developing efficient regulation.

As the paper discussed mainly legal challenges from the point of view of the EU and its member states, the effects of the problem provided can be vastly wider. The internet is global and access to blockchain applications is farely unregulated for the time being with only handful of jurisdiction banning access to them. The problems can therefore also account in global scale and include an immeasurable amount of jurisdiction to an individual case. Therefore, further research on the scale and impact of blockchain applications and in particularly global gambling issues have to conducted.

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