Josef Bergt

Decentralized Finance Unmasked

Behavioral Finance and Public Policy Insights
on Financial Market Regulation

Nomos

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Dedication

To Tabea, whose spirit inspired every line.
And to the one who is yet to be, who will bring the story to life,
May you discover the power of dreams and the magic of your own
journey.

To those who dare to dream beyond the confines of reality,
Who find solace in the whispers of imagination,
In your hands, we entrust the magic of worlds yet unseen,
For without you, these pages would wander through eternity,
Bound to the echoes of what could have been.
Imagination, our most faithful companion and guide,
Will often carry us to realms of wonder and delight,
Weaving tapestries of stories that never were,
Yet without its embrace, our souls would remain anchored,
In the harbor of the mundane, never to embark on the infinite
seas.
So, to the dreamers, the visionaries, the weavers of tales,
Let your hearts soar and your spirits take flight,
For you are the architects of the worlds that never were,
And it is your imagination that propels us to the stars,
Boundless, free, and forever untamed.

Acknowledgements

I would like to begin by expressing my profound gratitude to my colleagues and fellow researchers in the field. Without their collective wisdom, insights, and dedication to advancing our understanding, this book would not have been possible. The collaborative spirit that defines our academic community has been instrumental in shaping the ideas presented within these pages.

My heartfelt appreciation goes to my mentors and advisors, whose guidance and encouragement have been invaluable throughout my academic and professional journey. Their wisdom, expertise, and unwavering support have not only inspired my work but also nurtured my growth as a scholar and thinker.

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Lastly, I wish to express my eternal gratitude to my family and friends for their unwavering love, patience, and support throughout this journey. Their belief in me and my work has been a constant source of strength and inspiration.

To all who have played a part, both large and small, in the creation of this book, I offer my sincerest appreciation. It is my hope that this work contributes to the ongoing dialogue and furthers our collective understanding of the subject at hand.

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Editorial Notes

For better readability, the use of gender-specific forms of speech is dispensed with in work. All gender identities are expressly included.

Furthermore, it should be noted that the abbreviation and citation rules of the American Psychological Association (2020), Publication manual of the American Psychological Association (APA), 7. ed. Washington: APA, are predominantly followed with regard to citation in this work. Parts of the work have been used at the Seeburg Castle University, Seekirchen am Wallersee, Austria.

Lastly, where implementation has already taken place in the respective jurisdictions, the European Case Law Identifier (ECLI) is used to cite court decisions. Similarly, secondary European law is cited using the European Legislation Identifier (ELI).

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1 Abstract

<u>English</u>

The advent of decentralized finance (DeFi) has engendered a myriad of 1
novel challenges and prospects for investors, intermediaries, and regula-
tory bodies alike. To navigate this complex landscape, it is imperative to
understand the intricate interplay between behavioral finance and public
policy, enabling the development of efficacious regulatory strategies that
tackle these challenges while harnessing and capitalizing on the advantages
and benefits offered by DeFi. This conceptual literature review investigates
DeFi's transformative potential within financial systems and the associated
risks, encompassing smart contract vulnerabilities, dependencies on other
protocols, decentralization shams and trust mechanisms. By dissecting the
complexities at the intersection of behavioral finance and public policy, this
study delves into the decision-making processes in financial markets and
regulatory public policymaking, particularly within the context of DeFi.
Subsequently, recommendations for refining regulatory frameworks and
practices to facilitate a more robust and adaptive financial ecosystem are
proposed, taking findings from behavioral finance into account. In short,
the answer to regulating DeFi, may be found in regulating peers based on
their offered services (if any), making them responsible for compliance
with financial market regulation, trade law, tax law, and other provisions as
applicable.

<u>German</u>

Das Aufkommen von *decentralized Finance* (DeFi) hat eine Vielzahl 2
neuer Herausforderungen und Chancen für Anleger, Intermediäre und
Regulierungsbehörden gleichermaßen geschaffen. Um in dieser komplex-
en Landschaft navigieren zu können, ist es unerlässlich, das komplexe
Zusammenspiel zwischen *behavioural finance* und *public policy* zu ver-
stehen, um wirksame Regulierungsstrategien zu entwickeln, um diese
Herausforderungen zu bewältigen und gleichzeitig die Vorteile und Chan-
cen, die DeFi bietet, nutzen und ausschöpfen zu können. Diese konzep-
tionelle Literaturarbeit untersucht das transformative Potenzial von DeFi
innerhalb der Finanzsysteme und die damit verbundenen Risiken, ein-
schließlich der Schwachstellen von Smart Contracts, Abhängigkeiten von

anderen Protokollen, Dezentralisierungsschwindel und Vertrauensmechanismen. Durch die Aufgliederung der Komplexität an der Schnittstelle von *behavioral finance* und *public policy* analysiert diese Arbeit die Entscheidungsprozesse in Finanzmärkten und regulatorischen *public policy* Entscheidungen, insbesondere im Kontext von DeFi. Anschließend werden Empfehlungen zur Verfeinerung der regulatorischen Rahmenbedingungen und Praktiken vorgeschlagen, um ein robusteres und anpassungsfähigeres Finanzökosystem zu ermöglichen, unter Berücksichtigung von Erkenntnissen aus dem *behavioral finance* Bereich. Kurzum, die Antwort betreffend die Art der Regulierung von DeFi könnte darin bestehen, Peers auf der Grundlage der von ihnen angebotenen Dienstleistungen zu regulieren und sie für die Einhaltung der Finanzmarktregulierung, des Handelsrechts, des Steuerrechts und anderer Vorschriften, soweit anwendbar, verantwortlich zu machen.

Bergt, J. (2023). Word cloud – financial markets, DeFi & public policy

Bergt, J. (2023). Sociology of law as a candle in the dark & decentralization theater

2 Introduction

2.1 Interdisciplinarity of law and economics, sociology, psychology and information technology with regard to financial markets

The regulation of financial markets is a crucial aspect of the modern economy, with the goal of protecting consumers and preserving the financial system's integrity and stability. In recent years, in the wake of crises and other black swans – events which are unexpected but of major consequence and happen more often than one would statistically think (Taleb, 2007) – there has been increasing debate about the effectiveness of existing regulations and whether they need to be strengthened or modified.

While one might muse that the financial sector became a predator instead of a creator of wealth and that the financial industry has become too powerful and is not adequately regulated for the prevention of harmful practices such as predatory lending and financial fraud, others may argue that excessive regulation can stifle innovation and economic growth. In other words it might be deemed to not be Pareto efficient. Pareto efficiency, also known as Pareto optimality, refers to a state in which it is not possible to improve the well-being of one individual without decreasing the well-being of another. This concept is named after the Italian economist Vilfredo Pareto, who first described it in the early 20th century (Debreu, 1954, p. 588). Regulation is intended to prevent and counteract market failures, but it is a cost factor in its own right, which is why an optimum efficiency may not be achieved (Bergt, 2020, p. 244 fn 611).

As economist and Nobel laureate Milton Friedman famously said, *"I think the government solution to a problem is usually as bad as the problem and very often makes the problem worse."* (Friedman, M., 1975, p. 6). Critics of heavy-handed regulation argue that it can create unnecessary barriers to entry for new firms and limit competition, ultimately harming consumers.

One potential solution to this debate may be the implementation of more targeted and effective regulations. For example, rather than imposing blanket rules on the entire financial industry, regulators could focus on specific areas where there is a clear need for intervention, such as consumer protection or market integrity. This approach could allow for more flexibility and adaptability in the regulatory framework, while still achieving the overall

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goals of protecting consumers and promoting stability; albeit potentially imposing a higher workload on public policy makers.

7   Overall, the regulation of financial markets is a complex and contentious issue, with valid arguments on both sides. Legislative regulators and those who make public policy must closely consider the effects of their decisions and work to strike a balance between the needs of economic development and innovation and consumer protection.

8   As such the present work aims to provide a conceptual overview of financial market regulation, delving into economic aspects of regulation and public policy making of traditional or centralized financial intermediaries also taking behavioral economic and investment psychological findings like the making of investment decisions, etc into consideration.

9   There have been numerous studies examining the psychological factors that influence investment behavior in (centralized) finance. One common finding is that investors and consumers may be influenced by a fear of missing out (FOMO), which can lead them to make impulsive or poorly informed investment decisions. The investment process may also be affected by cognitive biases, which are consistent patterns of deviation from rationality or normal judgment. These biases can lead individuals to make irrational or suboptimal decisions, such as overconfidence in their ability to predict market movements or a tendency to underestimate risk. Consumer and investor protection is an important issue in the field of finance, as it seeks to make sure that individuals take well-informed choices about their investments and are not taken advantage of by unscrupulous actors. Public policy can play a role in promoting investor and consumer protection by setting rules and standards for financial institutions and products, as well as by providing education and resources to help individuals make informed decisions (Barberis & Thaler, 2003, p. 1053; IOSCO Research Report on Financial Technologies (Fintech), 2017, p. 32).

10   These findings on where we are coming from on regulation of centralized finance shall be analyzed with regard to decentralized finance (DeFi). This conceptional literature review will assess the definition of decentralized finance and will briefly digress on the technological aspects of necessary underlying technologies for DeFi and what was coined by Schär as "*decentralization theater*" – the risk of deception in the decentralized finance (DeFi) industry, where some protocols may appear decentralized but are actually centralized (Schär, 2022) – as well as the lost sociology of law in Europe in that regard. Topics will be covered such as: Where are we standing now on peer-to-peer lateral exchange markets? What is

the role of the EU Markets in Crypto-assets Regulation (MiCAR) and the European Securities and Markets Authority's (ESMA) distributed ledger technology (DLT) pilot regime and how do these policies interconnect with existing regulation on centralized finance? What are the risks, prospects and chances of decentralized exchanges respectively decentralized trading venues or exchange markets. And most importantly – which investment psychological or behavioral economic findings with regard to traditional centralized finance may be transposed to public policy making concerning decentralized finance and where does it make sense based on research to regulate such markets, to what degree an in what way? For this purpose, it is not only relevant but necessary to make excursions into cross-cutting subjects such as law and some technological aspects of information technology. As the research matter on one hand intersects with economical, sociological and psychological areas and on the other hand with legal aspects of public policy and to some degree also with technological implications, the thesis at hand aims to provide a conceptual overview on the subject matter considering the different disciplines and their respective approaches. While the mentioned overlapping individual fields of study offer their respective perspective on the regulation of financial markets, the intertwining of these fields construes a complex subject matter, which shall be presented and penetrated in this work to analyze the insights resulting therefrom in order to act as a basis for upcoming research.

2.2 Sciences vs Humanities – the lost sociology of law in Europe?

The complexity also becomes apparent due to controversies with regard to interdisciplinary approaches which particularly also hold true for economical and sociological components of legal sciences. The sociology of law has seemingly atrophied in Europe in contrast to the USA for example, probably still going back to some degree to Hans Kelsen's hypothesis of the "Pure Theory of Law" or "reine Rechtslehre" in German – at least for some jurisdictions like Austria and other German speaking jurisdictions. 11

In this regard there is also a new school of thought emerging in American legal philosophy referred to as new legal realism. Suchman and Mertz discuss the intersection of empirical legal studies and new legal realism and the potential future of empirical research on law. Empirical legal studies describe a field that uses social science methods to study law, while new legal realism is a school of thought which emphasizes the functions of law in 12

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people's daily lives and investigates it using multidisciplinary social science techniques. However empirical legal studies tend to focus specifically on legal questions in contrast to legal psychology and sociology of law. New legal realism in turn rather puts more weight on the utilization of both quantitative and qualitative social science methods and may also embrace mixed methods approaches (Suchman, Mertz, 2010, p. 555).

13   In the field of legal sciences, there is a distinction between normative and empirical questions. Normative questions concern what should be the case or what is considered morally right, while empirical questions concern what is actually the case or what can be observed in reality. In the process of applying the law, legal professionals typically first address normative questions by determining the statutory requirements or standards that apply to a particular case. They then move on to consider empirical questions by examining the specific facts of the case and comparing them to the established standards. Legal scholarship tends to focus more on normative questions, while the work of judges in the courtroom is to some degree empirical in nature but tends to be more descriptive and focused on clarifying the facts of a case. The study and consideration of empirical or sociological aspects of law, such as general causal relationships among social phenomena, has relatively little weight in public policy, legal practice and scholarship. However, there are some jurisdictions, e.g., the United States, where there is a long and distinguished history of empirical sociology of law (Petersen, 2010, p. 435).

14   Hopman argues that the theories of legal scholars Hans Kelsen (Pure Theory of Law) and Eugen Ehrlich ("Foundations of the sociology of law" or in German "Grundlegung der Soziologie des Rechts" from 1913), who are often seen as being on opposite ends of the legal theoretical spectrum, can be reconciled and should be seen as complementary rather than opposing. The author suggests that the theories of Kelsen and Ehrlich, which are typically seen as opposing, can actually be reconciled and seen as complementary. It is argued that combining both approaches, which focus on written legal codes and state law (Kelsen) and empirical data and society (Ehrlich), can provide a more comprehensive framework for understanding the legal systems within a given social field, including situations of legal pluralism as studied by Merry (Merry, 1988, p. 869). This argument is based on the idea that a synthesis of the two theories can be useful in studying the relationship between law and society (Hopman, 2021, p. 1).

15   One potential criticism of this interpretation is that it may not adequately address potential counterarguments or alternative viewpoints. For example,

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it is possible that some may disagree with the author's suggestion that the theories of Kelsen and Ehrlich can be reconciled or may argue that one approach is more useful or valid than the other, especially as both authors left a history landmark in legal sciences and are undisputed authoritative figures in their fields, and essentially stated themselves that "what should be the case" (normative questions) and "what is the case" (empirical questions) has to be strictly separated and may not be intermixed. The arguments of Hopman may therefore be set aside by critics while it should be pointed out that this new perspective might also lead to a rethinking at the core of legal sciences. Combining both approaches can provide a more comprehensive understanding of the legal systems within a given social field, including situations of legal pluralism where multiple legal systems coexist. This does not necessarily mean that one approach is more valid than the other, but rather that both approaches can offer valuable insights and should be considered together in order to gain a more complete understanding of law and its relationship to society.

In terms of the broader context in which these theories were developed, it is important to note that both Kelsen and Ehrlich were writing at a time when the study of law and society was a relatively new and rapidly evolving field. Kelsen was a prominent legal positivist who focused on the formal and written aspects of law, while Ehrlich was a pioneer in the field of sociology of law who emphasized the importance of studying empirical data and society in order to understand law. Both Kelsen and Ehrlich made significant contributions to the development of these fields and their theories have had a lasting impact on the study of law and society.   16

In this regard it should also be noted that Kelsen, who as a jurist is often thought of as an opponent of sociology, actually almost became a sociologist and saw himself as one in the 1920s. Even the University of Frankfurt's Oppenheimer Chair in Sociology was almost given to him in 1929. Kelsen argued that sociology has two roles, for one describing inherent normative laws and for another exploring the circumstances under which a normative conception becomes effective through a causal-scientific approach. It may be concluded that Kelsen had a surprising shift towards sociology for the 1920s (Feldmann, 2021, p 316).   17

Additionally, it is also important to recognize that these theories have evolved and been further developed over time, and there may be more recent approaches and perspectives that also contribute to our understanding of law and society.   18

19   Perhaps this opens the way leading to a new era of "scientification" of legal jurisprudence or putting the science back in legal sciences and doing aways with empirically unproveable hypotheses inaccessible to validation like the Pure Theory of Law. It is important to note, that this work in no way wishes neither to discredit the achievements of the two aforementioned distinguished legal scholars and thus place itself on the sidelines of scholarly debate nor try to reconcile the theories but merely critically disseminates them and then moves on to scholarly works developed in this field since then.

20   Kelsen, while undoubtedly a luminary genius of legal logic and doctrine and virtuoso of modernist legal theory and also a realist, considering the Zeitgeist of his epoch and his quote *"Democracy is the form of government that resists its opponents the least. It seems to be its tragic fate that it must also feed its worst enemy at its own breast."* (Klecatsky, Marcic, Schambeck, Kelsen et Merkl, 1968, p. 1417 et seq.), probably thwarted – inadvertently – empirical approaches due to his initial hypothesis of the Pure Theory of Law with regard to legal science for at least 100 years in Europe, if not more, even though he essentially renounced his own hypothesis as fictitious already in 1960. This phenomenon of a debunked myth, which still seemingly persists in the hearts and minds of people today and arguably to a large extent has the Austrian or German speaking legal education system in its grip, is well-known to cognitive psychologists.

21   Several studies indicate that the correction of false information memorized by people is difficult and attempts at correction frequently fail due to the inevitable focus on misinformation when trying to debunk it. This regularly increases the familiarity of the misinformation and makes it even more so believable (Lewandowsky, Ecker, Seifert, Schwarz et Cook, (2012), p. 106-131.). Simply repeating false information, even as absurd as flesh-eating bananas, may further strengthen a person's conviction in this information (Schwarz, Newman et Leach, 2016, p. 85-95.). Even the correction strategy of myth vs fact has shown to convince people even further of the first rather than the latter (Schwarz, Sanna, Skurnik et Yoon, 2007, p.127-161). As words of warning before the actual false information have shown effective in alerting people and making them able to repel false pieces of information (Ecker, Lewandowsky et Tang, 2010, p. 1087–1100; Blank et Launay, 2014, p.77–88.), the present work follows this best-practice approach by starting with the hard truth (especially for any legal practitioner or expert, particularly from the German speaking jurisdictions and there

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Austria and Liechtenstein) that the Pure Theory of Law by Kelsen is in fact fictitious– as he stated himself.

It may be argued that while jurisprudence studies law or legality directly in various situations, sociology, respectively the sociology of law studies society in such cases. Ultimately, they explore the same phenomena. However, one approach in uncovering this relativism of values, as Kelsen would have called it, in its core is scientific and empirical (sociology of law), while the Pure Theory of Law is an unproven, and unfortunately unprovable hypothesis – a fact which was beknown to its propagator (Kelsen, 2017, Study edition of the 2nd edition 1960, p. 363 et seqq.). 22

Unarguably values of a society are relativistic in the sense that certain values are agreed upon in a specific form of consensus in a social contract with defined participants and/or peers pursuant to the philosophical social contract theory. These values are in some form written down and stipulated as normative legal provisions, e.g., in a constitution. 23

This social contract should not be derived from some transcendental basic norm which would be somewhat akin to circular reasoning and apodictic. Kelsen's basic norm or "*Grundnorm*" pursuant to his Pure Theory of Law is not set (as statutory law) and has no content. It is presupposed in order to conclude a legal order in itself. The basic norm is therefore a transcendental logical presupposition. The Pure Theory of Law treats transcendental laws, like the so-called natural law or the "reason law" as advocated by Kant, among others, as unscientific, as they place their source and legitimacy in a divine entity or divine laws (e.g., the Greek logos in philosophy). The aim of the Pure Theory of Law is to separate the scientific description of law from the extraneous admixtures of a sociological, psychological, biological, nature, among others. The Pure Theory of Law advocates the postulate of separation between the sphere of being, i.e., propositions about facts (that which is), and the sphere of ought, i.e., propositions about the normative (that which shall be), resulting in a methodological dualism. Kelsen believed that within a scientific depiction of a legal system, there must be something that ensures the cohesiveness of the hierarchy of legal principles. This element, referred to by Kelsen as a "basic norm" or "Grundnorm," is itself a legal principle that represents a real (but presupposed) norm. However, it is important to note that in his first edition of the "*Reine Rechtslehre*" Kelsen initially understood his basic norm as a hypothesis (Kelsen, 2020, Study edition of the 1st edition 1934, p. 77), while in his second edition he himself proceeds to regard the basic norm as a (legal) fiction. Later on, he further distanced himself from 24

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his initial hypothesis (Kelsen, Ringhofer et Walter, 1979, p. 206): *"It should therefore be noted that the basic norm [...] is not a hypothesis - as what I myself have occasionally characterized it - but a fiction, which differs from the hypothesis in that it is accompanied, or is supposed to be accompanied, by the awareness that reality does not correspond to it [...].".* What seems to have been solidified in the minds as well as in the legal curricula, at least of Austria and potentially also in other (at least German speaking) jurisdictions of Europe, however, is the myth of the original hypothesis.

25　　With regard to Kelsen's basic norm an analogy may be drawn to Sagan's (1996) *"The dragon in my Garage"*. In this fictional dialogue published in *"The demon-haunted world: Science as a candle in the dark"* Sagan is discussing the concept of belief in something without concrete evidence to support it. He uses the example of a person claiming there is an invisible, incorporeal, heatless fire-breathing dragon in their garage as an example of a belief that cannot be tested or proven, and which is indistinguishable from a non-existing dragon. Sagan suggests that in the absence of evidence, such a claim is not valuable or meaningful, and that it may be more appropriate to consider the possibility that the person making the claim is experiencing a hallucination or other psychological issue. In turn he also discusses the idea of multiple people making similar claims with no concrete evidence, and the possibility that such claims could be true despite the lack of evidence (Sagan, 1996). The key takeaway from Sagan's play of thought is that *"Your inability to invalidate my hypothesis is not at all the same thing as proving it true. Claims that cannot be tested, assertions immune to disproof are veridically worthless, whatever value they may have in inspiring us or in exciting our sense of wonder. What I'm asking you to do comes down to believing, in the absence of evidence, on my say-so. The only thing you've really learned from my insistence that there's a dragon in my garage is that something funny is going on inside my head."* (Sagan, 1996). Kelsen's basic norm – as a symbol for the lost sociology of law (in parts of Europe) – is such an invisible, incorporeal, heatless fire-breathing dragon which is indistinguishable from a non-existing basic norm which may only inspire or excite one's sense of wonders.

26　　Kelsen arguably interpreted his pure theory of law in the Zeitgeist of his time meaning that legal sciences or law should be free from detrimental external influences and interests in the sense of corruption and the pure theory of law being a mechanism of checks and balances. This is of course still relevant today. As Jean-Jacque Rousseau emphasized, the national public power derives its legitimacy from its people, meaning that the government

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acts as the executive branch of its sovereign and the government's power in turn is backed by the trust of the people. When public power (including the public policy process or legislative power, next to the executive and judiciary power) is used in deviation of these basic principles, problems of corruption arise (Liu, 2016, p. 171.). In other words, public power may be abused for the benefits of the private, nevertheless it remains questionable whether the pure theory of law is a valid instrument to counter such external influences or whether it would not be more beneficial to better understand such external influencing factors of sociological, psychological, biological, religious, ethical and political nature in order to then counter detrimental aspects of such externalities.

While the Pure Theory of Law is certainly one of the most valuable and influential legal theories of the past millennia, let's propose our own hypo- 27 thesis as an outset, which will however not be validated in this paper. This hypothesis would state that the aforementioned consensus mechanisms, inherent to any social contract that establishes the core (yet relative and on a cosmic scale even ephemeral) values of a society at a given point in time, are prone to the many distortions and cognitive biases in human decision making. If this was the case, the sociology of law, as an empirical field of study would have its *raison d'être*. If societal values are relativistic, it goes without saying that it should at least be understood how we reach these decisions on which values we want to live by, bind ourselves and adhere to in a social contract, e.g., through constitutional law or stipulating other legal statutes and provisions pursuant to Adolf J. Merkl's and Kelsen's hierarchy of legal structure (Kelsen, 2017, p. 228 et seqq). Furthermore, it should be analyzed whether decisions made with regard to public policy are at all capable of implementing and achieving the intended goals – whether decisions are efficient with regard to the intended goals or mere miss and hit or pure guesswork. With Kelsen's Pure Theory of Law, it is much like with his quote on democracy – it should not allow itself to be influenced by interests that are alien to it and yet this is precisely the case if put in reality. However, Kelsen (Klecatsky et al, 1968, p. 1417 et seq.) was well aware of this discrepancy between ideology and reality – of that which shall be ("*Sollen*") and that which is ("*Sein*"): *"And despite this opposition to social reality, perhaps even because of this opposition, the idea of freedom is and remains the eternal basic dominant of all political speculation and thus forms, as it were, the counterpoint of all social theory and state practice."* Given that idealistic notions may never be, it may very well be best to focus on the things which actually "are" and how they appear respectively how they are

(empirically) called into existence (*nooumena* and *phainoumena* pursuant to *Kant*'s Critique of Pure Reason, both of which still refer to "that which is" if one was so inclined to interpret these two terms in the context of "Sein" and "Sollen", albeit both Kant's definition of *nooumena* and Kelsen's definition of the basic norm changed over time. Kant's definition before the Critique of Pure Reason probably aligned with Kelsen's initial formulation of the basic norm as a hypothesis as a "Sollen" which is intelligible yet not sensible in the words of Kant – cp. Kant, 1900; also cp. Kelsen, 2017, Study edition of the 2nd edition 1960, p. 363 et seqq.).

28   With all this in mind the hope remains – in the proverbial Pandora's box – that the empirical "scientification" of legal sciences will await us in the 21st century, away from pseudoscience, paving a way towards a science of jurisprudence. For lack of a better name, it shall not be called the "science of law" as the field of legal sciences are without a doubt already scientific in terms of humanities, or "empirical law", which may be misunderstood to refer only to empirical legal studies. Instead, the terminology is likely best to be kept within the frames of the sociology of law. Given that law is a set of norms that regulate social coexistence, it appears only obvious that aspects of sociology should play a major role in legal sciences. What has long since happened to physics and astronomy as well as other science studies, gradually is appearing in economic, sociologic and psychologic sciences, may yet emerge for legal sciences (particularly in central Europe). For this to happen it would likely also require further education in economic and sociological sciences with at least a modicum of behavioral economics in the curricula of legal sciences for future lawyers, judges, policy makers and others who are either involved in the legislative procedure or in the execution of these legal norms.

2.3 Scope & Research Subject

29   The research issue has been outlined to some degree under section 2.1 (margin number 10). The specific research question to be assessed is: *"Which objectives of financial market regulation make sense with regard to decentralized finance, taking into account insights from behavioral economics and regulatory policy?"* As this work is of conceptual nature in form of a literature review and not empirically in itself it is also the aim to attempt to identify, define and outline areas of research to be empirically investigated in the future. The focus lies on regulated intermediaries, not

on the perceived regulation by consumers. Thus, centralized intermediaries bridging the centralized and decentralized systems and peers in the decentralized finance (DeFi) ecosystem are analyzed and it is assessed whether intervention through regulation in the financial ecosystem should be considered, and if so in which form, based on behavioral economic and public policy findings.

2.4 Methodology

The methodology with regard to the work at hand is of literature-based conceptual nature. The aim of this literature review is to include relevant and current economical, sociological and psychological findings on regulation of centralized financial markets on the one hand and synthesize them with existing legal implications on the other hand in order to also give an outlook on future public policies in the field of decentralized finance, also taking into account the technological foundations of distributed ledger technology. From the perspective of the legal sciences law texts and other legal sources are used as primary legal literature, like the European Markets in Crypto-assets Regulation (MiCAR; COM/2020/593 final) with regard to the regulation of centralized intermediaries dealing with assets based on decentralized technologies which are as such at an intersection with decentralized finance. Other legal literature on centralized finance and financial markets or secondary European legislation may be consulted, like the Markets in Financial Instruments Directive as amended (MiFID II; Directive 2014/65/EU), the Central Securities Depositories Regulation (CSDR; Regulation (EU) No 909/2014), the Electronic Money Directive (EMD II; Directive 2009/110/EC) etc, each as amended, among others. [30]

A literature review is a written summary of published research on a specific subject. It could simply be a list of sources summarized, or it could have an organizational structure that includes a summary and synthesis of the information. A literature review is different from an academic research paper, as a literature review's primary goal is to summarize and synthesize the existing arguments, concepts and ideas on the topic. Literature reviews are commonly written in the sciences and social sciences and can serve various purposes, such as providing an overview of a topic, keeping professionals up to date with current research in a field, and providing a solid background for a research paper's investigation. The body of the review may be organized chronologically, thematically, or methodologically, [31]

depending on the focus of the review. The process of writing a literature review involves finding and evaluating sources, identifying key themes, and synthesizing and organizing the information. The final work should be a well-organized and concise overview of the current state of knowledge on the topic. The summary and synthesis of ideas is done with the goal of defining questions and providing a perspective on topics to be explored further (Anson et Schwegler, 2000; Jones, Bizarro et Selfe, 1997; Lamb, 2006; Rosen et Behrens, 2000; Troyka 2002).

32   A literature review aims to identify specific research questions, provide context for one's own research, and improve understanding of theoretical concepts and terminology in the field. The process of preparing a literature review involves defining the focus of the review, conceptualizing the topic, finding relevant literature, analyzing and synthesizing the literature, and defining research questions based on the literature studied (Becker, 2012). Cooper's (1988) taxonomy of literature reviews classifies them based on their focus (results, methods, theories, or application), goals (integration, critique, or identification of key challenges), perspective (neutral presentation or taking a position), coverage (full, selective, representative or central), organization (historical, conceptual, or methodological), and target audience (experts, science community, practice/policy, or the public) (Cooper, 1988). The literature search is a systematic and comprehensive search for all types of publications on a particular topic. It aims to identify key people, organizations, and texts in the field, evaluate the quality of different sources of information, and identify gaps in previous research. Different sources of literature include books, articles in scientific journals, and grey literature such as theses and technical reports. The focus of the search should be on high-quality literature such as peer-reviewed articles and conference proceedings. However, the search should not be limited by methodology, geographic region or a small set of journals. To plan the search effectively, it is helpful to consider the purpose of the search, the specific search question, any constraints on the search, the expected coverage of the search, and the resources available for the search. It is also important to document the search process and keep track of the literature found (Becker, 2012).

Characteristic	Categories			
Focus	Research outcomes	Methods	Theories	Applications
Goal	Integration	Criticism		Central Issues
Perspective	Neutral representation		Espousal of position	
Coverage	Exhaustive	Exhaustive and selective	Representative	Central / Pivotal
Organization	Historical	Conceptual		Methodological
Audience	Specialized scholars	General scholars	Practitioners / Politicians	General public

Figure 1: *Taxonomy of Literature Reviews (Becker, 2012), following Cooper, 1988, with categories applied on this work being emphasized in green.*

Using Cooper's abovementioned taxonomy as depicted in the table, the focus of this paper lies on theories, with its goals on integration and identification of key challenges and central issues, the perspective of a neutral presentation with a taking of position or recommendation with regard to potential future public policy on the regulation of decentralized finance at the conclusion. The coverage is central, focusing on relevant literature with regard to the research matter as defined hereinafter. The organization is of conceptual nature with the target audience being predominantly the science community, practitioners and policy makers. 33

The objective of this review is to examine the literature related to investment psychology in financial markets, behavioral finance and economics, public policy, financial market regulation, decentralized finance, and crypto asset market regulation. To systematically search for and select literature for this conceptual review, the following methodology was employed to ensure the comprehensiveness, actuality, and relevance with regard to the research matter: 34

- **Study Design and Scope**: The research question, subject and scope of the literature review were defined and specified clearly pursuant to section "2. Introduction", in particular under section "2.3 Scope & Research Subject" in connection with Section 2.1 margin number 10.
- **Database Selection and Search Strategy**: Relevant databases such as Google Scholar and Scopus were searched using keywords and filters

to narrow down the results related to *"investment psychological findings financial market"* (total results at time of search in Google Scholar: about 1,810,000), *"investment decisions and biases"* (total results: about 1,460,000), *"behavioral finance"* (total results: about 5,320,000), *"behavioral economics"* (total results: about 6,150,000), *"regulatory public policy"* (total results: about 4,310,000), *"financial market regulation / public policy"* (total results: about *3,930,000)*, *"decentralized finance"* (total results: about 928,000) and *"markets in crypto assets regulation"* (total results: about 37,200) both individually and combined with each other. The initial search using the eight keyword combinations yielded approximately 23,945,200 studies. This huge number of studies could not possibly be evaluated within the scope of this work. Only search results of 1,000 studies per search were displayed. Sorting by relevance was applied and the search was then further limited to 100 studies per search, totaling 800 studies.

- Search patterns were refined with asterisks to find related works (e.g., the search term "finan*" for both "finance" and "financial").
- **Eligibility Criteria & Quality Assessment**: Studies should be in English or have an available English translation. To ensure the quality of the research, peer-reviewed studies were prioritized. Studies should pertain to one or more of the following topics: investment psychology in financial markets, behavioral finance, behavioral economics, public policy, financial market regulation, decentralized finance, and crypto asset market regulation. High-impact journals were prioritized, and citation tracking was employed to determine the most influential papers in the respective field and with regard to the respective search term.
- **Time Constraints:** The search was not limited timewise; however, a focus was set on works published after the year 2000, with the exception of basic literature and central works, particularly in the context of an introductory historical digression.
- **Cited Reference Search**: Cited reference searching was used to determine influential research and to locate current research based on such previous influential research. This was conducted in order to subsequently include corresponding articles since the original publication. Cited references were also searched to find out how many times and where a publication is being cited and who is citing a particular paper. This approach also aimed to uncover a broader set of relevant literature.

- **Author Search**: Based on this, search for authors who have published relevant works in the fields covered in this review have also been identified and their works have been included.
- Additionally, the search pattern has been supplemented with the keywords that are keyworded in the respective article.
- **Inclusion of Other Relevant Works**: Works that had gained notable attention in other ways, such as at conferences or in the media, were also considered for inclusion. Regulatory documentation and government documents were also included, while other grey literature was not used.
- **Screening and Selection**: All studies identified this way were screened based on their titles and abstracts for relevance to the topic and research question (initial screening). After the initial screening, filtering out duplicates and considering the eligibility criteria, a total of 542 studies out of 800 remained.
- The full text of potentially eligible studies was assessed for inclusion in the review. After the quality assessment process and further detailed evaluation of the content, 312 studies and articles were finally included in the review.

The methodological approach taken in this research involves a selective, localized and exemplary assessment of three key decisions from the Austrian Supreme Court and European Court of Justice to understand how the focus of banking regulation has evolved in practice in the legal landscape to put regulatory goals into perspective, considering the contrasting interests of individual investor protection and collective financial market stability. In order to gain a comprehensive understanding of regulatory goals and to put the scientific findings into perspective, it is necessary to examine pertinent legislation and regulatory documents. The focus was on capturing the overarching objectives and policy implications rather than detailed provisions. This is done in parallel with the review of the scientific literature (data extraction and synthesis). From the final set of selected documents, information was extracted and synthesized to provide insights on regulatory goals as defined by legislators.

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3 Current state of research on behavioral economic insights for financial market regulation

Financial regulation is the set of rules, laws, and directives that oversee the financial sector and its players. The objective is to secure investors, prevent monetary emergencies, and maintain the stability of financial markets. When monetary crises occur, fresh regulations are frequently established to rectify the deficiencies that caused the crisis in an ad hoc reaction. 36

This phenomenon known as adhocracy or adhocracy model of organizational structure is characterized by an absence of formal arrangement and a focus on specialized cross-disciplinary teams grouped by functions. This model is believed to be more adaptable, imaginative, and flexible, which can permit it to respond quicker and be more receptive to new ideas than bureaucratic organizations. Nevertheless, adhocracy also has its drawbacks, including the likelihood of extremism and threats to democracy and legality. Researchers have suggested combining adhocracy and bureaucracy to rectify these issues, referred to as the bureau-adhocracy model (Mintzberg, McHugh, 1985, p 160; Travica, 1999, p. 7). 37

This adhocracy model on financial regulation is also something that shall consequently be scrutinized from the perspective of behavioral finance and biases hereinafter. 38

Sahi, Arora, and Dhameja (2013) conducted an exploratory qualitative study to determine the individual investors' views and attitudes that affect their financial investment decision-making. By examining the underlying beliefs and emotions that influence each investor's investment behavior, the research aimed to investigate investor biases. The researchers conducted 30 semi-structured interviews to gain a thorough grasp of how individual investors make decisions. The verbal data obtained from the interviews were analyzed through open coding to identify the various biases that influence investment decision making. The study found that different preferences and views displayed by individual investors influence their investment choices. Such biases show the investor's mental architecture rather than reasoning errors. According to the study, it may be possible to comprehend how individual investors make investment decisions by having a greater understanding of their psychology. The study explores the perceptions and beliefs of financial consumers regarding their financial investment biases 39

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ultimately contributing to novel data regarding the purchasing habits of financial products and providing insights into the behavior of individual investors (Sahi et al., 2013).

40   Already in 2003, two works named "*Regulation for Conservatives: Behavioral Economics and the Case for 'Asymmetric Paternalism*" (Camerer et al) and "*Libertarian Paternalism*" (Thaler, Sunstein) laid out the intellectual foundation for applying behavioral economics to policymaking. The goal was to create policies that benefit individuals who do not act in their own self-interest, while not burdening those who do. The approach aimed to win over conservatives and progressives by pledging to increase welfare while protecting individual freedom. This framework popularized the idea of "*nudges*", which are interventions in the choice architecture that, without prohibiting any choices or substantially altering people's economic incentives, modifies people's behavior in a predictable manner (Bhargava & Loewenstein, 2015). Policymakers must acknowledge the impact of decision-making architecture and biases on market participants to develop targeted interventions that promote responsible investment decisions and mitigate potential risk.

41   Before delving into details of biases in financial investment behavior, a brief historical outline of the research on behavioral finance will be presented hereinafter.

3.1 History of behavioral finance & psychological biases related to finance

42   Behavioral finance, an interdisciplinary field that combines psychology and economics, strives to provide explanations for various events in financial markets. Over the past decades, the efficiency of stock markets has been a topic of considerable debate, attracting the attention of researchers studying stock returns and their movements. The concept of efficient stock markets can be traced back to the late 1960s when Fama (1970) introduced the efficient market hypothesis (EMH). Based on expected utility theory, EMH postulated that stock markets were efficient systems with rational investors, becoming widely accepted and still followed for asset pricing decisions. However, EMH struggled to account for unexpected stock market phenomena, such as late 1990s internet bubble or the 2008 recession. Moreover, with an increased number of individual investors, stock returns often diverged from their fundamental values (Sharma & Kumar, 2020; Park & Sohn, 2013). One of the key challenges remaining in behavioral finance

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is to develop policy instruments that can effectively mitigate the effects of cognitive biases and emotional reactions on financial decision-making (Filbeck et al., 2017).

In response to these shortcomings, behavioral finance was argued as a more reasonable explanation for stock returns and unexpected market phenomena. Advocates of behavioral finance reject expected utility theory, arguing that stock markets are inefficient systems with irrational and biased investors offering a more realistic portrayal of stock markets and an explanation for sudden market shifts (Starmer, 2000) and prospect theory has largely replaced utility theory (Starmer & Sugden, 1989; Tversky & Kahneman, 1992, Sharma & Kumar, 2020). 43

Behavioral economics, contrary to popular belief, is not a novel concept, albeit its data driven approach is still fairly new. As McAuley (2013) points out, as early as 1739, David Hume effectively discussed what would later be termed hyperbolic discounting, highlighting the human tendency to favor immediate gains over distant and remote ones (Hume, 1739). Furthermore, in 1759, Adam Smith described the conflict between the rational, calculating *'indifferent spectator'* and the impulsive *'fury of his desires'* (Smith, 1759). Since then, behavioral economists have found several distinct behavioral characteristics in Smith's works, including loss aversion, overconfidence, and an interest in transactional fairness (Ashraf et al., 2005). The discipline of marketing also has long recognized the psychological underpinnings of consumer behavior. Concepts familiar to marketing professionals, such as prospect theory's findings on reference-point dependence and consumers' difficulty in understanding and comparing low-probability risks, are also central to behavioral economics. Advertising strategies typically focus on the short-term advantages of a product rather than its long-term expenses. (McAuley, 2013). 44

Empirical investigations have been conducted across various markets, including Germany, the United Kingdom, France, Japan, the United States, and Canada, to evaluate validity and generalizability of the sentiment effect (Baker et al., 2012). The sentiment effect in behavioral finance refers to the phenomenon where the mood or emotions of investors affect their decision-making regarding the buying and selling of stocks or other financial assets. This effect is based on the idea that investors' attitudes and feelings can influence their perception of the market, leading them to overreact or underreact to market news and events. For example, when investors are feeling optimistic and positive about the market, they may be more likely to buy stocks and other financial assets, even if the fundamentals do not 45

support such a decision. Conversely, when investors are feeling pessimistic and negative, they may be more likely to sell, even if the assets are undervalued. The sentiment effect can lead to market bubbles or crashes, as investors' emotions can cause them to push stock prices to extremes. The sentiment effect is also related to other behavioral finance concepts, such as herding behavior, which alludes to investors' propensity to copy other market participants' actions, rather than making independent decisions based on their own research and analysis. These studies have consistently found that investor sentiment negatively predicts aggregate stock market returns across countries (Schmeling, 2009). Additional studies have explored the relationship between investor sentiments and market returns in private markets (Ling et al., 2014), as well as the impact of investor sentiments on options prices (Han, 2008; Sharma & Kumar, 2020).

46   The study of the effects of cognitive and emotional deficits on investment decisions in the area of behavioral finance is a central theme. Investment mistakes caused by these biases can be grouped into two groups: how investors feel and how they think. Social factors can also influence financial choices, although most recent research has concentrated on psychological factors influencing investor decision-making (Statman, 1995; Baker and Nofsinger, 2002, p. 97).

47   The study of behavioral finance deviates from traditional finance, which assumes that people always behave rationally, by incorporating human fallibility into its models of financial markets and behavior of its agents which may be irrational (Thaler, 1993). The concept of behavioral finance, applying psychology to financial behavior, acknowledges that investors may not always act rationally but are always "human" (Shleifer, 2000, p. 10; Baker and Nofsinger, 2002, p. 97). The relaxation of the usual assumptions of traditional finance allows for the examination of systematic departures from rationality in investor behavior.

48   Behavioral finance is relevant as investors are often prone to committing specific investment errors that can cause harm to their wealth (Shefrin, 2000). Understanding these biases and correcting for them may lead to improved investment results, although it does not guarantee excess returns (Kahneman and Riepe, 1998).

49   The psychological phenomena in finance can be divided into three categories: heuristic-driven bias, inefficient markets and frame dependence (Shefrin, 2000). The foundation for some of the heuristic-driven biases can be traced back to the concept of prospect theory developed by Kahneman and Tversky (1979).

In conclusion, behavioral finance sheds light on the real-life behavior of investors and acknowledges the impact of cognitive and emotional biases on investment decisions. It is crucial for investors and policy makers alike to understand these biases and take steps to mitigate their effects on investors financial well-being at a regulatory level.

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Various mental shortcuts and biases that can impact an investor's decision-making process. The human brain tends to simplify complex information and use heuristics to process information more efficiently. This leads to systematic errors and psychological biases, such as the belief that individuals are better decision makers than they actually are and the tendency to seek information that confirms their beliefs (Baker and Nofsinger, 2002). In the following, the core biases will be briefly identified.

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3.1.1 Representativeness bias

One such bias is representativeness, where our mind makes the assumption that objects with similar features are comparable. This results in investors making judgments based on stereotypes and leads to confusion between a good company and a good investment. For example, investors may classify firms with strong earnings and high sales growth as good companies and good investments, but the stock of these firms can become overpriced as their popularity drives prices higher. A study by Lakonishok, Shleifer & Vishny (1994) found that the 10 % of firms considered to be "glamour" stocks, or those with high growth prospects, "*earned an 11.4% return during the purchase year. This compares to a return of 18.7% for the value stocks*", or those with minimal growth prospects, as good businesses do now automatically make for good investments.

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Investors also err by assuming previous stock returns are representative of future returns. For example, investors may chase after stocks that have had strong performance in the past, but initial research by De Bondt & Thaler (1985) revealed that the stocks that performed poorly over the following three years, typically outperform the winners by 30%. Similarly, investors may buy stocks that have recently increased in price, believing the past trend will continue (combined with fear of missing out and procyclical behavior), but a study by Dhar and Kumar (2001) found that such stocks only increased by 0.6% on average in the week prior to buying.

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3.1.2 Familiarity bias

54 The familiarity bias is a well-documented phenomenon in finance where people tend to prefer familiar things, including stocks (Huberman, 2001). Investors often concentrate their portfolios in securities of companies with a local or regional presence, even if that means missing out on potential gains from international diversification (French & Poterba, 1991). For example, American financial managers favor companies with local headquarters (Coval & Moskowitz, 1999).

55 Another form of the familiarity bias is when staff members purchase a sizeable percentage of the company's shares they are working for. This is often compounded by the representativeness bias, where employees allocate even more of their assets to the company's stock after its price increases (Benartzi, 2001).

3.1.3 Cognitive dissonance

56 Another factor that can impact an investor's decision-making process is cognitive dissonance, where the brain filters memories to avoid dealing with conflicting information. This can result in investors adjusting their beliefs about the success of past investments and recalling performance as better than it actually was (Akerlof & Dickens, 1982). A study by Goetzmann and Peles (1997) questioned two investor groups about their mutual fund returns and found that the average recollection of performance was higher than the actual performance, indicating the presence of cognitive dissonance.

57 The mood and optimism of investors also play a big part in their choice. A positive mood encourages judgements that are more optimistic, whereas a negative mood encourages judgments that are more pessimistic or of more critical and analytical nature (Nofsinger, 2002a). There is evidence to suggest that the sun has an impact on mood, which then has an impact on financial choices. For instance, individuals tip 50 % more on sunny days than on days when it's raining (Rind, 1996). The level of sunshine also appears to affect stock market returns, with sunny days having higher returns compared to non-sunny days (Kamstra, Kramer and Levi, 2003).

3.1.4 Endowment effect

The endowment effect refers to the situation where people place a higher 58
value on an object that they own and are trying to sell, compared to
the amount they would be prepared to pay to purchase the same object
(Kahneman, Knetsch and Thaler, 1990; idem 1991). Thaler (1980) named
this behavior, which is caused by the pain people associate with giving
up something they own rather than overvaluing the object itself. The en-
dowment effect can impact investors by causing them to hold onto their
investments. This is seen in a study by Samuelson and Zeckhauser (1988),
where students were given a substantial amount of money with different
investment choices and chose to hold onto the type of investment they
inherited, rather than choosing based on the risk and return ratios.

3.1.5 Overconfidence bias

The overconfidence bias is a pervasive phenomenon in the field of finance, 59
and it affects investors' behavior and decision making. This bias refers to
the belief that individuals have superior aptitude for completing challeng-
ing jobs, like selecting winning stocks, compared to their actual abilities.
The ego trap, as referred to by Belsky and Gilovich (2010), is driven by
several psychological factors, including the false sense or illusion of control
and knowledge.

This illusion of knowledge stems from the abundance of information 60
available to investors, which can lead them to think they comprehend the
market more thoroughly than they truly do (also linked to the availability
bias). This illusion is compounded by investors' tendencies to perceive new
knowledge as supporting their existing beliefs. On the other hand, the
illusion of control arises from individuals' beliefs that uncontrollable occur-
rences can be influenced by them. Presson and Benassi (1996) demonstrat-
ed "*that choice, task familiarity, information, and active involvement*" are
key attributes that foster this illusion.

Barber and Odean (2002) found that these characteristics are frequently 61
displayed by online investors., which leads to overconfidence in their deci-
sion making.

Past studies in the US have also shown that men are more likely than 62
women to be overconfident when performing duties deemed masculine,
including investing. Research showed that single men engage in the highest

amount of trading, with married men following, then married women and single women (Barber and Odean, 2001a; Beyer and Bowden, 1997). This overconfidence contributes to poor returns (Barber and Odean, 2000) as too much trading includes higher risk exposure and comes with paying more taxes and commissions.

63   In an effort to comprehend the overreliance of small investors on their competence, Graham et al. (2009) conducted a study that revealed self-perceived competence as a key determinant of trade frequency. Investors who felt competent were however also more likely to trade frequently and maintain diversified portfolios, whereas portfolio diversification in general is a valid investment strategy. This overconfidence was more prevalent among male investors, those with higher education, and those with larger portfolios (Bikas et al., 2013).

3.1.6 Status quo bias

64   Status quo bias, which involves preferring the default or do-nothing option when faced with choices, can also affect investors (Samuelson and Zeck-hauser, 1988). Tversky and Shafir (1992) developed the theory of *"choice under conflict"* and found that the decision to delay activity increases when several attractive options are available.

3.1.7 Law of small numbers

65   According to the theory known as the law of small numbers, individuals can identify patterns in seemingly random data and base future predictions on those patterns (Nofsinger, 2002b). Investors tend to believe that the stock market is not random, leading to the overinference of short sequences and faulty predictions about the future (Rabin, 2002). De Bondt (1993) found that investors' responses to the question of whether the stock market will be bullish, bearish, or neutral are highly correlated with historical market trend, demonstrating the law of small numbers in action.

3.1.8 Anchoring

66   Reference points and anchoring refer to the phenomenon where investors become fixated on particular stock prices and compare them for the current

stock price (Benartzi & Thaler, 1995). Heath, Huddart & Lang (1999) found that in stock option exercises "*the most likely reference point used is the highest stock price of the previous year*", and that when a stock price rises above its 52-week peak, the rate of option exercise nearly doubles. The reference point determines whether an investor views their position as a profit or loss.

3.1.9 Mental accounting

The concept of mental accounting plays a significant part in self-control and judgement in regard to financial goals (Thaler, 1980). This process involves the separation of different financial goals into separate mental accounts, allowing for easier tracking of progress. However, Barberis and Huang (2001) note that psychological biases, such as the disposition effect, can be exacerbated and amplified by this process..   67

Investors' perception of portfolio risks can also be impacted by mental accounting, as it can lead to overlooking the interaction between investments (Shefrin & Statman, 2000). This can result in investors taking more risk than necessary in order to achieve the intended return.   68

3.1.10 Disposition effect

The impact of emotions like greed, fear, hope, pride, and regret is also important in investment decision-making (Baker and Nofsinger, 2002). Investors have a propensity to hang onto their losers for an excessive amount of time and sell their winners too soon, due to the desire for pride and the fear of regret, which is referred to as the disposition effect (Shefrin & Statman, 1985). This emotional bias can have negative effects on returns, as good-performing stocks tend to continue performing well after they are sold, while poorly performing stocks continue to underperform (De Bondt & Thaler, 1985, 1987). This effect is attributed to heuristic-driven biases stemming from conservatism, overconfidence as well as salience (Shefrin, 2000).   69

Studies have shown investors are more apt to sell their profitable stocks than their unsuccessful ones (Odean, 1998). For example, Odean (1998) found that winners were sold when they represented 23% of the investor's total gains, while losers were sold when they represented 15.5% of the port-   70

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folio's unrealized losses. Additionally, a winner stock sold by an investor was found to outperform matching stocks by 2.35% the following year, while the loser stocks that were held underperformed by -1.06% (Odean, 1998). Grinblatt and Keloharju (2001) found similar results when studying sell trades in the Finnish stock market, with individual investors being more likely to sell stocks that experienced an increase in price and less likely to sell stocks that experienced a decrease in price.

3.1.11 Attachment bias

71 Investment behavior is not just a result of rational thinking, but also of psychological biases. One such bias is attachment bias, where investors get emotionally attached to a security, often to the extent of disregarding any negative information about the company (Baker and Nofsinger, 2002). The attachment can stem from various sources, such as working for the company or having a personal connection with it. This attachment can lead to hanging on to the security for too long, even when facing bad news, leading to significant losses (Baker and Nofsinger, 2002).

3.1.12 Prospect Theory – loss aversion and risk seeking

72 Furthermore, emotions also play a crucial role in changing risk preferences. The presence of large gains or losses can induce different emotional responses, leading to different investment decisions. Large gains can result in greed, causing investors to take on more risk, as seen in the tech boom of the late 1990s (Thaler & Johnson, 1990). On one hand, large losses can lead to loss aversion, where investors avoid taking any risks or on the other hand the *"double or nothing"* approach may be chosen, also termed the *"get evenitis"* phenomenon, where investors take on additional risk to try to recover the losses (Kahneman & Tversky, 1979; Shefrin, 2000). The way people react to gains and losses is a crucial factor in their investment decisions, as per the concept of prospect theory.

73 In conclusion, attachment bias and changing risk preferences due to emotions are two significant psychological biases that affect investment behavior. These biases need to be acknowledged and understood to make informed investment decisions.

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3.1.13 Social norming

Social interactions play a crucial role in shaping an individual's investment decisions, both directly and indirectly. According to Ellison and Fudenberg (1995), people learn from one another by observing the behavior of others and inferring their beliefs through talking. As a result, informational cascades develop, which serve as the foundation for certain models of investor herding (Bikhchandani, Hirshleifer & Welch, 1992; Banerjee, 1992). According to a survey by Shiller and Pound (1989) of 156 high-net-worth investors, investor interest in a stock was sparked in more than half of the instances by a recommendation from someone else, and the average number of people the investor spoke to after buying the stock was 20. This phenomenon may also be related to the familiarity and availability bias.

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The media can have a significant impact on individual investors. Business and investment authors frequently sensationalize their work by weaving an engaging tale, while journalists search for the best quotes, which don't always provide in-depth investment analysis (Nofsinger, 2002b). The media also tends to maintain investors' attention on certain stories for an extended length of time, causing an *"attention cascade"* that can contribute to speculative bubbles (Shiller, 2000).

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Peer groups can also greatly influence investment decisions. Social norms within peer groups can shape the preferred beliefs and decision-making processes of individuals within that group. The social environment of the investor, such as conversations with peers about day trading or international stocks, can cause the investor to adopt similar investment practices (Ellison and Fudenberg, 1993).

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Additionally, the advent of the Internet has significantly impacted on how people make investment decisions (Barber & Odean, 2001b). It provides a platform for interaction and exchange of ideas, such as through newsgroups and chat rooms for investing. Internet investing's emergence saw a surge in trading activity in the late 1990s and early 2000s (Baker and Nofsinger, 2002). Social norming of peer groups and the further advance of web platforms also in the decentralized finance context (e.g., virtual asset exchanges) may further increase these effects as well as bring forward other interactive phenomena.

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The trading decisions of investors worsened after switching to online trading when the internet and online investment brokerages emerged as the stocks they bought underperformed the market by an average of -0.33% per month, and the stocks they sold outperformed the market by 0.21% per

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month (Baker and Nofsinger, 2002). It remains to be examined whether parallels can be drawn to emerging decentralized platforms powered by distributed ledger technology, like blockchain, where digital assets or tokenized rights, like securities in form of tokens may be exchanged on a peer-to-peer basis.

3.1.14 Interim conclusion

79 Overcoming psychological biases in investment decision-making is challenging, as simply learning about them may not eliminate them (Belsky and Gilovich, 1999). Furthermore, many of these biases may have both positive and negative consequences, and they may also conflict with one another. To overcome these biases, investors can use various strategies such as understanding and avoiding cognitive biases, establishing investment goals and restrictions, creating quantitative investment standards, and diversifying assets (Van Eaton, 1999; Nofsinger, 2001). For example, diversifying, proper asset allocation including review and reallocation of investments can help reduce the risk of losses and shield against psychological biases, as long-term asset allocation decisions account for about 90% of total financial returns (Brinson, Singer & Beebower, 1991; Ibbotson & Kaplan, 2000).

80 While research on heuristic-driven bias, frame dependence, and inefficient markets has since further developed, more detailed, subdivided and partly overlapping finding and phenomena have crystallized, the historical outline above still represents the basis for biases related to investments and behavioral finance.

3.2 Biases in financial investment behavior

3.2.1 Investor decision making process and consumer biases

81 Financial markets have become increasingly competitive, with many players offering a plethora of investment alternatives (Sahi, Arora, and Dhameja, 2013). Making financial investment choices is a crucial part of managing household finances, which should lead to financial satisfaction and improved quality of life. However, the abundance and complexity of available financial products have increased the complexity of decision-making and the impact of heuristics and biases (Sjoberg and Engelberg, 2009). Given

this scenario, it is crucial to understand how individual investors make decisions, particularly the role of investor biases.

Behavioral Finance is concerned with the study of how different biases affect a person's investment decisions (Tversky and Kahneman, 1974). Psychological biases are sometimes referred to as "*Systematic Errors in Judgment*" in the behavioral finance literature (Kahneman and Riepe, 1998). The joint consideration of beliefs and values is essential to form preferences about risky options, which can create distortions in the decision-making process (Ritter, 2003). Moreover, individual past behaviors can have an emotional impact on future thinking, making decision-making even more subjective, and leading to biased behavior (Pompian, 2011). Knowing the cognitive biases that can affect a person's decision-making when investing and how they affect financial planning and management is necessary for identifying and designing better investment policies, practices, and products that suit individual needs.

Humans are not capable of always acting economically and rationally (*homo oeconomicus*) as in traditional finance theory, leading to the use of heuristics (colloquially referred to as rules of thumb), and acting on preferences and beliefs to deal with information overload, which results in biased behavior (Montier, 2002). Psychological biases are common in investors, as established and some of the most frequently observed ones next to framing effects were elaborated in the previous section. Investors are said to desire to maximize their risk-adjusted financial returns over a specified time period, according to conventional theories of investor behavior and this goal primarily influences the investments they make (Williams, 2007). However, a person's morals and beliefs can have an impact on their internal standards, leading to decisions deviating from the most optimal rational choices (Cummins and Nistico, 2002). Biased behavior is considered a flaw by standard finance models, assuming human beings are rational agents. But people are susceptible to biases due to cognitive limitations, and these biases have been seen in all living things, and they are thought to be a useful aspect of the mechanisms that allow people to make judgments and choices (Haselton and Nettle, 2006). Therefore, psychology and the departure from standard theoretical models like the homo oeconomicus are relevant for the study of financial markets and financial behavior (Sahi, Arora, and Dhameja, 2013). This, in turn, is vital for public policymakers for identifying necessary regulatory provisions to ensure investor protection (individual aspect) next to the other aim of regulation which is financial market stability (collective aspect).

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84   In a study on individual investor behavior in financial investment decisions, several themes emerged based on interviews conducted with investors. One such theme was the tendency of people to prefer known risks or to have a preference for certainty. People tended to give preference to outcomes that were certain, rather than uncertain, to feel more secure and have less ambiguity. This often resulted in investing in instruments they had some knowledge of, which offered fixed returns or security of principal, making them feel more at peace with the investment decision. Another theme that emerged was the tendency of people to rely on a point of reference, which acted as a guiding factor for their investment decisions. People found satisfaction in relying on reference points, which included best performance and rate of return amongst others. This gave them a benchmark to judge their investments. People also tended to make investment decisions based on how available information was. Before making their investment choices, people also had a propensity to double-check and confirm the information they had been given. Some individuals displayed a propensity to play it safe by investing in instruments they were familiar with, showing less willingness to take risks with their money. The risk preferences for people varied based on the source of the money, with those who have earned their money through their hard labor investing in safe and secure instruments, while money which was earned more easily was also invested in riskier options. Additionally, some people considered the company's degree of social responsibility and its ethics when making investment decisions, while others relied on financial experts for their investment decisions (Sahi, Arora, and Dhameja, 2013).

85   The framing of the decision influenced the choice of the people, as it was observed that when the same option was presented in different ways, people made different choices (related to loss aversion, as in one framing the opportunities were highlighted, while in another framing of the same option, the risks were highlighted). These results demonstrate how individual investors behave when choosing investments, indicating the importance of understanding investor behavior for investors, financial advisors, and researchers in making informed investment decisions. In addition, once decisions were made, people thought the results were unavoidable. Others tend to steer clear of certain investment decisions out of a fear of regret (also related to loss aversion), and in order "*to avoid this feeling of regret, people prefer the tried and tested investments*" (which may be seen as part of the status quo bias), while still others made investment choices based

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on past performance of specific financial products and prospective trends (Sahi, Arora, and Dhameja, 2013).

In summary, it is again established that these behavioral biases may have significant implications for individual investment decisions. While Financial institutions and advisors can use these findings to provide better investment advice to their clients and mitigate the impact of these biases on their investment decisions they might also exploit them to their advantage, thus making regulatory provisions necessary. 86

It is important to acknowledge that investment decisions inherently involve uncertainty and risk, which can lead to biased behavior (Sahi, Arora, and Dhameja, 2013). As Olsen (2007. p. 53) states, "b*ias is not necessarily bad as long as it leads to the results that the decision maker wishes*". Therefore, it is crucial to comprehend the reasons behind these biases and how they aid individuals in coping with the demands of decision-making. The study conducted by Sahi et al. (2013) showed that investor biases play a crucial role in financial investment behavior and that financial service providers can gain valuable insights into the behavior of financial consumers by using psychographic variables such as investor bias. 87

3.2.2 Interim conclusion

The complexity and abundance of available financial products have made financial investment decisions more intricate, influenced by heuristics and biases, and thus making it crucial to understand how individual investors make decisions, particularly the role of investor biases. This is especially relevant in the context of public policy with regard to financial market regulation, where investor protection and financial market stability are key aims. The study of how different biases affect a person's choice of investments, known as behavioral finance, has demonstrated that psychological biases are common in investors, leading to biased behavior. Although biased behavior is considered a flaw in standard finance models, it is an essential component of mechanisms for making choices and decisions. 88

Furthermore, the increasing popularity of decentralized finance models, which will be discussed in more detail in section 4 of this work, has introduced new challenges in terms of regulating the financial market. These models often operate outside the traditional regulatory framework and rely heavily on individual investors making informed decisions. As such, understanding the behavioral tendencies of individual investors is even more 89

important in this context. Policymakers will need to consider these findings when designing regulatory provisions to ensure investor protection and financial market stability in the evolving landscape of financial markets and products. They will also need to consider regulation to avoid exploitation of investors decision making processes by financial service providers.

3.2.3 Behavioral corporate finance and managerial biases

90   One of the most frequently observed psychological biases among managers is overconfidence, which refers to an unwarranted belief in their abilities and the accuracy of their predictions. Overconfident managers tend to rely on their internal resources before considering external financing options, prefer riskless debt to equity, and believe their firms are undervalued in the market. This behavior results in higher debt levels than rational managers and may lead to suboptimal capital structure decisions. In addition, over-confident managers tend to underestimate the cost of investment projects and overestimate their potential value (Bilgehan, 2014).

91   After Modigliani and Miller's (1958) seminal work on capital structure, numerous studies have attempted to explain the factors that determine a company's capital structure, including the optimal combination of debt and equity. However, these studies have predominantly relied on traditional finance theories. In contrast, recent research in behavioral finance has emphasized the importance of a manager's behavioral characteristics in the capital structure decision-making process. This insight has led to the emer-gence of behavioral corporate finance, which abandons the conventional rationality assumptions in favor of more sensible behavioral hypotheses in order to better understand the various financial choices made by firms (Bilgehan, 2014).

92   Several studies have investigated the impact of psychological biases on capital structure decisions using empirical analysis. For example, Ullah et al. (2012) found that managers tend to be risk-averse, and that there is a positive correlation between a company's size and profitability and its capital structure. Barros and Silveira (2007) observed that managerial optimism and overconfidence can significantly affect a firm's capital struc-ture decisions. Fairchild's (2009) study examines the influence of both managerial overconfidence and moral hazard on the choices related to a company's capital structure. the first of which anticipates a positive correla-tion between overconfidence and debt, and the second of which indicates

that overconfident managers may decrease debt due to their overestimation of future investment opportunities. The study provides further evidence to support previous empirical studies which identified a positive correlation between managerial overconfidence and debt and offers a new finding that overconfidence could lead to a reduction in debt due to the manager's overestimation of investment opportunities. A study by Malmendier, Tate, and Yan (2010) shows that overconfident managers prefer to use cash or risk-free debt and view external financing as unduly costly. The study also discovered that early-life experiences, such as experiencing the Great Depression during childhood or serving in the military, could result in more daring decisions regarding capital structure later in life.

In conclusion, psychological biases play a crucial role in corporate capital structure decisions, and managers' behavioral characteristics should be taken into account when analyzing financial decision-making. The literature reviewed suggests that biased managers tend to make suboptimal capital structure decisions by relying on internal resources before considering external financing options, preferring riskless debt to equity, and undervaluing the cost of investment projects. However, rational managers may make better capital structure decisions by taking into account firm-specific characteristics and market conditions (Bilgehan, 2014). 93

3.2.4 Interim conclusion

The psychological biases in the managerial decision-making process in the behavioral finance and capital structure decisions context, highlights the role of behavioral factors in shaping financial decision-making, particularly in relation to capital structure. Given the potential impact of such biases on firm financing decisions, these findings have important implications for public policy related to financial market regulation. For example, policymakers may need to consider measures aimed at reducing the impact of behavioral biases on decision-making processes, such as implementing stricter disclosure and transparency requirements, enhancing financial education and literacy initiatives, and promoting the adoption of more objective and rigorous decision-making processes within firms and financial intermediaries. 94

In addition, policymakers may need to consider the part market factors play in shaping financial decision-making and explore the potential for market-based mechanisms to incentivize more rational decision-making 95

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and mitigate the impact of behavioral biases. Overall, the findings underscore the need for policymakers to take a more holistic approach to financial market regulation, which takes into account the influence of behavioral factors on financial decision-making and seeks to promote more rational and informed decision-making processes within firms.

3.2.5 Behavioral biases, financial literacy and demographic variables

96   Previous studies have established connections between investors' demographic profiles and their investment behavior (Cronqvist & Siegel, 2014). Researchers have investigated the relationship between demographic variables and behavioral biases in investment decision-making. Key demographic variables that have been studied include gender, age, marital status, education, occupation, annual income, and experience. For instance, studies have found that male investors have a tendency of being more overconfident compared to their female counterparts (Kumar & Goyal, 2016; Barber & Odean, 2001a; Bhandari & Deaves, 2006; Lin, 2011), while females are more susceptible to herding bias (Eagly & Carli, 1981). There are also newer indications that female CFOs are less tax aggressive (Francis et al., 2014). Furthermore, research has shown that investors' familiarity and overconfidence biases diminish with age and wealth (Tekçe et al., 2016).

97   Marital status has also been linked to specific behavioral biases, with unmarried investors exhibiting higher levels of overoptimism, overconfidence, and loss aversion than their married counterparts (Ates et al., 2016). Education appears to play a role as well, as more educated investors exhibit a lower impact from disposition effect (Goo et al., 2010) and higher overconfidence (Bhandari & Deaves, 2006; Deaves et al., 2010). Investors with less education, however, tend to be more vulnerable to representative bias (Ates et al., 2016). Occupation has been found to be strongly associated with overconfidence, optimism, and the disposition effect (Prosad et al., 2015), while annual income has been shown to influence overconfidence and the disposition effect in different ways (Dhar & Zhu, 2006; Kumar & Goyal, 2016; Lin, 2011). Lastly, investment experience has been linked to higher overconfidence levels (Glaser et al., 2004; Ates et al., 2016).

98   Understanding investment behavior requires having financial literacy, which is the capacity to make wise judgments and choices about managing money (Noctor et al., 1992). Numerous studies have looked into the connection between behavioral biases and financial literacy (Dhar & Zhu,

2006; Takeda et al., 2013; Fernandes et al., 2014). However, the literature on this topic, particularly in the Indian context, remains limited (Sahi & Arora, 2012; Baker et al, 2019). Financial literacy is a critical aspect of modern societies, and the improvement of decision-making in the financial sector is vital to economic stability. Formal financial education courses and seminars are not the sole drivers of financial literacy improvement. Instead, a combination of factors, including information quality, structure, and accessibility, as well as institutional parameters, plays a significant role in enhancing individuals' ability to process and understand financial information. With regard to financial education and policy interventions the two most prominent approaches within behavioral economics are the bounded rationality approach, advanced by (Simon, 1978, 1987), pursuant to which it is suggested that people face limitations in their ability to make decisions based purely on reason, and therefore they are more likely to choose a satisfactory option rather than an optimal one (sufficing instead of optimizing or perfecting) as well as the errors and biases approach, which posits that individuals are prone to systematic errors in judgment, leading to deviations from rational decision-making, pioneered by Kahneman and Tversky as outlined previously (Altman, 2012).

Both the errors and biases approach and the bounded rationality approach have implications for the design of financial education programs. While the former emphasizes the need to correct for cognitive biases through education, the latter highlights the importance of enhancing individuals' capacity to process and understand information. Key policy recommendations include promoting transparency and clarity in financial product information, changing default options for pensions and credit limits, and enhancing the regulatory environment to detect and deter financial fraud. Moreover, to modify the incentive system to ensure that individual investors assume responsibility for the outcomes of their choices, especially for influential decision-makers within financial organizations (Altman, 2012).

The implications of these findings extend to financial educators, advisors, policymakers, and regulators. By understanding the decision-making processes of investors, financial advisors can offer tailored services based on clients' predispositions. Policymakers and regulators can also benefit from these insights by improving financial education and policies aimed at enhancing financial capability, resulting in individual and overall economic wellbeing.

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101   Traditional economic theory assumes that individuals possess unlimited cognitive capacity to process and use all available information optimally (Hayek, 1945; Simon, 1957). However, recent literature reveals that overconfidence and cognitive limitations significantly influence financial decision-making (Shiller, 2005, 2008). Overconfidence can manifest as a belief in one's abilities or the veracity of acquired information. It often leads to the dismissal of vital market signals, adversely affecting investment decisions (Shiller, 2008). Studies conducted in experimental economics and psychology have provided insights into the role of overconfidence in exacerbating financial crises and contributing to the economic disparities observed between individuals and countries. Furthermore, research has demonstrated that individuals' savings decisions appear random, contrary to what life-cycle models forecast, where agents are believed to save money in their early years to use it in their later years (Garcia, 2013, with further references).

102   Limited cognitive capabilities result in individuals resorting to heuristics or simple rules of thumb, rather than employing more complex decision-making processes (Akerlof & Shiller, 2009). The findings from both behavioral finance and financial education literature converge on this aspect, highlighting the human tendency to utilize shortcuts in the face of overwhelming information (Garcia, 2013). Studies, as cited by Garcia (2013) including Townsend (1994), Foster and Rosenzweig (1995), Easterly and Levine (1997), Zak and Knack (2001), Adato et al. (2006), Giné et al. (2006), Cassar and Crowley (2007), Cassar and Wydick (2010) and Chantarat and Barrett (2012), have highlighted the significance of trust in financial decision-making, particularly concerning the role of social networks and trust in financial transactions. These studies indicate that trust can sometimes diminish or even negate the use of available information in financial decision-making, as individuals may prioritize social relationships over objective information. Financial transactions are influenced by various factors beyond economic variables, including trust, reciprocity, altruism, and social relationships. In some cases, high levels of trust can even reduce individuals' reliance on available information when making financial decisions (Giné et al., 2006).

103   The insights from these studies do not invalidate the internal rigor of traditional financial theories; rather, they call for a generalization or expansion of existing frameworks to encompass the observed aspects of human behavior concerning information processing and overconfidence (Akerlof & Shiller, 2009). By incorporating these factors, it is possible to create

more comprehensive models of financial decision-making, better suited to explain individual and collective financial behaviors in various economic contexts (Garcia, 2013).

Ultimately, the role of information, confidence, and cognitive abilities in financial decision-making warrants further exploration.

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3.3 The role of bias in financial regulation

Regulatory bodies exist to prevent market failures and promote financial stability. However, their decisions are often affected by the psychological biases of various political actors, including voters, public officials and media commentators (Hirshleifer, 2008). The theory of psychological attraction in financial regulation suggests that these biases, as well as regulatory ideologies that exploit them, are responsible for shaping regulatory policies. The approach proposed by Hirshleifer (2008) highlights the importance of several key elements of psychological biases, such as "*salience and vividness, omission bias, scapegoating and xenophobia, fairness and reciprocity norms, overconfidence, and mood effects*". Additionally, emergent effects arising from the interactions of people affected by psychological biases, such as availability cascades and ideological replicators, also play a crucial role in regulatory outcomes (Hirshleifer, 2008).

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Hirshleifer (2008) addresses the issue of financial regulation and how the irrational behavior of those involved in the political process impacts the results of regulatory decisions. He proposes a new approach to financial regulation that acknowledges that regulatory bodies, politicians, and voters are prone to systemic biases, which he calls the psychological attraction approach to regulation (in contrast to Kelsen's pure theory of law as mentioned in the introduction) and he notes that if psychological biases have an impact on actions taken in financial markets, they should also have an effect on actions taken in politics.

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3.3.1 How attention and presentation impact information processing and memory retention

In public discourse, politics can be seen as a competition for attention. To this end, political competitors utilize slogans that are easily understood, plausible, and memorable. According to Nisbett and Ross (1980, p. 45), psy-

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chological research has demonstrated that focus is directed towards salient stimuli which stand out from other stimuli in the surroundings, and towards striking stimuli such as narratives about individual experiences and emotionally stimulating information. Regulatory debates are particularly influenced by such personal stories and extreme events due to their high salience and vividness, which are more memorable and attention-grabbing (Hirshleifer, 2008).

108   Loss salience is another important factor that influences the perception of regulation. Loss aversion refers to the aversion of losses in relation to a specific reference point (Kahneman & Tversky, 1979), which is one feature of what is also referred to as negativity bias. Loss salience, on the other hand, refers to being more concerned with financial losses than the gains of others (Wilson et al., 2006; Hirshleifer, 2008). This emphasis on losses is heightened at the societal level as discussions or media coverage tend to be skewed towards sharing negative and emotionally charged news. According to Heath et al. (2001), news media tend to report shocking and horrible news, and people also spread information more quickly when it makes them feel disgusted than when it doesn't.

109   When making financial decisions, losses tend to stand out more than gains, leading to a focus on worst-case scenarios in risk analysis instead of more comprehensive measures like variance that consider the full range of possible outcomes. Loss salience is the driving force behind the widespread use of the Value at Risk method in risk management, which prioritizes the potential for maximum loss as a risk metric. In addition, media coverage of high-profile losses in derivatives trading, such as the Barings scandal, can create a link in people's minds between derivatives and losses, which can result in the belief that derivatives are inherently risky and the possibility of mitigating risks through hedging is ignored. As a result of these attentional effects, there is often pressure to impose more regulations on derivatives (Olsen, 1997; Koonce et al, 2005).

3.3.2 The impact of omission bias on decision making, social norms and procyclical behavior

110 In the realm of behavioral economics, the concept of omission bias has been widely studied and found to play a significant role in shaping decision-making behavior (Ritov & Baron, 1990). Omission bias refers to the inclination to prefer inaction or omissions, even when the cost of inaction

outweighs the cost of action (while both omission and status quo bias involve a preference for inaction over action, omission bias is specifically related to the evaluation of harmful actions, whereas status quo bias involves a general inclination towards favoring the present state of things.). This cognitive bias is evidenced in a range of decision-making contexts, from vaccination choices to investment decisions (Hirshleifer, 2008).

Individuals may shy away from diversifying their investment portfolios, choosing instead to stick to a familiar or perceived safe investment option, even when the risk of loss is higher than that of the alternative option. One particular manifestation of omission bias is observed in the corporate world, where hedging is often employed as a means of mitigating risk. While hedging can be an effective means of avoiding losses, observers affected by omission bias often view hedging losses as avoidable because they could be eliminated by refraining from hedging in the first place. In such cases, the risk-reducing effect of hedging is often overlooked, and the potential for loss is viewed as higher when hedging is employed (Hirshleifer, 2008). [111]

Omission bias can also have significant implications for regulatory policies designed to protect unsophisticated investors. Del Guercio (1996) highlights how US courts often evaluate the prudence of investment choices in isolation, rather than considering them as part of a broader portfolio. Regulations to safeguard less knowledgeable investors or consumers from securities or asset classes that are thus perceived as risky may impede efforts to reduce risk through diversification (Hirshleifer, 2008). [112]

Beyond omission bias, xenophobia is another psychological phenomenon that can have a significant impact on decision-making behavior. Xenophobia refers to the fear or hostility towards strangers or foreigners and is thought to have an evolutionary basis in kin selection (Hamilton, 1964). Self-serving attribution bias is another source of conflict, which can lead individuals to view themselves as right and others as wrong and can extend to group-serving interpretations (Taylor & Doria, 1981). These biases can contribute to intense forms of group-based antagonism, fueling xenophobic attitudes towards outsiders (Beck, 1999). [113]

The restriction of foreign ownership and control of domestic enterprises may be influenced by xenophobia. Studies indicate that people in Europe are less likely to trust countries with different religious beliefs and genetic makeup, which can lead to reduced trade, direct investment as well as portfolio investment (Guiso et al, 2006). Additionally, in situations where something goes wrong, people often seek to assign blame to a visible and [114]

relatively powerless out-group or scapegoat, which can foster support for regulation to prevent future misconduct (Hirshleifer, 2008).

115   Fair exchange, or the rule of reciprocity, is another essential component of conduct that influences decisions and requires the punishment of violators to maintain mutually beneficial exchange (Hirshleifer, 1987). This norm is especially important in cases of usury, in which lending of money without interest is viewed as fair, despite the fact that the value of money varies over time. Medieval Christian beliefs on usury, which, like ancient Greek theories, argued that money is barren and incapable of reproduction like animals or crops, mirrored this confusion (Hirshleifer, 2008, with further references). Reciprocity norms contribute to the tendency to scapegoat intermediaries. Despite the fact that intermediaries add value to transactions, this is not always immediately apparent to buyers and sellers. Buyers often underestimate the costs incurred by intermediaries, such as those associated with product promotion, storage, and delivery, etc. Middlemen have often been viewed as parasites or price gougers, and the idea that they offer limited actual worth is implied in the proverbial statement "*eliminate the middleman.*" This notion dates back at least to the time of Jesus, who ejected foreign exchange dealers from the temple, and is also reflected in English common and statute law, which made commodity speculation a crime (Herbruck, 1929).

116   Despite the potential benefits of speculative activities, which include shifting resources to prevent losses, allowing inventors to profit from their creations, and enhancing asset price efficiency, the prevailing belief is that in a zero-sum game, speculators gain at the expense of others. This notion is reinforced by the idea that speculation causes hardships for consumers by raising prices. Adam Smith once compared the fear of speculators to that of witches. The correlation between speculative behavior in financial assets and volatility of markets as well as market crashes is often misinterpreted as causality, particularly with short sellers who actually help prices stabilize. As a result, many countries impose regulations on speculative activities, including increased taxation on capital gains earned over a short period, increased taxation on securities transactions and limitations or prohibition on short-selling. Unfortunately, such regulations can be misguided due to biases against speculation, leading to misconceptions about derivatives, which are sometimes perceived as manipulative tools. Although manipulation does occur, the notion that derivatives lack any legitimate purpose makes them vulnerable targets for regulation (Hirshleifer, 2008).

In summary, the influence of psychological biases on decision-making behavior is complex and multifaceted, with implications for a wide range of economic and regulatory contexts. Understanding the nuances of these biases is crucial for developing effective policies that support mutually beneficial exchange and mitigate against adverse consequences.

As already pointed out previously, human decision-making can often also be flawed by overconfidence, a tendency to overestimate one's own abilities and ignore limitations. This overconfidence can have significant consequences when it comes to policy decisions, particularly with regard to regulating markets. As pointed out by and Hayek (1978), the complexity of millions of interacting individuals with diverse preferences and information makes it impossible for central planners to fully understand the spontaneous order that emerges from market interactions. Markets are a collection of solutions to problems that have evolved through trial and error, with some carefully designed and others the result of biologically evolved adaptations. The human brain has evolved to comprehend social interactions as a result of individual causes and effects, rather than the intricate interdependence of market institutions that have evolved over time. This "*lack of understanding of the idea of spontaneous order, combined with general attentional constraints*" and a desire for solutions to perceived problems, can lead to the adoption of too many remedies and excessive activism in regulatory strategies (Hirshleifer, 2008).

One example of such activism is the suggested solution of transactions taxes to limit speculation in capital markets, which has been advocated by leading economists such as Keynes, Tobin, Stiglitz, and Summers (Hirshleifer, 2008; Stiglitz, 1989; Summers and Summers, 1989). While proponents argue that excessive speculation results in exaggerated responses, excessive volatility, and misallocation of capital, transactions taxes on stock trading can destroy liquidity and suppress the opinions of speculators. Instead, markets have many potential avenues for internalizing the potential social costs of irrational speculative trading, such as through the influence of exchanges on liquidity and firms' choices about their liquidity. However, policymakers may still believe that they can manage market fluctuations and may be overconfident in their ability to come up with effective methods for controlling interest rates or the money supply in order to avert bubbles and crashes. This illusion of control can lead to calls for more active intervention and new regulation after adverse outcomes (Hirshleifer, 2008).

120   Overall, policymakers need to be aware of their own overconfidence biases and limitations when making decisions about regulating markets and consider the rich adaptation of economic institutions that have developed through long-term evolutionary processes. They should also be wary of adopting apparent solutions, which may have unintended consequences and ignore the complexity of market interactions.

121   The influence of heuristic decision-making on financial regulation has been shown to be problematic when it is applied to domains that require careful analysis, as it can lead to significant errors (Kahneman, 2003). Furthermore, short-term moods have been found to impact judgments and decisions related to long-term prospects, and mood contagion has been shown to potentially cause errors to aggregate at the societal level (Hatfield et al., 1994).

122   Judgments about financial regulation can also become prevalent based on little information, as rational inference processes can recruit further support for measures and potentially create information cascades that may lead to widespread deference to the accepted viewpoint (Bikhchandani et al., 1992; Banerjee, 1992). Conformity-seeking tendencies might solidify common mistaken judgments to become seemingly uncontested truths, reinforcing this tendency (Hirshleifer, 2008).

123   Frequently, hazards gain widespread public attention in abrupt surges, causing individuals to assess the occurrence or significance of an event based on their capacity to recall specific instances of it, which is referred to as the availability heuristic (Tversky & Kahneman, 1973). This can result in a phenomenon known as availability cascades, where the more a risk or problem is discussed, the more significant it appears to be, creating a procyclic or self-perpetuating cycle of behavior (Kuran & Sunstein, 1999).

124   Evidence becomes more biased in favor of an increasingly one-sided stance during an availability cascade centered on a perceived threat, leading to political pressure on the government to action and put a halt to the perceived threat (Brenner et al., 1996).

125   When individuals experience negative emotions, they tend to have a more pessimistic outlook and engage in critical thinking. As a result, when bad news emerges, there is often a push for new regulations as a precautionary measure. In times of financial distress, public attention tends to shift towards misconduct, leading to increased pressure to tighten financial controls and prosecute those who are perceived to have acted wrongly. This cycle creates a self-reinforcing regulatory environment that benefits those who are able to take advantage of the situation, such as public prosecutors

(Hirshleifer, 2008). The phenomenon of new regulations manifesting in response to bad news in the financial regulatory sphere may not be based on concrete evidence or may not be the most effective response to an issue at hand. This adhocracy in public policy making or ad hoc regulation made on a case-by-case basis may be influenced by emotional responses to specific situations rather than a comprehensive and evidence-based approach. This can result in a patchwork of inductive case law-based regulations that are not necessarily effective or coherent. In contrast, a more deductive approach based on codified law and evidence-based decision-making may result in more effective and efficient regulations that are better suited to addressing issues in a comprehensive and evidence-based manner.

3.3.3 How ideological dimensions may shape financial regulation

Ideologies, such as religious, political, and economic ones, shape financial regulation by spreading from person to person as "*cultural replicators or memes*" (Hirshleifer, 2008; Dawkins, 1976). Ideologies are made up of such memes, which affect our thoughts and actions. Ideologies are made up of fundamental memes or straightforward concepts that shape our perceptions and actions. For instance, by forbidding usury and influencing attitudes toward inequity, religious ideology directly affects financial policy. Communist ideology and other utopian ideas encourage strong feelings against private property and the equality rule. Many intellectuals throughout history, including Plato, Aristotle, early Christian thinkers, Confucius, and Thomas Aquinas, shared this rejection. In popular culture, where businesspeople are frequently portrayed as criminals, ideologies that encourage envy of the wealthy and the belief that commerce is inherently evil, such as those based on class struggle, are common (Hirshleifer, 2008).

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In addition, the idea of commerce being a zero-sum game strengthens the assembly of socialist memes, as the perception that trade is a zero-sum game is prevalent and more attractive during a stagnant economy when individuals seek explanations and scapegoats for their struggles (Rubin, 2002). In times of change and uncertainty, utopian mass movements thrive, attracting individuals with low self-esteem who seek a cause beyond themselves (Hoffer, 1963). In light of this, according to the psychological attraction approach, when faced with challenging circumstances, people are more likely to gravitate towards socialism, whereas during periods of expansion and creativity, liberalism tends to be favored (Hirshleifer, 2008).

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128   The financial "*ideology of anti-short-termism*" (Hirshleifer, 2008) utilizes cognitive biases to foster its replication. In the 1980s, the notion that American businesses were excessively focused on short-term goals, leading to uncompetitiveness, underinvestment, and a lack of innovation, became popular, despite the lack of evidence to support this theory. This criticism appealed to psychological biases, leading to the development of the anti-short-termism ideology (Hirshleifer, 2008).

129   To many individuals, the financial system may appear complex and challenging to understand, leading to a receptiveness to conspiracy theories, which claim that a malevolent group possesses the power and intention to cause harm. During market crashes, accusations of foreign enemies engaging in bear raids or cabals of Jewish bankers or speculators controlling the financial system have garnered support. Most individual investors lack an understanding of how and to what degree key actors in the financial industry might influence market risks, leading to a predisposition toward attributing market crashes to intentional manipulation by powerful individuals or groups, rather than the interaction of many individuals, none of whom possesses significant power. The intricacy of the financial system is compounded by its specialized terminology, sensationalized media reports on market fluctuations, and the perceived uncontrollability of risks such as market crashes and bank runs (Hirshleifer, 2008).

130   According to the theory of psychological attraction, regulatory actions are based on the psychological biases of regulators and political actors, as well as the development of regulatory ideologies that take advantage of these biases. But also the rational self-interest approach faces the conundrum of implicitly relying on psychological biases as well. The psychological attraction theory also explains why regulatory mistakes are not immediately rectified and why many countries accept regulations that discourage young companies from going public. This theory also suggests that regulatory responses to perceived problems are often ineffective and predicts a tendency for overregulation and a buildup of rules over time. To control the effects of psychological biases on future policy decisions, inertia can be introduced into the political system by means of constitutional restrictions, for example separation of powers, irrevocable rights, and requirements for supermajority votes (Hirshleifer, 2008).

3.3.4 Interim conclusion

The role of bias in financial regulation is significant and complex. It is necessary for policymakers to recognize the impact of psychological biases on regulatory decisions, including salience and vividness, loss salience, and omission bias. Ideological dimensions also play a significant role in shaping financial policy. Policymakers must also be aware of their own biases and limitations to develop effective policies that support mutually beneficial exchange and mitigate against adverse consequences. Reactive financial regulations may not be effective as they are often based on ad hoc, case-by-case regulations (inductive) rather than evidence-based policymaking. A more deductive approach, relying on evidence-based aspects of decision-making, might be more effective in addressing issues comprehensively and efficiently. 131

The incorporation of constitutional limitations into the political system may further help curb psychological biases' implications on forthcoming policy choices. The outlook for financial regulation is unpredictable, but understanding the nuances of psychological biases is crucial to adapt to the constantly evolving financial landscape. By acknowledging the role of biases in financial regulation and adopting measures to mitigate them, policymakers can ensure a stable and prosperous economic future. 132

There are several potential measures that could be taken to mitigate biases in financial regulation. One approach is to increase transparency and accountability in the regulatory process, such as by requiring public disclosure of the rationale for regulatory decisions, and by subjecting regulatory bodies to external audits or oversight. Another approach is to introduce checks and balances into the regulatory process, such as by requiring a supermajority or unanimous vote for significant regulatory decisions, or by creating an independent regulatory body with a mandate to oversee the actions of other regulators. 133

Additionally, policymakers could consider introducing cognitive training programs for regulators to help them recognize and counteract common biases, such as confirmation bias or loss aversion. This could include training in decision-making techniques that promote more thorough analysis of available information, as well as techniques for managing emotional responses and avoiding common cognitive pitfalls. 134

Finally, policymakers could consider adopting a more adaptive approach to regulation, which involves regularly reviewing and revising regulatory frameworks in response to changing circumstances or emerging risks. 135

This could help to ensure that regulations remain relevant and effective over time, and that they are not unduly influenced by biases or outdated assumptions.

136   Ultimately, the goal should be to develop a comprehensive grasp of the elements that affect regulatory decision-making, and to develop strategies for promoting more effective and equitable regulation over the long term.

3.4 Regulatory behavior or behavioral public policy with regard to regulation

137   The financial crisis of 2008 revealed that a deregulated financial market in the United States was inadequate in protecting the public interest. The crisis proved that managers of financial intermediaries had the potential to generate risks of such magnitude that they endanger the entire financial system and not just their individual organizations (Grosse, 2012). In response, policies and governance mechanisms were proposed to restrict destructive behavior in financial institutions. Better risk management and accountability for managers were suggested as critical elements in preventing another financial crisis. Pre-established penalties for outcomes such as systemic risk or loss of money, including the drawback of previous bonuses, could hold managers accountable for their actions (Grosse, 2012).

138   To prevent future crises, stricter limits on credit extension by financial institutions and borrowers were proposed, as well as a predetermined strategy for providing backup funding to sustain the operations of the financial system during periods of turmoil. Additionally, regulating financial institutions by raising capital requirements and limiting leverage of non-bank institutions were suggested measures (Grosse, 2012). Grosse (2012) also notes that the US regulator was also played a role that led to the global financial crisis, by pushing mortgage loans to encourage growth in the housing sector, thus encouraging an ultimately detrimental behavior leading to the exaggerated yet astute question – *"Who will regulate the regulators?"*.

139   This question definitely is not an easy task to answer and while the position may be taken that certain mechanisms may be implemented as checks and balances to the regulatory policymaking process, it remains unclear, how such checks and balances may be implemented. At least a glance of an answer may be found in the insights of behavioral finance and neuroscience. Behavioral economics and finance research have had a significant impact on policymaking, with many applications focusing on addressing individual biases and cognitive constraints. However, it is equal-

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ly crucial to comprehend how psychological biases can lead to collective dysfunction in financial regulation and accounting policy (Hirshleifer & Teoh, 2017), which might be called the "economics of regulation".

Policy formulation in the realms of behavioral economics, finance, and accounting research has primarily centered on remedying the impacts of individual biases and cognitive limitations, with a focus on protecting investors and phenomena like nudging (Sunstein & Thaler, 2003). Nonetheless, it's crucial to acknowledge the potential impact of these biases on a collective level and how they can cause a so-called collective dysfunction, which can result in inadequate financial regulation and accounting policies. This contrast can be simplified as the differentiation between effective regulations for flawed users and ineffective policies that arise from the biases of designers, which can be unnecessary or harmful. Effective regulations should provide information that considers users' cognitive limitations and biases, while ineffective policies are the result of designers' psychological biases (Hirshleifer & Teoh, 2017). 140

Behavioral accounting research has identified several biases and cognitive limitations that can impact investor and auditor decisions, leading to the proposal of various methods to enhance accounting rules and regulation (Maines & McDaniel, 2000; Hodder et al., 2001). These principles also apply to financial regulation in general (Hirshleifer & Teoh, 2017). 141

While over time, some effective market regulations have been developed playing a crucial role in a market's functionality, rules and regulations are also influenced by the irrational aspects of human psychology (Waymire & Basu, 2008). Social processes can further distort popular ideas about regulations, which may be even more biased than individual opinions (Hirshleifer & Teoh, 2017). 142

The issue of irrationality in financial regulation extends beyond the influence of interest groups through lobbying efforts, as psychological biases can also make flawed regulations appear attractive to inexperienced political actors (Hirshleifer & Teoh, 2009; Hirshleifer, 2008; Daniel et al., 2002; Caplan, 2001). Up until recently, economists did not take the influence of political actors' irrationality on financial regulation into account (Hirshleifer & Teoh, 2017). 143

According to Hirshleifer and Teoh (2017), the way a regulatory ideology is presented to the public, including its emotional and attention attracting elements, is critical to its success. For example, policies that are framed as regulating a specific group of greedy wrongdoers or protecting a clearly identifiable set of victims are typically more appealing than policies that 144

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improve abstract notions of social welfare or save lives statistically (Jenni & Loewenstein, 1997).

145   The argument made is that recognizing the significant role that irrationality plays in policymaking does not necessarily imply that interventionist government policies are negative. Rather, irrationality may aid in addressing obstacles that could hinder the development of improved policies (Hirshleifer & Teoh, 2017).

146   The significance of recognizing the impact of psychological biases on shaping accounting policy and financial regulation is further underscored by the fact that individuals are more likely to resist transparent taxes compared to hidden ones, which is being made use of for example by implementation of withholding taxes (McCaffery & Baron, 2006).

147   In this context, politics can be viewed as a battle for attention, with simple slogans and sound bites used to shape debates. Understanding the limitations of how voters process information is crucial in comprehending regulatory outcomes, as politicians use arguments that exploit listeners' heuristic cognitive processes (Hirshleifer & Teoh, 2017). Salient stimuli that stand out from the environment tend to attract attention, making them more memorable. Moreover, attention is also attracted to vivid stimuli, such as those that elicit emotions or present compelling narratives (Nisbett & Ross, 1980: 45). On the issue of financial regulation, there is a sharp contrast between the tangible gains that come with protecting victims of fraud and the hidden and diffuse costs that arise from imposing regulations on the general public. Protecting victims of financial fraud is a visible and emotionally charged issue, making it more salient to voters and politicians alike. However, the costs of regulation, such as decreased innovation or decreased access to credit, may not be as apparent or may not directly affect voters. This disparity in salience can lead to a focus on immediate gains at the expense of long-term consequences. It is important to recognize this dynamic when designing financial regulations, as failing to consider the hidden and diffuse costs can lead to unintended consequences that ultimately hurt the very people the regulations were meant to protect.

148   Individuals have a propensity to mentally divide payoffs into distinct accounts, even if they have the freedom to move funds between them, which can lead to gains or losses being undervalued until a re-evaluation trigger occurs. Consequently, transactions are often only recognized once they are complete, such as at the point of product delivery, which supports the revenue recognition principle in accounting. Additionally, conservatism is a fundamental principle in accounting that has been ubiquitous across

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history and countries. Users tend to avoid the possibility of disappointment and believe that conservatism can alleviate this disappointment (Hirshleifer & Teoh, 2009). People often evaluate their decisions in relation to potential gains compared to a lower reference point or losses relative to a higher reference point. They have a strong aversion to even minor losses when measured against a significant reference point, which is called loss aversion (Kahneman & Tversky, 1979). According to Hirshleifer and Teoh (2017), this tendency extends to social perceptions, and individuals are more concerned about the losses of others than their gains, which they refer to as loss salience. Correspondingly, both investors and analysts' risk perceptions focus disproportionately on the potential for significant losses. However, financial professionals often concentrate on worst-case scenarios when managing risk, such as the value-at-risk methodology, which measures risk by the maximum possible loss (Hirshleifer & Teoh, 2017).

3.4.1 Diversification and the value of financial intermediation

The omission bias, or the tendency to prefer inaction over action, can also shed light on why investors frequently overlook diversification and why regulators, who are tasked with safeguarding investors, sometimes prohibit them from diversifying. Regulations intended to shield novice investors from risky financial products or asset classes, regardless of their potential benefits, limit diversification by their very nature (Del Guercio, 1996). This bias may also explain why historical cost accounting is often more appealing to investors, as revising the valuation of an asset requires taking action, while valuing it at historical cost is passive (Hirshleifer & Teoh, 2009). Negative publicity is common for firms that incur significant losses from derivative transactions. However, media coverage does not always clarify whether these transactions were speculative wagers or risk-hedging measures for the company. Individuals with an omission bias may view hedging, which aims to reduce risk, as risky and unnecessary, as they perceive any action as potentially hazardous. This can lead to the perception of risk-reducing strategies as dangerous, despite their potential to prevent avoidable losses (Hirshleifer & Teoh, 2017).

    In the context of decentralized finance and crypto assets, regulations that aim to shield investors from the risks associated with such markets or asset classes can also constrain diversification opportunities. These regulations may deter investors from venturing into the decentralized markets, despite

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the potential for diversification benefits. Furthermore, the preference for omission over commission bias can lead investors to overlook the potential benefits of diversifying into crypto assets, as they may be hesitant to take action and invest in a new and unfamiliar asset class. As a result, regulations aimed at protecting investors from risky assets may ultimately increase overall risk by limiting diversification opportunities. Therefore, it is essential to strike a balance between safeguarding investors and allowing for diversification in regulatory frameworks.

151   People consider caring preferences as significant since it allows them to care for those in need while exchanging resources with others (Haidt, 2012). However, individuals tend to evaluate the level of neediness in others based on historical benchmarks, and recent losses are perceived as posing a more severe burden. This is evident in the overwhelming sympathy shown towards individuals whose were destroyed in natural disasters, which frequently overshadows the persistent concerns of poor individuals who are homeless (Hirshleifer & Teoh, 2017). This is another consequence of the concept of loss salience. The idea of an equitable distribution of resources is a key reference point for assessing fairness, and as a result, norms of equal distribution are common (Camerer & Thaler, 1995). The inherent inclination of individuals to sympathize with the less fortunate and harbor a dislike for those who do not may result in their disapproval of sellers who charge exorbitant prices to people living in poverty, particularly during periods of distress, which results in price ceilings and usury laws. These laws are designed to regulate lenders who impose high interest rates to high-risk borrowers, especially during disaster periods. It is a common paradox that regulations designed to protect people living in poverty can ultimately harm them by preventing mutually beneficial exchanges. Usury laws aim to prevent individuals who are prone to present bias (colloquially referred to as "instant gratification" and related to hyperbolic discounting) from borrowing and over-consuming. When discussing usury laws, the conversation often centers around the exorbitant interest rates and avarice of lenders, while neglecting to address the imprudent spending habits of people living in poverty and the need to limit their consumption (Hirshleifer & Teoh, 2017).

152   The majority of individuals have limited comprehension of how financial intermediation generates worth, resulting in the perception that speculators, bankers, and other intermediaries are exploitative by nature. The act of middlemen shifting resources across time or place and the trust placed in financial intermediaries to carry out transactions can result in buyers

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paying more for a commodity or service. This seemingly goes against the principle of fairness in exchange, as demonstrated by the medieval concept of the just price (*iustum pretium*), which equates to the cost to the seller. Medieval Christian teachings and beliefs maintained that the just price for a claim to future consumption is equal to the current consumption unit, resulting in a zero-interest rate. This concept is founded on a common economic perception or intuition that ignores the potential for utilizing resources efficiently to yield profits in the future. The belief that positive interest rates are unjust is prevalent across various religions, cultures and eras scattered around a global scale, including Islamic finance, which opposes the concept of positive interest rates (Hirshleifer & Teoh, 2017).

3.4.2 Regulation of investors? Balancing investor protection and diversification in regulatory frameworks

The phenomenon of in-group bias, which describes people's propensity to display a favorable bias towards their own group in contrast to those outside of it, along with xenophobia, has been determined as significant factor which contributes to biased economic exchange and policymaking (Brewer, 1979). This tendency is visible in the realm of financial regulation, where anxieties or animosities towards foreigners fuel limitations on foreign ownership and control of domestic enterprises and, in certain instances, even lead to the government's ownership of specific industries (Hirshleifer and Teoh, 2017). Additionally, lower levels of trust have been found to be linked with reduced trade in goods, portfolio investment, and direct investment in countries with varying religions and lower genetic similarity in European nations, which suggests that in-group bias can cause economic bias, according to the research conducted by Guiso et al. in 2009.

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Another consequence of in-group bias is scapegoating, which involves blaming visible, unpopular, and relatively weak out-groups for hardships (Aronson et al, 2020, p. 452). This behavior fosters a desire to punish and regulate offenders. However, it is worth noting that such outrage does not always lead to optimal regulatory outcomes. In the Enron scandal of 2001, while the managers of the company who committed genuine misdeeds were targeted, the anger was also directed towards staff members whose pensions were invested in stocks of the company. Having diversified portfolios would have been the best prophylactic approach to stop such consequences. This implies that enhancing investor education or adopting nudges or

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regulations that promote diversified investing may be more effective than regulation focused on potential culprits rather than victims, as proposed by Hirshleifer and Teoh in their 2017 research.

155   The concept of regulating investors or peers to protect them may seem counterintuitive, but it may pose a practical approach to safeguarding their interests. This is due to the fact that many investors lack the knowledge and expertise required to make informed investment decisions, making them vulnerable to scams and high-risk investments. Regulations can provide guidelines and standards that ensure investors make informed choices and are protected from fraudulent practices. As part of this, regulations can encourage diversification and risk management, which can help investors mitigate potential losses. In addition to traditional regulations, policymakers can also use framing effects and nudging techniques to influence investor behavior and protect them. By framing investment options in a certain way, policymakers can encourage investors to make choices that are in their best interest. Framing effects refer to the manner in which information is conveyed to individuals and how it can affect their perception and decision-making. For example, emphasizing the risks and potential losses associated with a high-risk investment can discourage investors from making impulsive decisions. Alternatively, based on the above findings, highlighting the potential benefits of a diversified investment portfolio to nudge investors to make more balanced decisions (even including some investments deemed riskier) may seem more prudent than a mere focus on isolated risk-classes of a singular investment. Nudging involves designing policies and regulations in a way that encourages certain behaviors without mandating them. Policymakers can nudge investors towards more responsible investment choices this way, by suggesting portfolio diversification to ultimately lower the risk of loss instead of just pointing out potential risks of isolated investment choices. The first approach may lead to more diversified investment portfolios of investors which are intrinsically less prone to losses from a statistical point of view while the latter approach may just do what it is intended to do – make aware of risks of losses attached to a single investment decision without actually presenting a mitigating strategy. Conversely, individuals participating in fully decentralized systems as peers, as described in Chapter 4, could be considered service providers based on their interactions. Consequently, they might be subject to trade, tax, supervisory, or other regulations.

3.4.3 Negative implications of the fix-it-fallacy on social policymaking

Individuals who are overconfident tend to hold excessively favorable beliefs about themselves, even in the face of conflicting news arrival. This self-deception is closely linked to the illusion of control, which leads people to believe they have the power to influence uncontrollable events, like predicting the winning lottery number. This illusion of control and overconfidence can lead individuals to believe that they can swiftly identify social issues and evaluate potential remedies, despite the fact that making effective public policy requires a deep scientific understanding. The "*fix-it fallacy*" is the belief that complex systems can be fixed with common sense, and this can lead to intervention bias and simplistic, harmful solutions (Hirshleifer and Teoh, 2017).

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 It is important to recognize that market institutions exist for a reason, and lack of understanding of their capacity to develop institutions to address issues may result in the implementation of unnecessary regulations. For instance, some have proposed implementing security transaction taxes to reduce speculative trading and negative externalities, such as excessive volatility, mispricing, and capital misallocation. However, there are various levers that markets can use to control speculative activity, including rules imposed by firms, exchanges, and financial intermediaries. Exchanges and listing firms can influence security liquidity through their rules, while firms can control their own liquidity by deciding how much information to disclose and which exchange to list on. Mutual funds can reduce the frequency of withdrawals by imposing back-end loads or even blocking withdrawals entirely by operating as a closed-end fund. However, if such methods of regulating speculation can address the externality problem depends on the parties involved and their ability to negotiate effectively and efficiently (Hirshleifer, 2008; Hirshleifer and Teoh, 2017).

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 The "fix-it fallacy" refers to the idea that complex problems within an adaptive system can be solved through simple solutions. This mindset often leads to intervention bias, where social policy advocates promote naive solutions to complex problems. However, sometimes a passive response to social or medical problems can be a stronger default option than intuition suggests. The fix-it fallacy often results in a preference for simplistic, harmful solutions over potentially beneficial ones when action is required. Hindsight bias reinforces intervention bias, as people tend to believe they had foreseen events after the fact. The idea that regulators should be in charge of regulating fluctuations in asset markets is a demonstration of the fix-it

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fallacy. However, market prices reflect the aggregated knowledge of many professionals, each with specialized knowledge about different parts of the economy, making it unlikely that even expert regulators can systematically recognize when an asset is overvalued. Moreover, overconfidence makes observers write off market institutions as failures without fully considering their potential costs and benefits. For instance, critics of American business often criticize its short-termism. The ideology of anti-short-termism is illogical and unsupported by evidence, and its major prediction in the 1980s - that Japan would surpass the USA in growth and innovation - was proven wrong. Nonetheless, the emotional connection of the component ideas of anti-short-termism "*makes them highly attractive to people when bundled together as an ideology*", perpetuating critique of business short-termism (Hirshleifer & Teoh, 2017; Hirshleifer & Teoh, 2009).

159   Even when decision-makers act rational, information cascades can still hinder informed decision-making, as demonstrated by Banerjee (1992) and Bikhchandani et al. (1992). These cascades can spread ill-informed ideas, causing regulatory booms and busts. These information cascades are fragile, as public opinion can quickly turn against a regulation when new information arises, resulting in waves of optimism or pessimism similar to stock market bubbles (Bikhchandani et al, 1992). One form of information cascade is the attention cascade, driven by the availability heuristic, where individuals evaluate the frequency or importance of an occurrence based on their ability to recall examples (Tversky & Kahneman, 1973). When a threat gains public attention, it is perceived as more prevalent and significant, creating a self-reinforcing cycle that amplifies public pressure for regulation (Hirshleifer and Teoh, 2017).

160   Interestingly, negative mood can lead individuals to scrutinize evidence with greater skepticism and adopt a more negative outlook, which results in informal standards loosening during good times and a tightening during bad times. Therefore, firms may engage in greater earnings management during good times when they are subjected to less investigation and suspicion. However, during bad times, accounting irregularities come to light due to firm failures, leading to increased pressure for regulatory oversight. This motivates law enforcement and politicians alike to pursue instances of misconduct with increased vigor, reinforcing the cycle. The relationship between public perception and regulation indicates that formal regulation is typically tightened during difficult times and relaxed in prosperous ones. This could be the explanation of why laws that restrict investor rights

or enable greater risk-taking by banks are often implemented following periods of market growth (Hirshleifer and Teoh, 2017).

To address the impact of information cascades, decision-makers should examine the social processes that influence regulatory sentiment and practice anticyclical measures to break the ever-strengthening regulatory policy-making cascades. It is critical to be aware of the potential for attention cascades, which can be fragile and subject to rapid shifts in public opinion. Therefore, decision-makers must exercise caution when responding to such cascades, avoiding being swayed by the contagious sentiment. Self-reinforcing feedback-loops on financial market regulatory policymaking may only be countered, by the again counterintuitive, anticyclical breaking of (emotionally driven) ever strengthening regulatory policymaking cascades. As outlined, an inert or passive response by the legislator may pose a stronger default option in such cases than the need to reactively try to fix things by implementing regulations on an ad hoc basis. Conversely, as already outlined in the previous chapters on the topic of diversification, investors should take on or be more actively nudged by policymakers to take on a more active role with regard to asset portfolio diversification decisions while the legislator should practice itself in omission of (over-)regulation of financial intermediaries and financial institutions.

In this context, it is also required to further explore the extent to which social interactions (e.g., on social networks) influence investor beliefs and result in belief divergence in response to public information, private information, or fake news (Hirshleifer et al, 2023; Giglio et al, 2021), and how the dynamics drive economic outcomes and how this may be reflected in public policy.

3.4.4 Exploring the role of regulatory ideologies in shaping economic public policy

Ideologies are powerful cultural traits that can exert significant influence on economic regulation and behavior. There have been instances where ideologies have resulted in regulatory excesses, leading to disastrous state-controlled economies under communism or ineffective methods of economic regulation, like the imposition of price controls and implementation of restrictions on international trade (Hirshleifer & Teoh, 2017).

Even in market economies, anti-market ideologies remain prevalent and may form the basis of much regulation, often rooted in hostility towards

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wealth and the wealthy. Additionally, regulatory ideologies can also reflect animosity towards certain religious or ethnic groups, prompting calls for regulation targeting these minority groups. In some cases, regulations may even be formulated under the influence of conspiracy theories, which are built on hostility towards a particular group and draw on a psychological desire for a straightforward explanation for societal problems, as highlighted by Slovic et al. (2002). Questions that cannot be answered are not substituted by questions which can be answered but actually are answered with answers which are believed to be correct in such a case. As such it may be argued that conspiracy theories serve both as a mediator and moderator on social complexity and may thus serve as a mechanism to reduce social complexity.

165   The susceptibility of financial markets to significant fluctuations and the need for simplistic explanations makes individuals vulnerable to conspiracy theories that offer uncomplicated and plausible explanations for market booms and busts. During economic downturns, individuals may be inclined to attribute their hardships to external factors to preserve their self-esteem, which is evidenced by the popularity of conspiracy theories (D'Acunto et al, 2015; Pipes 1997). The belief that pursuing profit is synonymous with greed has been pervasive across cultures for millennia and has been advocated by renowned thinkers such as Aristotle, Confucius, and others. This perspective has been the driving force behind "*socialist and communist ideologies that reject private property and the freedom to engage in exchange*" as their core tenets (Hirshleifer and Teoh, 2017).

166   Furthermore, the application of constant-sum thinking, a straightforward mental shortcut for assessing business dealings that involves a conflict of interest over price and quality, reinforces the notion that trading for profit is unethical. However, anti-market ideology is not solely based on morality, as the attraction of socialism may arise from an overconfidence in the capability of a select group of technocrats to govern an economy. Ideologies are cultural characteristics that tend to propagate when they can effectively leverage human cognitive and emotional predispositions to support their core beliefs. "*Ideologies usually include a moral perspective about how people should transact with each other socially and economically. The psychological attraction approach to regulation suggests that anti-market ideologies will prosper during hard times*" as individuals tend to prefer attributing their hardships to external factors (Hirshleifer and Teoh, 2017). In this regard, additional empirical research is necessary to investigate

the connection between economic circumstances and the popularity of anti-market ideologies pursuant to Hirshleifer and Teoh (2017).

Hirshleifer and Teoh (2017) argue that it is more important to avoid creating bad regulation than to focus on identifying and enacting good regulation for malicious actors or as they call it: "*good rules for bad users*". They highlight that during economic downturns and attention cascades, the pressure for regulation increases, which can lead to extreme dynamics for unsophisticated regulatory ideologies. Therefore, political inactivity or inertia may act as a protective measure against hasty and impulsive changes in regulation. While mostly unrelated to financial markets, attention cascades may also have played a role in shaping COVID-19 policymaking and public perceptions of the pandemic which potentially might have been countered through political inertia.

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3.4.5 Advancing policy instruments research: Addressing key gaps and enhancing public policy outcomes on the crossroads of behavioral finance and neuroscience

In recent years, the study of policy instruments and their combinations in policy mixes has emerged as a vital area of inquiry in the realm of public policy research. One critical aspect of policy instrument research revolves around the dimensions of multilevel governance (MLG) and their implications for tool choice and program creation. Policymaking frequently involves a range of actors and institutions operating at various levels, such as local, state, national, and even international orders of government. These different actors and institutions often possess divergent goals and instrument preferences, making the reconciliation process a complex interplay of inter- and intragovernmental negotiating and decision-making (Biela et al., 2012; Bolleyer & Borzel, 2010). However, the precise manner in which MLG arrangements influence tool choice and system selection remains an open question (Capano & Howlett, 2020).

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One particular area of interest involves the role of MLG arrangements in European Union policy fields, where higher levels of government can sometimes just make a proposal on general policy guidelines and objectives, while in other instances, they are able to impose instruments for lower orders of government to adopt (Biela et al., 2012).

Another crucial area of investigation concerns the process of calibration, which encompasses the contextual actions and decisions through which

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policymakers adjust policy instruments to address specific targets. While empirical evidence documents the prevalence of various types of calibrations, there is a dearth of knowledge about the underlying patterns and regularities that guide policymakers as they undertake such adjustments (Ostrom, 2003; Hall, 1993). These adjustments, which may entail modifying the number of law enforcement officers in response to potential unrest, increasing hospital bed capacity in anticipation of disease outbreaks, revising subsidy distribution rules to better address poverty, or ultimately implementing new financial market regulation in the wake of market crises, highlight the need for a more nuanced understanding of how policymakers fine-tune their instrument choices during policy implementation (Capano & Howlett, 2020).

170   A third essential aspect of policy instrument research pertains to the distinction between substantive and procedural tools, with the latter often receiving less scholarly attention despite their significance in shaping policy interactions within sub-systems (Klijn et al., 1995). Substantive tools focus on the technical arrangements of policy alternatives, while procedural tools encompass the procedures and actions required to coordinate the actions of various policy actors involved in determining, developing and implementing policies (Howlett, 2019). To advance the field of policy instrument studies, it is necessary to explore the full range of procedural tools, including well-established techniques such as specialized investigatory commissions and government reorganizations (Schneider & Sidney, 2009).

171   In the field of public policy, research on policy instruments has yielded significant progress in understanding various aspects, such as the basic types of tools (Howlett, 2000), the factors influencing policymakers' choice of instruments (Capano & Lippi, 2017), changes in governance modes (Le Galès, 2011; Capano et al., 2015), the formation of "*instrument constituencies*" (Voß & Simons, 2014; Béland & Howlett, 2016), the political and policy effects of specific instruments (Edler et al., 2016; Jordan & Matt, 2014; Borras & Edquist, 2013; May et al., 2005; Campbell et al., 2004), and the consideration of policy instruments as institutions (Lascoumes & Le Galès, 2007).

172   Despite these advances, gaps remain in the understanding of policy instruments, particularly in the context of policy instrument mixes. Unresolved questions include the reasons for policymakers' choice of specific instruments within a mix, the direct impacts of instruments on policy performance, the study of policy mix characteristics and effects, and the functioning of policy instruments in delivering outcomes. These gaps can

be grouped into four clusters according to Capano & Howlett (2020): (i) issues related to comprehension of instruments and mix dynamics, (ii) underexplored behavioral aspects of policy tools, (iii) measurement and methodological concerns, and (iv) matters concerning policy implementation's influence on tool deployment and utilization as well as policy failure or success (Capano & Howlett, 2020).

Financial markets and decentralized finance (DeFi) are continually evolving and growing. As a result, policymakers must grapple with the intricacies of policy instruments and tools to ensure effective governance and regulation. More research is required in order to comprehend the impact of MLG arrangements on policy instrument selection and system selection in financial markets and DeFi and future research should also explore the underlying patterns to enhance knowledge of calibrations and their effectiveness in financial markets.

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One approach to policy design from a behavioral finance perspective involves the use of framing strategies, which can help to encourage better decision-making by presenting information in a manner that is more readily understood and acted upon. For instance, opting for an opt-out strategy rather than an opt-in strategy can lead to higher participation rates, as it leverages the status quo bias, which causes individuals to prefer the default option. There are also numerous opportunities for further research like the role of technology in influencing investment behavior. (Filbeck et al., 2017).

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Policymaking and policy design should also take the field of behavioral finance into account. While public policy needs to be further researched as briefly shown above, the same applies for behavioral finance, also in order to connect these disciplines and consider behavioral finance insights with regard to financial market regulations.

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Firstly, behavioral finance needs to delve further into the psychological underpinnings of economic behavior. While current research has documented various biases and heuristics, a comprehensive understanding of human economic decision-making is still lacking combining existing theories. To fully grasp the cognitive processes driving these biases, researchers must engage with the broader psychological literature and explore factors that shape human behavior, such as emotions, self-control, and social cognition (De Bondt et al., 2008).

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Secondly, the importance of sociocultural factors in shaping economic behavior cannot be overstated. People's motives, self-image, and outlook are molded by societal expectations and roles, necessitating an examination of the tangible content of people's thought processes. This inquiry must

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consider social, cultural, and historical contexts to fully comprehend the content, structure, and style of intuitive economic narratives (De Bondt et al., 2008).

178   Thirdly, behavioral finance must move beyond the micro-level study of typical mistakes and adopt a more comprehensive perspective. A deeper understanding of the causes of errors, such as over-optimism, requires examining context-specific factors and the role of individual characteristics. Furthermore, the concept of error must be expanded to consider not just economic efficiency but also broader criteria such as sustainable development, equity, and fairness (De Bondt et al., 2008).

179   Lastly, there is a need to reconcile the focus on individual human frailties with the reality of societal success. The role of institutions in fostering rationality and well-being is paramount, as they enable organization, specialization, and the dissemination of knowledge. Technological advancements, administrative organization, and financial ergonomics all contribute to this process, ultimately enhancing overall system performance and individual well-being (De Bondt et al., 2008).

180   The advancement of behavioral finance therefore necessitates a more integrative and comprehensive approach that combines neoclassical and behavioral elements, incorporates psychological, sociocultural, and historical contexts, and acknowledges the role of institutions in shaping human behavior. By embracing the true nature of human imperfections and bounded rationality, researchers, policymakers, and practitioners can make more informed decisions and contribute to the ongoing evolution of economic and financial systems.

181   Financial decision-making is an intricate process shaped by various cognitive factors and experiences that significantly impact the behavior of individuals, from household members to CEOs as outlined. The neural basis of decision-making, and the role of cognitive science in behavioral finance also plays an important role (Frydman & Camerer, 2016).

182   One critical aspect of financial decision-making is how personal experiences shape decisions on a large scale. For instance, the likelihood of stock market investment was lower for those who lived through the Great Depression compared to later generations (Malmendier et al., 2011). Similarly, people who experienced high inflation rates in the past tended to anticipate higher inflation rates in the future (Malmendier & Nagel, 2016). Furthermore, people from lower socioeconomic backgrounds may harbor views on future stock returns that are more negative in nature (Kuhnen &

Miu, 2017). These findings suggest that personal experiences play a crucial role in financial decision-making (Frydman & Camerer, 2016).

Research has also examined the influence of traumatic experiences on financial behavior. Exposure to violent civil war or natural disasters has been found to alter behavior in subsequent years, sometimes increasing risk aversion. Interestingly, a study on Korean War survivors discovered that individuals aged 4-8 during the war demonstrated a greater aversion to financial risk even after decades have passed (Cameron & Shah, 2015; Eckel et al., 2009; Kim & Lee, 2012). This evidence aligns with reinforcement learning (RL) models in decision neuroscience, which propose that an agent updates the value of an action based on the results of this action (Frydman & Camerer, 2016). 183

Emerging research on the neural basis of financial decision-making suggests that the hippocampus, responsible for storing memory, plays a significant role in economic decisions. Activation in the hippocampus has been observed to correlate with activity in the valuation area of the brain, the ventromedial prefrontal cortex (Shadlen & Shohamy, 2016; Gluth et al., 2015). This implies that the hippocampus may contribute to the effects of experience on financial decisions (Frydman & Camerer, 2016). 184

The integration of cognitive science principles and emerging data sources, such as functional magnetic resonance imaging (fMRI), hormones and genetics may pose fields of future research in understanding financial decision-making. By examining the correlation structure among various biases and determining how they may be called into existence by a common neurological and psychological process, cognitive science can provide valuable insights into the behavioral finance field (Frydman & Camerer, 2016). 185

Moreover, the application of cognitive science to policymaking has resulted in the successful implementation of soft, paternalistic "nudges," which help people avoid mistakes without burdening firms or individuals already making optimal decisions (Camerer et al., 2003, Thaler & Sunstein, 2008). Numerous randomized trials have been conducted to assess the effectiveness of such nudges in improving financial, health, and educational decisions (Frydman & Camerer, 2016). 186

In conclusion, the interdisciplinary study of financial decision- and policymaking is an exciting field that stands to benefit from the synergistic use of mathematical modeling, cognitive and neural metrics, and behavioral observation. By leveraging cognitive science principles, researchers can better understand its implications for behavioral finance and regulatory public policy. 187

3.4.6 Interim conclusion

188   In summary, financial regulations aimed at protecting investors are emotionally charged, like calls for reactive and adhocratic regulatory responses in the wake of the bankruptcy of the Bahamas-based cryptocurrency-exchange FTX (FTX Trading Ltd.), and receive more attention, while the hidden costs of regulation, such as decreased innovation or access to markets, may go unnoticed. The failure to consider these costs can lead to unintended consequences that hurt the very people the regulations were meant to protect.

189   In the context of decentralized finance and crypto assets, regulations that aim to shield investors from risks may also limit diversification opportunities and increase overall risk by deterring investors from venturing into emerging markets and new types of asst forms, e.g., crypto assets, as part of a diversification strategy. Risk-reducing strategies may therefore be perceived as dangerous, despite their potential to prevent avoidable losses, as a consequence of emotional storytelling and given that the potential for a sound loss prevention strategy is deemed unintuitive.

190   From an investor side it is also important to recognize the potential benefits of diversifying into new and unfamiliar asset classes and not let the preference for omission bias hinder investment decisions, which should also be reflected and addressed in regulatory and supervisory policymaking with regard to financial markets.

191   Additionally, the idea of regulating investors or peers to protect them may seem counterintuitive, but it is a practical approach to safeguarding their interests because many investors lack the necessary knowledge and expertise required to make informed investment decisions, making them vulnerable to scams and high-risk investments. Regulations can provide guidelines and standards that ensure investors make informed choices and are protected from fraudulent practices, while also promoting diversification and risk management, which can help mitigate potential losses. Policymakers can use framing effects and nudging techniques to this effect in order to influence investor behavior and encourage responsible investment choices, such as highlighting the potential benefits of a diversified investment portfolio. Such nudges could involve public policies which by design encourage responsible investment choices by suggesting portfolio diversification to lower the risk of loss, rather than just pointing out potential risks of isolated investment choices, which ultimately may be more effective in creating diversified investment portfolios that are inherently less prone to

losses from a statistical point of view, whereas just pointing to the potential risks of an investment choice may only raise awareness of the risks of losses without providing a mitigating strategy. On the other hand, peers acting on truly decentralized systems as outlined under chapter 4 may themselves be classified as service providers, depending on their interactions. In turn it is only logical that such peers may be expose to trade, tax, supervisory or other regulation.

Furthermore, the concept of overconfidence and a false sense of control can lead individuals to believe that they can easily identify social problems and assess potential solutions to resolve them, which can result in harmful and simplistic solutions. This mindset, known as the "fix-it fallacy," often leads to intervention bias, where social policy advocates promote naive solutions to complex problems. However, sometimes a passive response to social or medical problems can be a stronger default option than intuition suggests. Hindsight bias reinforces intervention bias, as people tend to believe they had foreseen events after the fact. It is important to recognize that market institutions have developed to solve problems and thus exist for a reason, and failure to comprehend this aspect can result in implementation of unnecessary regulations.

Related to this, it is important to understand social processes that shape regulatory sentiment, as self-reinforcing feedback loops on financial market regulation which can lead to ever-strengthening regulatory policymaking cascades. To counter such feedback loops, it may be necessary to break the cycle through anticyclical measures, meaning in some cases, an inert or passive response by the legislator may be a stronger default option than implementing (bad) regulations on an ad hoc basis. Concludingly, investors should be more actively encouraged to take on a role in asset portfolio diversification decisions, while policymakers should practice restraint in over-regulating financial intermediaries and institutions.

3.5 Regulation of centralized Finance

In order to discuss the potential application and shortfalls of regulatory mechanisms of centralized finance to decentralized finance, it must first be established what is defined as centralized or traditional financial market. A financial market is a venue where individuals and entities can engage in buying and selling financial instruments and products as part of the financial economy in contrast to the real economy where products and

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services are directly traded and transferred. These financial instruments may include stocks or equity-like instruments, bonds or debt-like instruments and non-equity instruments like derivatives. In financial markets, the term "market" can refer to exchanges that facilitate the trade of financial instruments or in legal terms pursuant to article 4 no 1(21) MiFID II: "*regulated market means a multilateral system operated and/or managed by a market operator, which brings together or facilitates the bringing together of multiple third-party buying and selling interests in financial instruments – in the system and in accordance with its non-discretionary rules – in a way that results in a contract, in respect of the financial instruments admitted to trading under its rules and/or systems, […]*". Financial markets can be divided into different categories, such as capital markets, commodities markets, money markets, derivatives markets, futures markets, foreign exchange markets, spot markets, interbank lending markets and others. The capital markets can be further divided into primary and secondary markets. Primary markets are where newly issued securities may be subscribed to, while secondary markets allow investors to buy and sell already existing and circulating securities. The money market deals with short-term finance, while long-term finance markets are capital markets. Centralized or traditional finance refers to the conventional financial system in which financial institutions and intermediaries, such as banks, investment firms, brokers and other agents, play a central role in providing financial services, including savings and loans, investment management, payment services and insurance. This system is typically regulated by government agencies (national supervisory authorities) and operates within a well-established legal framework. Centralized finance is often contrasted with decentralized finance, which utilizes blockchain technology and cryptocurrencies to create a more open and transparent financial system that operates without intermediaries. Centralized virtual asset service providers or VASPs are however also part of centralized finance falling under regulatory and supervisory provisions (compare in more detail section 4).

195   European legislation like the Markets in Financial Instruments Directive and Regulation (Directive 2014/65/EU or MiFID II, ELI: http://data.europa.eu/eli/dir/2014/65/oj; and Regulation (EU) No 600/2014 or MiFIR, ELI: http://data.europa.eu/eli/reg/2014/600/oj) as well as the final proposal for a Markets in Crypto Assets Regulation (COM/2020/593 final or MiCAR) which is expected to enter into force in 2023 and be fully applicable in 2024 are such regulations of traditional finance (MiFID II and MiFIR) or

centralized finance (MiCAR), as the latter only applies to intermediaries providing virtual asset services.

Regulatory provisions are laws and regulations that set out the rules and requirements for financial institutions, markets, and products. These regulations may cover issues such as disclosure, capital requirements, risk management, and consumer protection. Regulatory provisions are designed to ensure that financial markets operate fairly and efficiently and that consumers are protected from fraud and abuse. Supervisory provisions, on the other hand, refer to the mechanisms used to ensure that financial institutions comply with regulatory provisions. This can include on-site inspections, off-site monitoring, and reporting requirements. Supervisory provisions are typically enforced by regulatory agencies, which have the authority to take enforcement actions such as fines, cease and desist orders, and revocation of licenses. The goal of supervisory provisions is to ensure that financial institutions comply with regulatory standards, thereby promoting sound and compliant operations in accordance with regulatory requirements, in order to safeguard consumers and maintain financial stability.

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Lancaster's concept of commodity characteristics (1966) may be applied to define financial goods or services, which are expected to have three key features: expected rate of return, security, and liquidity. These features are important to buyers, as they impact the utility of the product. The expected rate of return includes the mean yield and forecast gain or loss net of transaction costs. Security refers to the potential range of returns in different scenarios, while liquidity refers to the ease and cost of conversion into an acceptable medium of exchange. Although all risks are typically factored into the expected rate of return, liquidity is still considered one of the crucial characteristics of financial products due to its significance for households and firms (Heffernan, 1990).

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Graham and Dodd (1934) defined an investment operation as one that promises safety of principal and a satisfactory return after thorough analysis. Investment operations that do not meet these requirements are consequently considered speculative. The definition has three crucial components: 1) thorough analysis, 2) safety of principal, and 3) satisfactory return. This is also the origin of value investing. However, when decision-makers face complex data and high levels of uncertainty (such as during investment decision-making), they tend to employ heuristics as a simplification strategy. Nevertheless, these intuitive heuristics are susceptible to cognitive bias errors. To minimize the likelihood of succumbing to cognitive biases,

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Otuteye & Siddiquee (2015) proposed to predefine the decision-making process (or rule) and adhere to it with strict emotional discipline (Otuteye & Siddiquee, 2015).

199   From a legal standpoint there are different jurisdictional interpretations of what may classify as a financial instrument. For example, the Howey Test is utilized by the United States Securities and Exchange Commission (SEC) for determining whether an investment is classified as a security. The test was named after the 1946 U.S. Supreme Court case, SEC v. W.J. Howey Co. To qualify as a security, an investment must satisfy all four elements of the Howey Test, which include the following: 1) an investment of money, 2) an expectation of profit, 3) the investment should be in a common enterprise, and 4) the profits should result mainly from the efforts of others. An investment contract that meets all four elements is deemed a security and subject to federal securities laws and regulations (SEC v. W. J. Howey Co., 328 U.S. 293, 1946).

200   Pursuant to Art 4 no 1(44) MiFID II financial instruments are transferable securities, which in turn are defined as those classes of securities which are negotiable on the capital market – to the exclusion of payment instruments – such as shares in companies, partnership shares, depositary receipts for shares, bonds, depositary receipts for securitized debt, and any other securities that give the right to purchase or sell transferable securities, or result in cash settlement based on transferable securities, currencies, interest rates, yields, commodities, or other measures.

201   The term "*classes*" of securities is not specifically defined under MiFID II. However, according to the European Securities and Markets Authority (ESMA; 2019), it can be understood as interchangeable units that are similar to a certain degree and comparable, having essentially the same rights vis-à-vis the same issuer. This interpretation is consistent with the opinions of different national competent authorities (NCAs). In the context of MiFID II, transferability refers to the legal transfer of ownership between parties and is a necessary condition for negotiability of financial instruments. Negotiability is not directly defined by MiFID II but is interpreted as the ability to effectively and legally trade instruments on a capital market. Transferable securities are considered freely negotiable if they can be traded between parties, subsequently transferred without restriction, and if all securities within the same class are fungible. The capital market in this context is broadly defined as any place where buying and selling interests meet, which does not necessarily have to be regulated. Even if a market has not yet formed, the possibility of trading is sufficient for an instrument to be

considered negotiable. To be classified as transferable securities under Mi-FID II, relevant instruments must be functionally comparable to the typical examples provided in the regulation, such as equity and debt instruments and certain derivatives. The examples in Art. 4(1)(44) are not exhaustive but offer guidance for the classification of other instruments. Relevant instruments must embody a membership or property right comparable to shares or debt securities, with either a profit or return participation right or a financial claim against the issuer and they may not constitute an instrument of payment (ESMA, 2019). Financial instruments under European Union law are therefore defined as transferable securities which are mass-issued, standardized, transferable as well as tradable instruments on the capital market which come with an equity-like or debt like interest or have a derivative character and do not constitute payment instruments.

3.5.1 Considerations when applying behavioral economic findings in real-world situations and policymaking

An important aspect before applying behavioral economic findings to real-world situations and policymaking is to consider the specific context and to critically evaluate the evidence and assumptions underlying the findings. In some cases, the findings may be applicable and useful for guiding policy or decision-making, but in other cases, they may be based on incomplete or flawed data and may not be reliable predictors of behavior. For example Art 1 no 4(b) of the European Prospectus Regulation (Regulation (EU) 2017/1129; ELI: http://data.europa.eu/eli/reg/2017/1129/oj) stipulates that the obligation to publish a securities prospectus shall not apply to an offer of securities addressed to fewer than 150 natural or legal persons per member state (the same applies *mutatis mutandis* to the public offering of crypto assets pursuant to Art 4 no 2(d) of the final proposal of the markets in crypto assets regulation or MiCAR). 202

    This essentially corresponds to the so-called Dunbar's number which is often rounded up to 150. The number was the result of an exploratory extrapolation from regression equations describing how the size of the neocortex affects the size of social groups among primates. The predicted group size for humans was 147.8 (Dunbar, 1993). Although it would make for a nice anecdote the 150-person limit as exemption of public offerings pursuant to EU prospectus regulation is unlikely to have been specifically 203

influenced by Dunbar's research (the fact aside that Dunbar's number has itself been subject to criticism and debate (Lindenfors et al, 2021).

204   The thought mused on above provides an example of another psychological phenomenon, the concept of false pattern recognition or as Sagan (1996, p.45) also called it "the pattern-recognition machinery", which refers to the tendency to see patterns or connections in data or events that are not there and which are actually random or coincidental. While the connection between Dunbar's number and the EU prospectus regulation may seem compelling, it is important to carefully evaluate the evidence and consider alternative explanations before drawing definitive conclusions or making policy decisions based on such make-do notions.

205   Overall, the field of behavioral economics provides valuable insights into how people make decisions and respond to incentives, but it is important to apply these findings with care and critical evaluation in order to ensure their accuracy and applicability in specific contexts.

206   Conversely to the above, made up example, there is another regulatory mechanism, the liquidity coverage ratio or LCR, which is backed by evidence and was introduced in the wake of the 2007-2008 global financial crisis.

207   In December 2010 a new regulatory regime was introduced by the Basel Committee on Bank Supervision (BCBS) in response to the global financial crisis. Basel III strengthened the existing bank capital rules and introduced a global framework for liquidity regulation for the first time. The framework included the LCR, which requires banks to hold enough highly liquid assets in order to endure market stress for a period of at least 30 days (Keister & Bech, 2012).

208   One of the most well-known externalities or spill overs that pose a risk to the financial system is the occurrence of fire sales by individual banks under duress from their short-term lenders, which can depress asset prices, which in turn may cause a chain reaction resulting in contagion and failure of many banks. Several studies, such as Korinek and Jeanne (2020), Gertler, Kiyotaki, & Prestipino (2016), Brunnermeier & Sannikov (2014), Gertler, Kiyotaki & Queralto (2012), have analysed this issue and found that greater capital adequacy ratios than what individual banks would decide upon are needed to counter these undesirable spill overs. These studies recommend that capital ratios be set such that the constraints on banks' capital do not bind frequently during normal times. Furthermore, according to Gertler and Kiyotaki (2015), the risks faced by banks are significantly increased

by the potential occurrence of bank runs, which means that even higher capital ratios are necessary.

Cifuentes, Ferrucci, and Shin (2005) suggest that liquidity buffers, along with capital, can help mitigate the risks of bank failures and contagion caused by fire sales. Perotti and Suarez (2011) propose that liquidity requirements and Pigouvian taxes can also help address the systemic risks caused by financial intermediaries' excessive reliance on short-term funding by internalizing the externality of systemic fire-sales. Pigouvian taxes are taxes designed to address externalities, which occur when costs or benefits affect third parties who are not directly involved in a transaction. They aim to correct market failures by increasing the cost of activities that generate negative externalities until the social cost and private cost are equal. In the financial system, Pigouvian taxes can be applied to discourage excessive risk-taking and activities that generate negative externalities, thereby encouraging financial institutions to take into account systemic risks. According to Boissay, Collard, & Smets (2016) and Boissay & Collard (2016), regulating capital and liquidity can effectively prevent the accumulation of excessive liquidity in the economy and the resulting decrease in lending quality In their framework, optimal policies using capital and liquidity tools can eliminate the occurrence of a banking crisis caused by an interbank market collapse.

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Kashyap, Tsomocos & Vardoulakis (2014) also advocate that liquidity and capital tools can be used to prevent bank runs. Morris & Shin (1998; 2001) in their framework, called "*global games*", treat bank runs as endogenous and propose higher capital ratios and tools similar to the liquidity coverage ratio (LCR) or the net stable funding ratio (NSFR) to reduce the probability of such bank runs.

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While the LCR is a risk mitigating mechanism aimed at financial institutions, other regulatory mechanisms at an investor level which might be applied by design or by default as a policy could refer to stop-loss rules. As Kaminski and Lo (2014) showcased, whether stop-loss rule can stop losses depends "*on the return-generating process of the underlying investment as well as the specific dynamics of the stop-loss policy itself.*" They demonstrated that stop-loss policies can generate a positive stopping premium "*under more empirically plausible return-generating processes such as momentum or regime-switching models*", in contrast to Lei and Li (2009), who argue that the benefits of such strategies mainly come from reducing risk, rather than enhancing returns.

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212   The implementation of particular stop-loss policies can increase the effectiveness of a portfolio compared to simply buying and holding, and significantly lower risk by decreasing the volatility of the strategy, which is applicable in real-world situations. These aspects intersect with the behavioural finance literature (flight-to-safety, disposition effect, ambiguity aversion, loss aversion, etc), which suggests that different regions of the brain are responsible for handling gains and losses and that investors may make irrational trading decisions following significant losses. Stop-loss policies may be effective because of the non-linear characteristics of stock and bond returns, where avoiding downward momentum and taking advantage of "*asymmetries in asset returns following periods of negative cumulative returns*" can be beneficial (Kaminski and Lo, 2014).

213   This implies that regulators could consider implementing stop-loss policies or encouraging their use in certain contexts. Additionally, the study highlights the importance of considering non-linearities and behavioural factors in financial regulation. Regulators should take into account the potential impact of cumulative losses and the disposition effect on market dynamics, as well as the possibility of irrational forces temporarily dominating the market during times of significant losses.

214   An opposite example, which might arguably fall under the "*bad regulation*" section for maintaining financial market stability is the definition of persons known to be close associates of politically exposed persons (PEPs) which, as per FATF (Financial Action Task Force) Guidance on politically exposed persons, recommendations 12 and 22, (2013), are individuals who are closely connected to a PEP, professionally, but also socially or politically. While the incrimination of mere social connections is problematic if they lead to exposure and burdens when acting on financial markets, the regulation can be too broad, leading to potential privacy violations. One potential solution to this for centralized as well as decentralized finance could be the use of privacy-enhancing tools, which would only identify historical transactions and their beneficiaries when necessary or indicated rather than by default.

215   However, with regard to PEPs or other due diligence questions recent court decisions in Liechtenstein and Austria have emphasized the importance of the protective purpose of bank and insurance supervision regulations. In the case OGH 05 CG.2017.107, LES 2020 156 in Liechtenstein the Liechtenstein Supreme Court found that anti-money laundering standards in the Due Diligence Act did not have a protective purpose for the individual client, but rather aims to protect the financial system and state

interest in combating money laundering, organized crime, and terrorism financing. The court rejected the plaintiff's argument that the bank had violated its duty of care under the Due Diligence Act and the claim for damages was dismissed. From a methodological point of view, the decision was criticized for not differentiating between the objectives of a law and its protective effects (Stern, 2022).

3.5.2 Who does banking regulation protect?

A central question which is not as obvious as it may seem is who banking regulation is supposed to protect. There are opposing interests of individual investor protection and the protection of financial market stability on a collective level. In order to shed light on the change over time of the answer to this question, at least from a European centered perspective, a selective assessment of guiding decisions of the Austrian Supreme Court under consideration of European law and decisions of the European Court of Justice is made. The focus was on put on overarching objectives and policy implications and how public policy – subject to the relativism of societal values, may change over time and thus be interpreted differently.

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3.5.3 Case study 1

A legal case decided by the Austrian supreme court in 2006 (ECLI:AT:OGH0002:2006:0010OB00142.06Y.1017.000) involved a bank that purchased bonds from another bank which subsequently went bankrupt. The bonds were not intended to be kept in the purchasing bank's assets but rather to be resold to customers. At the time of purchase, the selling bank was already insolvent, which was not known by the purchasing bank's board. When the insolvency of the selling bank was announced, the bonds were still held by the purchasing bank. The bankruptcy administrator of the purchasing bank sued to recover the loss caused by the bond purchase. The court found that the purchasing bank was not protected by the relevant banking regulations, and thus no government liability existed. The court also determined that the purchasing bank's claim for damages was not valid, as the bank's board had failed to exercise appropriate due diligence in purchasing the bonds. Finally, the court found that the bond purchase was not causally linked to the failure of the government to super-

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vise the selling bank, as the board of the purchasing bank would not have purchased the bonds had it known the selling bank was insolvent.

218   The legal assessment in this case revolved around the question of whether a bank that purchased bonds from another bank, which later became insolvent, has a right to claim compensation under the Austrian Official Liability Act (Amtshaftungsgesetz) for the failure of the banking supervisory authority to exercise its oversight duties. According to Austrian law, a mere financial loss is not sufficient to trigger liability under official liability statute. Instead, the claimant must show that the supervisory authority violated an absolute right, breached a protective statute, or engaged in reprehensible behavior. In this case, the only potential ground for liability is a breach of a protective statute. However, for liability to exist, the breached regulation must have been intended to protect the claimant against financial losses. This requirement is met if the violated norm had the prevention of financial harm as one of its purposes.

219   The Austrian Banking Act (Bankwesengesetz) at that time stipulated that the banking supervisory authority, under the supervision of the Federal Ministry of Finance, is responsible for ensuring compliance with banking regulations and protecting the interests of depositors and creditors. The primary goal of the Act is to ensure the functioning of a stable banking system in the interest of the national economy. However, the Act also aims to protect creditors of banks from losses resulting from banking transactions. Therefore, the Austrian government was in general deemed liable for the violation of its oversight duties towards the creditors of a bank. Ultimately the court ruled that the claimant cannot seek compensation under the Official Liability Act for other reasons, as the claimant, as a distributor of the bonds, was acting on its own behalf and not on behalf of the bank's creditors. Therefore, the banking supervisory authority had no duty to protect the claimant's financial interests in this case as there was no breach of a protective statute that was intended to protect the claimant from financial harm.

220   The European Union already had a different approach to bank regulation at that time, which allows member states to exercise banking oversight solely in the public interest (ECLI:EU:C:2004:606). Under this approach, depositors and investors have no individual rights to banking supervision. Instead, the EU requires member states to provide deposit insurance schemes to protect the interests of depositors. The EU Court of Justice has ruled that as long as the deposit insurance scheme is in place, individuals cannot claim compensation for a lack of banking supervision.

3.5.4 Case study 2

Another case in front of the Austrian Supreme Court decided in 2007   221
(ECLI:AT:OGH0002:2007:0010OB00269.06Z.0327.000) concerned the in-
solvency of an Austrian bank that occurred due to fraudulent behavior of
its management and inadequate internal controls, which were confirmed
as such by the bank's auditors, who nevertheless reported that the controls
were satisfactory. As a result, the bank supervision authorities were not
alerted, and the bank's insolvency caused significant losses for its deposi-
tors. To provide them with additional compensation beyond the statutory
deposit insurance, the Austrian banking associations established a support
organization, which issued a notice inviting depositors to submit claims
for redemption of their deposits up to a certain amount. The support
organization later paid out over EUR 4 million to depositors, including
those who had filed claims with the deposit insurance scheme. The support
organization subsequently sued the Republic of Austria for compensation
for the losses incurred by depositors, alleging that the fraudulent activities
and inadequate controls were the result of the negligence of bank auditors,
who were regarded as officials of the state. The lower courts found in
favor of the support organization, ruling that the auditors were indeed state
officials and that the organization was entitled to seek compensation for the
losses incurred by depositors. The Republic of Austria appealed the ruling
to the appellate court, which confirmed the lower courts' decision.

The Austrian Supreme Court rejected the argument of the Republic of   222
Austria that the application of the Official Liability Act to bank supervi-
sion, including the treatment of bank auditors as part of the supervisory
authority, is contrary to EU law. The court confirmed its previous decisions
recognizing claims for damages based on official liability of the Republic of
Austria for the mistakes of bank auditors. The court argued that granting
claims for damages in certain exceptional cases does not violate EU law, as
it is a sanction for wrongful and unlawful behavior. The court also clarified
that the fact that bank auditors are required to be "independent" under EU
law does not contradict the liability of the supervisory authority for their
mistakes.

The court further addressed the issue of whether the claims for damages   223
of depositors have been transferred to the plaintiff. While the court found
that the lower court's decision on the transfer of claims was not sufficiently
reasoned the court then argued that, in the absence of a specific contract,
the transfer of claims can be inferred from the circumstances. In this case,

the Austrian Supreme Court found that the transfer of claims includes not only the claims against the bank but also the claims for damages against the supervisory authority. The court argued that it is reasonable to assume that the parties would have agreed on the transfer of all claims, including the claims for damages, if they had been aware of their existence. The court noted that the payment made by the plaintiff to the depositors fully satisfied their claims and that allowing depositors to retain their claims for damages would result in double compensation, which was not intended by the parties.

224   Overall, the decision provides a detailed legal analysis of issues such as the liability of the supervisory authority for the mistakes of bank auditors, the transfer of claims for damages, and the plaintiff's standing to bring the claim for official liability.

3.5.5 Case study 3

225   In a more recent case decided by the Austrian Supreme Court in 2022 (ECLI:AT:OGH0002:2022:0010OB00091.22X.0714.000) a plaintiff was seeking compensation from the defendant, the Republic of Austria, for damages incurred as a result of the defendant's alleged failure to perform its supervisory duties over a bank. The plaintiff argues that the defendant's failure to exercise proper oversight and initiate legal action against the bank's management allowed fraudulent and criminal activities to occur, leading to the bank's collapse and the plaintiff's loss of funds.

226   The court rejected the plaintiff's claim, arguing that the defendant was not responsible for the protection of the plaintiff's assets but only for ensuring the stability of the banking system as a whole. The court also found that the defendant's official liability was limited by law and did not extend to the protection of individual creditors or depositors. The court held that the plaintiff's claim was therefore not legally justified, and the defendant was not liable for the plaintiff's losses. The court also rejected the plaintiff's arguments that other government agencies, such as the state prosecutors and the bank's auditors, were responsible for the bank's failure and, as such, liable for the plaintiff's losses.

227   Regarding governmental liability, the court notes that under the Austrian Act on Official Liability, public entities are liable for damages caused by their officials in the course of carrying out their duties, if such officials acted unlawfully and with fault. However, for a claim for mere financial

loss to be successful, it must be shown that the unlawful behavior violated an absolute legal right, a protective law, or constituted conduct contrary to morality.

The court also explains that the principle of the purpose of the law is an essential criterion for determining the scope of official liability. The purpose of the norm is a separate criterion of liability alongside unlawfulness and causation. Both the claimant and the nature and origin of the damage must fall within the scope of the norm's protective purpose. The court emphasizes that not every protection that a norm provides is relevant to the determination of the scope of official liability. The court stresses that failure to consider the limits of the causal connection between the unlawful conduct and the damage would result in an unlimited scope of liability for public entities. Therefore, it is crucial to examine whether the legal obligations of a public entity exist solely in the interest of the general public or also in the interest of the specific individual harmed by the unlawful conduct. If the protective purpose of the norm only concerns the interests of the general public, any impact on individual interests would be considered mere reflex effects, which would not be sufficient to establish official liability.

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Furthermore, the liability of the Financial Market Authority (FMA) for damages caused by its employees or bodies in the execution of federal laws was addressed. Due to legal amendments the official liability of the FMA got restricted in contrast to the first two cases discussed before. The new provision limited the definition of damages to those directly caused to legal entities subject to supervision. The purpose of the amendment was to exclude damages that only have a reflex effect on the assets of third parties from the obligation to compensate. The constitutionality of this provision was challenged, but the Constitutional Court upheld it, stating that the aim of the provision is to limit liability to directly affected legal entities subject to FMA supervision. The court further clarified that the purpose of banking and financial market supervision is to ensure the smooth functioning of the sector as a vital part of the economy, and therefore, the protection of creditors is only an abstract or institutional protection. As a result, only the directly affected supervised legal entities are entitled to compensation under the public liability law.

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Additionally, the court referenced older literature that suggests that from a European Union law perspective, it is not necessary to grant bank creditors claims for damages resulting from a breach of supervisory duties. It is further explained that the European Union's banking supervisory

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objectives focus on specific mechanisms and are not designed to protect individual creditors. The European Court of Justice (ECJ) confirmed that national authorities responsible for supervising credit institutions cannot be held liable for damages resulting from inadequate supervision if there is an EU directive in place ensuring the compensation of depositors (ECLI:EU:C:2004:606; ECLI:EU:C:2021:249). The European Union's legal framework has not significantly changed since this decision, and the EU legislature has not indicated a desire to impose strict liability on national supervisory authorities or states for damages resulting from inadequate supervision. The author also discusses the requirements for a successful claim of state liability under EU law, which includes the existence of a concrete EU legal norm that grants individual rights, a sufficient degree of qualification of the infringement, and a causal link between the damage and the infringement. In the case at hand the Austrian Supreme Court did not initiate a preliminary reference procedure with the ECJ under Article 267 TFEU (Treaty on the Functioning of the European Union).

231   The legal case analyzed above highlights a shift in banking regulation from prioritizing individual investor protection to prioritizing collective financial market stability. This shift is evident in the rulings that exempt the state from liability for damages caused by a bank's failure to protect individual investors, which ultimately resulted out of deficiencies in supervision, as well as in the legal rationale for these rulings, which emphasizes the importance of maintaining the stability of the financial system as a whole. The decisions reflect a recognition that individual investor protection is sufficiently met by deposit protection schemes (limited to EUR 100'000.-) and that above that banking supervisions pursues the purpose of ensuring the stability of the financial system as a whole and therefore banking supervision focuses more broadly on the overall health of the financial markets.

232   Likewise, Stern (2021) argues that the protection of individual creditors is not the purpose of banking supervision, and that limitations on state liability for damages are necessary to avoid moral hazard, noting that the debate over the purpose of banking supervision in Austria has been reignited by the Commerzialbank Mattersburg case, as well as more relevant internationally, the Wirecard scandal.

233   The European law and regulations aim to harmonize banking regulations and ensure financial stability, soundness of banks, protection of investors, and prevention of criminal activities. However, the European lawmakers have not explicitly defined the purpose of banking supervision, and there is no hierarchy or ranking of objectives. As it is, the primary objective of

banking supervision is to ensure the functioning of banking and financial markets, as it forms the basis for achieving other goals such as investor protection and financial stability (Stern, 2021). While the general definition of goals by the European policymaker is high, this makes it difficult to deduct a more concrete purpose of banking supervision. It is important to protect against the undermining of prudential supervision objectives, with one such structural goal being minimizing costs for taxpayers as much as possible (recital 5 of the Bank Recovery and Resolution Directive or BRRD; ELI: http://data.europa.eu/eli/dir/2014/59/oj) and another structural goal being equal competition in the European single market (Stern, 2021).

The European bank regulatory system has a variety of prudential and supervisory instruments to internalize the potential and extent of a creditor or systemic threat. These are largely designed to reduce the risk before the outbreak of a financial crisis, including requirements for minimum equity, bail-in capital instruments, and liquid assets. To ensure critical functions of financial intermediaries, the resolution authority may even interfere with the rights of creditors, for example, write off liabilities or convert them into equity as part of a bail-in. This may involve bank rescue at the expense of creditors. The focus of the bank supervision may be subsumed to be on the institutions and the financial system, rather than the interests of individual creditors, although there are certain protections in place, such as deposit guarantee schemes. The instruments are calibrated to reduce the probability of a bank's failure, thus contributing to financial stability, which in turn promotes confidence in the financial markets. The protection of individual creditors is not explicitly demanded by these prudential requirements (Stern, 2021). | 234

3.5.6 Interim conclusions

In conclusion, various aspects of banking regulation, supervision, and liability, focusing on recent court cases in Austria and the broader European context have been explored. | 235

Effective banking regulation requires a delicate balance between protecting individual investors and ensuring the stability of the financial system as a whole. Behavioral economics can provide valuable insights into how people make decisions and respond to incentives (or more general: nudges), but their findings must be applied with care and critical evaluation in order to ensure their accuracy and applicability in specific contexts. Addi- | 236

tionally, regulators should consider non-linearities and behavioral factors in financial regulation, and should take into account the potential impact of cumulative losses and the disposition effect on market dynamics. Finally, there has been a shift in banking regulation from prioritizing individual investor protection to prioritizing collective financial market stability, which has been reflected in recent legal rulings in Austria and Liechtenstein, in line with European decisions. The purpose of banking supervision is to ensure the stability of the financial system as a whole, and limitations on state liability for damages are necessary to avoid moral hazard.

237   Key principles and core statements that emerged include:

- The purpose of banking supervision is to ensure the functioning of banking and financial markets, as it forms the basis for achieving other goals such as investor protection and financial stability.
- The protection of individual creditors is not the primary purpose of banking supervision, and limitations on state liability for damages are necessary to avoid moral hazard.
- The liability of supervisory authorities or states for damages resulting from inadequate supervision is limited, and individual creditors may not have a claim for damages resulting from a breach of supervisory duties.
- The European bank regulatory system has a variety of prudential and supervisory instruments to internalize the potential and extent of a creditor threat or systemic threat. These are largely designed to reduce the risk before the outbreak of a financial crisis, including requirements for minimum equity, bail-in capital instruments, and liquid assets.

238   Overall, these principles highlight the tension between individual creditor protection and the broader goals of financial stability and market functioning. While individual creditors may not have a direct claim for damages resulting from inadequate supervision, various prudential and supervisory instruments are in place to reduce the risk of bank failure and promote confidence in the financial markets. The case of the Silicon Valley Bank (SVB) in California early in 2023 demonstrated a different approach in the US, where essentially a bail-out occurred with the deposits being restituted to depositors, while the bank itself, along with investors, etc, won't be saved.

4 Application of regulatory mechanisms to decentralized finance

Decentralized Finance (DeFi) is a rapidly emerging area of finance next to traditional centralized financial institutions with decentralized protocols that are blockchain-based or operate on another distributed ledger technology. DeFi leverages the power of smart contracts, which are self-executing contracts which may have the terms of an agreement between a buyer and a seller directly written in code. This technology enables financial transactions to occur without the need for intermediaries such as banks, allowing for faster, cheaper, and more transparent financial transactions (Bergt, 2020). As DeFi continues to grow, it is important to consider how regulatory mechanisms can be applied to ensure its safety and stability. This chapter will explore the application of regulatory mechanisms to DeFi coming from a centralized finance perspective.

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The term "*smart contract*" was coined by Szabo (1994): „*A smart contract is a computerized transaction protocol that executes the terms of a contract. The general objectives of smart contract design are to satisfy common contractual conditions (such as payment terms, liens, confidentiality, and even enforcement), minimize exceptions both malicious and accidental, and minimize the need for trusted intermediaries. Related economic goals include lowering fraud loss, arbitration and enforcement costs, and other transaction costs. Some technologies that exist today can be considered as crude smart contracts, for example POS terminals and cards, EDI, and agoric allocation of public network bandwidth.*" The name smart contract, which refers to a contract, is rather misleading, especially since a smart contract represents a tamper-proof, self-verifying, and self-executing script. While such a script can indeed also represent a contract in a legal context, since contracts can also be concluded verbally or implicitly, not all smart contracts are actually contracts or even smart for that matter (Bergt, 2020). In the words of Buterin (2018): „*To be clear, at this point I quite regret adopting the term 'smart contracts'. I should have called them something more boring and technical, perhaps something like "persistent scripts."*"

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In his manifesto on smart contracts, Szabo (1994) suggests that the considerations for smart contracts go even further back to the so-called agoric computing, which has its origins in the 1970s and 1980s (cp. Drexler & Miller, 1988; Miller & Drexler, 1988; Bergt 2020).

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4.1 Decentralization shams vs real DeFi

242 DeFi is a distributed-ledger-technology-based or blockchain-based financial infrastructure that offers open, transparent, and secure transactions without relying on intermediaries or centralized institutions. The backbone of DeFi is smart contracts, which are programs executed by a large number of validators and that are stored on a blockchain, ensuring security and transparency. Blockchains essentially solved the double-spending problem of decentralized systems. Smart contracts allow for flexibility and customizable criteria for storing and releasing assets. DeFi may ultimately lead to a more open and resilient financial system (Schär, 2021). Distributed ledger technology enables public, decentralized, and permanent storage of data through token-based transactions, which represent specific economic values (Bergt, 2020, p. 6). Transactions on blockchains are facilitated by decentralized apps, known as smart contracts, which follow "if-then-else" logic (Bergt, 2020, p. 10; Nägele, Bergt, 2018). The various types of transactions on a blockchain include peer-to-peer, human-to-machine, or machine-to-machine (Mehrwald et al, 2019; Bergt, 2021a). Blockchain technology offers public visibility of stored transactions while ensuring permanence and immutability through cryptographic hash functions and decentralization (Bergt, 2020, p. 7). In an ideal scenario, blockchain allows for tamper-proof, distributed record-keeping and transfer of values, while ensuring consensus through cryptographic mechanisms (Böhme et al, 2015; Glaser, 2017; Bergt, 2021a).

243 In the more expansive interpretation of sharing economy (Lessig, 2008) and peer-to-peer markets by Perren and Kozinets (2018), these markets are characterized as instances of lateral exchange markets. A lateral exchange market can be described as a market established via an intermediating technology platform that enables exchange activities among a group of economically equivalent actors (Perren and Kozinets (2018; Bergt, 2021a). These lateral exchange markets or LEM form a higher-level definition including decentralized exchanges or DEX with regard to crypto assets.

4.1.1 Types of blockchains

244 A database refers to a structured storage of data that is simple to access, handle, and modify. Similarly, a blockchain is a digital ledger that stores data in a decentralized and distributed manner, with each block containing

a set of transactions that are linked together in a chain. Like a traditional database, a blockchain allows for the storage and retrieval of data. However, the key difference between a blockchain and a traditional database is the way in which data is stored and secured. In a traditional database, data is stored in a centralized location, such as a server or a data center, and can be accessed and updated by authorized parties with appropriate permissions. In contrast, a blockchain stores data across a network of computers, with each node containing a copy of the entire ledger. This decentralized architecture makes it more secure and resistant to tampering or hacking. In summary, a blockchain can be thought of as a specific type of database that is distributed, decentralized, and secure (Bergt, 2020, p. 7; 2021a; 2021b).

The types of blockchains can be summarized as a matrix of read and write rights, as follows:

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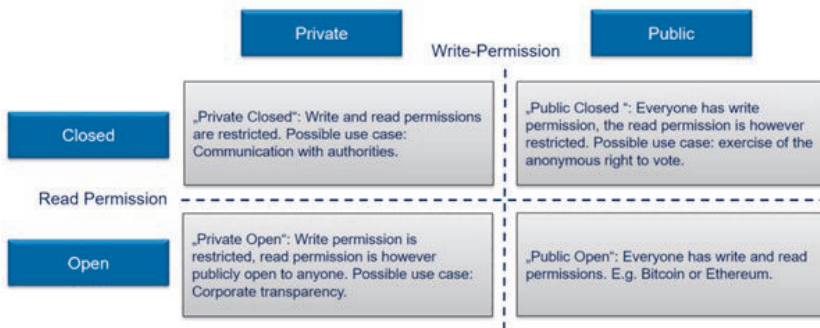
Figure 2:   Blockchain type matrix based on read and write rights (Bergt, 2020).

By classifying blockchains based on their read and write rights, we can better understand the different use cases and advantages of each type. For example, public blockchains are more decentralized and provide greater security and transparency, while private blockchains offer greater control and privacy for enterprise applications.

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Different variations have emerged from these types. On public blockchains anyone can read and write. Public blockchains are open to everyone and allow anyone to participate in the network, read the data, and submit transactions. Examples of public blockchains include Bitcoin and Ethereum. Whereas on private blockchains only designated parties can read and write. Private blockchains are permissioned and only authorized parties can participate in the network, read the data, and submit transactions.

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Examples of private blockchains include Hyperledger and Corda. There are also consortium blockchains, where a group of designated parties can read and write. Consortium blockchains are similar to private blockchains, but they are controlled by several organizations rather than one individual or entity. Examples of consortium blockchains include R3 Corda and Quorum. Then there are hybrid blockchains. As a combination of public and private blockchains hybrid blockchains combine the features of public and private blockchains, allowing certain data to be kept private while also allowing for public access to some parts of the network. Examples of hybrid blockchains include Dragonchain and Ardor.

4.1.2 The decentralization promise of DeFi

248 The analysis of the allocation of tokens in Decentralized Finance (DeFi) protocols is crucial in understanding the protocols' decentralization efforts. Decentralized Finance (DeFi) is a stack of protocols that is both composable and trust-minimized, built on public blockchain networks, and employs smart contracts to construct publicly accessible and interoperable financial services. Most DeFi protocols issue tokens that represent partial protocol ownership and entitle holders to vote on contract upgrades or parameter changes and participate economically in the protocol's growth. Therefore, token allocation plays a crucial role in the protocols' decentralization efforts because a strongly centralized token distribution can lead to a number of super-users unilaterally modifying the protocol (Nadler & Schär, 2020).

249 Previous academic research on DeFi token distribution is limited, and the few analyses available severely overestimated ownership concentration. Thus, to address this gap, Nadler and Schär (2020) suggested an iterative mapping procedure that enables the separation of combined token possessions from custodial and escrow arrangements and allocates them to the respective ultimate beneficial owners. This approach considers liquidity pools, lending pools, staking pools, and token wrappers, and is applicable for dissecting token ownership, even in cases with multiple layers of nesting.

250 Their data indicated that DeFi tokens tend to have a relatively centralized ownership distribution, which raises important questions regarding protocol decentralization. Specifically, the minimum number of addresses required to achieve a majority might be especially significant for protocols

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utilizing token-based governance models, as it could suggest a greater probability of collaboration and centralized decision-making (Nadler & Schär, 2020).

Additionally, the research highlights the constraints of DeFi in terms of transparency. Although DeFi is highly transparent as most data can be found on-chain, gathering and presenting this information in an easily understandable format is difficult. The presence of multiple protocols, high nesting levels, and token wrappers can be too complex for the majority of users and analysts, necessitating the use of advanced analytical tools (Nadler & Schär, 2020). 251

DeFi represents a fast-expanding financial framework, yet there is a specific danger that elevated ownership concentration and intricate wrapping structures could introduce governance risks, compromise transparency, and generate substantial interdependence that impacts protocol stability. Future studies may utilize the methods presented in this paper to examine token attributes within the realm of governance models, employing the data as a factor for more accurate simulations and game-theoretical governance models (Nadler & Schär, 2020). 252

4.1.3 DeFi architecture

To understand the various DeFi building blocks and their roles within the DeFi architecture, Schär (2021) suggests adopting a multi-layered approach, whereas it's crucial to note that this framework follows a hierarchical structure, meaning that errors in lower levels will be dragged on to the higher levels. The first layer or settlement layer consists of token standards, which are technical specifications that define how tokens are created, transferred, and interacted with (e.g., on the Ethereum blockchain). Token standards provide a common interface for different smart contracts and applications to communicate and interact with one another, which is essential for creating a highly interoperable financial system. The most widely used token standards in DeFi are ERC-20 and ERC-721 based on the Ethereum protocol, which define fungible and non-fungible tokens respectively and lead over to the second layer or asset layer (Schär, 2021). 253

The third layer or protocol layer of the DeFi ecosystem is composed of decentralized, peer-to-peer services, like decentralized exchanges (DEXs or Lateral Exchange Markets; LEM), decentralized lending, etc, which enable peer-to-peer trading or lending of cryptocurrencies and other digital assets 254

without the need for an intermediary. DEXs are a set of smart contracts and allow users to trade directly from their wallets, thereby eliminating the need for custody or custodians or other intermediation (Schär, 2021).

255   The fourth layer in the DeFi ecosystem is the application layer which focuses on customer applications that interface with specific protocols. Typically, the front end of these applications is a web browser-based interface for the interaction with smart contracts, making the protocols more accessible to users. The fifth or aggregation layer s an expansion of the application layer, where aggregators develop platforms for users that connect to multiple applications and protocols. These platforms often provide users with tools to compare and evaluate services, enable them to execute complex tasks by simultaneously connecting with multiple protocols, and present information in an easy-to-understand format (Schär, 2021).

Layers	Components
1 – Settlement layer	Blockchain platforms and networks that provide settlement infrastructure
	Native protocol tokens
2 – Asset layer	Fungible tokens and non-fungible tokens
3 – Protocol layer	DeFi protocols that provide p2p liquidity, lending, and other financial services
4 – Application layer	Front-end user applications that allow users to interact with DeFi protocols and manage their assets
5 – Aggregation layer	Aggregator services that combine and optimize transactions across multiple protocols and platforms

Figure 3:   Multi-layered DeFi architecture following Schär (2021).

256   The levels of Schär's (2021) DeFi architecture or DeFi stack may be summarized as follows:

- Layer 1: Settlement layer consisting of the blockchain and native protocol asset for secure ownership and state changes.

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- Layer 2: Asset layer consisting of native and additional assets issued on the settlement layer.
- Layer 3: Protocol layer providing standards for particular use-case-scenarios like decentralized exchanges, on-chain asset management, derivatives and debt markets.
- Layer 4: Application layer creating user-oriented applications with web browser-based front ends for easy use.
- Layer 5: Aggregation layer extending the fourth layer with user-focused platforms that link multiple applications and protocols, providing instruments for comparison and rating services, and combining information.

4.1.4 Decentralization shams and other supervisory challenges

Regulating a truly decentralized infrastructure is a questionable task for regulators. However, pursuant to Schär (2021), two aspects demand particular focus: fiat entry and exits points or on- and off-ramps as well as the decentralization theater or decentralization shams. The on-ramps and off-ramps for legal tender are the connection points between the centralized financial system and blockchain-based or decentralized systems. To move assets between these two systems, people have to use regulated centralized financial service providers, who may require background checks on the origin of funds and so forth. Likewise, it is essential to differentiate between genuinely decentralized protocols and projects that merely purport to be decentralized but are under the control of a few individuals or organizations. This kind of "*decentralization theater*" – the term coined by Schär (2021) – can create reliance on centralized operators with little to no supervision, if any. In light of this, it is important for regulators to diligently observe and thoroughly assess DeFi protocols to determine if they are genuinely decentralized (up to layer three pursuant to figure 3 above) or if they are using the DeFi label as a facade to avoid regulation. 257

  As genuine decentralized finance (DeFi) offers an alternative solution by utilizing public blockchain networks to conduct transactions, thereby eliminating the need for intermediaries such as custodians, central clearinghouses, and escrow agents, by using smart contracts stored on public blockchains and executed as part of the system's consensus rules, ensuring that all participants comply with the rules before engaging and verifying the accuracy of the execution, to execute the functions of these intermediaries, it is important to be able to differentiate between true decentraliza- 258

tion and decentralization shams. In the context of DeFi, smart contracts are mainly utilized to ensure the simultaneous transfer of two assets or to hold collateral in an escrow account, both of which are subject to predefined conditions. This characteristic of DeFi can effectively mitigate counterparty risk, which is the risk of other parties failing to meet their end of the deal, as the assets can only be released if the predefined conditions are met (Schär, 2022).

259   Despite the promising benefits of DeFi, several potential pitfalls also exist. Security concerns, such as smart contract vulnerabilities and attacks on the blockchain network, pose significant risks. Regulatory issues can also pose challenges, given DeFi's inherent decentralized structure. Nonetheless, DeFi may represent a promising solution to the challenges posed by the centralized financial system (Schär, 2022).

260   Although decentralized infrastructure can provide various advantages, many of these aspects may also be achieved through centralized systems. As such, smart contracts, can also be used on both decentralized and centralized infrastructure. In terms of efficiency centralized systems perform better than decentralized infrastructure, although it argued by Schär (2022) that this argument rests on the assumption of trust in intermediaries and that centralized institutions are benevolent, which does not always hold true. Nevertheless, as pointed out under chapter 4.2.2, trust still plays a role in decentralized finance and may shift from intermediaries to intermediating technology platforms.

261   Public blockchains offer several benefits due to their transparency, neutrality, and accessibility. They provide a neutral, independent, and immutable infrastructure for financial transactions as they are not controlled by a single entity. The data is readily available and verifiable, for everyone, including researchers and policymakers, allowing for real-time analysis. Access to public blockchains is not restricted, providing a neutral foundation that cannot discriminate between use cases or stakeholders. Conversely, permissioned ledgers have rules set by a centralized entity, leading to the politicization of the rights to access and use the infrastructure (Schär, 2022).

262   As established, DeFi is built on a layered infrastructure, where certain smart contracts may be deployed on top of it coming with or without restrictions for different reasons. However, such restrictions, if any, can be implemented without compromising the decentralized foundation of the infrastructure. If the core protocol itself would be centralized, it would in turn be impossible to add decentralization in higher layers (Schär, 2022).

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Decentralized finance (DeFi) has several challenges and risks that must be taken into account, despite its many advantages. The first challenge is the risk of decentralization shams, where some market players claim to work on decentralized protocols but provide centralized infrastructure instead. People holding admin keys or with a large share of governance tokens can also exert influence on DeFi protocols. The issue of immutability presents a second challenge as it can create new risks such as difficulties in protecting investors and programming errors that can have severe consequences. The complex token wrapping schemes and composability also contribute to shock propagation in the system, which can pose significant challenges to the real economy. The transparency of the blockchain, which is the third challenge, may not be desirable from a privacy perspective and additionally transactions may be intercepted and front-run, resulting in yields being extracted to the detriment of the original principal. Lastly, scaling public blockchains presents the fourth challenge as there is a trade-off between security, decentralization, and scalability due to the costs of decentralized block creation and external hardware costs (Schär, 2022).

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Front-running poses a particularly problematic issue from a regulatory point of view and could be a reference point for future policymaking. On the one hand front-running refers to the use of insider-information on the other hand transactions that have not yet been processed may be scanned by front-running bots or AI tools and offer a higher gas fee to ensure that its own transaction is processed before others. This allows it to take advantage of upcoming trades that may influence market prices. While front-running is considered illegal in traditional stock markets due to the use of insider information, these regulations do not necessarily apply to crypto assets and in addition, in the crypto market all information is publicly available through digital ledgers. Therefore, front-running is not considered illegal in this context. Market abuse is the act of using information in a way that harms other financial market investors or gives an unfair advantage to the abuser. This can be done in three ways: by using information that is not available to the public, by spreading false information, or by manipulating financial instrument pricing mechanisms. Elements of market abuse may be applicable to front-running in crypto markets and might be of particular interest of public policymakers. The European Market Abuse Regulation (MAR; (EU) No 596/2014, ELI: http://data.europa.eu/eli/reg/2014/596 /oj) identifies three types of market abuse. The first being insider dealing, which involves using confidential information to execute, change or cancel trades or to encourage others to trade using that information. The second

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being unlawful disclosure of inside information, by releasing confidential information without the proper authorization and the third being market manipulation, which encompasses a variety of actions intended to distort the performance of the market. Again, the European MAR does not apply to crypto assets, unless they are also financial instruments (i.e., security tokens). However, as crypto assets are undoubtedly part of the financial market, abusive and distorting actions with regard to the performance of crypto markets might be grounds for future regulation.

4.1.5 Interim conclusion

265   Decentralized Finance (DeFi) is a financial infrastructure based on blockchain technology which holds promise for a more open, transparent, and secure financial system. Its backbone is smart contracts, which offer flexibility and customizable criteria for storing and releasing assets, with the potential to lead to a more resilient financial system. However, there are challenges in regulating DeFi, particularly in distinguishing between genuine decentralization and "*decentralization theater*." While it remains questionable whether true DeFi can or should be regulated the emergence of DeFi presents a unique opportunity for public policy makers to explore the potential benefits of decentralized financial systems while also addressing the challenges that arise with regulating such systems. To this end, it is crucial to establish a framework for assessing the degree of decentralization of DeFi protocols.

266   Following Schär (2021), DeFi protocols can be broken down into five layers, with the first three layers (settlement, asset and protocol layer) being the most crucial for ensuring decentralization. Regulators must closely monitor and analyze DeFi protocols to determine if they are genuinely decentralized or if they are using the DeFi label as a facade to avoid regulation. If one of the lower levels in this proposed DeFi architecture is centralized, then decentralization attempts at higher levels are set up to fail. Additionally, there is a need for special attention to be given to fiat entry and exit points, which are the connection points between the traditional centralized financial system and the blockchain-based system, as these are centralized intermediaries bridging the decentralized framework. Regulators must ensure that centralized financial service providers that facilitate asset transfers between these two systems are properly regulated.

In the context of public policy, the rise of decentralized finance (DeFi) presents both opportunities and challenges. On the one hand, DeFi offers a promising solution to the challenges posed by the centralized financial system. It has the potential to promote financial inclusion, reduce transaction costs, and increase transparency and efficiency in financial markets. On the other hand, DeFi also poses several risks, such as security concerns, regulatory challenges, and potential exploitation of vulnerable consumers. 267

To address these challenges, regulators should first and foremost carefully analyze DeFi protocols to determine if they are genuinely decentralized or if they are using the DeFi label as a facade to avoid regulation. Regulators should also pay specific attention to the areas of fiat on- and off-ramps, as these are critical areas intersecting between the centralized and decentralized finance systems to ensure the protection of consumers and financial stability. In other words, legislators should on the one hand in the terms of Hirshleifer and Teoh (2016) avoid bad rules with regard to regulation of true DeFi or at least carefully evaluate any potential consequences before enacting and implementing public policies and on the other hand regulatory and supervisory bodies should scrutinize centralized intermediaries providing financial services with regard to decentralized systems. 268

One potential challenge could be front-running, the act of using insider information or offering a higher fee to prioritize a transaction in financial markets, is illegal in traditional stock markets, but not necessarily in the crypto market where information is publicly available. However, such actions can still constitute market abuse, which is the use of information to harm other investors or gain an unfair advantage. The European Market Abuse Regulation (MAR) identifies and categorizes market abuse into three types: insider trading, market manipulation and unauthorized disclosure of inside information. While MAR may not apply to crypto assets, abusive actions in the crypto market could be grounds for future regulation as it is still a part of the financial market. 269

Lastly, regulators should pursue a regulatory strategy that prioritizes areas of concern based on risk, focusing on the areas of highest risk while allowing for innovation in areas that pose less risk and avoiding bad rules or bad policies. 270

4.2 Emerging markets of DeFi & regulatory approaches, MiCAR and DLT pilot regimes

271   The growth and rapid development of the cryptocurrency market have opened new dimensions in financial investment and decision-making processes. As a result, policymakers and regulatory authorities need to consider how behavioral finance aspects based on heuristic theories, prospect theory and herding among others, affect investment decisions in this market. Studies have shown that investors' choices regarding crypto assets or digital currency types are influenced by the choices of other investors, which in turn, significantly affect investment decisions. The findings also indicate that investors tend to make subsequent investment decisions based on their previous experiences, knowledge, and skills, thereby behaving as speculators in the crypto asset market (Al-mansour, 2017; 2020).

272   DeFi can replicate several financial services without the need for intermediaries, thereby reducing costs and the potential for errors. Examples of these services include lending markets, exchange protocols, financial derivatives, etc (Schär, 2022).

4.2.1 DAOs, the tokenization of assets and rights and the regulatory goals of MiCAR

273   The process of tokenization is one of the key features of blockchains, enabling the creation of shared and immutable records of ownership, also known as ledgers, which is the prerequisite for any DeFi services. Tokenization involves making additional assets available on these ledgers, making transactions more efficient and assets more accessible to anyone in the world. This has made tokens an essential component of the DeFi ecosystem, where they may be utilized in various decentralized apps and held within smart contracts (Schär, 2021; Roth, Schär, & Schöpfer, 2019).

274   Multiple methods exist for generating public blockchain tokens, however, the majority of tokens are produced on the Ethereum blockchain utilizing the ERC-20 (Ethereum Request for Comments) token standard smart contract template. These tokens are interoperable or fungible (Schär, 2021).

275   Tokenization enables the creation of digital representatives of assets or rights to them, although the primary consideration with tokenized assets is the risk related to the issuer. The token's value hinges on the reliability and trustworthiness of the issuer, and if the issuer is hesitant or incapable

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of fulfilling their obligations, the token may lose its value or be traded at a substantial markdown. (Berentsen & Schär, 2018; 2019). From a profit generation perspective this may put tokens dangerously close to one of the four key elements of the Howey test as discussed under chapter 3.5 with regard to US securities law. The same may be argued with regard to the European financial instrument definition under MiFID II insofar as tokens are mass-issued, standardized instruments representing a claim on the issuer at least from an accounting perspective, albeit this discussion seems mostly moot at this point with MiCAR and other specific regulations on crypto assets at the rise.

In addition to this there exist various categories of tokens such as governance tokens that serve decentralized autonomous organizations (DAOs), tokens that authorize certain operations in smart contracts, tokens which bear resemblance to stocks or bonds as well as synthetic tokens capable of monitoring the price of any tangible asset, etc which serve different purposes in a DeFi ecosystem (Schär, 2021). However, with governance tokens allowing for participation of token holders in decision-making processes within decentralized autonomous organizations, this creates a risk of blurring the lines to voting rights inherent to simple corporate societies or entities, which would in turn again raise the question with regard to transferable securities.

To counter issuer risk, guarantees may be introduced. There are in general primary types of token backing models: No collateral, on-chain collateral and off-chain collateral. On-chain collateral entails locking assets on the blockchain using a smart contract, while off-chain collateral involves physical assets held by an escrow service. On-chain collateral offers the advantage of increased transparency, and smart contracts may ensure claims through collateralization, enabling semi-automated execution of processes. However, such collateral typically consists of a native protocol asset or a related asset, which may be subject to price fluctuations, requiring over-collateralization to mitigate risk. Off-chain collateralized tokens, on the other hand, may help reduce exchange rate risk as it may have a value equal to the tokenized claim, but they introduce counterparty risk and external dependencies. To guarantee the availability of the underlying collateral at all times, regular audits and safety measures are essential. However, these can be expensive and may not always provide complete transparency to token holders. With no collateral, the counterparty risk is the highest and exchange is entirely trust-based (Schär, 2021).

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4.2.1.1 Evolution of the theory of the firm, social economy organizations and decentralized autonomous organizations

278 The burgeoning presence of social economy organizations (SEOs) in advanced, developing, and transition economies has generated increasing recognition of their relevance for balanced social and economic development. However, traditional economic theory struggles to provide a comprehensive explanation for their existence, often reducing it to a response to market and state failures (Sacchetti & Sugden, 2002). Borzaga and Tortia (2008) developed a more accurate explanation by first reevaluating the conventional paradigm that views economic actors as driven solely by self-seeking motives. Instead, it acknowledges that individuals are motivated by a range of preferences that extend beyond extrinsic and monetary incentives, including relational, reciprocal, intrinsic, and social preferences (Frey, 1997). These motivations significantly impact entrepreneurial activities and intra-organizational dynamics, particularly in terms of procedural fairness (Borzaga and Tortia, 2008).

279 Borzaga and Tortia (2008) also explored an alternative conception of the theory of the firm (Coase, 1937), rooted in the evolutionary tradition, which views production organizations as governance structures that are not necessarily dedicated to maximizing profit (Sugden & Wilson, 2002). This perspective posits that firms must achieve economic sustainability while considering the motivations and needs of all involved actors, who are often embedded in local contexts. From this vantage point, firms are understood as problem-solving devices that adapt to their environments and utilize localized knowledge to achieve specific production objectives (Sacchetti & Sugden, 2002). Incentive mixes emerge as the primary means by which firms strengthen relationships with their stakeholders and adapt to pursue organizational goals (Borzaga and Tortia, 2008).

280 This evolutionary perspective enables economic theory to incorporate the role of SEOs in economic development, both generally and locally. Borzaga and Tortia (2008) argue that the proliferation of SEOs may contribute to a reduction in transaction costs, thereby promoting economic development. Specifically, SEOs can lower transaction costs in the presence of market failures, particularly when markets are underdeveloped or uncompetitive, or when product-specific high costs arise due to asymmetric information. The multi-stakeholder governance model of SEOs can reduce transaction costs by mitigating information asymmetries and reconciling contrasting objectives. Furthermore, SEOs can lower production costs by

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leveraging non-monetary incentives and facilitating exchanges in situations where for-profit firms cannot operate, such as social services or the production of collective goods (Frey, 1997).

Additionally, SEOs can foster trust and facilitate the accumulation of social capital, as horizontal coordination and intra-organizational participation may have positive social spillover effects. The importance of local interaction between firms and their environments must also be acknowledged, as this interaction shapes the motivations and demands of stakeholders in relation to the firm's operations. Consequently, firms must consider localized knowledge and the motivations of actors within their locale to effectively adapt incentive mixes and reinforce relationships with stakeholders (Borzaga and Tortia, 2008).

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The concept of local development employed here encompasses more than merely the growth of aggregate variables like production and employment; it involves the aggregate result of demands and needs expressed by social actors, to which firms must respond. This bottom-up approach to local development, characterized by endogenous objectives expressed at the local level, has been proposed by several authors (Sugden & Wilson, 2002; Sacchetti & Sugden, 2002) and warrants integration into the understanding of the firm and the role of SEOs. SEOs are well-positioned to adopt this perspective, as they tend to emphasize motivations and demands arising from actors within the locality. This focus is less common in organizations with strong hierarchical control, where local actors' motivations and demands are often overlooked (Borzaga and Tortia, 2008).

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Decentralized Autonomous Organizations (DAOs) represent a new paradigm in organizational structure, utilizing blockchain technology to enable transparent, decentralized decision-making and governance. As with social economy organizations (SEOs), DAOs challenge conventional economic theory and the traditional understanding of the firm. Both SEOs and DAOs contribute to a broader view of organizations that prioritize the needs and motivations of stakeholders beyond purely monetary incentives.

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A decentralized autonomous organization is an entity formed by regulations embedded within a computer program (e.g., blockchain-based smart contracts), which typically offers transparency, is governed by its members, and remains uninfluenced by a central authority. Broadly speaking, DAOs represent collectively owned communities that operate without a centralized hierarchy (Prusty, 2017; Chohan, 2017).

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While SEOs focus on fostering social and environmental objectives alongside economic sustainability, DAOs emphasize decentralized gover-

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nance through the use of smart contracts and token-based voting systems. This decentralized approach allows for greater stakeholder participation in decision-making processes, aligning with the principles of SEOs that value horizontal coordination and participation. Moreover, DAOs can facilitate the accumulation of social capital by promoting trust and collaboration among stakeholders.

286   However, the key distinction between SEOs and DAOs lies in their underlying structures and technologies. SEOs typically operate within a legal and regulatory framework, with governance structures and incentive mixes that incorporate both monetary and non-monetary incentives. In contrast, DAOs primarily are aimed at being digital entities that function autonomously on blockchain platforms, allowing for global participation and seamless integration with decentralized finance (DeFi) systems.

287   As outlined above, organizations may be understood as social problem-solving vehicles that adapt to their environments and utilize localized knowledge to achieve specific (production) objectives. Given this broad definition DAOs also fall under the economic definition of organizations, and they may be seen as a social contract pursuant to Jean-Jacques Rousseau's understanding (1762), albeit in general without claiming to form a state and negating other existing state formations. If put in a legal context it may consequently be argued that DAOs constitute some form of legal entities under commercial and corporate law like simple societies, where at least two founders join together to pursue a business purpose, or a societal association dedicated to a political, religious, scientific, artistic, charitable, social or other economic or non-economic task, or where an open-ended number of individuals or commercial companies, whose main purpose lies in promoting or securing specific economic interests of their members through mutual self-help, joins together.

288   In the evolving landscape of organizational structures, both SEOs and DAOs present alternative models that challenge the traditional conception of the firm. By prioritizing stakeholder needs, social objectives, and decentralized governance, these organizations contribute to a more inclusive and sustainable economic ecosystem.

289   Decentralized autonomous organizations can be considered an evolution of social economy organizations due to their shared emphasis on stakeholder involvement, social objectives, and innovative governance structures. Both SEOs and DAOs value stakeholder involvement in decision-making processes. While SEOs promote horizontal coordination and participation, DAOs take this concept further by utilizing blockchain technology to en-

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able decentralized, transparent, and direct stakeholder participation in governance through token-based voting systems. Similar to SEOs, DAOs can prioritize social and environmental objectives alongside financial sustainability. By integrating these objectives into their organizational structures, DAOs have the potential to advance the social mission of SEOs in a digital and global context. Both SEOs and DAOs contribute to the accumulation of social capital by fostering trust and collaboration among stakeholders (cp. chapter 4.2.2.2). DAOs can expand the reach and impact of SEOs by operating on a global scale, connecting stakeholders from diverse geographical locations, and leveraging decentralized finance (DeFi) systems. This extended reach allows DAOs to address social and environmental challenges across borders and to create new opportunities for collaboration and resource allocation. DAOs can further reduce transaction costs by automating various processes through smart contracts, enhancing the efficiency of SEOs in addressing market failures and promoting economic development. The evolution of SEOs into DAOs aligns with the broader trend of digital transformation and the increasing importance of emerging technologies like blockchain, artificial intelligence (AI), and the internet of things (IoT) in shaping the future of organizations and the economy.

4.2.1.2 Public policy goals of MiCAR and classification of crypto assets

The present chapter examines the EU proposal for a regulation on markets in crypto-assets, more commonly known as MiCA-Regulation or MiCAR (COM/2020/593 final) which is an integral part of the EU Digital Finance package, next to the digital operational resilience regulation (also referred to as digital operational resilience act or DORA; (EU) 2022/2554; ELI: http://data.europa.eu/eli/reg/2022/2554/oj). MiCAR will supposedly be entering into force in 2023 and will be applicable 18 months (respectively 12 months with regard to Title III and IV on asset referenced tokens and e-money tokens) thereafter pursuant to its transition period stipulated in Art 126 MiCAR. This package aims to promote the possibilities of digital finance concerning innovation and competitiveness, while minimizing the associated risks. This package corresponds with the Commission's goals of preparing Europe for the digital era and constructing an economy equipped for the future that advantages its citizens. The Digital Finance package introduces a strategy for the EU financial sector, emphasizing the creation of an EU financial services regulatory framework that is conducive to inno-

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vation and does not obstruct the implementation of emerging technologies (European Commission, 2020).

291   Crypto assets have emerged as a significant application of blockchain technology within the financial sector. Since the release of its Fintech Action Plan in March 2018, the European Commission has been diligently observing the potential benefits and obstacles presented by crypto assets. The advice issued by the European Banking Authority (EBA) and the European Securities and Markets Authority (ESMA) in January 2019 highlighted the challenges in applying existing EU legislation to crypto-assets and highlighted that provisions in current laws could impede the usage of distributed ledger technology. The EBA and ESMA also highlighted that the majority of crypto assets are not covered by EU financial services regulations, resulting in a lack of consumer and investor protection, as well as market integrity provisions. Moreover, market fragmentation has resulted from recent legislations by Member States on issues related to crypto assets (European Commission, 2020).

292   The advent of 'stablecoins', a relatively new subset of crypto assets, has attracted attention from the public and regulators worldwide. Although the crypto-asset market is currently limited in scale and does not jeopardize financial stability, the advent of 'global stablecoins' may change this situation by introducing characteristics designed to stabilize their value and take advantage of network effects (European Commission, 2020).

293   The proposal of MiCAR aims to address these concerns by establishing an EU framework that facilitates crypto-asset markets, tokenization of conventional financial assets, and broader adoption of DLT in financial services. The proposal has four general and related goals: legal clarity, encouragement of innovation, safeguarding consumers and investors, and maintaining financial stability. Pursuant to the Explanatory Memorandum of the European Comission the proposal is consistent with existing policy provisions in the policy area and builds on market monitoring and participation in international policy work. It is also consistent with other Union policies, such as those related to the digital age, blockchain technology, the Capital Markets Union (CMU), the SME strategy, and the Security Union Strategy (European Commission, 2020).

294   The proposed MiCAR strives to create a comprehensive framework that supports innovation and fair competition while addressing the risks and challenges associated with the development and use of crypto assets in the EU financial sector.

Among the various DLT applications, crypto assets represent a signifi-   295
cant innovation, as they offer numerous advantages to market participants
and consumers, according to the European Commission (EC). While some
crypto assets are considered financial instruments under MiFID II, most of
them remain beyond the reach of current EU financial services regulations
(MiCAR, recital 2-3).

The lack of a comprehensive EU framework for crypto assets is deemed   296
to hinder market development, lead to missed opportunities in digital
services, and create regulatory fragmentation, thus impeding cross-border
scaling of crypto-asset service providers and enabling regulatory arbitrage.
Furthermore, the growth of certain types of crypto assets could pose chal-
lenges to monetary sovereignty and financial stability. Consequently, a har-
monized framework at the Union level was proposed to establish specific
rules for crypto-assets and related services, facilitate cross-border scaling of
crypto-asset service providers, and address potential financial stability and
monetary policy risks (MiCAR, recital 4-5).

Crypto assets that are classified as financial instruments, such as security   297
tokens, under MiFID II will not be subject to MiCAR, regardless of the
technology employed for their issuance or transfer. Additionally, crypto
assets issued by central banks or other public authorities should not be
subject to MiCAR (MiCAR, recitals 6-7).

The legislation adopted in the field of crypto assets follows the difficult   298
goal of furthering innovation and at the same time being future proof.
Three distinct sub-categories of crypto-assets will fall under more targeted
regulation – utility tokens, electronic or e-money tokens and asset-refer-
enced tokens. Utility tokens are designed for non-financial purposes associ-
ated with the functioning of a digital platform and digital services, while
asset-referenced tokens strive to preserve a stable value by referencing mul-
tiple currencies, commodities, or other crypto-assets, according to the EC.
E-money tokens, conversely, are intended to primarily serve as a means of
payment and preserve a constant value by referencing a single fiat currency
(MiCAR, recitals 8-9). The types of tokens falling under the MiCAR may be
visualized as follows:
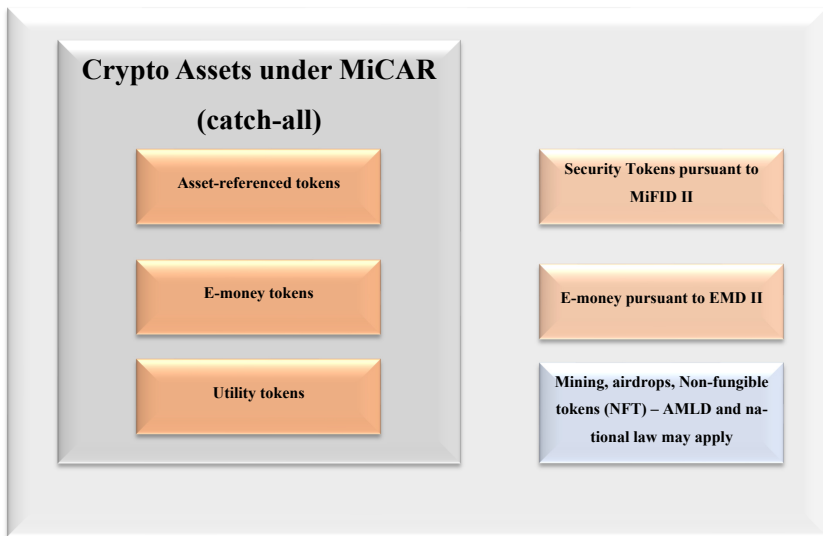
Figure 4: MiCA-Regulation Token Classification, own figure.

299   While asset-referenced tokens, utility tokens and e-money tokens are covered by MiCAR, the regulation does not pertain to tokens classified as financial instruments under MiFID II (security tokens) or e-money under EMD II. Crypto assets are defined in article 3 no 1(2) MiCAR as a "*digital representation of value or rights which may be transferred and stored electronically, using distributed ledger technology or similar technology*". By this catch-all definition, also services with regard to other tokens or coins (BTC, ETH, etc) like trading and custody are regulated. By the process of elimination, considering the token and crypto asset service definitions in Art 3 of MiCAR, it does not apply to airdrops or mining activity with regard to crypto assets. Initially, the treatment of NFTs still left some open questions, as originally the issuance of unique and non-fungible tokens did not constitute a crypto asset issuance pursuant to article 4 no 2(c) of the proposed MiCAR (presumably also given that a public offering in financial market terms implies mass-issued and standardized, thus fungible, instruments), while services with regard to NFTs, like trading or custody, would have potentially fallen under the proposed MiCAR. In the final proposal of MiCAR it was clarified in its article 2 no 2a, that MiCAR is not applicable to unique, non-fungible crypto-assets that cannot be interchanged with other crypto-assets. While the initial proposal would have potentially also

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covered emerging markets in the intersecting area of gaming (gambling) and video game markets with regard to NFTs, this is no longer the case with the final proposal. On the other hand, such a broad interpretation, as with the initial proposal, would have ultimately regulated the technology as a whole (e.g., pure technical blockchain-based tokens containing documentary evidence or used in information technology), which would be in contrast to the furtherance of innovation. In any case, jurisdictional national law as well as anti-money-laundering provisions (Directive (EU) 2015/849 or AMLD 5, as amended; ELI: http://data.europa.eu/eli/dir/2015 /849/2021-06-30) may still apply to the aforementioned services and also to services with regard to NFTs.

Even though they share some similarities, electronic money and crypto assets referencing a single fiat currency have several significant differences. In order to prevent regulatory arbitrage, stringent conditions should be imposed on the issuance of e-money tokens, including the stipulation that they must be issued either by a credit institution or by an electronic money institution authorized under EMD II (MiCAR, recital 10). 300

In light of the various risks and opportunities presented by crypto-assets, specific rules are laid down for issuers of crypto-assets and entities that provide services with regard to crypto-assets. Crypto-asset service providers are defined as any person providing crypto-asset services on a professional basis, including the operation of trading platforms, exchanging crypto-assets against legal tender or other crypto-assets, and ensuring the custody and administration of crypto-assets on behalf of third parties. Furthermore, to ensure proper monitoring and supervision of all offers to the public of crypto-assets or their admission to trading on a crypto-asset trading platform, regulatory connecting point for the issuance of crypto-assets are natural or legal persons (MiCAR, recitals 11-13, 50). In the initial proposal this was limited to legal entities instead of natural or legal persons and other undertakings, but either way these recitals leave room for interpretation with regard to DAOs, as mentioned under chapter 4.2.1.1, as it generally implies that centralized issuers have to be incorporated as a legal entity or form a legal person or some form of undertaking. However, it leaves the question open whether truly decentralized platforms and the issuance or minting of governance tokens are still possible under this clause as a decentralized architecture may be exposed to a certain degree of centralization before becoming truly decentralized and it is unclear whether this provision is also supposed to capture DAOs (which would effectively impose a ban on them). As one of the goals of the regulation is to further innovation, and 301

it generally only applies to centralized crypto asset service providers, it is assumed that it is not supposed to affect DAOs. Also, by way of implication as outlined before, MiCAR shall not apply to crypto mining or validation activity (e.g., through proof of work or proof of stake mechanisms) and hence does not affect DAOs; likewise, it also does not effect or regulate staking unless the staking takes place as part of the management of crypto assets by a third party (crypto asset portfolio management).

302   In order to safeguard consumers in the realm of crypto assets, focus is put on buyers being well-informed about properties, uses, and hazards associated with the crypto assets they plan on buying. As part of this process, crypto asset issuers have to create, submit to their competent authority, and make public a so-called crypto asset white paper containing mandatory disclosures, which must be fair, clear, and not misleading, while certain exemptions apply to avoid imposing excessive administrative burdens on small and medium-sized enterprises and start-ups (MiCAR, recitals 13-16). Information disclosures in general are suitable for mitigating information asymmetries if the information is actually read and digested by potential buyers.

303   Regarding utility tokens for services not yet operational, the duration of a public offer, as detailed in the crypto-asset white paper, must not surpass 12 months. Before initiating a public offering of crypto-assets in the European Union or European Economic Area (EEA), issuers should notify their competent authority of their crypto-asset white paper and, if relevant, their marketing materials. To minimize unnecessary administrative burdens, competent authorities are not required to approve a crypto asset white paper, but they have the power to request additional information after publication (MiCAR, recitals 17-19).

304   After properly notifying a competent authority about a crypto-asset white paper and, if necessary, marketing materials, crypto-asset issuers are allowed to offer their crypto-assets across the EU and EEA and pursue admission for trading on a crypto-asset trading platform pursuant to the passporting system. Consumer protection is further reinforced by providing consumers who purchase crypto-assets directly from the issuer or a crypto-asset service provider, excluding crypto-assets admitted to a trading platform for crypto-assets, a 14-day withdrawal period following their acquisition (MiCAR, recitals 21-22).

305   Asset-referenced tokens pursuant to the EC pose unique risks to consumer protection and market integrity due to their value stabilization mechanisms and as a result are subject to stricter regulations than other

crypto-assets, including supervision and monitoring of the issuance, after the national competent authority's approval. Public offers of asset-referenced tokens should only be allowed where the competent authority has authorized the issuer and approved the crypto-asset white paper (MiCAR, recitals 25-28).

In order to mitigate financial stability risks within the broader financial system, it is proposed under MiCAR that the capital requirements imposed on issuers of asset-referenced tokens are proportional to the magnitude of the issuance of these tokens and determined as a percentage of the reserve of assets supporting their value. Issuers of asset-referenced tokens must further establish and maintain a reserve of assets to stabilize the value of their tokens and ensure prudent management of this reserve. Issuers must invest reserve funds in safe, low-risk assets with little market or credit risk in order to shield token holders from a decline in the value of the assets underpinning the tokens and profits or losses from reserve asset investments have to be borne by the issuer (MiCAR, recitals 36-39).

Both, significant asset-referenced tokens and significant e-money tokens, utilized by a considerable number of users, that potentially pose unique challenges concerning monetary sovereignty or financial stability, are subjected to stricter overall requirements as well as higher capital and interoperability requirements as well as liquidity management policies. Issuers also have to have a plan for a smooth wind-down to protect the interests of asset-referenced token holders in the event that the issuer ceases operations or winds down its activities in accordance with national insolvency laws (MiCAR, recitals 42-43, 49).

E-money token issuers have to be licensed as credit institution pursuant to CRD IV (2013/36/EU; ELI: http://data.europa.eu/eli/dir/2013/36/oj) or as e-money institution pursuant to EMD II and e-money token holders always have to be granted redemption rights at par value with the referenced fiat currency (MiCAR, recitals 44-45).

To ensure consumer protection, it is essential for crypto-asset service providers to establish adequate arrangements for safeguarding client ownership rights for their crypto-asset holdings and they may be held liable for any damages resulting from information communications technology related incidents, such as cyber-attacks or malfunctions (MiCAR, recitals 58-59).

In order to maintain orderly crypto-asset market functioning, providers operating trading platforms should implement detailed operating rules, ensure resilient systems and procedures, and adhere to crypto-asset mar-

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ket specific pre- and post-trade transparency standards. Trades executed on the platform must be swiftly settled and recorded on the DLT, and providers should maintain a transparent fee structure to prevent market abuse or disorderly trading conditions without obtaining any payment or other compensation for transmission of orders to specific platforms or providers. To ensure consumer protection, crypto-asset service providers that provide advice on crypto-assets are required to initially evaluate their clients' experience, knowledge, objectives, and capacity to endure losses (MiCAR, recitals 60-63).

311   In MiCAR it is proposed to maintain user confidence and market integrity in the crypto-asset market by implementing rules to deter market abuse for crypto-assets traded on a platform to prohibit behaviors that undermine market confidence and integrity, like insider trading, leaking private information without permission, and other manipulating of the market for crypto-assets (MiCAR, recital 64).

312   MiCAR, through its article 80, addresses market manipulation more concretely, prohibiting activities that give misleading signals, set abnormal or artificial prices, or use deceptive practices. It also covers behaviors such as securing a dominant position, disrupting the functioning of trading platforms, and voicing opinions on crypto assets without disclosing conflicts of interest. By tackling market manipulation, MiCAR aims to promote fair trading conditions and protect investors. As outlined in chapter 4.1.4, in the context of DeFi and behavioral finance, it is crucial to create a regulatory framework that mitigates biases and prevents potential market manipulations. MiCAR is addressing this with regard to centralized financial intermediaries in crypto markets which are bridging the centralized and decentralized finance world. Avoiding bad regulation in the public policy context helps to maintain the balance between fostering innovation in the crypto-assets market and safeguarding the financial ecosystem's stability and integrity. While the issue is addressed in MiCAR, it does not explicitly mention frontrunning in the given context. However, the regulation targets market manipulation and deceptive practices, which could potentially encompass frontrunning-like activities. Frontrunning, in the context of crypto-assets and DeFi, typically involves a party using privileged information or exploiting transaction ordering to gain an unfair advantage over other market participants. While not explicitly mentioned, the broader scope of MiCAR's prohibition on market manipulation may implicitly cover such activities to ensure fair trading conditions and protect investors. However, while centralized intermediaries under MiCAR may fall under this regu-

lation, this issue still remains unsolved for true DeFi. Additionally, the same methodology may essentially be used to exploit traditional trading in financial instruments through the use of artificial intelligence.

Due to the cross-border nature of crypto asset markets, EU national financial market supervisory authorities may cooperate to detect and deter legal framework infringements for crypto-assets and markets. In order to prevent supervisory arbitrage among member states, the EBA oversees issuers of significant tokens. The EBA sets up a college of supervisors for these issuers, which includes all competent authorities associated with relevant entities and service providers in charge of managing and safeguarding crypto assets, operating trading platforms, and so on. This college fosters collaboration and information sharing among members and provides nonbinding opinions on supervisory actions or modifications in authorization regarding issuers and pertinent entities offering services or activities connected to significant tokens (MiCAR, recitals 65-69). 313

In order to prevent interference with market participants offering services and activities related to crypto assets issued prior to MiCAR's implementation, transitional provisions apply to such service providers (MiCAR, recital 77). 314

In the Permanent Representatives' Committee meeting on 05th October 2022 the final compromise text was endorsed which brought further amendments to the proposed MiCAR draft to be enacted (Counsel of the European Union, 2022, 13198/22, EF 293, ECOFIN 965, CODEC 1428; MiCAR Draft).

For one, environmental, social and governance aspects were included in the final proposal as consensus mechanisms used for transaction validation in crypto assets may have environmental impacts and in order to mitigate these effects, environmentally friendly solutions should be employed, and adverse impacts should be identified and disclosed by issuers and service providers. Additionally, it was noted that the global nature of crypto-assets markets necessitates international efforts to promote convergence in their treatment through organizations like the Basel Committee, the Financial Stability Board and the Financial Action Task Force (MiCAR Draft, recital 5a-5c). Most importantly however, the regulation shall not apply to unique and non-fungible crypto assets, such as digital art and collectibles, product guarantees, or real estate, while naturally, fractionalized NFTs shall not be considered unique and non-fungible any longer (MiCAR Draft, recital 6c). Additionally, digital assets that cannot be transferred to other holders are excluded from the scope of the regulation, such as loyalty schemes where 315

points can be exchanged only with the issuer or offeror (MiCAR Draft, recital 8a).

316   In the final proposal it is clarified that the MiCAR applies to natural and legal persons, as well as other undertakings including services which are performed by them at least partially in a decentralized manner, whereas fully decentralized crypto asset services as defined in MiCAR do not fall under its regulatory scope (MiCAR Draft, recital 12a). It is further clarified that certain exemptions apply to crypto assets that are offered for free (e.g., airdrops), created as a reward for maintaining distributed ledger technology or regarding the verification of transactions within the framework of consensus building mechanisms, or those representing the purchase of goods or services within a limited network. The final proposal of MiCAR als notes that simply admitting crypto-assets to a trading platform or publishing bid and offer prices does not constitute an offer to the public (MiCAR Draft, recitals 14b-15a). Furthermore, MiCAR does not cover the regulation of borrowing and lending activities involving crypto assets (MiCAR Draft, recital 63e).

317   The core sentiments of MiCAR aim to establish a robust regulatory framework for crypto assets in the EU and EEA, ensuring market integrity, financial stability, and investor protection. It does not target true DeFi but is aimed at centralized financial intermediaries which provide services with regard to crypto markets bridging the centralized and decentralized systems by seeking to strike a balance between regulation and fostering innovation. While the proposed EU regulation on crypto-assets aims to establish a comprehensive framework for the issuance and operation of crypto-assets, ensuring market integrity, financial stability, and investor protection there are a few aspects that could be further explored or clarified, taking into consideration behavioral finance and public policy implications, whereas in the public policy context a focus should be put on avoiding bad regulation instead of enacting good rules for bad players:

- Behavioral biases and heuristics in regulatory decision-making: The regulation does not explicitly address how regulators will account for their own potential biases in decision-making when developing and implementing regulatory standards for crypto assets. Recognizing and addressing such biases could improve the effectiveness of regulation in achieving its stated objectives. It is proposed that policymaking institutions and the members involved should in general implement a proce-

dure containing mechanisms to counter potential decision-making biases in the legislative process.

- Investor protection: The regulation emphasizes the importance of investor protection but could better address how the needs and biases of retail investors will be considered in the designing of regulatory technical standards and implementing technical standards. For instance, the regulation could elaborate on how disclosure requirements in crypto-asset white papers will be tailored to ensure that retail investors can easily understand and assess the risks associated with crypto assets.

- Financial literacy and education: The regulation does not explicitly mention the role of financial literacy and education in promoting responsible investment in crypto assets. Given the complex nature of crypto-assets and the potential risks involved, promoting financial literacy and education among investors could be an essential component of the public policy context.

- Market manipulation and fraud: While the need for legal certainty and prevention of market abuse in the context of the crypto asset market is highlighted in recital 64a MiCAR, the regulation could further detail how the competent authorities will work together to address the potential for market manipulation and fraudulent activities in the crypto asset markets, considering that these risks are often exacerbated by behavioral biases such as herding, fear of missing out and overconfidence and also address frontrunning behaviors more directly. The potential impact of social media and smart contracts on market manipulation should also be considered. The regulatory framework should address the unique challenges posed by the rapidly evolving crypto-asset landscape and its intersection with technology.

- Impact on innovation: The regulation seeks to establish a consistent legal framework for crypto assets to ensure market stability and investor protection. However, the potential impact of the regulation on innovation and the development of new crypto-asset technologies should be considered analyzed further as striking a balance between regulation and fostering innovation is critical in the public policy context.

- International coordination: The regulation mainly focuses on the EU context and does not explicitly address the importance of international coordination and cooperation in regulating crypto assets. Given the global nature of crypto asset markets, increased collaboration between international regulatory bodies could strengthen the effectiveness of the regulation and mitigate potential regulatory arbitrage.

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318   In summary, the EU regulation on markets in crypto assets appears to be a comprehensive framework. However, further consideration of behavioral finance and public policy implications could enhance the effectiveness of the regulation in attaining its objectives, specifically in areas such as investor protection, financial literacy, and fostering innovation.

4.2.1.3 Interim conclusion

319   Both social economy organizations (SEOs) and decentralized autonomous organizations (DAOs) challenge traditional economic theory by prioritizing stakeholder needs, social objectives, and innovative governance structures. SEOs and DAOs emphasize diverse motivations, horizontal coordination, and local interaction, promoting trust, collaboration, and social capital accumulation. While SEOs focus on social and environmental objectives in addition to economic sustainability, DAOs extend this approach through decentralized governance and blockchain technology, facilitating global participation and seamless integration with decentralized finance systems. These alternative organizational models contribute to a more inclusive and sustainable economic ecosystem and showcase the potential for digital transformation in addressing contemporary social and environmental challenges. DAOs may be argued to be a further evolutionary step from SEOs.

320   On a different topic, the regulatory goals of MiCAR, in respect to the EU Digital Finance package, aspire to support innovation and competition in the realm of crypto assets while managing the risks involved. The European Commission has recognized the significance of crypto assets in the financial industry as well as the need for a comprehensive EU framework to prevent market fragmentation and regulatory arbitrage. MiCAR proposes a harmonized approach, classifying crypto-assets into three sub-categories: e-money tokens, utility tokens and asset-referenced tokens. While the regulation does not apply to tokens considered transferable securities under MiFID II or e-money under EMD II, it does provide a legal structure to facilitate cross-border scaling and address potential financial stability and monetary policy risks. The regulation seeks to strike a balance between promoting innovation and maintaining a future-proof legislative environment.

321   Considering the various risks and opportunities associated with crypto-assets, specific regulations have been established for crypto asset issuers and service providers. These rules cover a range of professional services,

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including trading platform operation and crypto-asset custody. To ensure proper oversight, crypto-asset issuers must be legal persons, although questions remain regarding decentralized platforms and governance tokens, while it is presumed that they do not fall under the scope of MiCAR. Crypto asset issuers must create and disclose white papers to inform potential buyers about risks and features of the assets. Utility tokens have specific duration requirements, and asset-referenced tokens face more stringent regulations due to their value stabilization mechanisms. E-money token issuers must be licensed and provide redemption rights at par value. Crypto-asset service providers must safeguard client ownership rights and adhere to operating rules for trading platforms. MiCAR also addresses market manipulation to promote fair trading conditions. Additionally, EU supervisory authorities cooperate to maintain market integrity and stability. Amendments to MiCAR include environmental, social, and governance considerations and exclusions for unique, non-fungible crypto assets.

In conclusion, the MiCAR initiative intends to establish a thorough regulatory structure for crypto assets within the EU and EEA, focusing on market integrity, financial stability, and investor protection. The proposal primarily targets centralized financial intermediaries while attempting to balance regulation with innovation. Despite the comprehensive nature of the framework, aspects such as regulatory decision-making biases, retail investor needs, financial education, market manipulation, innovation impact, and international coordination warrant further exploration and clarification. By addressing these behavioral finance and public policy concerns, the regulation's effectiveness in achieving its objectives can be enhanced, with particular emphasis on investor protection, financial literacy, and promoting innovation. 322

4.2.2 Regulated markets, lateral exchange markets, decentralized exchanges and trust in intermediating technology platforms

As centralized crypto exchanges (CEX) have the problem of requiring traders to deposit assets on an exchange, through which users relinquish direct control over their assets and place trust in the exchange operator, decentralized exchanges (DEX) have gained traction as deceptive or incompetent centralized exchange operators or intermediaries may seize or misplace assets. This creates a single point of vulnerability and an ongoing risk of being targeted by malicious third parties (Schär, 2021). Before delv- 323

ing into the intricacies of peer-to-peer based decentralized exchanges, let's first have a look at conventional regulated markets and trading facilities.

4.2.2.1 Traditional regulated markets

324 On a regulated market or trading facility the buying and selling interests with regard to financial instruments are brought together. The matching or aggregation of interests in relation to financial instruments requires three elements. The first criterion is that an intermediary, for example, the operator of a multilateral trading facility (MTF) or organized trading facility (OTF) acts as an intermediary between the participants buying and selling interests. This intermediary is interposed in a way that, during the execution of the transaction, there is no exposure to any market risks and execution takes place simultaneously. The intermediary thus acts as a risk-free intermediary (risk component based on the multilateral intermediation). The second essential characteristic focuses on a temporal element, whereby both processes – the purchase and sale orders – are executed simultaneously and are final. The often-cited so-called atomic swaps akin to decentralized exchanges thus *de iure* also exist in traditional markets and trading venues. The EU Settlement Finality Directive (98/26/EC; ELI: http://data.europa.eu/eli/dir/1998/26/oj) aims to ensure that once a transaction has been entered into the system, it cannot be unwound, reversed or challenged by a third party and is also unaffected by insolvency. With regard to the third and final element, the transaction must be concluded by the intermediary in such a way that, apart from a transparently communicated commission or fee for the transaction, no profit or loss is generated from the transaction itself (element of remuneration) (Art 4 no 1(38) MiFID II; Bergt 2020, p. 238).

325   An exemplary transaction on a trading facility typically looks like this (Bergt, 2020, p. 228 et seq.; Bergt, 2021b, p. 55):

1. A commercial transaction is concluded between two trading members (authorized financial intermediaries) on a multilateral trading facility (MTF) through the MTF's trading platform, possibly to fulfill an underlying order from an end customer (economic buyer or seller).
2. The transaction (the aggregated interests) is transmitted by the MTF to the clearing house (central counterparty; CCP).
3. Clearing takes place between the clearinghouse and the clearing members.

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4. A reconciliation is made between the clearing members and the trading members (determination of reciprocal claims).
5. The clearinghouse (CCP) sends instructions to the settlement platform (central securities depository or CSD).
6. The settlement platform (CSD) then effects the actual transfer of the financial instruments involved in the transaction and also ensures the actual transfer of the corresponding funds; settlement takes place on a book-entry basis (dematerialized financial instruments).
7. Finally, there is a reconciliation between the members of the CSD and the clearing members.
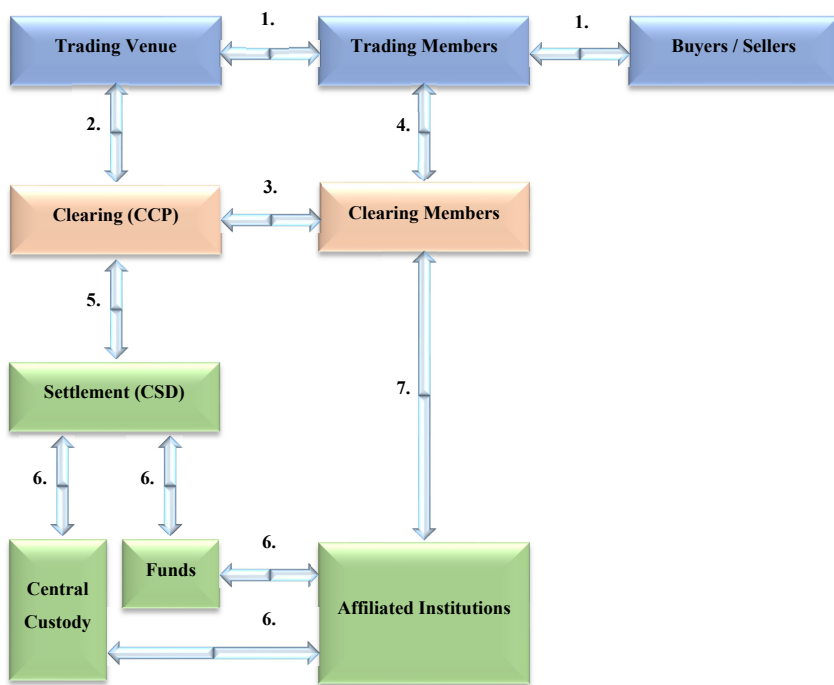
Figure 5:   Trading facility or stock exchange functioning based on Bergt (2020, p. 228; 2021b, p. 55).

In contrast to this, truly decentralized, technological exchange platforms   326
allow peers to directly participate on exchanges and initiate their own
trades. Peers on such a DEX maintain sole authority over their assets up
until the trade is settled, which occurs through a smart contract, thus

also mitigating counterparty credit risk (Schär, 2021). Through distributed ledger technologies, it may be possible to at least partially replace the many required intermediaries due to existing regulatory complexity by technology (intermediating technology platforms) to prevent market failures and to lower costs (Bergt, 2020, p. 244). However, it should not be overlooked that, economically speaking, crypto markets are still inefficient markets that allow for arbitrage trading and market manipulation as found by Griffin and Shams (2020), which should be mitigated on a public policy level as previously pointed out under chapter 4.1.4: *"By mapping the blockchains of Bitcoin and Tether, we are able to establish that one large player on Bitfinex uses Tether to purchase large amounts of Bitcoin when prices are falling and following the printing of Tether. Such price supporting activities are successful as Bitcoin prices rise following the periods of intervention. Indeed, even 1% of the times with extreme exchange of Tether for Bitcoin have substantial aggregate price effects. The buying of Bitcoin with Tether also occurs more aggressively right below salient round-number price thresholds where the price support might be most effective […]. Overall, our findings provide support for the view that price manipulation can have substantial distortive effects in cryptocurrencies. Prices in this market reflect much more than standard supply/demand and fundamental news. These distortive effects, when unwound, could have a considerable negative impact on cryptocurrency prices. More broadly, these findings also suggest that innovative technologies designed to bypass traditional banking systems have not eliminated the need for external surveillance, monitoring, and a regulatory framework as many in the cryptocurrency space had believed. Our findings support the historical view that dubious activities are associated with bubbles and can contribute to further price distortions."*

4.2.2.2 Trust in intermediating technology platforms

327 Schär (2021) argues that decentralized exchange protocols remove the trust requirement by allowing users to retain sole control over their assets until the trade is completed. While no trust in a financial intermediary is required anymore it may be argued that a shift of trust in intermediating technology platforms may take place, which has to be assessed more deeply.

328   Blockchain has been considered as an intermediating technology that can facilitate disintermediation and enable true peer-to-peer transactions in sharing economy contexts, provided sufficient trust is built (Mehrwald et al., 2019; Hawlitschek et al, 2018; Bergt, 2021a). However, it should be noted

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that trust in intermediaries is not entirely obsolete and that a completely trust-free system is likely an illusion (Hawlitschek et al., 2018).

The sharing economy or lateral exchange market (LEM) as defined under chapter 4.1 is characterized by a system of trade and exchange that ideally generates added value to the parties involved (Belk, 2014a; Belk, 2014b; Mehrwald et al., 2019; Bergt, 2021a), has evolved to incorporate internet-based platforms that facilitate lateral exchange markets (LEMs), which are intermediating technology platforms connecting equivalently positioned economic actors (Perren and Kozinets, 2018; Mehrwald et al., 2019). These LEMs enable bilateral exchanges, such as human-to-human or human-machine-human transactions and have the potential to replace financial intermediaries in the form of intermediating technology platforms for example based on smart contract systems on blockchains (Bergt, 2020, p. 248; Mehrwald et al., 2019).

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However, the utilization of blockchain technology for such purposes raises legal and regulatory questions as already pointed out and also when dealing with tokenized securities and financial instruments (Bergt, 2020, p. 377; Bergt 2021a; Bergt et al 2019, p. 117). Furthermore, while blockchain may reduce regulatory and transaction costs, it still faces challenges related to slow transaction speeds, scalability, and the potential high costs of development and implementation (Bergt, 2021a). Ultimately, trust remains a critical aspect of adopting blockchain-based systems in sharing economies (Mehrwald et al., 2019).

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According to Blau (2017), economic institutions like impersonal markets and contracts are designed to separate exchange concerns and specify obligations, allowing for rational calculations. In contrast, social exchange involves unspecified obligations that depend on trust for fulfillment, as they cannot be enforced without a binding contract (Blau, 2017). Established economic institutions and contractual relationships create trust, while inefficient markets, legal shortcomings, and unenforceable agreements undermine it.

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Trust refers to a collection of beliefs between individuals which include qualities such as benevolence, integrity, sincerity, honesty, competence, expertise, and predictability, or a willingness to be vulnerable to others' actions (Dakduk et al., 2020 with further references). Mehrwald et al. (2019) explain that trust represents behavioral intentions that increase vulnerability to other parties under conditions of interdependence and vulnerability, given trustworthiness (also compare Bergt, 2021a). Trust is essential in lateral exchange markets, including blockchain-based markets,

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because transactions between parties typically occur only once, with no ongoing business relationships (Gefen & Straub, 2004).

333   In peer-to-peer markets, trust is considered the currency, as it is one of the most important factors for participation, platform success, and transaction completion and fulfillment (Hawlitschek et al, 2016a; Strader and Ramaswami, 2002, quoted after Mehrwald et al., 2019). Trust also plays a critical role in intermediating technology platforms such as blockchain-based platforms, a decentralized peer-to-peer markets built upon them. Trust is generally viewed as the most effective mechanism for reducing complexity and vulnerability (Corbitt et al., 2003; Bergt, 2021a).

334   In traditional business-to-consumer commerce, the primary trust target is the vendor (vertical trust level) and the product. In peer-to-peer markets, new trust targets emerge, and others take on more significant roles. Trust in peers (similar to a vendor but on a horizontal trust level) becomes a new target, while trust in the platform gains a more independent character from trust in the traditional vendor (Hawlitschek et al., 2016b; Bergt, 2021a; Mehrwald et al., 2019).

335   Gefen (2000) posits that consumer trust in an e-commerce vendor depends on the perceived trustworthiness of the vendor, based on Luhmann's (1979) concept of trust as a social complexity-reducing mechanism (as quoted pursuant to Gefen and Straub, 2004). This mechanism involves a willingness to depend on a vendor, assuming they will fulfill their obligations (Gefen and Straub, 2004). This model can be applied to peer-to-peer markets, where more recent studies by Costello and Reczek (2020) reveal that peer-focused marketing increases consumers' willingness to pay, as they empathize with the provider, a phenomenon they refer to as the "empathy lens." This willingness to pay also indicates trust in the peer, although the studies focused on a marketing perspective (Bergt, 2021a).

336   The concept may be extrapolated from centrally operated peer-to-peer markets to intermediating technology platform economies, although further research in this area is necessary to solidify this notion. The transition from centrally operated markets to intermediating technology platforms, such as those utilizing blockchain technology, involves a shift in trust dynamics that warrants further investigation (Bergt, 2021a).

337   The role of trust in intermediating technology platforms is critical, as these platforms intersect with peer-to-peer markets, and trust in the platform significantly impacts the users' willingness to engage in transactions (Hawlitschek et al., 2016a; Strader and Ramaswami, 2002; Mehrwald et al., 2019; Bergt, 2021a). Trust in the platform is regarded as a predictor

of trust in peers (Mehrwald et al., 2019), which implies that users' level of platform trust significantly affects their trust in other users within the platform ecosystem.

The fundamental elements of trust can be categorized into ability, integrity, and benevolence. Ability encompasses a platform's capacity to effectively, securely, and reliably match buying and selling interests of participants, process transactions, and offer an intuitive graphical user interface (Hawlitschek et al., 2016c; Bergt, 2021a). Integrity and benevolence address aspects such as fees, data privacy, order authenticity, and potential user support (Mehrwald et al., 2019).

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In the context of intermediating technology platforms, trust in the platform may replace trust in other peers (vendors) with regard to ability, integrity, and benevolence since transactions are executed through pre-defined rules encoded in smart contracts. Consequently, the trust required for the intermediating technology platform, or trust in technology, would be greater (Bergt, 2021a based on Mehrwald et al., 2019). Further evidence is required to test this thesis.

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Moreover, trust in peer networks can also be generated without traditional intermediaries, through a phenomenon referred to as "*consociality*" (Mehrwald et al., 2019). Pursuant to Perren and Kozinets (2018) consociality refers to the presence of social participants within a network – physically or virtually – which may offer a chance for social engagement between these individuals. Consequently, trust among equivalent economic actors may rely on structural assurances and intermediation in peer-to-peer markets. Thus, intermediating technology platforms can enhance consumer trust by ensuring that providers will not engage in opportunistic betrayal (Perren and Kozinets, 2018; Bergt, 2021a).

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According to Comer et al. (1999), product trust is the conviction that a product or service will perform its intended functions as perceived by the purchaser. In sharing economy platforms, products are typically presented in digital environments, and on intermediating technology platforms, the product is often virtual (e.g., tokens representing rights or values). Consequently, the product must exhibit the agreed-upon and promised attributes (Bergt, 2021a). Hawlitschek et al. (2016b) suggest that trust related to the product plays a unique role in the context of consumer to consumer (C2C) sharing economy platforms.

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While blockchain technology is not inherently "trust-less," it may act as a mediator with an effect on trust (institution-based trust and trust in peers) in peer-to-peer markets, influencing both structural assurance beliefs and

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opportunistic behavior. Although intermediating technology platforms may be able to significantly impact trust creation and perception, trust in the platform (institution-based trust) is still necessary for incentivizing consumption intentions or market interaction, this arguably holds true for the settlement layer, asset layer and protocol layer on the one side as well as the application and aggregation layer (as centralized interfaces or bridges between centralized and decentralized systems) pursuant to Schär's (2021) DeFi architecture as described in chapter 4.1.3. Issues such as programming errors in smart contracts, malicious activity exploiting faulty code, slow transaction speeds, and scalability problems may diminish trust in these platforms.

343   Although blockchain technology may replace trust in intermediaries to some extent by shifting it to trust in the platform, it is essential to recognize that trust in technology is still required for peer-to-peer markets, such as blockchain-based systems or lateral exchange markets based thereupon. Further research is needed to understand trust mechanisms and effects in and on peer-to-peer markets in the form of blockchain-based decentralized technology platforms, and the role of "*trusted interfaces for blockchain-based sharing economy ecosystems*" as it was called by Hawlitschek et al. (2018).

344   Trust mechanisms should be further analyzed also with regard to the different layers of the DeFi architecture, the bridging-role intermediaries play between centralized and decentralized finance, true DeFi and also decentralization shams. Even with regard to truly decentralized levels of a platform, peers participating on it are willing to be vulnerable to others' actions as truly decentralized layers of a decentralized architecture may still be prone to errors etc and it may thus be argued that trust will always play a role throughout the DeFi architecture – where there is the opportunity of consociality – a chance for social engagement – there will be trust.

4.2.2.3 Lateral exchange markets in the form of blockchain-based decentralized exchanges (DEX)

345   A need exists for platforms where individuals can exchange their digital assets, enabling them to modify their holdings based on their preferences and risk tolerance, as well as adjusting their portfolio distribution. Typically, transactions involving crypto assets take place through centralized exchanges, which offer relative efficiency but also have certain disadvantages. In order to trade on a centralized platform, participants must first

transfer their assets to the exchange, relinquishing direct control over their assets and placing their trust in the centralized financial intermediary, the exchange operator. This scenario exposes traders to potential risks, including asset confiscation or loss due to dishonest or incompetent exchange operators, and the vulnerability of centralized exchanges to malicious actors targeting them as a single point of attack (Schär, 2021).

Decentralized exchange protocols aim to address these. Users are not required to transfer their funds to a centralized exchange and maintain sole possession of their assets until the transaction is completed. The trade is executed atomically (instead of on a quid pro quo basis where the respective consideration is exchanged consecutively step by step) which carries out both sides of the transaction in a single, inseparable operation, thus reducing counterparty credit risk. Depending on the specific implementation, the smart contract can take on additional functions, making many intermediaries, such as escrow services, central counterparty clearinghouses (CCPs), and central securities depositories (CSDs), obsolete (Schär, 2021; Bergt, 2020, p. 244).

Initial decentralized exchanges, like EtherDelta, functioned as isolated systems with no interoperability between different implementations. They lacked shared liquidity, leading to low trading volumes and wide bid/ask spreads, high network fees, and inefficient processes for transferring funds among decentralized exchanges. However, a recent shift towards open exchange protocols has improved the structure of decentralized exchanges by establishing standards for asset trading, allowing exchanges built on these protocols to access shared liquidity pools and other protocol functionalities. Crucially, other DeFi protocols can utilize these marketplaces to exchange or liquidate tokens when necessary (Schär, 2021).

Schär (2021) compared various types of decentralized exchange protocols, including decentralized order book exchanges, constant function market makers (CFMMs), smart contract-based reserve aggregation, and peer-to-peer (P2P/OTC) protocols. Decentralized order book exchanges can be designed using various methods, characterized by either on-chain or off-chain order books. On-chain order books are fully decentralized, with each order being stored in the smart contract. However, this approach necessitates a blockchain transaction for every action, resulting in higher costs and slower processing. Off-chain order books, on the other hand, are managed and updated by centralized third parties known as relayers. These relayers supply takers with the necessary information to choose an order

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they wish to match. The predominant protocol using this approach is 0x (Warren & Bandeali, 2017, Schär, 2021).

349   Constant Function Market Makers (CFMMs) are liquidity pools within smart contracts that hold a minimum of two crypto assets in reserve, permitting users to deposit tokens of one kind and withdraw tokens of another kind. Examples of such platforms include Balancer, Bancor, UniSwap and Curve (Schär, 2021).

350   Smart contract-based reserve aggregation brings together liquidity reserves through a smart contract, allowing major liquidity providers to join and offer prices for specific trading pairs. Kyber Network is a notable example of this approach (Luu & Velner, 2017; Schär, 2021).

351   Peer-to-peer (P2P) protocols, also referred to as over-the-counter (OTC) protocols, utilize a two-step method in which participants search the network for counterparties to trade a specific pair of crypto assets, then negotiate the exchange rate between themselves. After agreeing on a price, the transaction is executed on-chain through a smart contract. AirSwap, proposed by Oved and Mosites (2017), is the most well-known implementation of a decentralized P2P protocol (Schär, 2021). This approach offers a more efficient and secure trading environment by facilitating bilateral negotiations between parties and executing trades through smart contracts. Distinct from other protocols, offers can only be accepted by the negotiating parties, which prevents third-party frontrunning by monitoring the pool of unconfirmed transactions (mempool). To enhance efficiency, the process is typically automated, and off-chain indexers can be used for peer discovery, acting as directories for advertising particular trading intentions. It is essential to point out that these indexers only facilitate connections, with prices still being negotiated on a peer-to-peer basis (Schär, 2021).

4.2.2.4 DLT Pilot Regime

352   The European Commission's pilot regime on market infrastructures based on distributed ledger technology (DLT Pilot Regime; Regulation (EU) 2022/858; ELI: http://data.europa.eu/eli/reg/2022/858/oj) is part of a broader digital finance package aimed at facilitating and advancing digital finance's potential while mitigating risks. This package is in line with the Commission's priorities to make sure that the EU embraces and drives the digital revolution with forward-thinking European businesses at the vanguard, benefiting European consumers and businesses pursuant to the initial proposal's explanatory memorandum. This pilot regime is accompanied

by other legislative proposals addressing crypto-assets, digital operational resilience, and amendments to certain EU financial services rules (Proposal DLT Pilot Regime, (COM/2020/594 final; 2020/0267 (COD)), European Commission explanatory memorandum).

One of the identified priority areas in the digital finance strategy is to guarantee that the EU's financial services regulatory framework supports innovation and does not hinder the adoption of new technologies. The pilot regime, in conjunction with MiCAR, seeks to provide appropriate consumer and investor protection, establish legal certainty for crypto-assets, facilitate the use of blockchain, DLT, and crypto-assets by innovative firms, and maintain financial stability (Proposal DLT Pilot Regime, explanatory memorandum).

The DLT pilot regime aims to establish legal certainty, promote innovation, ensure consumer and investor protection, and maintain financial stability. Moreover, the pilot regime aligns with the Union's policies aimed at creating a Capital Markets Union (CMU), as it addresses the underused potential of crypto-assets and calls for increased legal certainty and clear rules for their use. The DLT pilot regime, based on Article 114 of the Treaty on the Functioning of the European Union (TFEU), seeks to enable experimentation through exemptions for using DLT in the trading and post-trading of crypto assets that qualify as financial instruments, where current legislation excludes or limits their use. Introducing a unified EU pilot regime for the experimentation of DLT market infrastructures would allow firms within the EU to maximize the existing framework's potential. This regime is designed to eliminate regulatory barriers that could hinder the growth of DLT market infrastructures, potentially driving the transition to tokenized financial instruments and DLT market infrastructures, fostering innovation, and bolstering the global competitiveness of the EU. The European Commission deems the pilot regime approach the most proportional to the objectives for the time being, given the lack of substantial evidence supporting more extensive, lasting alterations to the current financial services infrastructure to accommodate DLT usage. (Proposal DLT Pilot Regime, explanatory memorandum).

The DLT pilot regime in general aimed to enable a DLT or blockchain-based market infrastructure equivalent to the one depicted in figure 5 above for investment firms and market players (stock exchange for security tokens). The pilot regime seeks to enable the development of a secondary market that is more secure and dependable for crypto-assets qualifying as financial instruments, ensure consistency and a level playing field across

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the EU, and permit actual use cases to aid in accumulating the expertise and data required for enacting a definitive EU regulatory structure.

356   crypto assets are classified as financial instruments under MiFID II, the existing EU financial services legislation was not crafted with DLT and crypto assets in consideration. The tokenization of financial instruments presents potential efficiency enhancements in trading and post-trading areas, yet the lack of market infrastructures utilizing DLT impedes the sustainable expansion of the primary market for these crypto assets. This regime allows temporary exemptions from certain requirements under the Union's financial services legislation that may otherwise hinder the development of DLT-based solutions for trading and settling transactions involving crypto assets representing securities (Proposal DLT Pilot Regime, recitals 3-5).

357   The pilot framework introduces a DLT market infrastructure that can be either a DLT securities settlement system or aDLT multilateral trading facility (DLT MTF). A DLT MTF is a multilateral trading facility administered by an investment firm or market operator authorized under MiFID II. It is subject to all provisions and standards imposed by EU financial services legislation on a multilateral trading facility, except when granted exemptions by its national competent authority. Given the potential of DLT to streamline trading and settlement activities, a DLT MTF should be allowed to perform certain activities typically performed by central securities depositories (CSDs) when granted relevant exemptions. A DLT securities settlement system on the other hand is a system for settling financial instruments maintained by a CSD authorized pursuant to the CDSR (Central Securities Depositories Regulation) and granted specific permissions under the pilot framework (Proposal DLT Pilot Regime, recitals 7-10).

358   Incorporating distributed ledger technology (DLT) in the financial landscape has the potential to streamline and integrate trading and settlement processes almost in real-time, allowing consolidation of trading and post-trading services and activities. Nevertheless, current regulations do not account for such combinations, focusing on risk specialization and unbundling to encourage competition. The pilot regime is not supposed to be a justification for a complete overhaul of the financial market infrastructure landscape or the separation of trading and post-trading activities. Nonetheless, due to the potential advantages offered by DLT in combining trading and settlement, the pilot regime also introduces a dedicated DLT market infrastructure known as the DLT TSS (DLT Trading and Settlement System). A DLT TSS can be either a DLT MTF (DLT Multilateral Trading

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Facility) that combines the services of a DLT MTF and a DLT SS (DLT Securities Settlement System) or a DLT SS that combines these services and is operated by a CSD (Central Securities Depository) with specific permission under the pilot regime. Given the unique nature of a DLT TSS, investment firms or market operators and CSDs must comply with additional requirements (DLT Pilot Regime, recitals 14--17). The pilot regime may thus be seen as a regulatory sandbox trial run to harness the potential advantages of DLT trading and settling systems and gain experience for all market participants while doing so.

To maintain financial stability and foster innovation within a sound regulatory environment, tokenized transferable securities are limited to illiquid shares and bonds for DLT MTFs or DLT securities settlement systems under the pilot regime and they are not to admit sovereign bonds. Furthermore, no sovereign bonds may be listed for trade on DLT market infrastructures, and they may not be recorded on the distributed ledger (Proposal DLT Pilot Regime, recital 12).   359

A DLT MTF may request temporary exemptions from regulation otherwise required by traditional regulated markets or MTF, from the competent authority, provided it meets the conditions and additional requirements associated with such exemptions to address new risks arising from DLT usage. Financial instruments traded on an MTF are to be registered with an authorized Central Securities Depository (CSD) under CSDR. However, recording and settling transactions on a distributed ledger may impose redundant overlays on the trade lifecycle of financial instruments managed by a DLT market infrastructure. Therefore, DLT MTFs may seek exemption from the book-entry requirements and recording with a CSD if it meets equivalent requirements applicable to a CSD (Proposal DLT Pilot Regime, recitals 14-15).   360

DLT MTFs must ensure simultaneous payment and delivery of DLT transferable securities (delivery versus payment) (compare already Bergt, 2020, p. 168, FN 394). Cash transactions shall be settled with money from the central bank when practicable and available; otherwise, commercial bank money, settlement coins (tokenized commercial bank money), or e-money tokens. DLT MTFs must also limit counterparty risk by establishing strict criteria for credit institutions used for cash payment settlements. Under the upcoming MiFID III, a DLT MTF can request a temporary derogation from intermediation obligations and provide access to retail investors (a standard MTF is only allowed to provide access to participants which are institutional financial intermediaries), provided adequate   361

investor protection safeguards are in place and retail investors are fit and proper preventing money laundering and terrorism financing purposes (Proposal DLT Pilot Regime, recitals 16-17).

362   DLT market infrastructures must meet additional requirements compared to traditional market infrastructures to mitigate risks arising from DLT usage or the novel way in which they carry out their activities. Permissions and exemptions are granted on a temporary basis, lasting six years maximum from the date of the specified authorization, while competent authorities can withdraw specific permissions or exemptions if a flaw is discovered in the underlying technology (Proposal DLT Pilot Regime, recitals 27-37).

363   In conclusion, the DLT pilot regime aims to foster innovation in distributed ledger technology within the financial sector while ensuring market stability and investor protection. It aims to provide a regulatory framework that accommodates emerging technologies without stifling growth. Behavioral finance may play a role in understanding the adoption and risk-taking behavior of market participants in this context. As always, avoiding bad regulation is crucial, as it allows for a balanced approach that supports innovation while mitigating potential risks, promoting financial stability, and maintaining a level playing field for all market participants.

364   From a behavioral finance and public policy perspective, the discussion of the DLT pilot regime can be critiqued on several fronts. The introduction of DLT market infrastructures may lead to the emergence of new systemic risks if not adequately monitored and managed. These risks could stem from the interconnectedness of DLT market infrastructures with traditional financial institutions or the potential for technological issues to cascade across markets. Systemic risks refer to the potential for failures in one segment of the decentralized ecosystem to cascade and disrupt the broader financial system. The interconnected nature of decentralized platforms can magnify these risks, as the failure of a single platform or smart contract may have far-reaching consequences.

365   On another note, as it is a pilot regime overemphasis is put on potential flaws and risks. The focus on withdrawing specific permissions and exemptions in case of flaws or breaches in the underlying technology might discourage innovation and experimentation in the DLT space. Instead, it is recommended to encourage a proactive and constructive approach to resolving issues, promoting continuous improvement and learning, rather than solely focusing on punitive measures. There is also insufficient focus on investor behavior as the discussion does not adequately address how

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investor behavior might be influenced by the introduction of DLT market infrastructures and the associated risks, such as potential herd behavior, overconfidence, or panic selling in the face of technological issues, which is not the case for traditional regulated markets or MTF on which as no retail investors are allowed on these market infrastructures in contrast to a DLT MTF. To mitigate issues in this regard, behavioral finance insights, focusing on investor education, disclosure requirements, and other mechanisms to encourage responsible investment behavior, may be implemented into the design of the DLT pilot regime.

Furthermore, there is also uncertainty regarding the post-pilot period. The discussion leaves open various possibilities for the future of the DLT pilot regime, including extension, modification, or termination. This uncertainty could create hesitancy among market participants to fully commit to DLT market infrastructures. Clearer indications of the potential outcomes and criteria for evaluating the success of the pilot regime, reducing uncertainty and facilitating long-term planning for market participants, should be provided in this regard.

While from a behavioral finance perspective, the DLT pilot regime acknowledges the growing importance of distributed ledger technology in the financial sector and aims to create a regulatory sandbox for fostering innovation, it is crucial to consider the implications of this regime on market participants' decision-making, risk-taking behavior, and adoption of new technologies.

The DLT pilot regime may create an uneven playing field between regulated DLT market infrastructures (DLT MTF or DLT securities settlement systems) and non-regulated DeFi platforms like decentralized exchanges (DEX) or lateral exchange markets (LEM). While the pilot regime intends to provide a controlled environment for DLT-based systems, it might inadvertently incentivize market participants to favor less-regulated DeFi platforms, leading to potential financial instability. To address this concern, regulators should ensure that the DLT pilot regime is flexible and adaptable, allowing for a level playing field between centralized and decentralized platforms. This not only involves continuous monitoring of the market and the regulation along with reporting pursuant to article 10 of the DLT Pilot Regime, but also periodic revisions of the regulatory framework based on the industry's evolution.

Lastly, cognitive biases as well as heuristics may impact the decision-making process of market participants engaging with DLT-based systems as already previously pointed out. This might lead to excessive risk-taking

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or an irrational preference for decentralized platforms over regulated ones. Policymakers should consider incorporating investor education and awareness initiatives to mitigate the influence of such biases.

4.2.2.5 Interim conclusion

370 While centralized crypto exchanges (CEX) require users to relinquish direct control over their assets, decentralized exchanges (DEX) have emerged as an alternative, allowing users to maintain control through peer-to-peer transactions. Traditional regulated markets involve multiple intermediaries for transactions, whereas decentralized exchanges use distributed ledger technologies and smart contracts to mitigate risks and reduce costs. Despite the potential advantages of DEXs, crypto markets remain susceptible to inefficiencies, arbitrage trading, and market manipulation. As a result, it is crucial to recognize the need for continued surveillance, monitoring, and regulatory frameworks within the crypto market to address potential market failures and maintain a fair trading environment.

371 Decentralized exchange protocols and blockchain technology have the potential to reduce the need for trust in traditional financial intermediaries by allowing users to maintain control over their assets. However, trust remains a critical aspect of these systems, shifting towards intermediating technology platforms and peers within the sharing economy. The role of trust in these platforms significantly impacts users' willingness to engage in transactions and influences their trust in other users within the ecosystem. Trust in the platform (institutional trust) encompasses aspects such as ability, integrity and benevolence, with blockchain technology potentially increasing trust in the platform while replacing trust in peers (or vendors due to a shift of vertical trust to a horizontal trust model). Despite these advancements, trust remains essential for peer-to-peer markets like blockchain-based systems or lateral exchange markets, like trust in technology or the platform. Further research is necessary to understand trust mechanisms and effects within blockchain-based decentralized technology platforms and the different layers of the DeFi architecture.

372 Lateral exchange markets in the form of blockchain-based decentralized exchanges (DEX), while having drawbacks themselves, are more inclusive as they are generally open to anyone, they allow users to maintain control over their assets throughout the trade process and they are rendering at least some of the traditional intermediaries unnecessary. DeFi market infrastructures are still less efficient than traditional markets, yet they manage

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to handle certain aspects better than centralized markets and offer other opportunities, some maybe still unthought of at the moment. As with most disruptive innovations DeFi markets may be overestimated in the short term and underestimated in the long term due to potential exponential growth of performance. If this was the case, now might be the sweet spot for financial intermediaries and other financial market players to cannibalize their own business and expand their DeFi capabilities pursuant to Christensen's (1997) innovators dilemma.

While early decentralized exchanges faced limitations, such as low transaction volumes and high network fees, the development of open exchange protocols has improved liquidity and streamlined the trading process. Various types of decentralized exchange protocols have been implemented, including decentralized order book exchanges, smart contract-based reserve aggregation, constant function market makers, and peer-to-peer (P2P/OTC) protocols. Each of these approaches offers unique advantages, with the overall goal of providing a more secure, efficient, and decentralized trading environment. 373

In line with public policies on financial markets, the European Commission's DLT Pilot Regime is part of a broader digital finance package aimed at fostering innovation in distributed ledger technology (DLT) within the financial sector while ensuring market stability and investor protection. This initiative seeks to provide legal certainty, support innovation, and maintain financial stability by allowing experimentation with DLT in trading and post-trading of crypto assets that meet the criteria to be considered securities. The pilot regime is intended to facilitate the development of DLT market infrastructures, potentially catalyzing the shift to tokenized financial instruments and bolstering the EU's global competitiveness. 374

While the pilot regime aims to balance innovation with risk mitigation, it may be critiqued for overemphasizing potential flaws and risks and their regulation, which may discourage innovation and experimentation in the DLT space. Additionally, there could be more focus on investor behavior and the potential impact of DLT market infrastructures on market participants as DLT market infrastructures, due to their inherent inclusiveness, are in general open to anyone, while on centralized market infrastructures only institutional intermediaries or institutions may participate. To address these concerns, a more proactive and constructive approach to resolving issues, as well as incorporating behavioral finance insights, may be considered in the design of the DLT pilot regime, as behavioral biases and heuristics may impact investors' decision-making processes when engaging 375

with DLT market infrastructures, leading to excessive risk-taking or irrational preferences. Policymakers should consider incorporating investor education and awareness initiatives to mitigate the influence of such biases, ultimately promoting responsible investment behavior and stability in the financial sector.

376   Concludingly, the DLT Pilot Regime recognizes the significance of distributed ledger technology in the financial sector and aims to create a regulatory sandbox for innovation. However, the current discussion leaves open various possibilities for the future of the pilot regime, leading to potential uncertainty and hesitancy among market participants. Clearer indications of potential outcomes and criteria for evaluating the pilot's success should be provided to reduce uncertainty and facilitate long-term planning. From a behavioral finance perspective, the pilot regime's implications on market participants' decision-making, risk-taking behavior, and adoption of new technologies should be considered. There is a risk of creating an uneven playing field between regulated DLT market infrastructures and non-regulated DeFi platforms, which may inadvertently incentivize market participants to favor less-regulated platforms (DeFi markets) and lead to potential financial instability. Regulators should ensure that the DLT pilot regime is flexible and adaptable, allowing for a level playing field between conventional regulated markets and DLT trading facilities through continuous monitoring and periodic revisions of the regulatory framework.

4.2.3 Crowdfunding Services & emerging markets of DeFi lending

377   Crowdfunding, as a nascent and yet promising mode of finance, has caught global attention. It enables entrepreneurs to tap into a diverse pool of investors, democratizing access to funding and fostering innovation. Acknowledging this, the European Union (EU) introduced Regulation (EU) 2020/1503 on European crowdfunding service providers (ECSP) for business. The Crowdfunding Regulation provides a comprehensive legal framework for the operation of crowdfunding platforms within the EU. It encompasses two distinct types of crowdfunding: lending-based and investment-based. The former involves the offering of a direct loan agreement, whereas the latter involves transferable securities, including shares and bonds associated with the crowdfunding project.

378   To ensure investor protection and market transparency, the regulation introduces specific requirements for crowdfunding service providers. Key

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among these are licensing obligations, operating conditions, transparency rules, and measures to manage conflicts of interest. Importantly, it also introduces a 'passporting' provision, allowing platforms authorized in one Member State to provide services across the entire EU. Crowdfunding service refers to the process of connecting investors and project owners for business funding through a crowdfunding platform. This service may include the following activities:

- Facilitating the provision of loans.
- Placing of transferable securities and admitted instruments for crowdfunding purposes without a firm commitment basis and the reception and transmission of client orders in relation to those financial instruments.

The Regulation applies to crowdfunding offers provided to businesses with a consideration of up to €5 million, calculated over a period of 12 months per project owner. It excludes offers directed exclusively to consumers. The primary objective of the Crowdfunding Regulation is to establish a harmonized and conducive environment for crowdfunding activities across the EU. By providing clear operational guidelines and investor protection measures, it seeks to enhance market integrity, foster cross-border crowdfunding activities, and enable the growth of innovative businesses.   379

Moreover, by addressing market fragmentation, the regulation facilitates the single market's completeness for financial services, aligning with the broader goal of building a Capital Markets Union (CMU) in the EU. signifies an important step in the EU's journey towards financial digitalization and democratization.   380

Following our discussion on traditional crowdfunding models, let us now transition into the realm of decentralized finance (DeFi) and its unique lending systems. In the DeFi ecosystem, loans are a crucial component with an extensive range of protocols that facilitate the lending and borrowing of crypto assets. Decentralized lending platforms are distinguished by their lack of identification requirements for both borrowers and lenders. This characteristic ensures unrestricted access to the platform for any individual seeking to either borrow funds or supply liquidity to generate interest (Schär, 2021).   381

To protect the lender's interests and deter the borrower from absconding with the money, two main approaches are utilized. First, credit can be granted with the stipulation that the loan is repaid atomically, meaning that the borrower receives, uses, and returns the funds within a single   382

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blockchain transaction. If the borrower does not repay the money (along with interest) by the conclusion of the transaction's execution cycle, the transaction becomes void and its outcomes, including the loan, are reversed. These types of loans are commonly referred to as flash loans, which pose an intriguing yet highly experimental application with the potential to become an integral part of DeFi lending as they offer efficient instruments for arbitrage and portfolio restructuring (Schär, 2021).

383   Secondly, loans can be completely backed by collateral. This collateral is kept in a smart contract and is only freed when the debt has been settled. Collateralized loan platforms can be divided into three types: collateralized debt positions, peer-to-peer collateralized debt markets and pooled collateralized debt markets. Collateralized debt positions involve loans that use newly minted tokens, while debt markets employ existing tokens and require a pairing between a borrower and a lender (Schär, 2021).

384   DeFi applications offering collateralized debt positions enable individuals to generate and distribute new tokens that are backed by collateral. A user must lock crypto assets in a smart contract to generate these tokens. The creation of tokens is determined by the target price of the generated tokens, the value of the crypto assets acting as collateral, and the desired collateralization ratio. These freshly generated tokens effectively function as fully collateralized loans without the need for a counterparty, allowing individuals to acquire liquid assets while maintaining market exposure through the collateral (Schär, 2021).

385   This concept can be illustrated using MakerDAO as an example, a decentralized protocol that issues the USD-pegged Dai stablecoin. Initially, a user deposits ETH into a smart contract, known as a collateralized debt position (CDP) or vault. They then invoke a contract function to produce and withdraw a specific number of Dai, effectively locking the collateral. The current process requires a minimum collateralization ratio of 150 percent, which means that for every 150 USD worth of ETH secured in the contract, the user can create up to 100.00 Dai. Outstanding Dai is subject to a stability fee, theoretically corresponding to the maximum interest rate of the Dai debt market. This rate is determined by the community of MKR token holders, the governance token for the MakerDAO project. To close a CDP, the owner must repay the outstanding Dai and the accrued interest to the contract. Once the debt is settled, the smart contract allows the owner to withdraw their collateral. If the borrower defaults on the loan or the collateral's value falls below the 150 percent threshold, the smart contract initiates the liquidation of the collateral at a potentially discounted

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rate (equivalent to the failure of meeting a margin call). Interest payments and liquidation fees contribute to the reduction of the total MKR supply by partially burning MKR. In return, MKR holders bear the residual risk associated with negative ETH price fluctuations, which could result in collateral being insufficient to maintain the USD peg. In such cases, fresh MKR tokens are minted and sold at a discounted price. Consequently, MKR holders have a vested interest in the system's stability and should strive to maintain a healthy ecosystem (Schär, 2021).

Borrowing existing crypto assets from others is another possibility of De-Fi lending (collateralized debt markets), as opposed to creating new tokens (collateralized debt positions). This approach necessitates a counterparty with an opposed interest. To put it another way, in order to borrow ETH, someone else must be ready to lend ETH. All loans must be completely collateralized, with the collateral being secured in a smart contract to reduce counterparty risk and protect the lender. Various methods can be employed to match lenders with borrowers, generally falling into two categories: P2P and pooled matching. P2P matching entails liquidity providers lending crypto assets to specific borrowers, with lenders only earning interest upon successful matching. The benefit of this method is that the stakeholders can reach consensus on a fixed interest rate and a specified time period. Pooled loans, on the other hand, utilize variable interest rates influenced by market forces of supply and demand dynamics. After depositing their funds, lenders immediately start earning interest because all of their funds are combined into a singular smart contract-based lending pool. The utilization rate of the pool, however, governs interest rates. As a result, loans will be more inexpensive when liquidity is plentiful and more expensive when liquidity is scarce. The ability to change maturity and size while keeping a high level of liquidity for individual lenders is another benefit of lending pools (Schär, 2021).

Numerous lending protocols exist, including dYdX, Aave and Compound. including Aave, Compound, and dYdX among the most well-liked examples. In the DeFi ecosystem as of September 2020, Dai accounted for over 75% of all loans. (Schär, 2021).

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4.2.4 Decentralized derivatives – a growing trend in the DeFi ecosystem

Decentralized derivatives, which can be categorized into asset-based and event-based derivative tokens, derive their value from a variety of sources

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such as an underlying asset's performance, an event's result, or another variable. These derivatives often necessitate an oracle to monitor the variables in question, resulting in dependencies and centralized components; however, these dependencies can be mitigated by employing multiple independent data sources within the derivative contract (Schär, 2021).

389   Asset-based derivative tokens, a development of the collateralized debt position (CDP) model (cp. Chapter 4.2.3), have prices that function based on the performance of an underlying asset. These tokens can represent a range of assets, such as tokenized representations of shares, precious metals, or other crypto assets, and the risk of falling below a specific collateralization ratio increases with the underlying asset's volatility. Synthetix, a well-known derivative token platform, operates in a manner that allows the total debt pool of all participants to fluctuate based on the total price of all synthetic assets that are still outstanding, ensuring the fungibility of tokens with identical underlying assets. Inverse tokens, where the price is decided by an inverse function of the performance of the underlying asset within a given price range, are a notable example of asset-based derivative tokens, offering users short exposure to crypto assets (Schär, 2021).

390   On the other hand, event-based derivative tokens' prices depend on any observable variable not linked to an asset's performance. These tokens are founded on objectively observable variables with known potential outcomes, specified observation times, and resolution sources. By locking for example one ETH in a smart contract, users can purchase an entire set of sub-tokens for a given event, with each sub-token representing a potential outcome. The sub-tokens may then be exchanged individually, and upon market resolution, the crypto assets of the smart contract are divided among the winning outcome's sub-token holders. Consequently, without distortions in the market, the ETH price of each sub-token is supposed to match with the probability of the associated outcome (Schär, 2021).

391   Nonetheless, these event-based derivative tokens introduce external dependencies and potential vulnerabilities due to the reliance on the trustworthiness of the resolution source. Malicious reporters can unilaterally influence the tokens, with potential attack vectors involving inaccurate or deceptive question specifications, incomplete outcome sets that make the event irresolvable, and untrustworthy or fraudulent resolution sources.. In addition, these kinds of tokens may also be on the verge of gaming, and accordingly gaming regulation. Augur, a popular event-based derivative token implementation (Peterson et al., 2019), employs a multi-stage resolution and disputing process aimed at minimizing dependency on a single

reporting source. In cases where token holders disagree with the specified reporter, they can initiate a dispute that ultimately ought to bring about an accurate result (Schär, 2021).

4.2.5 DeFi portfolio management and investment schemes

On-chain asset management, akin to traditional portfolio management and investment funds, primarily serves the purpose of portfolio diversification, enabling individuals to invest in a collection of crypto assets and use various tactics without managing individual tokens. A key distinction between on-chain funds and their traditional counterparts is the absence of a custodian, with the crypto assets being held in a smart contract instead. This arrangement allows investors to retain control over their assets, liquidate or withdraw them, and monitor the token balances of the smart contracts at any moment (Schär, 2021).

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Smart contracts employed in on-chain asset management can adhere to a range of simple strategies, such as semi-automatic portfolio weight rebalancing and trend trading using moving averages or rely on one or more fund managers for active management. In the latter scenario, smart contracts ensure that asset managers act in the investors' best interests and abide by the pre-defined strategy and risk profile established in the contract. Consequently, smart contracts can address numerous principal-agent issues and enforce regulatory requirements on-chain, potentially reducing fund setup and auditing costs (Schär, 2021).

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Upon investing in an on-chain fund, an investor receives fund tokens issued by the corresponding smart contract, which signify partial ownership of the fund enabling token holders to redeem or liquidate their share of the assets. The fund tokens are burned, the underlying assets are traded on a decentralized exchange, and the investor receives the ETH equivalent of their share of the basket when they decide to exit their investment (Schär, 2021). This resembles the equivalent of the redemption of a fund share and the associated capital reduction in the case of a stock corporation with variable capital (SICAV) with regard to centralized finance.

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There are multiple on-chain fund protocol implementations, such as the Set Protocol, etc, which are all limited to ERC-20 tokens and Ether and mainly rely on third-party protocols and price oracles. These dependencies can be quite significant (Schär, 2021).

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4.2.6 The role of crypto asset mixers as privacy enhancing protocols and financial intermediaries

396 Contrary to popular belief, maintaining privacy on public blockchains is a challenging task. Despite their permissionless nature, such blockchains are entirely transparent, with all confirmed transactions being publicly visible as the history of the blockchain is accessible and recorded. Using pseudonymous addresses helps to hide the identities of users but privacy concerns remain prevalent. Should anyone manage to associate an individual with a specific blockchain address, that individual's entire transaction history and activities become observable ((Nadler & Schär, 2023).

397 So-called Crypto asset mixers or tumblers, also known as privacy-enhancing protocols, are a prevalent approach to achieving some degree of privacy on public blockchains. These mixers pool deposits from various persons, who then withdraw funds using new addresses without revealing the connection between deposit and withdrawal addresses. Consequently, such mixers remove the apparent connection between transactions (Nadler & Schär, 2023).

398 Although there are legitimate uses for privacy-enhancing protocols due to the transparency of public ledgers, evidence exists that these tumblers are employed in money laundering and concealing illicit activities. For instance, the Tornado Cash mixer has attracted regulatory scrutiny due to its association with funds originating from illegal activities. In August 2022, the OFAC (U.S. Treasury's Office of Foreign Asset Control) added the smart contracts of Tornado Cash on the SDN (Specially Designated Nationals and Blocked Persons) sanctions list, penalizing any engagement with the protocol (Nadler & Schär, 2023). This poses another possible, yet far reaching, way of regulating DeFi, by putting the respective protocols or smart contracts and anyone interacting with them under sanction. As this comes close to regulating or rather banning the technology or its applications and legit use cases remain, a more fine-grained and fine-meshed assessment at the level of users and their respective interaction with the protocol and the interactions economic background would seem a more reasonable and prudent approach.

399 In the realm of crypto asset mixers, differing levels of technological sophistication exist, ranging from the simplest custodial models to more complex non-custodial mixers. The custodial model relies on a centralized service provider to facilitate the mixing process, where individuals transfer assets to a public deposit address and privately specify a recipient address.

While seemingly functional, with custodial mixers users must rely on the service provider's fulfillment of obligations, proper handling of assets, and commitment to preserving privacy by eliminating identifying data (Nadler & Schär, 2023).

In contrast, non-custodial crypto asset mixers leverage distributed cryptographic systems, allowing for the verification of a withdrawal's validity without revealing the link between deposits and withdrawals. As such, these mixers do not necessitate sharing identifying information and eliminate liquidity risks, since the funds are locked and inaccessible for other uses. Consequently, non-custodial mixers may function as an independent and immutable infrastructure, free from centralized control. A fundamental issue with non-custodial privacy enhancing protocols is balancing two opposing objectives: maintaining anonymity by not storing information linking deposits and withdrawals, while ensuring that only those who deposited crypto assets can initiate withdrawals and each deposit can be withdrawn only once. This can be achieved through smart contracts, hash functions, merkle trees and zkSNARKs (Nadler & Schär, 2023). 400

Hash functions serve as checksums and cryptographic fingerprints, mapping input data to fixed-length output. Crucial for ensuring data integrity and validating secret knowledge, hash functions must be one-way and collision-resistant, making it infeasible to find multiple inputs for a given output or derive input from output. Merkle trees address the inefficiency of using hash values to demonstrate an element's part of an input vector, providing more efficient means for hash-based integrity proofs. By hashing elements pairwise and iteratively until a single output value (the Merkle root) is obtained, Merkle trees enable efficient inclusion proofs, particularly for large input vectors (Nadler & Schär, 2023). 401

zkSNARKs (zero-knowledge, succinct, non-interactive argument of knowledge) offer a means to demonstrate knowledge of a secret value without revealing it. These proofs are non-interactive, thus not requiring any direct interaction between the prover and the verifier, and succinct, allowing for efficient verification in terms of data size and verification time. A proof is considered to be zero-knowledge if it doesn't disclose any information beyond the fact that a statement is true, without revealing the secret value or any other related information. zkSNARKs have been applied in various privacy-enhancing technologies, including non-custodial crypto asset mixers like Tornado Cash, as a powerful tool for preserving anonymity within public blockchain networks (Nadler & Schär, 2023, with further references). 402

403   Users can thus present cryptographic evidence that their withdrawal transactions are linked to prior deposits without divulging the details of their transaction history. It is proposed by Nadler & Schär (2023) that through cryptographic proofs individual may protect their public chain privacy while maintaining compliance with regulatory requirements, such as AML and CFT measures by showing a financial intermediary the corresponding cryptographic proof, allowing analysis as if one had never used privacy enhancing protocols. Vice versa, this proof may not be provided in case it discloses the association with illicit activities. This may facilitate a balance between privacy and transparency, permitting legitimate users to preserve their anonymity while ensuring that malicious actors face significant challenges in using these technologies for illicit purposes (Nadler & Schär, 2023).

404   Regulated financial intermediaries won't accept the assets unless a client is able and willing to show evidence of its source. Similar to this, merchants that sell products or services beyond a set legal threshold are obligated by law to record these transactions and are strongly compelled to ask for proof of origin. Otherwise, they risk breaking the law and running into problems if they try to use assets for which they are unable to identify the source (Nadler & Schär, 2023).

Honest actors can partially maintain their anonymity as a result of this procedure, while dishonest actors must incur high search and matching costs to find a counterparty prepared to accept the assets without requesting proof of origin. This is analogous to how money transactions are processed. One must show confirmation of the moneys' origin in order to deposit larger sums of legal tender with financial intermediaries or utilize them to make large cash payments for goods or services. Due to their immutable transaction history, blockchain-based non-custodial crypto asset mixers provide easier and more trustworthy verification than cash transactions. (2023; Nadler & Schär).

405   A significant challenge arises when assets deposited in non-custodial crypto mixers may be withdrawn to any wallet without the possibility of rejection or blocking, even if the recipient (mentally) refuses to accept assets from a crypto mixer. Notably, it is illegal to accept money from sanctioned entities. Bad actors may exploit this by first sending assets to a sanctioned non-custodial crypto asset mixer and then withdrawing and forwarding these assets, in whole or in part, to other individual's wallets, making it impossible for observers to ascertain if the receiving party interacted with the protocol. Furthermore, individuals receiving assets this way cannot

prove their non-involvement since it is impossible to show that they do not possess the cryptographic proof (Nadler & Schär, 2023). Consequently, the burden falls upon the receiving party to take action and attempt to resolve the situation, while it is not their burden of proof and the legal principle *negativa non sunt probanda* may apply, which states that a party making a claim has the burden of providing evidence to support that claim, rather than the other party being required to prove that the claim is false.

One possible solution proposed by Nadler & Schär (2023) involves disposing of the tainted assets in a publicly observable manner, such as sending the same amount as the assets received to a recognized burning wallet on the blockchain—a wallet address for which the private key is in no one's possession. Although imperfect, as it still imposes mandatory measures and transactional fees on the receiver, this method may in theory at least prevent third parties from freezing other party's wallets or causing legal issues. The OFAC previously addressed this type of attack called "dusting" and stated that they will not prioritize enforcement regarding these transactions to unaware receiving parties. Since sellers have no control over the source of the assets they receive or the identity of the buyer, additional issues arise in smart contract protocols that function as open marketplaces with auctions or peer-to-peer sales. To mitigate this issue, marketplaces may need to restrict participants and only allow users with verified identities (Nadler & Schär, 2023).

Sanctions aim to prompt behavioral changes in sanctioned entities. However, smart contract systems are in general immutable by design and thus incapable of altering their functioning. In this context, sanctions effectively become a ban on the protocol. Since the code for smart contracts is publicly accessible on the blockchain, anyone can simply copy it and launch a fresh instance of any protocol at a different address, making regulatory efforts against particular smart contract addresses at best a band-aid solution. It can be difficult to tell if anything is a functioning copy of an approved protocol or a new implementation that needs additional inquiry and treatment, which makes minor code variations even more problematic (Nadler & Schär, 2023). Thus, regulating protocols or the technology itself does not seem to have a lot of merit, also considering that when exchanging crypto assets back to legal tender, in general, financial intermediaries will have to be approached, which in turn have to analyze the source of funds and conduct due diligence. For fraudulent activities and injured parties this may still pose a long and weary process due to non-optimized enforcement on a global level. In addition, any crypto assets stemming from fraudulent

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activities may potentially be left untouched in a crypto tumbler for long periods of time, ultimately with the potential of ruining injured parties (e.g., causing insolvency) and raising concerns with regard to the statute of limitations for criminal liability of the perpetrator and the relative permanence of storage in smart contracts.

408   While non-custodial blockchain based tumblers or privacy enhancing protocols represent a disruptive development that demonstrates the potential of zero-knowledge proofs by offering good actors to keep their transaction history private while utilizing public blockchains in a manner similar to other electronic payment systems, the risks are substantial and should not be underestimated (Nadler & Schär, 2023). While regulating or banning the technology would be drastic and also does not seem to be an effective and viable solution, centralized financial intermediaries can be drawn to responsibility if they are involved when converting crypto assets to legal tender, which requires them to conduct due diligence duties on the source of funds, etc. However, non-optimized global enforcement may lead to lengthy processes for fraud victims. Crypto assets from fraud may also sit in tumblers for extended periods, potentially causing insolvency for affected parties and raising concerns about the statute of limitations for criminal liability due to quasi permanent storage in smart contracts.

4.2.7 DORA – digital operational resilience

409   The rapid digitalization of the financial sector has increased reliance on information and communication technology (ICT) systems while also heightening ICT risks, such as cyber threats and ICT disruptions. The European Systemic Risk Board (ESRB) (DORA, 2022, recital 3) highlighted that the interconnectedness and interdependencies of financial entities and ICT systems could lead to systemic vulnerabilities, enabling localized cyber incidents to spread throughout the entire financial system. Despite international and national initiatives, "*ICT risk continues to pose a challenge to the operational resilience, performance, and stability of the Union financial system.*" (DORA, recital 5). This has led to the enactment of Regulation (EU) 2022/2554 of the European Parliament and of the Council of 14 December 2022 on digital operational resilience for the financial sector (also known as digital operational resilience act or DORA; ELI: http://data.europa.eu/eli/reg/2022/2554/oj) which will be applicable early in 2025 pursuant to its article 64 (DORA, recitals 1-5).

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The Single Rulebook and European system of financial supervision have not included an adequate framework with regard to ICT or operational risks, resulting in unharmonized national legislation. This has caused inconsistencies and challenges for financial institutions and intermediaries with international operations, which can hinder the smooth functioning of the internal market in financial services and distort competition between financial entities (DORA, recital 9). Considering the significant links between online and offline resilience of financial organizations, a consistent strategy for the robustness of such entities shall be established through DORA. Providers of cloud computing services are regarded as a subset of the digital infrastructure covered under DORA. All crucial ICT third-party service providers, including cloud computing service providers providing ICT services to financial firms, are subject to the Union Oversight Framework created under DORA (DORA, recitals 19-20).

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The increasing reliance on outsourcing and the concentration of ICT third-party service providers has led to potential systemic risks in the financial sector, and national mechanisms have proven insufficient in equipping financial supervisors with appropriate tools to address such risks. To address these concerns, an Oversight Framework is being established, pursuant to which financial entities' essential ICT third-party service providers are continuously monitored while maintaining client privacy and security. Both intra-group and external provision of ICT services should be subject to the same regulatory framework, although the risk assessment should account for the higher level of control over intra-group providers (DORA, recitals 19-20).

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Sharing threat and vulnerability intelligence among financial firms on a regular basis is essential for the efficient detection and prevention of ICT threats. The ability of financial firms to prevent and lessen the effects of ICT-related incidents is strengthened by increased awareness of cyber dangers. Such intelligence sharing has been hampered, nevertheless, by ambiguity regarding compliance with data protection, antitrust, and liability regulations. Additionally, the existing status of information sharing is constrained and dispersed, with the majority of exchanges of information being local and the absence of uniform Union-wide policies. Therefore, DORA's primary objective is to strengthen communication channels (DORA, recitals 32-33).

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The Regulation addresses risks arising from all varieties of ICT services in an effort to maintain a high level of operational digital resilience for the financial sector. With rare exceptions, the definition of ICT services

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is broad and includes digital and data services delivered regularly through ICT systems to internal or external consumers. (DORA, recital 35). Financial enterprises having less requirements or exemptions under sector-specific Union law, such as small, unaffiliated investment firms and other smaller institutions, are subject to a streamlined ICT risk management framework in accordance with the concept of proportionality (DORA, recital 42).

414   This Regulation encourages a balanced approach to addressing the risk of ICT third-party concentration by being adaptable and incremental. Financial institutions should carefully review their contracts to see whether there is a chance of concentration risk developing. This assessment should include in-depth evaluations of subcontracting agreements, especially when done with ICT third-party service providers based in a third country. (DORA, recital 67).

415   The Union's financial ecosystem is now intrinsically dependent on certain ICT services offered by ICT service providers due to the digital revolution of the financial services industry, which has resulted in an unprecedented level of use and reliance on ICT services. Given the extensive reliance on vital ICT third-party service providers and the interdependence of the information systems used by different market operators, there are direct and potentially serious risks to the Union financial services system should these providers be impacted by major cyber incidents or operational disruptions (DORA, recital 79).

416   Critical third-party ICT service providers should be able to offer ICT services from anywhere in the globe, not just from locations in the EU, according to the oversight framework. However, the Lead Overseer should be able to exercise their necessary oversight capacities in third countries, provided the crucial ICT third-party service provider in question consents and the competent third-country authorities concur (DORA, recital 83).

417   Competent authorities must refrain from adopting any individual actions to monitor the risks posed by crucial ICT third-party service providers in order to avoid duplications and overlaps and must instead rely on the judgment of the relevant Lead Overseer (DORA, recital 93).

418   In addition to DORA, the proposal for a Regulation of the European Parliament and of the Council on information accompanying transfers of funds and certain crypto-assets (recast) (TFR; COM(2021) 422 final, 2021/0241 (COD)) has been made which aims to establish a regulatory framework for enhancing the traceability and transparency of cross-border fund transfers and certain crypto-asset transactions. This proposal is designed to combat money laundering, terrorist financing, and other finan-

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cial crimes by ensuring that financial institutions and crypto-asset service providers collect, retain, and transmit adequate and accurate information about the sender and beneficiary of transactions.

The recast proposal seeks to update and streamline existing regulations, taking into account the rapidly evolving financial landscape and the emergence of new technologies, such as cryptocurrencies and other digital assets. By doing so, the regulation aims to strengthen the overall anti-money laundering and counter-terrorism financing (AML and CTF) framework within the European Union.

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From a behavioral finance and regulatory public policy perspective, the discussion on the Digital Operational Resilience Act (DORA) raises several points that warrant further analysis, as the critical role of behavior in determining the effectiveness of risk management in cybersecurity practices with regard to ICT should be recognized in order to design strategies that influence the decision-making process and incorporate nudge-based interventions that promote desirable behaviors among financial entities and individuals. This could include simplifying compliance processes, using framing techniques to present information effectively, and leveraging social norms and incentives to drive behavioral change. For example more secure default settings in hardware, software, and applications to reduce the likelihood of human error or inaction could be established on a regulatory level. On an operational level, organisations may also implement mechanisms to simplify complex cybersecurity information, establish secure default settings, frame cybersecurity risks effectively, promote positive cybersecurity social norms, provide timely reminders for security actions, offer incentives for secure behaviors, give feedback and track progress, use gamification for training and awareness, and optimize choice architecture for secure decisions

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It should also be acknowledged that one size does not fit all and it is necessary to ensure that regulations can be tailored to the unique characteristics and risk profiles of individual financial entities, striking a balance between harmonization and customization. Likeweise, proportionality principles should be applied to ensure that smaller financial entities are not overwhelmed by extensive regulations and in order to scale down regulatory requirements based on size, complexity, and risk exposure. In addition, a cost-benefit analyses to evaluate the potential impacts of regulatory measures on financial entities should be conducted. This would help analyzing and ensure that the advantages of enhanced resilience outweigh the expenses of compliance and administrative burdens.

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422   Lastly, the discussion mentions avoiding duplication and overlaps with existing regulations, where there is a risk of creating inconsistencies, contradictions, or conflicts with other regulatory frameworks, such as GDPR. A more thorough analysis of the interaction between DORA and other relevant regulations is needed and a holistic approach to financial regulation that considers the interconnectedness of risks, and the broader financial ecosystem should be adopted. This includes examining the interaction between various regulatory frameworks and ensuring consistency and coherence in the regulatory landscape.

423   By focusing on these aspects, the design and implementation of financial regulations can be improved, resulting in a more effective, efficient, and adaptive regulatory environment that promotes financial stability and operational resilience. Through architecting nudge-based interventions, policymakers and organizations alike may encourage individuals and businesses to adopt more secure practices and reduce their exposure to ICT risks.

4.2.8 Global financial regulation?

424   The intricate web of international financial regulation has continued to evolve in response to the increasing complexity and interconnectedness of global financial markets. There have been various approaches and mechanisms used to address the challenges of financial regulation, including hard law, soft law, and intermediate arrangements, extending on the debate of the global financial crisis of 2007-2008 and its implications for regulatory reform as well as the diverse methods that have been proposed and implemented to achieve stability and mitigate risks in the international financial system (Arner & Taylor, 2009).

425   In the face of global financial crises, the European Union (EU) has been at the forefront of efforts to develop more effective supervisory and regulatory mechanisms. The establishment of a working group chaired by Jacques de Larosière, in response to the financial crisis, led to the proposal of two major recommendations that significantly influenced the legal development of European financial integration. These recommendations included the creation of the ESRB (European Systemic Risk Board) and the ESFS (European System of Financial Supervision), which aimed to enhance macroprudential supervision and harmonize regulatory standards within the EU (Arner & Taylor, 2009).

As the need for better coordination and regulation in global capital markets has become increasingly apparent, various proposals for a global financial regulator have emerged. While proponents argue that such an agency would reduce regulatory arbitrage and be less susceptible to political pressures, critics contend that the feasibility of a global financial regulator is questionable due to the preservation of national sovereignty and the difficulties in reconciling differences in legal systems and enforcement powers (Arner & Taylor, 2009). **426**

The myriad of regulatory approaches that have been proposed and implemented to address the challenges of global finance can be categorized as traditional hard law, uncoordinated domestic responses, and intermediate arrangements. Each approach has its merits and drawbacks, with hard law and international organization-based approaches often facing political and practical obstacles, while purely soft law cooperative arrangements have proven inadequate in preventing and resolving global financial crises. Consequently, recent discussions have gravitated towards intermediate arrangements, such as the Financial Stability Board (FSB), which seeks to strike a balance between the extremes of the regulatory spectrum (Arner & Taylor, 2009). **427**

The FSB, which emerged from the strengthening of the Financial Stability Forum, represents a compromise between hard law and soft law approaches in international financial regulation. By incorporating elements of peer review and external monitoring, the FSB aims to enhance coordination and prevention efforts. However, the FSB's effectiveness in addressing cross-border financial institution failures and facilitating burden-sharing remains uncertain, as it lacks the ability to impose binding obligations on its members (Arner & Taylor, 2009). **428**

In 2023 the European Commission has launched a regulatory sandbox to support innovative use cases involving Distributed Ledger Technologies (DLT), such as blockchain. The sandbox will provide a pan-European framework for regulatory dialogues, increasing legal certainty for innovative blockchain solutions. The sandbox will operate from 2023 to 2026, and its goal is to facilitate cross-border dialogue between regulators and supervisors on one hand, and companies and public authorities on the other (Launch of the European Blockchain Regulatory Sandbox, 2023). **429**

Proponents of a more formal and binding arrangement as outlined above by Arnter & Taylor (2009) argue that the current approaches to international financial regulation, which are largely based on soft law and voluntary cooperation, have proven to be insufficient in preventing and managing **430**

financial crises. They believe that a formal, binding framework would lead to better coordination, enforcement, and compliance among countries, thus enhancing the overall stability of the international financial system. A binding arrangement could potentially address some of the issues that have arisen in past financial crises, such as burden-sharing in the event of cross-border bank failures. The establishment of a formal treaty or international organization, with clearly defined rules and dispute resolution mechanisms, may create a more predictable and equitable system for managing crises. On the other hand, critics argue that implementing a formal and binding arrangement could face significant political and practical obstacles. Sovereignty concerns and the diversity of national financial systems and legal frameworks may make it difficult to achieve consensus on a single, unified approach to financial regulation. Additionally, the enforcement of binding rules and agreements could prove to be challenging, given the complex and interconnected nature of the global financial system.

4.3 Further behavioral finance and regulatory public policy aspects in the context of DeFi and new developments

431   As technology continues to advance, the application of regulatory and public policy based on investment psychology and behavioral finance becomes increasingly important in ensuring investor protection and maintaining market integrity. Balancing the need for intervention with the risk of stifling innovation is a delicate task. The following areas provide opportunities to apply regulatory and public policy insights from investment psychology without undermining the fundamental principles of DeFi.

- Enhancing transparency and disclosure: Regulators can work to improve the transparency of platform operators, services and products with regard to crypto assets and centralized intermediaries between centralized and decentralized systems by requiring clear and comprehensive disclosures of risks, fees, and underlying mechanisms. By using findings from investment psychology, regulators can design disclosure requirements that effectively communicate critical information and enable investors to make informed decisions without overly burdening DeFi platforms.
- Promoting financial education and awareness: Policymakers can leverage insights from investment psychology to develop financial education programs that raise awareness of the risks and opportunities associated with DeFi investments. These programs can help investors recognize and

counteract common cognitive biases, fostering more prudent decision-making and reducing the potential for herd behavior and market manipulation.

- Encouraging responsible innovation: Regulators can support responsible innovation in DeFi by creating frameworks that allow for experimentation while maintaining investor protection. Regulatory sandboxes and innovation hubs can provide a controlled environment for centralized intermediaries providing services on the bridge between centralized and decentralized systems to test new products and services while engaging with regulators, promoting collaboration and knowledge-sharing without stifling innovation.

- Implementing risk-based regulations: Policymakers can design regulations that are proportionate to the risks posed by different service providers with regard to crypto assets and services bridging the gap of centralized and decentralized finance, using insights from investment psychology to identify potential areas of vulnerability. This approach ensures that higher-risk activities are subject to more stringent oversight, while less risky activities can operate with fewer regulatory burdens, thereby maintaining a balance between investor protection and innovation.

- Facilitating international cooperation: Given the global nature of DeFi, regulators can collaborate with their counterparts in other jurisdictions to harmonize regulatory standards and share best practices. By working together to address common challenges and risks, policymakers can develop a coherent and coordinated approach to DeFi regulation that accounts for the insights of investment psychology without unduly restricting innovation.

4.3.1 Perceived risk and uncertainty in decision research and implications for public policy and behavioral finance

Numerous academic studies on risk perception-focused research have been carried out since the middle of the 1970s in a variety of social science domains, including non-financial areas (Ricciardi, 2008). Early efforts on risky behaviors activities laid the academic groundwork for "*psychological aspects of risk perception studies in behavioral finance, accounting, and economics.*" (Ricciardi, 2008). "*This research on risky and hazardous situations was based on studies performed at Decision Research*", a company founded

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in 1976 by Paul Slovic that specialized in risk perception and it identified certain psychological behavioral risk traits that could be applied in the context of making financial and investing decisions. These studies examined risk perception and documented specific behavioral risk characteristics (Ricciardi, 2008).

433   How investors processes information and numerous behavioral finance theories, aspects and problems with the potential of affecting how individuals perceive risk in the context of decision making processes are key themes in the literature on risk perception. "*Heuristics, overconfidence, prospect theory, loss aversion, representativeness, framing, anchoring, familiarity bias, perceived control, expert knowledge, affect (feelings), and worry*" (Ricciardi, 2008) are some of the theories on behavioral finance which influence a person's risk perception with regard to various financial services and products (Ricciardi, 2008).

434   The study of perceived risk was inspired by findings of novices and professionals frequently disagreeing on what constitutes risk and how risky various sorts of technologies and hazards were. "*Researchers at Decision Research, especially Paul Slovic, Baruch Fischhoff, and Sarah Lichtenstein, developed a survey-oriented research approach for investigating perceived risk*" in the 1970s and 1980s that is still widely used today (Ricciardi, 2008).

435   Decision research has been influencing a wider number of academic fields, including behavioral finance, accounting, and economics, since the early 1990s. With regard to risk perception studies in the area of financial and investment decision-making, Decision Research academics started applying numerous behavioral risk characteristics (cognitive and emotional concerns), discoveries, and research methodologies from social sciences. This risk perception research has also been expanded by academics outside the Decision Research group in the fields of financial psychology, behavioral accounting, economic psychology, and consumer behavior (Ricciardi, 2008).

436   Since the 1960s, perceived risk has been a topic of interest to explain consumer behavior (Bauer, 1960). Within consumer behavior, perceived risk is the consumer's belief about the risk associated with buying products or services from a certain vendor, regardless of whether the risk is real or imagined. This concept shares similarities with behavioral finance in terms of the decision-making process (Cox & Rich, 1964). Bauer (1960) was among the first to introduce the idea of perceived risk, arguing that consumer behavior involves risk due to the potential for unanticipated consequences, some of which may be unpleasant. This notion of risk becomes

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especially relevant when considering high-cost purchases Cox and Rich (1964) offered a more specific definition of perceived risk describing it as a function of consequences (financial risk) and uncertainty (subjective feelings of potential gain or loss) (Ricciardi, 2008).

Similar to the emphasis on downside risk in behavioral finance, marketing research frequently focuses on the possible negative effects of perceived risk (Stone & Gronhaug, 1993). Financial, product performance, social, psychological, physical, and time/convenience loss are a few of the elements of perceived risk that have been found (Jacoby & Kaplan, 1972; Tarpey & Peter, 1975; Ricciardi, 2008). Tarpey and Peter also examined perceived risk in relation to maximizing perceived gain and net perceived return, drawing similarities to modern portfolio theory's positive relationship between risk and return (Ricciardi, 2008). | 437

Risk perception is affected by a variety of variables, including personal experiences, background, and understanding (Slovic, 1988). Perceived risk has been found to play a larger role in decision-making in several industries than actual risk. Risk perception research spans various academic disciplines, primarily in the social sciences, with psychology playing a significant role (Ricciardi, 2008). | 438

Numerous disciplines, including behavioral accounting, consumer behavior, marketing, and behavioral finance, all make extensive use of the notion of perceived risk. These academic fields look at how people react to risk according on their emotions, beliefs, and attitudes, as well as the influence of social norms and group dynamics. Due to a lack of reliable information, people frequently mistake the danger connected with certain activities, which can result in inaccurate judgements or actions (Ricciardi, 2004, 2005). | 439

Risk perception is a multidimensional and interdisciplinary concept that goes beyond objective risk measurements (e.g., variance) or purely behavioral perspectives (e.g., heuristics) (Weber, 2004). Risk is inherently subjective and relative, as individuals' perceptions of risk may vary significantly. Perceived risk involves evaluating a risky situation based on instinctive and complex decision-making, personal knowledge, and external information sources (Sitkin & Weingart, 1995). | 440

Ultimately, perceived risk is an individual's assessment of the propensity for risk, or the potential for exposure to loss, danger, or harm, connected to a particular activity. Numerous factors, such as intuitive heuristics, perceived average losses over time, situational characteristics, associations with risk sources, credibility and trust in risk-handling institutions, media | 441

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coverage, other people's opinions, and personal experiences with risk, can have an impact on this assessment (Renn, 1989; Ricciardi, 2008).

442   Despite the abundance of studies on risk and investor perception, many academic investigations fail to offer a clear definition of "*perception*" or address the concept in a comprehensive manner (Ricciardi, 2008). This lack of clarity can be misleading for readers who expect a thorough exploration of the subject. While perception is a fundamental concept in behavioral sciences and organizational behavior, it is often overlooked or underutilized in traditional finance research. Gooding (1973) has provided one of the few extensive discussions on perception within the context of finance, and only a handful of economists, such as Schwartz (1987, 1998) and Weber (2004), have substantively addressed the concept (Ricciardi, 2008).

443   The term perception of, or perceived risk, denotes a qualitative or subjective element that is frequently disregarded by academics in finance, accounting, and economics. Organizational behavior researchers have offered two perspectives on perception: one emphasizing a complex cognitive process resulting in a unique picture which may be divergent from reality, and the other highlighting its role in selecting and organizing environmental stimuli to create meaningful experiences for the perceiver (Ricciardi, 2008, with further references).

444   Perception is essential for understanding behavior since it is the process through which stimuli affect individuals, allowing them to arrange and analyze sensory information so they can make sense of their environment (Gregory, 2001). Perception relies on an individual's knowledge and past experiences, and it can sometimes lead to misinterpretations or illusions (Ittelson & Kilpatrick, 1951, pp. 50, 55). Two distinct definitions of perception from a psychological standpoint are discussed, one focusing on the discriminatory process among stimuli, and the other on the experiential aspect of perception (Ricciardi, 2008).

445   The academic literature reveals a variety of interpretations of perception across different fields of psychology (cp. Ricciardi, 2008). A similar challenge exists with the varying interpretations of risk across various disciplines. The following basic characteristics of perception should be taken into account by researchers in finance and investments (Ricciardi, 2008):

- A person's perception is based on their prior encounters with events, situations, or activities that are comparable to the one at hand.
- People pay attention to various aspects (pieces of information) of the same circumstance.

- A fundamental tenet of perception is that people can only digest a finite quantity of information at once in order to develop opinions or come to conclusions about a given circumstance, event, or activity.
- The innate tendency of humans is to categorize and structure data in order to comprehend it.
- When an environmental stimulus does not reach a, it also does not affect their actions. However, if they perceive a stimulus as genuine, even if it is factually incorrect, it will shape their behavior.
- The process by which each person observes reality and forms a particular knowledge, perspective, or viewpoint is known as perception.
- What a person thinks they perceive may not actually exist.
- A person's actions depend more on how they perceive reality than on reality itself.

Risk perception, or perceived risk, refers to the subjective judgements individuals employ when evaluating risk and the degree of uncertainty involved. Perception serves as a mechanism that enables people to categorize and comprehend their sensory experiences, allowing them to assess their environment by recognizing actions or objects rather than mere factors or traits. Numerous investigations into perceived risk and risk-taking behavior, carried out by social scientists, have been utilized in different business environments. The groundbreaking research on hazardous activities and risk-related behavior, initiated by the Decision Research organization, established the basis for contemporary studies on risk perception in fields such as behavioral finance, accounting, and economics. The influential findings of Decision Research, along with those of other social scientists, revealed several key points about perceived risk (Ricciardi, 2008): 446

- Risk is frequently rated differently by novices and specialists for a variety of risky behaviors and potential threats.
- Based on a variety of behavioral risk indicators, including dread, worry, familiarity, and controllability, perceived risk is quantifiable, predictable, subjective (qualitative), and descriptive.
- Information from sources which are trusted is given greater credence than that from sources which are distrusted.
- Cultural theory has looked into how culture affects risk assessments rather than only focusing on an individual's psychology.
- Perceived risk and perceived benefit are inversely correlated.
- Risk takes into account emotion (affect) as a crucial part of judgment and decision-making.

- External variables, like media attention, can affect one's perception of and appraisal of risk.

447 Classic decision-making underpins standard finance, which is founded on the concept of rationality, wherein investors make financial decisions. Standard finance has historically dismissed the idea that psychological factors can impede individuals from making the most rational decisions. In contrast, behavioral finance is predicated on the idea that investors make decisions in accordance with behavioral decision theory and bounded rationality. When making decisions, for instance, investors display cognitive and affective (emotional) elements in assessing risks and evaluating specific investment products or services (Ricciardi, 2008). With regard to public policy such bounded rationality likely also applies to regulatory policymaking in the financial markets, as it is also a decision-making process.

448 The literature on risk perception in the social sciences has shown that a variety of cognitive and affective (emotional) elements affect a person's risk perception for non-financial judgments. Several of these cognitive and affective components are also present during financial decision-making processes. These factors shape how investors perceive risk with regard to various financial products and services (e.g., tax planning, selecting financial consultants, etc) (Ricciardi, 2008). It is hypothesized that such risk perception also plays a role in public policymaking when it comes to regulation of financial markets (with potential other motivators, such as radiating confidence, ability to act, raising popularity, gaining voters and ensuring re-election, etc).

449 The advent of Decentralized Finance (DeFi) has added new dimensions to risk perception in the financial industry. DeFi is a system of financial services and applications built on blockchain technology, offering users more control, transparency, and accessibility to financial tools. However, decentralized systems also come with new and evolving risks, such as smart contract vulnerabilities, regulatory uncertainties, scams built on faux decentralization etc.

450 Applying the concepts of risk perception in the context of DeFi can help better understanding the variables affecting decision-making processes of investors within this emerging sector. Some of the key behavioral finance theories and ideas which may impact a person's perception of risk in DeFi include:

- Heuristics: Investors might rely on mental shortcuts to simplify complex DeFi protocols, potentially leading to misjudgements of the underlying risks.
- Overconfidence: As the DeFi ecosystem evolves rapidly, investors may overestimate their understanding of novel technologies and underestimate potential risks.
- Prospect theory and loss aversion: Investors might be more sensitive to potential losses than gains in DeFi, leading to risk-averse behavior, even when the expected returns may be significantly higher.
- Familiarity Bias: Users may preferentially invest in DeFi protocols they are more familiar with, even if those protocols might not offer the best risk-return profiles or investors unexperienced in centralized financial markets may prefer DeFi even though it does not suit their risk-return profile.
- Perceived control and expert knowledge: In the DeFi landscape, users have more control over their investments compared to traditional finance. This perceived control may affect their risk-taking behavior and investment decisions.
- Affect and worry: The emotional aspects of investing in DeFi, including fear of missing out (FOMO), fear of potential loss, and excitement about the potential for financial gains, can impact risk perception and decision-making.

Considering these factors, it is crucial to further study risk perception within the DeFi context to identify potential biases and improve the decision-making process for investors in this rapidly evolving financial landscape as there is almost no research and correspondingly only few data on the perceived risk within the DeFi context. By understanding how individuals perceive and react to risks in DeFi, researchers and policymakers alike can develop better tools, educational resources, and risk management strategies to mitigate potential pitfalls and promote informed decision-making.

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It also has to be noted that the financial system is inherently complex and constantly evolving, making it difficult to model and regulate effectively. The conventional approaches employed to manage this complexity may not always be successful, leading to the exploration of simpler methods as complementary tools. Financial systems may also be better characterized by uncertainty rather than risk because of the existence of numerous unpredictable factors (Aikman et al., 2021). The distinction between risk and uncertainty, as put forth by Knight (1921), is important to consider when

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designing financial regulations. Conventional methods for modelling and regulating financial systems often focus on risk, which may not adequately capture the full range of uncertainties faced by the system. In the context of risk, the result is unknown, but the probability distribution that dictates the outcome is known. Conversely, uncertainty is marked by not only an unknown outcome but also an indeterminate probability distribution. In this context, simpler approaches could be more effective at addressing the inherent uncertainties in financial systems (Aikman et al., 2021).

453   One of the main arguments for incorporating simplicity into financial regulation is its potential to complement existing, more complex methods. For instance, the analysis of "*capital requirements against potential losses and the empirical evidence on bank failures during the global financial crisis*" suggest that simple rules can indeed yield valuable results in what is called the less is more effect, as complex models may yield more accurate results than a heuristic approach in case of risk but once uncertainty is introduced, heuristics may actually fare better than complex models (Aikman et al., 2021). Furthermore, simpler approaches can enhance transparency, communicability, and accountability, thereby reinforcing macroprudential policies' signaling channel of (Giese et al., 2013).

454   Simpler regulatory regulations may have benefits, but there are drawbacks as well. One worry is that these laws might be open to arbitrage, gaming, and circumvention. It is crucial to remember that simplicity does not always imply a single-minded focus on a certain variable. For instance, combining simple indicators can assist in determining bank exposure without adding needless complexity. Furthermore, no matter how complex the laws are, there is always a chance for gaming and arbitrage. In fact, intricate stipulations may make it more difficult to recognize and treat problematic gaming activities. Simpler methods might help identify gaming and make it easier to combat it. (Aikman et al., 2021).

455   Simpler regulatory approaches offer several benefits, including reducing the resources directed towards compliance, promoting better understanding and communication among stakeholders, and improving internal governance and market discipline. In addition, they may contribute to a more efficient financial system by redirecting resources towards productive activities instead of unproductive regulatory arbitrage (Friedman, 2010; Aikman et al., 2021).

456   While simple rules are not a panacea, they can play a crucial role in complementing complex approaches to financial regulation. Emphasizing simplicity in financial regulation may lead to better outcomes for society

by addressing the challenges posed by uncertainty, improving transparency and accountability, and promoting the efficient allocation of resources (Aikman et al., 2021). With regard to DeFi or it's potential regulation this should be kept in mind, and it needs to be differentiated whether regulation is supposed to address risks or uncertainties, as simpler approaches in regulation may be more flexible and effective in case of the latter phenomena, in accordance with Friedman's (1953) postulated "as if" approach, which posits that, even if the assumptions of a model do not fully reflect the complexity of human behavior or the real world, the model can still be considered valuable if it generates reliable predictions..

A key argument for adopting a pragmatic approach, where behavioral factors are incorporated into economic models also lies in its potential to address important economic questions. By combining insights from psychology and other social sciences, this approach can help identify new policy tools, generate better predictions for existing policies, and offer fresh welfare (in reference to Pigou's social welfare, 1920) implications. Model uncertainty is a central issue that arises when incorporating behavioral factors into economic models. By acknowledging the existence of uncertainty, researchers can adapt their models to optimize expected welfare in response to policy tools like nudges or subsidies. In situations where model uncertainty exists, nudges can provide a more robust means of correcting internalities than for example tax incentives because they work effectively when agents make behavioral mistakes and have no impact when they do not (Chetty, 2015).

4.3.2 Choice architecture, framing effects, and default options in DeFi policy

It is essential to clarify the involvement of cognitive biases in financial decision-making, particularly with regard to DeFi. Cognitive biases are systematic deviations from rational decision-making that can significantly impact investors' behavior, leading to market inefficiencies and suboptimal outcomes.

Confirmation bias is one of these cognitive biases, which happens when people disproportionately look for or interpret information in a way that supports their pre-existing ideas. In the context of DeFi, confirmation bias can lead investors to overlook or downplay risks associated with a particular project or asset, resulting in ill-informed investment decisions.

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Additionally, confirmation bias can contribute to the formation of asset bubbles, as investors become overly optimistic and ignore warning signs of overvaluation.

460   Herd mentality, which refers to investors' propensity to mirror other people's actions, often driven by social influence or fear of missing out, also has an impact on financial decisions. In DeFi markets, herd mentality can exacerbate price volatility and facilitate the rapid spread of both investment fads and panic selling. For instance, when a large number of investors simultaneously flock to a new DeFi platform or crypto asset, the resulting demand surge can artificially inflate asset prices, leading to unsustainable market conditions and potential crashes.

461   The already discussed anchoring effect is a cognitive bias in which individuals make choices that are overly dependent on the anchor, a first piece of information. In the DeFi space, anchoring can manifest in various ways, such as investors basing their valuation of a new token on its initial offering price or historical performance, even if market conditions or fundamentals have significantly changed. This can result in mispriced assets and suboptimal investment decisions.

462   By understanding how these cognitive biases affect financial decision-making, regulators and policymakers can better anticipate potential market inefficiencies and design public policies that mitigate their adverse effects. In the context of DeFi, this entails crafting regulatory frameworks that account for the behavioral tendencies of market participants, promote transparency, and encourage more informed decision-making. By understanding the cognitive biases and heuristics that influence financial decision-making, regulators can also design more effective public policies that nudge investors towards better outcomes without restricting their choices.

463   Some policy interventions that leverage behavioral economics to shape investor behavior and improve market outcomes could include elements of choice architecture, framing effects and default options. Designing the environment in which decisions are made with the intention of influencing those decisions without restricting options is known as choice architecture. In the context of DeFi, choice architecture could be used to present investment options in a way that encourages more informed decision-making. For example, a DeFi platform could display the most relevant information, such as fees, risks, and potential returns, more prominently, helping investors to better assess the trade-offs associated with different investment choices.

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In general, complex and lengthy disclosure documents can be overwhelming for investors, leading them to ignore important information or rely on cognitive shortcuts to make decisions. By simplifying disclosures and presenting information in a clear, concise, and standardized format, it can be made easier for investors to understand the risks and rewards associated with DeFi investments. This can help to reduce information asymmetry and promote more informed decision-making. **464**

Decision making is also impacted by so-called framing effects. Framing is the method by which information is presented, which can significantly impact decision-making (Kahneman and Tversky, 1979). Framing effects may be leveraged to influence investor behavior in the DeFi space. For example, presenting potential losses more prominently than potential gains could counteract investors' natural tendency towards loss aversion, encouraging them to consider the risks associated with an investment more carefully. **465**

In addition, default options may be integrated by design. Default options are pre-selected choices that take effect unless an individual actively decides to change them. In the context of DeFi, default options could be used to promote more prudent investor behavior. For example, a DeFi platform could set default investment settings to more conservative options, such as lower leverage levels or more diversified portfolios, nudging investors towards less risky choices while still allowing them the freedom to opt for higher-risk alternatives if they wish, enabling a more diversified total asset portfolio. **466**

By incorporating behavioral insights into policy design, regulators can craft more effective public policies that address the unique challenges posed by the DeFi ecosystem. This can lead to improved investor behavior, enhanced market stability, and ultimately, a more robust and resilient financial system. Nevertheless, the question persists, on which level such policies should be implemented as true DeFi systems are in lack of a regulatory subject, and the above suggestions may therefore be rather seen as best practice policies for such truly decentralized infrastructures. However, centralized intermediaries bridging the gap of the centralized and decentralized economic and finance systems may be required to impose such rules. **467**

It is crucial to address the potential conflict between innovation and regulation, particularly in the rapidly evolving DeFi space. Regulators face the delicate task of maintaining a balance between fostering innovation and ensuring adequate protection for investors. On one hand, DeFi has the potential to revolutionize financial services by offering increased accessibility, efficiency, and transparency. By fostering innovation, regulators can help **468**

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drive the development of new financial products and services that benefit a broader range of market participants. However, the decentralized nature of DeFi also presents unique risks and challenges, such as vulnerability to hacks, fraud, and market manipulation. As a result, regulators must ensure that investor protection measures are in place to maintain trust in the financial system and minimize the potential for harm.

469   The potential conflict between innovation and regulation arises when regulatory efforts inadvertently stifle innovation or drive market activity to less-regulated jurisdictions. For example, overly stringent regulations might limit innovation as they can hinder the growth and development of DeFi projects, as startups may struggle to navigate complex compliance requirements or bear the costs associated with regulatory compliance. This can result in fewer innovative solutions reaching the market and reduced competition in the financial services sector. This may also drive market activity to less-regulated jurisdictions as overly restrictive regulations can incentivize DeFi projects and investors to relocate to jurisdictions with more lenient regulatory environments. This can lead to regulatory arbitrage, where market participants exploit differences in regulatory standards across jurisdictions, potentially undermining the intended goals of regulation and exposing investors to greater risks due to the inherently global nature of DeFi systems.

470   To strike a balance between fostering innovation and ensuring investor protection, regulators should adopt a measured, risk-based approach. This could involve tailoring regulation to specific risks and encouraging regulatory collaboration. By focusing on the most significant risks posed by DeFi activities, regulators can target their efforts more effectively and minimize the impact on innovation. This might include addressing concerns related to consumer protection, market integrity, and financial stability. Regulators should work closely with DeFi stakeholders, including industry participants, academics, and other policymakers, to better understand the emerging technology and its implications. This can help to create a regulatory environment that supports innovation while addressing potential risks. In order to prevent the mentioned regulatory arbitrage and ensure a level playing field, regulators should work towards harmonizing regulatory standards across jurisdictions. This can be achieved through international cooperation, knowledge sharing, and the development of common regulatory frameworks.

471   Regulators must remain adaptable in their approaches to regulation to keep pace with the fast-changing landscape. They should be prepared to

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update their regulatory frameworks and supervisory practices as new technologies, platforms, and risks emerge. This can help to strike a balance between promoting innovation and ensuring investor protection, financial stability, and market integrity. One way to foster adaptability in regulation is through the use of regulatory sandboxes. These controlled environments allow innovators to test their products and services under the supervision of regulators, while also providing regulators with valuable insights into emerging trends and potential risks. Regulatory sandboxes enable a more iterative, collaborative approach to regulation, facilitating knowledge exchange between regulators and the industry participants. Additionally, international cooperation is crucial in the context of DeFi, given the borderless nature of decentralized finance. As DeFi platforms and services often operate across multiple jurisdictions, a fragmented regulatory environment (with centralized financial intermediaries or on- and off-ramps between decentralized and centralized systems as a connecting point) can lead to regulatory arbitrage, where market participants exploit differences in regulatory standards across countries.

To address this issue, regulators should engage in international cooperation and knowledge sharing for developing common guidelines and principles, fostering a more coordinated global response to the harmonization of regulatory standards and ensure a consistent approach to the regulation of DeFi peers or market participants. Regulators could also establish bilateral agreements and memoranda of understanding with their counterparts in other jurisdictions to facilitate cross-border supervision, enforcement, and information sharing. 472

4.3.3 Potential for herding and mass contagion in AI-driven investment decisions

The Industrial Revolution, which began in the late 18th century, represented a monumental shift in the way societies functioned. It introduced mechanized production, changing the dynamics of work by gradually replacing manual labor with machines. This transition had significant implications, both positive and negative, on society. On one hand, the Industrial Revolution was a time of increased productivity and economic growth. Machines could produce goods more efficiently and in higher volumes than human laborers, leading to a substantial rise in overall production. On the other hand, the mechanization of labor brought about significant social 473

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and economic disruptions. Many manual laborers lost their jobs, leading to displacement, suffering, and inequality. While these individuals eventually found new employment opportunities as society adjusted, the transition period was tumultuous and marked by social unrest.

474   Fast forward to the 21st century, and we are experiencing a similar transition, often referred to as the Fourth Industrial Revolution or the age of artificial intelligence (AI). AI technologies are increasingly replacing not just manual labor but also cognitive tasks once thought to be the exclusive domain of humans. As with the first Industrial Revolution, AI is producing both positive and negative effects. On the positive side, AI has the potential to significantly increase productivity and efficiency. It can perform tasks more accurately and quickly than humans, and unlike humans, it doesn't tire or require breaks. It can analyze vast amounts of data in milliseconds and come up with insights that would take humans hours, days, or even years.

475   Yet, just as with the introduction of machines in the Industrial Revolution, the rise of AI also brings challenges. People for example may be afraid that AI could lead to job losses, particularly in sectors where cognitive tasks are dominant. Lawyers, accountants, teachers, journalists, customer service representatives—these are all professions that could potentially be replaced, to some degree, by AI. This echoes the fears of manual laborers during the Industrial Revolution. AI's influence is unlikely to result in a net loss of jobs but rather in a transformation of the job market. New roles will emerge that we can barely imagine today, just as the workers in the 18th century couldn't have imagined the types of jobs that the Industrial Revolution would create. The challenge will be to manage this transition in a way that minimizes hardship and inequality, just as it was during the Industrial Revolution.

476   Another challenge are machine biases. Biases are prevalent in algorithm-based applications such as machine learning, deep learning, or large language model algorithms. This is also referred to as machine bias, which refers to the tendency of machine learning algorithms to produce unfair or discriminatory results. This bias can arise when the algorithms are trained on biased or incomplete data, or when they incorporate biased assumptions or features. While machines do lack the ability to think critically, they can still learn and make decisions based on patterns and correlations in the data they are trained on. If that data is biased, for example, if it contains more examples of one race or gender than another, the machine may learn to associate certain characteristics or behaviours with that group, leading to discriminatory outcomes. In the legal system, machine bias can have

serious consequences. For example, a machine learning algorithm used to predict the likelihood of reoffending or granting parole may be biased against certain groups, such as minorities or people from low-income neighbourhoods. This could lead from unequal treatment to wrongful imprisonment.

Similarly, algorithms used to evaluate job candidates or credit applications may discriminate against certain groups, perpetuating inequality and limiting opportunities for some individuals, reinforcing the need for fair and transparent algorithms. Therefore, it's important to ensure that the algorithms used are developed and trained with unbiased data and assumptions or that super-code is implemented locking out the biased information in the algorithm-based decision making, and that they are subject to ongoing testing and evaluation to detect and correct for any potential biases.

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The rapid advancements in artificial intelligence (AI) have also brought significant changes to the landscape of investment decisions. However, it needs to be established, what is deemed artificial intelligence. Already in 1984, Ken Thompson in "*Reflections on Trusting Trust*" illustrated the idea that a computer can learn through a hypothetical scenario involving a self-replicating program. Thompson (1984) describes a program that, when executed, examines its own source code and modifies it to include a replication function. The program then compiles the modified source code and executes the resulting binary, creating a copy of itself. Thompson (1984) notes that the original program did not include any code for self-replication, and yet, through its ability to examine and modify its own source code, it was able to learn this new behavior. He argues that this ability to modify its own source code is what makes a computer truly "*programmable*" and enables it to adapt and improve over time. Thompson (1984) goes on to describe how this ability to learn and adapt can be used to create more sophisticated programs, including ones that can learn from their own experiences and modify their behavior accordingly. In simple words, computers may learn in the sense that they can modify their own behavior based on their experiences and interactions with the environment, and that this ability is what enables them to become more intelligent and capable over time.

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AI-driven investment strategies, including robo-advisors, algorithmic trading, and machine learning models, have become increasingly prevalent in the financial sector. However, the use of AI in investment decision-making raises important concerns about the potential for mass contagion and

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herd mentality effects, which could amplify existing biases and contribute to market inefficiencies.

480   Mass contagion refers to the rapid spread of behaviors, emotions, or ideas through a population, often driven by social influence or information cascades. In the context of AI-driven investment decisions, mass contagion can manifest in several ways. Algorithmic trading systems that rely on similar data sources or employ comparable strategies may generate correlated trading signals, causing a self-reinforcing feedback loop that amplifies market trends and machine learning models may learn from and perpetuate existing market biases, particularly if their training data is not representative or diverse. This may lead to investors blindly following the recommendations of AI-driven robo-advisors or trading algorithms, without critically evaluating the underlying rationale for their decisions.

481   Herd mentality is the propensity of people to follow the behaviors or beliefs of a group, often driven by the fear of missing out or the desire to conform. In AI-driven investment decisions, it is hypothesized that herd mentality can exacerbate the effects of mass contagion, as market participants may be more inclined to trust AI-generated advice or signals, assuming that the majority of other investors are also following similar strategies. This can lead to a self-reinforcing cycle, where AI-driven investment decisions contribute to market trends, which in turn influence the behavior of other investors, further amplifying the initial trend.

482   All of the aforementioned effects must be subjected to further evidence-based research as the mass contagion and herd mentality effects in AI-driven investment decisions may have significant implications for financial markets, including increased volatility, the formation of asset bubbles, and the misallocation of capital.

483   Irrespective of the further required analytical analysis, potential risk mitigation strategies could include the diversification in AI-driven investment strategies. Policymakers and market participants can promote the development and use of diverse AI-driven investment models to reduce the potential for correlated trading signals and market contagion. It should also be ensured that AI models are trained on diverse and representative data to help minimizing the risk of perpetuating existing biases or contributing to mass contagion effects and that such models include some sort of fail-safe switch to avoid systemic risks.

484   Furthermore, encouraging transparency in AI-driven investment algorithms can help investors to better understand the rationale behind their recommendations, fostering more informed decision-making and re-

ducing the potential for herd mentality and financial education programs that emphasize the potential risks and limitations of AI-driven investment strategies may help investors to make more informed choices and avoid blindly following the crowd.

The mass contagion effects arising from AI-driven investment decisions can have far-reaching consequences, potentially leading to systemic risks and global-scale failures in financial markets. The possibility of a widespread financial system failure is referred to as systemic risk, often caused by the collapse of a single institution or the propagation of financial distress through interconnected networks. Mass contagion in AI-driven investment decisions can increase systemic risk in several ways such as high levels of correlation among AI-driven investment strategies potentially leading to a simultaneous unwinding of positions during periods of market stress, exacerbating price movements and causing a liquidity crunch. Furthermore, self-reinforcing feedback loops created by mass contagion through AI-driven investment decisions can contribute to the formation of asset bubbles, which can subsequently burst and lead to financial crises. In addition, if a large number of investors rely on AI-driven investment decisions, an unforeseen failure in a widely used AI model or algorithm could trigger a rapid sell-off, causing severe market disruptions and potentially destabilizing the entire financial system. 485

The interconnected nature of global financial markets means that mass contagion in AI-driven investment decisions can easily spread across borders and asset classes, creating cascading failures that amplify the initial shocks. The following factors can contribute to the propagation of mass contagion effects: 486

- Cross-border spillovers: AI-driven investment decisions can lead to highly correlated trades across multiple countries, causing financial contagion to spread rapidly through global networks.
- Contagion across asset classes: If AI-driven investment decisions are highly correlated across different asset classes, a shock in one market segment can quickly transmit to other segments, creating a domino effect that exacerbates financial distress.
- Interconnectedness of financial institutions: The growing reliance on AI-driven investment strategies by major financial institutions can increase the risk of contagion, as the failure of a single institution or model can have ripple effects throughout the financial system.

487 To mitigate the risk of global-scale failures resulting from mass contagion in AI-driven investment decisions, policymakers and market participants should consider the following strategies:

- Implement robust stress-testing and scenario analysis: Financial institutions should be required to conduct regular stress tests and scenario analyses to assess their vulnerability to mass contagion effects and ensure that they have adequate capital buffers and risk management practices in place.
- Monitor and regulate AI-driven investment strategies: Regulators should closely monitor the development and use of AI-driven investment strategies, implementing appropriate regulations to reduce the risk of mass contagion due to robo-advisors and ensure the robustness of financial systems.
- Foster international cooperation: To address the cross-border and interconnected nature of financial markets, regulators should work together to harmonize regulatory standards, share information, and coordinate their response to potential global-scale failures arising from mass contagion in AI-driven investment decisions.

488 By understanding the risks associated with mass contagion in AI-driven investment decisions and implementing appropriate mitigation measures, policymakers and market participants can minimize the likelihood of global-scale failures and promote the financial system's resiliency and stability.

4.3.4 The role of behavioral economics in public policy and its challenges

489 Empirical research is frequently used by economists to resolve important policy issues, such as the effects of real wage changes on the labor market. However, these empirical investigations can be narrowly inductive, with little attention paid to the underlying theory of consumer behavior. One criticism of behavioral economics is its reliance on laboratory studies. While experimental economics, a subset of behavioral economics, tests biases in controlled environments with theoretical simulations, there is a growing body of research examining financial markets with real-world metrics. For example, biases identified in laboratory studies were also present in high-stake situations (Camerer & Loewenstein, 2002). Similarly, Iyengar and Lepper (2000) and Iyengar et al. (2003) found that choice overload

occurred in both small items, such as jam in supermarkets, and more significant decisions, like selecting US 401K pension plans (McAuley, 2013).

Knowledge of psychological underpinnings in consumer behavior has long been essential to marketing. Behavioral economics challenges the assumptions of advertisers, while also providing strategies such as offering cashback rather than discounts, based on prospect theory's findings on reference-point dependence. Although explicit references to behavioral economics in public policy are relatively rare, government policies are influenced by an implicit understanding of behavioral economics. McAuley (2013) names, money illusion, self-control failures, and hyperbolic discounting as having influenced policies in Australia and prospect theory also having been used to support the expansion of government programs. By supporting decision-makers in creating more cost-effective interventions and avoiding inefficient or expensive initiatives, behavioral economics can dramatically impact public policy. According to McAuley (2013), the New Zealand Ministry of Economic Development's policy-related guidance offers helpful recommendations on how behavioral economics research might influence public policy (McAuley, 2013).

To direct public policy initiatives, Camerer et al. (2003) suggested the asymmetric paternalism principle. This principle suggests that regulations should provide significant benefits to those who are making errors by correcting them while imposing minimal harm on those who make rational decisions. For instance, in the credit card market, sophisticated and disciplined consumers, making rational decisions use their credit cards optimally, while undisciplined consumers may accumulate high-interest debt due to hyperbolic discounting. Behavioral biases can shape entire markets, resulting in cross-subsidies that favor one group over another. Asymmetric paternalism can inform policy responses, such as mandating *credit card issuers to warn of the consequences if only minimum payments are made*". Consequently, it may be argued that behavioral economics and likewise behavioral finance has long influenced various aspects of society, including marketing and public policy. Integrating its findings into microeconomics and adopting principles such as asymmetric paternalism can help create more effective and evidence-based policies (McAuley, 2013).

It has been suggested that guiding individuals towards judicious choices congruent with their biases could be achieved by establishing defaults, while still preserving their autonomy to select alternative options. McAuley (2013) provides an illustrative example of such default policies or opt-in vs opt-out model regarding the New Zealand 'Kiwisaver' pension, wherein

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the default enrolls workers into a pension scheme that deducts a certain percentage of their earnings, yet they retain the option to opt out (McAuley, 2013).

493   However, in policy implementation it is also important to consider possible side or negative effects. Extrinsic rewards have been observed to frequently diminish intrinsic motivation, commonly known as "*crowding out*". Governments may explore providing financial incentives in order to promote civic action, such as volunteer work, however doing so may reduce intrinsic motivation (McAuley, 2013).

494   Behavioral economics like behavioral finance, with its empirical focus, reinforces the importance of ex ante and ex post evaluations in public policy, cautioning that consumer and producer responses to interventions may deviate from microeconomic assumptions (Camerer et al., 2003). For instance, in 2002, the US Department of Housing and Urban Development proposed that mortgage broker commissions be disclosed in home loan proposals. However, research by the Federal Trade Commission found that such disclosure tends to draw customers' focus away from the loan's true value, leading to inferior decisions (Lacko & Pappalardo, 2004). This effect needs further study also with regard to disclosure of kickbacks in the financial markets from banks to investment managers for brokering financial products.

495   Addiction results in an inelastic demand curve at some point of positive consumption, with individuals often expressing a desire to escape this entrapment (McAuley, 2013). Gamification mechanisms in DeFi or service provider platforms bridging the centralized and decentralized systems, also with regard to emerging gaming markets due to NFTs, may give rise to addictive behaviors. Another challenge for public policy in this regard lies in designing interventions that target addictive behavior without imposing undue burdens on people who don't require external controls.

496   In the realm of behavioral economics, research has consistently demonstrated that people have an inherent desire for fairness in their interactions, emphasizing not just their personal welfare but also the underlying equality of an exchange, in the field of behavioral economics (e.g., ultimatum games, dictator games, and legal disputes over minor stakes). fairness is acknowledged as a constraint on immediate self-interest in behavioral economics, which also provides explanations in terms of group benefits. People build social capital by punishing those who act unfairly, for instance, by paying a net cost to avoid an unfair agreement. According to social evolution theories, societies with high stocks of social capital outperform those with-

out them. Therefore, failing to consider consumers' desire for fairness may result in public policy failures (McAuley, 2013).

Furthermore, McAuley (2013) proposes that usage charges in general can result in high political costs if not managed sensitively. According to prospect theory, individuals resent paying for previously free services even if offset by tax reductions, as the utility of the reduction is lower compared to the disutility of moving from a free to a paid plan. Concerns for transactional fairness may also prompt resentment if people perceive cross-subsidies or inequities in user charges (McAuley, 2013). 497

It is challenging to include envy, a particular facet of fairness concern, in traditional economic models. Elster (1991) distinguished between two types of envy: weak envy, characterized by the disutility experienced when observing another's unshared gain, and strong envy, involving a willingness to incur personal costs to bring down another person. In repeated prisoners' dilemma situations, participants frequently prioritize punishing the opposing side for prior wrongdoings at the expense of their own welfare (Camerer, 2003). 498

Risk-related biases also present challenges in public policy. For example, individuals often struggle to conceptualize and compare low-probability risks, demonstrate heightened awareness of vivid risks, exhibit framing biases, display pseudo certainty, and exhibit over-optimism. These biases raise questions about the allocation of public risk-reducing resources based on objective or perceived risks and whether government organizations ought to attempt to make an effort to account for individual biases in risk management. However, public policy faces the challenge of whether to allocate regulatory resources based on perceived or actual risk and whether to educate citizens to adopt a more rational approach to risk, even if it might be politically disadvantageous (McAuley, 2013). 499

Behavioral economics research reveals that, under certain conditions, an excessive array of choices can lead to consumers making no decision at all, which results in a deadweight loss (Iyengar & Lepper, 2000). In response to choice overload, strong interventions, such as restricting entry into specific markets or employing default options that guide consumers towards particular products while allowing easy switching, could be considered. However, these approaches may have competition implications and could stifle innovation in certain markets (McAuley, 2013). 500

Overall, behavioral economics and behavioral finance offer valuable insights into human behavior and decision-making processes, challenging traditional microeconomic assumptions and contributing significantly to 501

public policy, marketing, and finance. By integrating findings from behavioral economics and adopting principles like asymmetric paternalism, policymakers can design more cost-effective and evidence-based interventions, minimizing the risk of ineffective or high-cost policies. While it is crucial to consider possible side or negative effects in policy implementation, behavioral economics' empirical focus highlights the importance of ex ante and ex post evaluations. Issues such as fairness, envy, addiction, and risk-related biases present unique challenges for public policy, also considering that the same decision-making issues are prevalent in the policymaking process itself, necessitating a careful balance between addressing these concerns and promoting competition and innovation. Ultimately, behavioral finance has the potential to enhance our understanding of consumers', financial market participants' and policymakers' behavior and shape more effective, informed policies across various aspects of society.

4.4 Interim conclusion

502   The widespread accessibility of DeFi protocols enables the creation of a truly open and inclusive financial system. DeFi presents further opportunities, such as enhanced efficiency, transparency, accessibility, and composability of financial infrastructure. The efficiency gains stem from centralized institutions or intermediaries with smart contracts, which can act as custodians, escrow agents, and central counterparty clearinghouses (CCPs) or as central securities depository (CSD). DeFi applications offer unparalleled transparency due to the public observability of transactions and the on-chain analysis of smart contract code (Schär, 2021). However, the transparency also raises issues of frontrunning practices.

503   However, DeFi is not without its risks, which include errors in programming or execution of smart contracts, operational security, reliance on external data and protocols, which may introduce centralization risks, and scalability issues. The deterministic and decentralized nature of smart contract execution, while advantageous, can be vulnerable to coding errors, which may lead to vulnerabilities and potential attacks permitting unintended usage. Operational security concerns may be raised by the usage of admin keys as well as malicious or corrupted keyholders, which may be mitigated to some degree through multi-signature mechanisms. Lastly, the label "decentralized" may prove misleading or straight-out fraudulent in certain instances (Schär, 2021).

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The openness and composability of DeFi, while offering exciting possi-bilities, also create significant dependencies and potential ripple effects throughout the entire DeFi ecosystem. Regulators are concerned about illicit activities associated with crypto assets and must carefully balance the need for intervention against the risk of stifling innovation. In summation, the realm of DeFi provides intriguing prospects and harbors the potential to establish an authentically open or inclusive, public and transparent as well as unalterable and final financial infrastructure. Owing to the many interoperable programs and systems that DeFi comprises, every transaction can be independently verified, and data is readily available for users and researchers to review (Schär, 2021).

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4.4.1 Decentralized organizations, tokenization as well as centralized and decentralized market infrastructures under the EU digital finance package

To conclude, social economy organizations (SEOs) and decentralized au-tonomous organizations (DAOs) have both challenged traditional econo-mic models by emphasizing stakeholder needs, social objectives, and inno-vative governance structures. In a way, DLT-based DAOs may be seen as the next evolutionary step in the organizational development.

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In parallel, the EU Digital Finance package, including the Markets in Crypto Assets Regulation (MiCAR) and the Distributed Ledger Technolo-gy (DLT) Pilot Regime, aims to balance innovation with risk mitigation in the realm of crypto assets. While the former prioritizes the regulation of centralized crypto asset service providers acting as a relay or beacon to true DeFi markets, the latter seeks to enable a pilot regime for DLT market infrastructures for token-based financial instruments or security tokens equivalent to traditional stock exchanges, regulated markets or trad-ing facilities, taking the unique properties of distributed ledger technology into account. However, both initiatives face challenges. Challenges from a behavioral finance perspective may be seen trust mechanisms, investor behavior, and potential regulatory biases. To maximize their effectiveness, further research and proactive approaches should be considered, alongside investor education initiatives and continuous monitoring of the rapidly evolving landscape. By doing so, a more inclusive and sustainable economic ecosystem could ideally be achieved, showcasing the potential for digital

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transformation in addressing contemporary social, economic and regulatory challenges.

4.4.2 DeFi lending, derivatives, portfolios and privacy enhancing protocols

507 DeFi lending is a crucial component of the ecosystem, with various protocols that facilitate loans and borrowing. Decentralized lending platforms do not have identification requirements, ensuring unrestricted access for users. To safeguard lenders and borrowers, two primary strategies are employed: atomic loans, also known as flash loans, and fully secured loans using collateral.

508 Collateralized loan platforms can be divided into three types: collateralized debt positions, P2P collateralized debt markets and pooled collateralized debt markets. DeFi applications offering collateralized debt positions enable users to create and issue new tokens backed by collateral.

509 Alternatively, borrowing existing crypto assets from others can be achieved through collateralized debt markets, which require a counterparty with opposing preferences. To match lenders with borrowers, P2P and pooled matching methods are employed, each with its own advantages and disadvantages.

510 Decentralized derivatives are also a growing trend in the DeFi ecosystem, with two main categories: asset-based and event-based derivative tokens. Asset-based derivative tokens derive their value from an underlying asset, while event-based derivative tokens depend on observable variables unrelated to asset performance. The latter type of tokens may be on the verge of gaming markets, depending on the economic model behind it (decentralized gaming or gambling).

511 In addition, on-chain asset management, similar to traditional portfolio management, enables users to diversify their investments without managing individual tokens. A key difference is the absence of a custodian, as crypto assets are held in smart contracts. These contracts can follow various strategies or rely on fund managers for active management. Investors receive fund tokens that represent partial ownership and can redeem or liquidate their share.

512 Another central topic in the DeFi space is privacy on public blockchains, which is difficult to achieve due to their transparent nature, where all transactions are publicly visible. Crypto asset mixers, or tumblers, are a common approach to improving privacy, as they pool crypto asset deposits and allow

withdrawals without revealing the connection between addresses. However, these mixers can also be used for money laundering and concealing illicit activities, leading to regulatory scrutiny.

Non-custodial crypto asset mixers leverage distributed cryptographic systems to maintain anonymity and eliminate liquidity risks. These mixers can strike a balance between privacy and transparency, enabling legitimate users to preserve anonymity while making it difficult for malicious actors to use the technology for illicit purposes through disclosure of cryptographic proofs. However, there are still challenges in ensuring funds from sanctioned entities don't end up in the hands of unsuspecting recipients. While regulating or banning the technology might not be effective, involving centralized financial intermediaries when converting crypto assets to legal tender can help enforce due diligence and mitigate risks. Nevertheless, inefficient global enforcement can result in long processes for fraud victims. Fraudulent crypto assets may remain in tumblers for extended periods, potentially leading to insolvency for impacted parties and raising concerns about criminal liability statutes due to the near-permanent storage in smart contracts.

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4.4.3 Additional EU digital finance packages

The rapid digitalization of the financial sector has increased reliance on information and communication technology (ICT) systems, exposing the financial system to risks such as cyber threats and ICT disruptions. To address these challenges and enhance "*the operational resilience, performance, and stability of the Union financial system*" (DORA, 2022), the Digital Operational Resilience Act (DORA) has been enacted. With the use of DORA, critical ICT third-party service providers will be continuously monitored in order to create a cogent strategy for the resilience of critical entities, such as cloud computing service providers.

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Effective detection and prevention of ICT risks require regular sharing of threat and vulnerability intelligence among financial entities. DORA seeks to strengthen communication channels, maintain a high level of digital operational resilience, and promote a balanced solution to ICT third-party concentration risk. Furthermore, the proposal for a Regulation on information accompanying transfers of funds and certain crypto assets (TFR) aims to establish a regulatory framework for enhancing traceability and transparency, combating money laundering and terrorist financing.

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516   From a behavioral finance and regulatory public policy perspective, it is crucial to recognize the role of behavior in determining the effectiveness of risk management in cybersecurity practices. Nudge-based interventions can be designed to promote desirable behaviors among financial entities and individuals. Regulations should be tailored to unique characteristics and risk profiles, applying proportionality principles and conducting cost-benefit analyses. Lastly, a holistic approach to financial regulation should be adopted, ensuring consistency and coherence in the regulatory landscape, ultimately leading to a more effective, efficient, and adaptive regulatory environment.

4.4.4 Behavioral finance and regulatory public policy implications

517   Individuals' cognitive biases and affective influences play a significant role in financial markets. Common biases, such as hyperbolic discounting with regard to monetary gains and losses, shifting in reference-points, limited search for information due to confirmation bias, erroneous understandings of inflation, etc, can contribute to market anomalies. These biases are often exacerbated by emotional and social factors, which is why it may be challenging for people to make rational financial decisions. Social norms and cultural conventions are also deeply ingrained in financial organizations, making it challenging to change traditional market practices (Gärling et al., 2009).

   In the rapidly evolving DeFi landscape, understanding cognitive biases and their impact on financial decision-making is critical. Biases such as confirmation bias, herd mentality, and the anchoring effect can lead to market inefficiencies and suboptimal outcomes. Regulators and policymakers should consider these behavioral tendencies when designing public policies to mitigate adverse effects, promote transparency, and encourage informed decision-making in the context of DeFi or service providers bridging centralized and decentralized finance.

518   Behavioral economics can inform policy interventions through choice architecture, framing effects, and default options. By presenting investment options in a way that encourages informed decision-making, choice architecture can help investors better assess the trade-offs associated with different investment choices. Simplifying disclosures and presenting information in a clear, concise, and standardized format can reduce information asymmetry and promote informed decision-making. Framing effects can also

influence investor behavior; for example, presenting potential losses more prominently than potential gains could encourage investors to consider risks more carefully. Additionally, incorporating default options considering diversified investments can promote prudent investor behavior while maintaining freedom of choice.

However, implementing these policies in truly decentralized systems may be challenging due to the lack of a regulatory subject. Centralized intermediaries bridging centralized and decentralized financial systems may be required to impose such rules. Regulators must strike a balance between fostering innovation and ensuring investor protection and remain adaptable to keep pace with the rapidly changing DeFi landscape.

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Regulatory sandboxes can offer an iterative, collaborative approach to regulation, facilitating knowledge exchange between regulators and industry participants. Additionally, international cooperation is essential for harmonizing regulatory standards across jurisdictions and preventing regulatory arbitrage in the context of decentralized finance. By engaging in international cooperation and knowledge sharing, regulators can develop common guidelines and principles, fostering a more coordinated global response to regulation in the context of DeFi.

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Another concern is the growing prevalence of AI-driven investment strategies, such as robo-advisors, algorithmic trading, and machine learning models, which has led to apprehensions regarding the potential for mass contagion and herd mentality effects, which could amplify existing biases and contribute to market inefficiencies. Mass contagion, the rapid spread of behaviors, emotions, or ideas through a population, and herd mentality, the tendency of individuals to follow group actions or beliefs, can manifest in AI-driven investment decisions by creating correlated trading signals and self-reinforcing feedback loops that amplify market trends.

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These potential effects necessitate further research to understand the implications for financial markets, including increased volatility, asset bubble formation, and capital misalloation. To mitigate risks, diversification in AI-driven investment strategies, ensuring AI models are trained on diverse and representative data, and promoting transparency in investment algorithms can help reduce the potential for correlated trading signals, market contagion, and herd mentality. Financial education programs can also assist investors in making informed choices and avoiding blind conformity with algorithmic or AI-based trading decisions.

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Mass contagion effects in AI-driven investment decisions has the potential to lead to unforeseen systemic risks and global-scale failures in finan-

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cial markets due to interconnectedness, cross-border spillovers, contagion across asset classes, and the reliance of financial institutions on AI-driven strategies. Policymakers and market participants should consider strategies like robust stress-testing and scenario analysis, monitoring and regulating AI-driven investment strategies, and fostering international cooperation to mitigate the risk of global-scale failures and promote financial system stability and resilience.

5 Key findings & future prospects

The emergence of decentralized finance (DeFi) has paved the way for a truly open and inclusive financial ecosystem, providing a wealth of opportunities for enhanced efficiency, transparency, accessibility, and composability within financial infrastructures in the future even if there are still drawbacks. Centralized financial intermediaries and a specific spectrum of services they provide may be replaced by smart contracts, which can serve and take over various roles such as custodians, escrow agents, central counterparty clearinghouses, and central securities depositories. The high degree of transparency is achieved through the public visibility of transactions and the ability to scrutinize smart contract code. However, this very transparency may at the same time pose one of DeFi's mentioned pitfall inadvertently enabling frontrunning amongst other malicious practices.

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Despite the numerous benefits, DeFi is not without its risks, including weaknesses in how smart contracts are executed, issues with operational security and reliance on external data and other protocols, centralization risks, and scalability issues. The deterministic nature of smart contracts, while advantageous, can be susceptible to coding errors, resulting in potential attacks or unintended usage. Furthermore, operational security risks may arise from the use of admin keys and the possibility of keyholders being malicious or compromised, although multi-signature mechanisms can mitigate these risks to some extent. In addition, the term decentralized or DeFi can occasionally be misleading or even fraudulent if an architecture is actually not truly decentralized but controlled by central market players.

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DeFi's openness and composability create significant dependencies and possible ripple effects throughout the entire ecosystem, potentially creating cascading and contagion effects on traditional financial markets which may result in market failures of unprecedented scale. Regulators face challenges in addressing the dilemma of balancing the need for intervention with the risk of stifling innovation as DeFi also provides the opportunity of establishing a genuinely inclusive, public and final financial infrastructure, with a variety of interoperable programs and protocols that allow users and researchers to verify every transaction and access data easily leading to most comprehensive inclusion on the financial markets.

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527   In the European Union, the Digital Finance package, encompassing the Markets in Crypto Assets Regulation (MiCAR) and the Distributed Ledger Technology (DLT) Pilot Regime, strives to balance innovation with risk mitigation in the realm of crypto assets with regard to centralized intermediaries which are bridging the decentralized and centralized financial systems. While these initiatives are essential steps toward a more inclusive and sustainable economic ecosystem, challenges remain in terms of trust mechanisms, investor behavior, and potential regulatory biases. To maximize their effectiveness, proactive approaches, investor education initiatives, and continuous monitoring of the rapidly evolving landscape are crucial.

528   Decentralized exchanges (DEX) or lateral exchange markets (LEM), decentralized lending, derivatives, and portfolios are vital components of the DeFi ecosystem. Both decentralized exchanges and decentralized lending platforms ensure unrestricted access for users by not requiring identification (zero trust in the vendor with trust in the platform) and collateralized loan platforms, decentralized derivatives, and on-chain asset management play essential roles in this DeFi landscape. DeFi lending and borrowing can be facilitated through atomic loans or flash loans or fully secured loans using collateral, enabling transactions and markets which were not possible or thought of under existing quid pro quo systems of exchange of consideration.

529   From a behavioral finance standpoint, the DeFi ecosystem has demonstrated the potential to disrupt traditional financial systems by potentially offering enhanced efficiency, transparency, accessibility, and composability in the long term. However, the transparency of DeFi protocols has also brought forth new risks, such as frontrunning practices, which highlight the need for further research into trust mechanisms and investor behavior and how to possibly mitigate these risks from a public policy perspective. Additionally, the rise of decentralized derivatives, particularly event-based derivative tokens, exposes the potential overlap between financial instruments and gaming markets. Likewise, NFTs and services with regard to them in the video gaming sector may also intersect with gambling markets or give rise to other new markets due to their transferability and interoperability, necessitating further scrutiny and analysis to ensure proper classification and regulatory oversight.

530   The emergence of DAOs, which may be viewed as a natural progression of SEOs (social economy organizations), signifies the potential for innovative (decentralized) governance structures that prioritize stakeholder needs and social objectives. This development aligns with the ongoing evolution

of DLT-based organizational models, further reinforcing the transformative impact of DeFi on traditional economic systems.

Another core topic regarding DeFi is privacy on public blockchains, which is challenging due to their transparency. Crypto asset mixers, or tumblers (privacy enhancing protocols), help improve privacy but can also be used for money laundering and illicit activities, attracting regulatory attention. Non-custodial mixers balance privacy and transparency by allowing legitimate users to maintain anonymity while presenting challenges for malicious actors. Involving centralized financial intermediaries when converting crypto to legal tender may mitigate risks, but inefficient global enforcement can prolong processes for fraud victims. Prolonged storage of fraudulent assets in tumblers could lead to insolvency for affected parties and concerns about criminal liability statutes due to near-permanent storage in smart contracts.

The EU's additional digital finance packages, such as the Digital Operational Resilience Act (DORA) and the proposal for a Regulation on information accompanying transfers of funds and certain crypto assets (TFR), aim to further enhance the financial system's operational stability and traceability relating to crypto assets and related services. A holistic approach to financial regulation is necessary, ensuring consistency and coherence in the regulatory landscape, ultimately with the goal of leading to a more effective, efficient, and adaptive regulatory environment.

The DeFi landscape offers numerous opportunities and challenges, with the potential to transform and revolutionize traditional financial systems. As the DeFi landscape continues to evolve, it is imperative for researchers, regulators, and industry stakeholders to remain vigilant, adaptive, and proactive in addressing emerging complexities and risks. By carefully navigating the risks and embracing innovation, a more inclusive and sustainable economic ecosystem may be achieved. Developing nudge-based interventions may be an effective strategy for promoting desirable behaviors both in the public policymaking process itself as well as in the actual regulations, targeting financial entities and individuals, while tailoring regulations to specific characteristics and risk profiles may enhance regulatory efficiency. Future prospects, for one, lie in the analysis and research of these suggestions, and for another on the continuous development and integration of DeFi, the evolution of regulatory frameworks, and the exploration of novel applications and mechanisms in the decentralized financial space.

At the heart of financial market regulation lies the understanding of human behavior and decision-making. Behavioral finance, an interdisci-

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plinary field that integrates psychology and economics, uncovers the cognitive biases and heuristics that shape investors' behavior in financial markets. Recognizing that market participants do not always act rationally, behavioral finance provides valuable insights for regulators when addressing the unique challenges posed by DeFi and the rise it gives to new markets. In the decentralized financial ecosystem, the absence of traditional intermediaries and gatekeepers results in increased investor autonomy. While this can lead to innovation and democratized access to financial services, it also exposes investors to heightened risks. Policymakers must therefore recognize and account for the cognitive limitations of market participants, including bounded rationality, loss aversion, and overconfidence, in order to design effective regulatory frameworks for DeFi.

535   The development of regulatory public policy with regard to financial markets in the context of DeFi and services building upon distributed ledger technology necessitates a careful balance between fostering innovation and mitigating risks. To achieve this equilibrium, regulators must take into account not only the behavioral tendencies of market participants but also the cognitive biases that may influence their own decision-making processes. Central to this endeavor is the incorporation of behavioral insights in the design and implementation of regulatory frameworks. Policymakers should consider employing tools such as nudges, which encourage desired behavior without restricting choice, or default options, which exploit individuals' inherent inertia to promote beneficial outcomes. For instance, regulators might introduce disclosure requirements that present information in a manner that mitigates cognitive biases, enabling investors to make more informed decisions.

536   In light of the rapidly evolving DeFi landscape, regulators must remain flexible and responsive to emerging trends and challenges. This entails constant reevaluation of established regulatory approaches and the development of novel, adaptive strategies. The incorporation of a behavioral perspective in financial market regulation necessitates ongoing collaboration between policymakers, academics, and industry stakeholders. One potential approach is to adopt regulatory sandboxes, which allow DeFi innovators to test their products and services in a controlled environment, under the supervision of regulators. This fosters a collaborative, iterative process that promotes both innovation and the identification of potential risks. In addition, regulators should engage in international cooperation and knowledge exchange to address the global nature of DeFi and to harmonize regulatory standards.

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With regard to financial market regulatory public policy, regulators should firstly pose themselves the question whether regulatory measures may effectively protect consumers or investors from engaging in risky investments, or whether such transactions persist despite the regulation, also given due to fraudulent schemes, which may continue to thrive without adequate oversight, and the response of warnings, measures, and procedures being insufficient. Furthermore the (untested) hypothesis may be considered, that such regulations, inefficient in actually protecting consumers, may still inadvertently place excessive burdens on financial intermediaries, thereby restricting their business operations and innovation capacity due to the costs associated with implementing the regulations.
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5.1 Interpretation and classification of the results

The analysis of the decentralized finance (DeFi) landscape reveals a combination of expected and unexpected outcomes, some of which are consistent with previous research, while others expose new challenges and opportunities in this rapidly evolving domain. The impact and relevance of DeFi are evident, as it has the potential to be transformative to the financial systems by offering innovative approaches in developing new markets which may bring increased efficiency in the long term, transparency, accessibility and inclusion in the financial market, and composability. These characteristics are in line with the overarching objectives of decentralized technologies and the initial vision of blockchain-based applications.
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The possibility of removal of centralized intermediaries in true DeFi systems, like decentralized exchanges, and the utilization of smart contracts as key components of DeFi's infrastructure may contribute significantly to overall efficiency gains. This outcome aligns with the expectations of a decentralized system, where automation and disintermediation have the potential to streamline processes and reduce costs. However, if higher efficiency and cost reduction is actually gained remains to be monitored closely and analyzed further. The high degree of transparency is another anticipated outcome, as blockchain technology inherently provides public observability of transactions and open access to smart contract code. However, the discovery that this level of transparency may inadvertently contribute to frontrunning practices (insider trading or the practice of scanning pending transactions and paying a higher gas fee in order to prioritize its processing by miners, in order to take advantage of a significant
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trade that will impact market pricing) represents an unexpected challenge within the DeFi ecosystem. This finding highlights the need for further research and development to mitigate the potential negative consequences of transparency while preserving its benefits.

540   The vulnerabilities and risks associated with DeFi, like smart contract execution issues, operational security concerns, and dependence on external data and protocols and external data, were not unforeseen but have emerged as more significant concerns than initially anticipated. This realization underscores the importance of ongoing efforts to address these risks potentially through investor information campaigns and raising awareness together with over-all financial literacy and investment education.

541   In terms of regulatory efforts, the European Union's Digital Finance package and additional digital finance regulations, such as DORA and TFR, aim to balance innovation with risk mitigation, as expected. However, the challenges faced in terms of trust mechanisms, investor behavior, and potential regulatory biases may not have been fully anticipated and also not considered accordingly in the Digital Finance package, necessitating a more proactive approach and greater emphasis on investor education initiatives. This unanticipated complexity highlights the need for continuous monitoring and adaptation of regulatory frameworks to ensure that they effectively address the evolving business models provided by centralized intermediaries based on DeFi systems bridging the central and decentral financial system.

542   The emergence of decentralized autonomous organizations (DAOs) as a natural progression in the evolution of social economy organizations (SEOs) is consistent with the ongoing development of innovative governance structures driven by DLT. This alignment underscores the potential for DAOs to revolutionize traditional economic models and further promote stakeholder-centric objectives.

543   Regarding DeFi lending, derivatives, and portfolios, the various protocols and strategies employed to facilitate loans, borrowing, and asset management are largely as expected. However, the growth of decentralized derivatives, particularly event-based derivative tokens, may have the potential for these tokens to blur the line between financial instruments and gaming markets. The same applies for NFTs which may be used in video games, however creating new emerging markets, given that such NFTs may be transferred out of otherwise closed games and traded or exchanged as well as used in relation to random number generated events, again blurring the lines of gambling markets. This discovery introduces additional

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complexities and considerations for regulators and researchers alike to be further researched in the future.

The identified challenges and complexities emphasize the importance of interdisciplinary research that bridges the gap between behavioral finance and regulatory public policy, enabling a more comprehensive understanding of the DeFi landscape, centralized DLT infrastructures and crypto asset service providers. 544

In line with previous research, the DeFi space has demonstrated remarkable potential for growth and innovation. Nonetheless, the emergence of new trends, technologies, and risks underscores the importance of conducting ongoing investigations to further elucidate the intricacies of this complex landscape. By fostering interdisciplinary collaboration between behavioral finance and regulatory public policy experts, a more holistic understanding of DeFi and centralized intermediaries bridging the decentralized and centralized financial system as well as traditional financial market players can be achieved, facilitating the development of robust, effective, and adaptive strategies that promote sustainable growth while addressing the ever-changing challenges in this fast-paced, interconnected financial ecosystem with an admonitory plea to focus on avoiding bad regulations altogether instead of trying to stipulate good rules for bad players and to practice in regulatory omission as a default instead of reactive regulatory measures or adhocracy which is potentially distorted by biases and heuristics. 545

Ultimately, the findings and interpretations presented here may lay the groundwork for upcoming research and policy development, emphasizing the significance of a multi-disciplinary approach in grasping the full spectrum of financial market regulation, DeFi's potential impact on the financial sector, transactions that go beyond the previously thought limits of quid pro quo exchanges through atomic executions, centralized financial intermediaries bridging the centralized and DeFi markets, while revealing that regulation of true DeFi remains questionable, as it would amount to regulation of technology, if it would at all be enforceable. Nevertheless, monitoring and assessment of the level of decentralization should be observed closely by supervisory authorities, as centralized intermediaries may put on the cloak of decentralization to cover their level of control and centralization and ultimately avoid regulation. 546

5.2 Implications in practice

547 From a practical standpoint, the implications of the findings presented in this analysis span both behavioral finance and regulatory public policy domains. These implications highlight the necessity of a cooperative and adaptive approach to address the unique challenges and opportunities posed by the DeFi ecosystem and DLT-based, yet centralized intermediaries.

548 In the realm of behavioral finance, the review elucidates the significance of trust mechanisms, investor behavior, and psychological factors that influence the adoption and utilization of DeFi platforms and markets. These insights can be employed to design educational initiatives, investor protection mechanisms, and targeted interventions aimed at promoting responsible investment practices, risk diversification by default and mitigating the risks associated with uninformed decision-making. Moreover, fostering an understanding of cognitive biases and heuristics that may impact investor behavior throughout the financial markets as well as public policy processes by the legislator and other involved parties and participants can facilitate the development of strategies to counteract their potentially detrimental effects, contributing to a more stable and resilient financial ecosystem.

549 From a regulatory public policy perspective, the implications of this review extend to the design and implementation of an adaptable and proportional regulatory framework that accommodates the rapidly evolving DeFi landscape and emerging markets as well as intermediaries bridging the centralized and decentralized systems. The EU Digital Finance package, MiCAR, DLT-Pilot Regime, DORA, and TFR serve as examples of regulatory initiatives that aim to strike a balance between fostering innovation while ensuring consumer protection and the stability of the financial system. By continuously monitoring the DeFi ecosystem and engaging in open dialogue with stakeholders, regulators can identify emerging trends and risks, allowing them to refine existing policies and develop a holistic approach. Ensuring consistency and coherence across the regulatory landscape will be crucial in addressing the interconnected nature of crypto asset service providers, traditional financial intermediaries and DeFi market infrastructures.

550 Further implications in practice are outlined hereinafter:

- Regulators should address their own biases in decision-making to improve the effectiveness of crypto asset regulations. Implementing procedures to counter these biases in the legislative process is essential. Instead

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of enactment of good rules for bad players, a focus should be put on the avoidance of bad regulations and adhocracy effects – the reactive enactment of regulations based on isolated events – altogether.

- Policymakers must consider the complexities of market interactions, being aware of their own biases and limitations. Adopting solutions without considering potential unintended consequences may be detrimental. The application of pre-mortems might be advocated, where the policymakers imagine that a regulation will fail and then have to work backwards to determine what could potentially lead to the failure and how to avoid such failure.
- To mitigate biases in financial regulation, increased transparency, accountability, checks and balances, and independent oversight can be introduced. These measures ensure more informed and unbiased regulatory decisions.
- Policymakers could introduce cognitive training programs to help regulators recognize and counteract common biases, promoting thorough analysis and avoiding cognitive pitfalls.
- Adopting adaptive regulatory approaches, involving regular review and revision of frameworks, ideally after evidence-based assessment, ensuring regulations remain relevant and effective over time, without being influenced by biases or outdated assumptions.
- Focusing on avoiding bad regulations and encouraging investor diversification may be more effective than reactively implementing ad hoc regulations (avoidance of adhocracy).
- Regulating investors or peers, although sounding drastic and unintuitive, may safeguard their interests by providing guidelines, standards, and promoting diversification by use of framing effects and choice architecture dependent on investor's information on financial markets. Using framing effects and nudging techniques, policymakers can influence investor behavior and protect them, promoting responsible investment choices and diversified portfolios. Regulating investors or peers with regard to DeFi infrastructures may also be a viable approach insofar as it would avoid regulating the technology of these systems, as there are no intermediaries due to the decentralization as previously pointed out. In truly decentralized systems, where individuals may act as peers and potentially be considered service providers or business entities, regulating such peers appears even more logical (instead of targeting the underlying technology or intermediating technology platform). This approach also acknowledges the inherent decentralization of DeFi infrastructures and

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preserves technological innovation while also creating legal certainty and mitigating risks associated with trade, tax (particularly VAT tax), supervisory, or other regulatory concerns, which may then be directly applicable to individual peers interacting on the DeFi system, somewhat akin to the regulation of platform operators. The often-propagated empowerment through DeFi will then also be accompanied by the corresponding responsibility.

551   The last implication also leads to the answer of the research question of this work – *"Which objectives of financial market regulation make sense with regard to decentralized finance, taking into account insights from behavioral economics and regulatory policy?"* The answer is as simple as it is unintuitive at first and as logical once outspoken: The regulation of peers! Given that the legal connecting factor for regulatory consequences is always the service provider and the services provided, it only makes sense to regulate peers, based on their provided services, as they may act similar to platform operators and will therefore be responsible not only for complying with financial market regulation, but also with trade law, tax law and other provisions.

5.3 Implications in theory and research

552   From a theoretical and research standpoint, the insights gained from both the behavioral finance and regulatory public policy perspectives provide valuable opportunities for advancing understanding of interactions in the DeFi ecosystem. In terms of behavioral finance, the study of trust mechanisms, investor behavior, and potential biases within the context of policy-making can contribute to the development of more robust models and frameworks for analyzing decision-making processes and behavioral patterns in decentralized financial environments. This, in turn, can inform the design of targeted interventions, nudges, and educational initiatives aimed at promoting responsible and well-informed investment decisions in the DeFi space.

553   On the regulatory public policy front, the review underscores the need for a more adaptive and dynamic yet also holistically coordinated approach to regulation that is capable of responding to the rapid pace of innovation and technological advancements in the DeFi ecosystem, while generally refraining from implementing ad-hoc regulations as a default to avoid bad regulations. This necessitates ongoing research efforts to monitor and

assess the effectiveness of existing regulatory frameworks, as well as the exploration of novel regulatory tools and mechanisms that can address the unique challenges and risks associated with decentralized financial systems. By fostering a more evidence-based and data-driven approach to regulation, policymakers can ensure that their interventions are tailored to the specific characteristics and risk profiles of the DeFi sector, while also adhering to the principles of proportionality and cost-benefit analysis. Furthermore, additional mechanisms on the policymaking level itself should be considered to mitigate biases in decision making in the legislative context.

Moreover, the interdisciplinary nature of the DeFi ecosystem calls for collaborative research efforts that bridge the gap between behavioral finance, regulatory public policy, law and economics and other relevant domains, such as computer science and cryptography. By fostering cross-disciplinary dialogue and cooperation, researchers can develop a more comprehensive understanding of the intricate interplay between the various components of the DeFi landscape. This comprehensive approach will enable the development of more effective and targeted strategies for mitigating risks, promoting responsible innovation, and addressing the social, economic, and regulatory challenges that arise within the DeFi ecosystem.

Furthermore, the theoretical implications of DeFi research extend beyond the realm of finance and regulation, potentially influencing the way we conceptualize and study other decentralized and emergent phenomena. The insights gained from the review of DeFi can inform our understanding of the dynamics of decentralized systems in general, providing valuable lessons for the analysis of distributed governance structures, decentralized organizations, and other complex adaptive systems as well as complex, multifaceted atomic transactions beyond a quid pro quo basis.

In conclusion, the implications of DeFi research for theory and practice are both vast and multifaceted, requiring an interdisciplinary approach and fostering collaborative efforts among researchers from various fields, to analyze the full potential of decentralized financial systems in depth.

5.4 Limitations and future research

Despite the comprehensive exploration of the DeFi landscape and its implications for both behavioral finance and regulatory public policy, this work is not without its limitations. Firstly, the rapidly evolving nature of the DeFi ecosystem presents a significant challenge, as the information and analysis

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provided in this work may quickly become outdated. As such, ongoing research and continuous monitoring of the DeFi space are necessary to ensure that the insights presented here remain relevant and accurate.

558   Secondly, the interdisciplinary nature of this work, while beneficial in offering a holistic perspective, may also result in some oversimplification or omission of certain aspects specific to individual disciplines. For example, the complex technicalities of blockchain technology and cryptography may not have been addressed in full depth, limiting the granularity of the analysis. Future work could expand upon these topics by incorporating expertise from a broader range of disciplines.

559   Another limitation is the primary focus on European regulatory frameworks, which may not be directly applicable or transferrable to other jurisdictions. Different countries and regions may have their unique regulatory challenges and opportunities, and a more global perspective could provide valuable insights into the broader implications of DeFi for the international financial system.

560   Finally, it is important to acknowledge that the conclusions drawn in this work are based on the current state of DeFi and the regulatory landscape. As new innovations and challenges emerge, the landscape may shift, necessitating the reevaluation of certain assumptions and assertions. Therefore, it is essential for researchers to maintain a flexible and adaptive approach when studying DeFi, acknowledging the inherent uncertainty and fluidity of this domain. In addition, while empirical research is propagated in this work, it is itself limited by its conceptual approach.

561   While this work provides a comprehensive examination of the DeFi landscape from both behavioral finance and regulatory public policy perspectives, it is important to recognize and address its limitations. By doing so, researchers can continue to refine and expand upon the existing body of knowledge, ensuring that the study of both decentralized and centralized markets and their intersection remains relevant, accurate, and adaptive to the ever-changing ecosystem.

562   Future research endeavors should strive to incorporate interdisciplinary expertise, expand the geographical scope, and remain vigilant for emerging trends and challenges in the DeFi space. By acknowledging the limitations and embracing the dynamic nature of this field, researchers can contribute to a deeper understanding of DeFi and its potential impact on the global financial system, fostering innovation and growth while mitigating the associated risks.

Building upon the findings and arguments presented in this work, future research can explore several avenues that extend the understanding of DeFi from both behavioral finance and regulatory public policy perspectives and also address newly emerging markets. Future research could delve deeper into the behavioral aspects of DeFi systems, examining the cognitive biases and heuristics that influence decision-making within the ecosystem. This could involve investigating the factors that drive risk-taking behavior, the role of trust in decentralized platforms, and the impact of information asymmetry on market participants. Empirical studies that employ experimental or survey-based methodologies may offer valuable insights into the psychological underpinnings of DeFi adoption and usage. **563**

Furthermore, researchers can explore the implications of regulatory innovations on the DeFi landscape. As new regulatory frameworks and guidelines emerge, particularly with regard to centralized intermediaries providing services with regard to crypto assets and other fields, bridging the gap between truly decentralized markets and centralized systems, it is essential to analyze their influence on the development and growth of the DeFi ecosystem as well as the financial market as a whole and its stability. Comparative studies that examine the effectiveness of various regulatory approaches across different jurisdictions can provide valuable insights into the design of optimal regulatory strategies that balance innovation with risk mitigation. **564**

In addition, the role of emerging technologies and their potential impact on the DeFi ecosystem warrants further investigation. As advancements in areas such as cryptography, artificial intelligence and even quantum computing continue to unfold, it is essential to understand how these technologies might reshape the DeFi landscape and create new opportunities and challenges for both market participants and regulators. **565**

Lastly, research that focuses on the intersection of DeFi with other emerging, centralized financial paradigms, such as central bank digital currencies (CBDCs) and the tokenization of traditional assets, can offer valuable insights into the broader implications of decentralized finance for the global financial system. This research could explore how the integration of DeFi with these new instruments might impact financial stability, monetary policy, and the overall efficiency of financial markets. **566**

In summary, the rapidly evolving DeFi ecosystem presents a myriad of research opportunities across various domains, including behavioral finance, regulatory public policy, but more broadly also on economics, sociology and psychology, law, political sciences and information technol- **567**

ogy. By embracing interdisciplinary collaboration and keeping abreast of technological and regulatory developments, researchers can contribute to a deeper understanding of DeFi and its potential to reshape the financial landscape in the years to come.

5.5 Conclusion

568   The advent of DeFi presents opportunities for efficiency, transparency, and accessibility within future financial infrastructures. Despite its benefits, DeFi faces risks including smart contract vulnerabilities and operational security issues. Key components of the DeFi ecosystem include decentralized exchanges, lending, derivatives, portfolios and other emerging fields. With regulatory legislation like the Digital Finance package of the EU, a holistic approach to financial regulation coordinated with other economic regulation is essential in balancing innovation and risk mitigation.

569   Future research should incorporate interdisciplinary expertise, expand geographical scope, and explore emerging trends and challenges in DeFi. Potential avenues include investigating behavioral aspects of DeFi systems and centralized intermediaries bridging the CeFi and DeFi world, trust mechanisms, regulatory innovations, emerging technologies, and the intersection with emerging financial paradigms such as central bank digital currencies, tokenization of traditional assets as well as NFTs and the potential for new gaming markets. By embracing interdisciplinary collaboration and monitoring developments, researchers can contribute to understanding DeFi and its potential to reshape the financial landscape as a whole. Policymakers must adapt their decision-making processes to enact effective regulation to the rapidly changing markets. This requires adopting a more dynamic, evidence-based and data-driven approach to regulation while considering potential biases in legislative contexts.

570   Lastly, the response to the research question posed in this work – "Which objectives of financial market regulation make sense with regard to decentralized finance, considering insights from behavioral economics and regulatory policy?" – is both straightforward and initially counterintuitive: Regulate peers. As legal regulatory consequences are typically associated with service providers and their services, it's logical to regulate peers based on the services they offer (if any), since they may act similarly to platform operators. Consequently, they would be responsible for complying with

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financial market regulation, trade law, tax law, and other relevant provisions as applicable depending on services provided.

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"When I was small you took me by the hand
Father you should know I finally understand
You taught me wrong from right
And how to live you gave the greatest gift
That one could give
You never let me down you made me strong
When I made mistakes when I was wrong
Some days we'd laugh
And some days we'd fight
Somehow you knew one day
I'd say you were right
You're with me in every word I say
In every hour of every single day
In all I do I'm just a part of you
You lived your life for us
That was your plan
Those hands that never take
They worked the land, hands that never take
Can only give and because of you
I know how to live
You're with me in every word I say
In every hour of every single day
In all I do I'm just a part of you
Father just one thing you always knew
Every word you said to me was true"

"Father" – Song by Manowar

Josef's Vanity Card #2:
To Gunnar, the luminary who transcends the realm of stars,
A visionary whose wisdom illuminates the cosmic void,
We offer this humble tribute, a beacon of gratitude,
For you have guided us through the labyrinth of thought,
And led us to the outer reaches of our own potential.
In the celestial tapestry of mentors and guides,
Yours is a constellation that shines with unmatched brilliance,
A supernova of inspiration, forever etched in our hearts,
Through the boundless expanse of the universe, you've charted our course,
A celestial navigator, beckoning us to soar beyond the known.
The mentor who dared us to dream of galaxies unexplored,
Whose sagacity unlocked the secrets of the cosmos,
You've woven the fabric of our dreams with stardust,
Encouraging us to reach beyond the limitations of the skies,
To embrace the infinite, and dance among the celestial spheres.
In these pages, your essence resonates, your wisdom prevails,
For every word is but a reflection of the radiance you've shared,
A cosmic journey, inspired by the mentor who transcends time and space,
May the echoes of your legacy reverberate through eternity,
A testament to the indelible impact of a visionary out of this world.