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A Behavioral Approach to Irrational Exuberances – An Artificial Intelligence Roboethics Taxonomy

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> "Clearly, sustained low inflation implies less uncertainty about the future, and lower risk premiums imply higher prices of stocks and other earning assets. We can see that in the inverse relationship exhibited by price/earnings ratios and the rate of inflation in the past. But how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade?" (Alan Greenspan, 1996)

ABSTRACT: Contemporary theories and studies of economics apply a behavioral approach. Behavioral Economics revolutionized mainstream neo-classical economics in the past years. The success of behavioral economics is reflected by two Nobel Prizes in Economics. The wide range of psychological, economic and sociological laboratory and field experiments proved human beings

deviating from rational choices and standard neo-classical profit maximization axioms often failed to explain how human actual behavior. Human beings rather use heuristics in their day-to-day decision making. These mental short cuts enable to cope with a complex world yet also often leave individuals biased and falling astray to decision making failures. Artificial intelligence (AI) driven robots and machines are forecasted to grow dramatically in the next years . AI reflects many algorithms, models and techniques, machine learning, databases and visualizations. One of the main advantages of AI-driven machines is that they follow consistently rational algorithmic rules without being biased. Ethical considerations intend to make AI-driven robots more human and introduce morality into machines. The Uber-Waymo trial made transparent how much artificial intelligence development is impacted by human irrationality and irrational exuberances. It reveals a culture of agile software development, which prioritize releasing the latest software over testing and verification, and one that encourages shortcuts and irrationality. This also give proof that applying artificial intelligence cannot ensure that irrational exuberances are prevented. The reason for this irrational exuberance may have its roots in the exponential growth in computing and storage technologies predicted by Gordon Moore five decades ago. This paper develops a concept how irrational exuberances can be prevented from happening. One general approach for solutioning of the issue is to increase transparency. The paper recommends applying technology to make data more accessible and more readable on the application of artificial intelligence. For this purpose the application of"transparency technology XBRL (eXtensible Business Reporting Language)" is incorporated. XBRL is part of the choice architecture on regulation by governments (Sunstein 2013), which applies nudging for influencing towards a preferred option used by the mass consumers. XBRL is connected to a taxonomy. The paper develops a taxonomy to make application of artificial intelligence more transparent to the public and incorporates ethical considerations. As a business case the strongly growing robo-advice market in Germany is taken. The taxonomy is either inductively derived from the robo-advice market offerings and deductively includes the existing standards on ethical codes for robot's usage and application of artificial intelligence. The paper focus on the way to enhance AI that aligns with human values. How can incentive be provided that AI systems themselves do not become potential objects of moral concern. The main outcome of the paper is that Digitalization implies with AI moral concerns however transparency technologies at the same time also offer way to mitigate such risks.

KEY WORDS: Irrational exuberances, Artificial Intelligence Ethics, Behavioural Economics, Human-Computer Interaction, Taxonomy, XBRL and Transparency

Introduction

Contemporary theories and studies of economics apply a behavioral research approach. This is underpinned by the fact that behavioral economics reversed mainstream neo-classical economics in 21st century. Since then two Nobel Prizes in Economics were distributed as a wide range of psychological, economic and sociological laboratory and field experiments proved human beings deviating from rational choices and standard neo-classical profit maximization axioms often do not constitute explanations for human behavior. Human instead of pure rationality rather apply heuristics in their day-to-day decision making. These mental deficiencies often leave individuals incapable of avoiding decision making failures within a complex world. Research e.g. in Political Science about voting decision from people give proof that people are strongly influenced by rather unreflective first impressions and as a result decisions based on that are not driven by rational reflections and deliberations .

Behavioral Economics intend to specify anomalies and shortfalls in neo-classical economics. Due to mental deficiencies, humans are incapable to guide their lives proactively within a complex world and rather become victim and tributary to complexity. Opposite to the assumptions of the standard neo-classical theory, individuals intend to reduce complexity, whenever the opportunity is provided , which reflect irrational exuberances. Irrational exuberances are well described in Shiller's book about the housing market "The market is high because of the combined effect of a lot of indifferent thinking across millions of people, very few of whom feel a need to do careful research about the long-term investment value of the aggregate stock market, and who are motivated substantially by their own emotions, random attentions, and perceptions of conventional wisdom. Their behavior is heavily influenced by news media that are interested in attracting viewers or readers, with little incentive to report regularly on quantitative analysis that might give a correct impression of the aggregate stock market level." Reducing complexity also implies decreasing cognitive drain on mental resources. For many day-to-day problems, humans develop certain heuristics as in Shiller's description on the appreciation of the housing market, which represent mental simplifications or rule of thumbs . Contrary to neo-classical

assumptions, pareto optimality for society over time does not become in conformity with the aggregated individual generations' preferences, as the sum of individual generations' preferences will not lead to societally favorable outcomes over time .

Due to this conflict, behavioral economists have recently started to nudge – and most recently wink – people into favorable decision outcomes, offering promising avenues to steer social responsibility in public affairs. The freedom of economic choice and the assumption that free markets lead to efficient outcomes, which is often described in the literature with the metaphor of Adam Smith invisible hand is questioned due to human irrationality. This new idea of interfering into the market became very sucessful and was extended to different fields. What followed was the powerful extension of behavioral insights for public policy making, international development and decision usefulness. Behavioral economists proposed to nudge and wink citizens to make better choices for them and the community around the globe. Many different applications of rational coordination followed ranging from improved organ donations, health, wealth and time management, to name a few. Starting with the beginning of the entrance of behavioral aspects in economic analyses and intercultural differences in behavioral understandings, the paper will then embark on a wide range of classic behavioral economics extensions in order to guide a powerful application to AI in the age of the digitalization of the economy.

This paper applies behavioral economics to an issue appearing in the area of investor decision usefulness caused by the digitalization of the economy in a truly interdisciplinary way. What role do ethics play for behavioral economists? In the future age of AI, should we create algorithms that resemble human decision making or strive for rational artificiality? Can transparency technology such as XBRL help to counteract against the associated risk of unethical application of AI? And does nudging in the wake of libertarian paternalism entail a social class division into those who nudge and those who are nudged? This paper develops based on AI-driven products in the Banking and Finance Industry such as Roboadvisors and AI-driven finance robots, a taxonomy that reflects ethical consideration and upon application enables a way to mitigate such risks by providing enhanced transparency.

Artificial Intelligence (AI)

Artificial Intelligence (AI) implies historically unique opportunities but also threats to humankind. As an emerging global trend, AI becomes relevant at almost all levels of social conduct and thereby raised both – high expectations but also grave concerns. AI reflects many algorithms, models and techniques, machine learning, databases and visualizations. One of the main advantages of AI-driven machines is that they follow consistently rational algorithmic rules without being biased. Ethical considerations intend to make AI-driven robots more human and introduce morality into machines. The Uber-Waymo trial made transparent how much artificial intelligence development is impacted by human irrationality and irrational exuberances.

This also give proof that applying AI cannot ensure that irrational exuberances are prevented. The reason for this irrational exuberance may have its roots in the exponential growth in computing and storage technologies predicted by Gordon Moore five decades ago. With the dramatic increase in diversity and the usage of emerging technologies in today's societies, such as social robots, lifelike computer graphics (avatars), virtual reality tools and haptic systems and Roboadvisors the social complexity of these challenges are rising . One of the main challenges in developing and applying modern technologies in our societies is the treatment of ethical issues surrounding AI (Meghdari and Alemi 2018). The call for AI Ethics (AIE) has emerged e.g. reflected by the European Group on Ethics in Science and New Technologies. It reveals a culture of agile software development, which prioritize releasing the latest software over testing and verification, and one that encourages shortcuts and irrationality.

A growing number of AI and robotics researchers have expressed their willingness and the requirement to create a framework on AI ethics building on the benefits of humanities, philosophy, natural sciences, sociology, and social neuroscience. AI enables the potential to replicate human existence but with indefinite lifetime. From the view of overpopulation concerns, under the assumption that AI can help to substitute machines for humans AI would be a solution to avoid a crowding of the planet. AI currently also reaches quasi-human status through actual personhood – e.g., via citizenship

and quasi-human rights applied in the Common Law but also Roman Law territories of the US and the EU. Leveraging AI entities to the status of being through the attribution of legal personhood raises challenging legal and ethical questions. A novel predicament between eternity and overpopulation hence calls for revising legal codes for killing and ethical imperatives and religious concerns over suicide.

AI consist of a large number of algorithms, models and techniques, machine learning, databases and visualizations . According to AI is the science and engineering of producing intelligent machines, particularly computer programs, which incorporate intelligence and implies also the task of using computers to understand human intelligence. Historically, the process leading to the enormous spread of information and technology is frequently considered as the digital revolution. The term reflects a revolutionary development from the industrial to the information age. This transition towards economies and business models implies the usage of information and communication technology and virtual processes instead of analogue mechanics and face-to-face services (Moudud-Ul-Huq 2014). The second half of the last century was dominated by the development of computer technology. This is often referred to as the Third Industrial Revolution, which was driven by the invention of microprocessors that enabled the mass production of personal computers and a very fast increase in storage and computing capacity . As the most novel trend, AI, robots and algorithms are believed to soon disrupt the economy and employment patterns. With the advancement of technologies, employment patterns will shift to a polarization between AI's rationality and humanness. Robots and social machines have already replaced people in a variety of jobs – e.g. airports smart flight check-in kiosks or self-check-outs instead of traditional cashiers. Almost all traditional professionals are prospected to be infused with or influenced by AI, algorithms and robotics. For instance, robots have already begun to serve in the medical and health care profession, law and–of course–IT, transportation, retail, logistics and finance, to name a few. Social robotics may also serve as quasi-servants that overwhelmingly impact our relationships.

AI's entrance in society will revolutionize the interaction between humans and AI with amply legal, moral and social implications . Autonomous

AI entities are currently on the way to become as legal quasi-human beings, hence self-rule autonomous entities . AI can in principle be distinguished between weak AI, where "the computer is merely an instrument for investigating cognitive processes" and strong AI, where "[t]he processes in the computer are intellectual, self-learning processes". Weak AI is labeled as Artificial Narrow Intelligence (ANI) while strong AI is further distinguished between Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI).

Exponential growth in data availability enabled the development of AI systems for pattern selection in big data and a broad range of applications, such as speech and natural language processing, computer vision, image recognition (e.g. in search engines and social networks) and predictive analytics. This founded the basis for virtual personal assistants such as Alexa, Siri or Cortana, which have become first AI-enabled tools used by the mass consumers. Remarkable is the speed with which these radical changes are occurring, and their extensive and comprehensive systemic proliferation have become known as the Fourth Industrial Revolution, as popularized by World Economic Forum founder Klaus Schwab. The pace of technological development has gained such speed that corporates, consumers and governments often find themselves struggling to keep pace. Developments in AI have far-reaching economic and sociopolitical consequences, some of them are already materializing (Körner 2018). However, it is still unclear, what will be the exact impact on human society. How will AI and robotics lead to the allocation of labor and capital? When people decide, limitations in their capacity to foresee long-term impacts and the collective outcomes of their choices can contribute to institutional downfalls. The more machine learning systems apply AI becomes powerful it will become more important that ethical frameworks are incorporated. According to machine learning are computational algorithms that use certain characteristics to learn from data using a model.

It has been long history since society was concerned with the impact of robotics technology. From nearly a century ago the word "Robot" was mentioned for the first time . The EU Committee on Legal Affairs (2016, 4) holds that "[U]ltimately there is a possibility that within the space of

a few decades AI could surpass human intellectual capacity in a manner which, if not prepared for, could pose a challenge to humanity's capacity to control its own creation and, consequently, perhaps also to its capacity to be in charge of its own destiny and to ensure the survival of the species." AI mimicking human intellect could soon surpass humans intellectually but also holistically breaking the barrier of human controlled-automization (Schuller 2017). Modern literature about robots features cautionary accounts about insufficient programming, evolving behavior, errors, and other issues that make robots unpredictable and potentially risky or dangerous. "Observe, orient, decide, act" will therefore become essential in the eye of machine learning autonomy and AI forming a new domain of intellectual entities (Armstrong & Sotala 2012, 52; Copeland 2000; Galeon & Reedy 2017; Marra & McNeil 2013). The uncertainty surrounding AI development and self-learning capabilities give rise to the need for guarding AI and an extension of the current legal system to cope with AI (Themistoklis 2018).

With the advancement of technology, social robots have found broader applications in the private and public sectors, such as educational and cultural affairs, games and entertainment, clinical and rehabilitation, nursing of children and/or elderly, search and rescue operations). For example, social robots such as ASIMO, Nao, iCub, ARASH, and RASA have been developed for "Edutainment" or "education entertainment" purposes. They aid the study of cognition (both human and artificial), motion, and other areas related to the advancement of robotics serving our society (Meghdari and Alemi 2018). In addition, a few medical and healthcare toy-like robots, such as PARO, which looks like a baby seal, or ARASH, which is a humanoid, have been designed for therapeutic purposes such as reducing distress, stimulating cognitive activity, teaching specific subjects, and improving socialization (Meghdari and Alemi 2018). Similarly, Sharif University of Technology's socially assistive robot RASA has been developed to help coach and teach Persian Sign-Language to Iranian deaf children (Meghdari and Alemi 2018). Personal care and companion robots are increasingly being used to care for the elderly and children, such as RI-MAN, PaPeRo, and CareBot (Meghdari and Alemi 2018). In recent years, robotics technology has extended its applications from factories to more general-purpose practices in

society – for instance, such as the use of robots in clinical and rehabilitation, nursing and elderly care, search and rescue operations (Meghdari and Alemi 2018). Social robots have become clinical and educational assistants for social interventions, treatment, and education such as language trainings but also assistance with children with disabilities like autism, down syndrome, cancer distress, hearing impairment, etc. (Meghdari and Alemi 2018). Initial investigations clearly indicate that social robots can play a positive role in the improvement of children's social performance, reduction of distress during treatments, and enhancing their learning abilities (Meghdari and Alemi 2018). Surprisingly, although not too hard to imagine, relationships of a more intimate nature have not quite been satisfied by robots yet (Meghdari and Alemi, 2018; Veruggio 2005).

Contemporary theories and studies of economics have turned behavioral. Behavioral Economics revolutionized mainstream neo-classical economics in the past two decades. Laboratory experiments have captured heuristics as mental short-cuts easing choices of mentally constrained human in a complex world. At the same time, heuristics were examined as a source of downfalls on rational and socially-wise choices given future uncertainty. Behavioral economists have recently started to nudge – and most recently wink – people into favorable decision outcomes, offering promising avenues to steer social responsibility in public affairs. Since then two Nobel Prizes in Economics have crowned this growing field as a wide range of psychological, economic and sociological laboratory and field experiments proved human beings deviating from rational choices and standard neo-classical profit maximization axioms often failed to explain how human behave. Human beings rather use heuristics in their day-to-day decision making. These mental short cuts enable to cope with a complex world yet also often leave individuals biased and falling astray to decision making failures. What followed was the powerful extension of behavioral insights for public policy making and international development. Behavioral economists proposed to nudge and wink citizens to make better choices for them and the community around the globe. Many different applications of rational coordination followed ranging from improved organ donations, health, wealth and time management, to name a few. Starting with the beginning of the entrance

of behavioral aspects in economic analyses and intercultural differences in behavioral understandings, these days sustainability accounting and reporting as a powerful application in a truly interdisciplinary fashion. Reporting innovatively apply behavioral economics in the professional domain. The application of behavioral economics to corporate sector economic analysis is a cutting-edge approach to capture the power of real-world relevant economics. Drawing from a line of research on bounded rationality, reporting can improve corporate success based on economic analysis tools. Delineating the potential of behavioral economics to implement market value portrays economics as a real-world relevant means to maximize value in a constantly transitioning world economy.

As one of the newest trends in Behavioral Economics, governments and institutions around the world nowadays apply behavioral economic models (Sunstein 2013) for choice architecture on regulation. In the next section it will be further analyzed how that choice architecture offers opportunities to nudge institutional and private investors into the preferred solution investments considering common sustainable criteria's and standards.

Artificial Intelligence Evolution

The human perception of and interaction with robot machines with a higher quality physical appearance differs from interaction with a computer, cell phone, or other smart devices. For robotics technology to be successful in a human-driven environment, robots do not only need to meet a level of strength, robustness, physical skills, and improved cognitive ability based on intelligence but should also fulfill a social impetus and ethical conscientiousness. The design and construction of social robots faces many challenges, one of the most important is to build robots that can comply with the needs and expectations of the human mind with cognitive capabilities coupled with social warmth. While we have Social-Cognitive Robotics (SCR) as a transdisciplinary area of research and a basis for the human-centered design of technology-oriented systems to improve human knowledge functions, judgements and decision making, collaborations, and learning; hardly any information exists on socio-evolutionary comparisons Social cognitive robotics has been evolving and verified through a series

of projects to develop advanced and modern technology-based systems to support learnings and knowledge functions, and is beginning to play an effective role in societies across the globe SCR or Socio-Cognitive Robotics is the interdisciplinary study and application of robots that are able to teach, learn and reason about how to behave in a complex world. Social robotics technology promises a many benefit but also challenges that society must be ready to confront with legal means and ethical imperatives.

Artificial Intelligence Ethics

Ethics describes moral principles that govern a person's or group's behavior. Roboethics describes the ethics and morals of robotics, the science of robots. Roboethics therefore captures the integration of ethics into AI and algorithms. So, it is not the ethics of robots or artificial ethics but the human ethics of the robot's designer, manufacturers and users. This field recently gained considerable attention among humanities and robotics engineers who draw on insights from computer science, artificial intelligence, mechanics, physics, math, electronics, cybernetics, automation and control . What specifies the emergence of socio-cognitive robotics is that humanity is at the threshold of replicating an intelligent and autonomous agent. In order to enhance the ability of social robots to successfully operate in humane ways, roles and environments, they are currently upgraded to a new level of physical skills and cognitive capabilities that embrace core social concepts (Meghdari and Alemi 2018). Robotics thereby unifies two cultures, in which complex concepts – like learning, perception, decision-making, freedom, judgement, emotions, etc. – may not have the same semantic meaning for humans and machines . In the design and construction of social robots, the consideration of ethical concerns has therefore leveraged into an imperative (Lin, Abney & Bekey 2012). Human-robot (a machine with a higher physical and social ability) interactions, are somewhat different compared to other types of human-machine interactions (i.e. with a computer, cell phone, or other smart device) , It is therefore essential for researchers, scholars, and users to clearly identify, understand, and consider these differences and ethical challenges so that they can benefit from and no one gets harmed by the assistance of social robots as a powerful tool in providing modern and quality services to society.

Robots and algorithms now taking over human decision-making tasks and entering the workforce but also encroaching our private lives, currently challenges legal systems around the globe.The attribution of human legal codes to AI is one of the most groundbreaking contemporary legal and judicial innovations. Until now legal personhood has only been attached directly or indirectly to human entities (Dowell 2018). The detachment of legal personhood from human being now remains somewhat of a paradox causing an extent of "fuzziness" of the concept of personhood (Barrat 2013; Solum 1992, 1285). As AI gets bestowed with quasi-human rights, defining factors of human personhood will need to be adjusted (Dowell 2018). Human concepts, such as morality, ownership, profitability and viability will have different meaning for AI. The need for redefining AIE has therefore reached unprecedented momentum. As predicted trend, the co-existence of AI with the human species is believed to change the fundamental concepts of social, political and legal systems. AI has already produced legal creations and will do so even more in the near future, through its developing autonomy. In addition, the technology leading to AGI and ASI is already present, posing moral and legal dilemmas about who should control it and under what terms. The emergence of AGI and ASI will necessitate the attribution of some extent and of some type of legal personhood, bearing rights and obligations. AI will not be most probably an exact replication of human intellect behavior. "[U]ultimately, robots' autonomy raises the question of their nature in the light of the existing legal categories –of whether they should be regarded as natural persons, legal persons, animals or objects– or whether a new category should be created, with its own specific features and implications as regards the attribution of rights and duties" (Committee on Legal Affairs 2016, 5). Behavioral economists add the question whether AI and robots should be created to resemble human beings' decision making with fast thinking and fallible choices or rather be targeted at perfect rationality and slow thinking (Kahneman 2011). General conscious is strived for so that AI possesses consciousness, which it can evolve and enhance on the basis of its own critical reflection and assessment of external factors . A lower level of autonomy exists if an entity can demonstrate such consciousness at a narrow field or can

self-evolve and self-adapt to external influences, thus reaching decisions "of its own," without being conscious of its intelligence as such (Tzimas 2018).

Capacities coupled with human-like emotional features, they are attributed a legal personhood in order to ensure to be comprehended correctly and to avoid unfair treatment, towards humans as well . Artificial entities are currently gaining human or quasi-human status in the Western and Arab worlds in forming an intellectual autonomy of the entity (MacDonald 2016). For instance, in Saudi Arabia the first female robot got a citizenship in 2017 and the robot appears to have more rights than a human female in Saudi Arabia.

Taxonomy development with XBRL

Behaviorally informed tools for disclosure and transparency are selected by governments (Sunstein 2013). To use a technical standard for the exchange of information, regulators or independent institutions introduce taxonomies using flexible "transparency technology XBRL (eXtensible Business Reporting Language)". It is part of the choice architecture on regulation by governments (Sunstein 2013), which applies nudging for influencing towards a preferred option. XBRL represents an open free of charge technical standard for electronic reporting and the exchange of data (Cohen, Schiavina and Servais 2005; Mirsch, Lehrer and Jung 2017; Sunstein 2013; Weinmann, Schneider and vom Brocke 2016) and should democratize the information access between institutional and private investors. XBRL inevitably requires the usage of an adequate taxonomy (Kurt and David 2003).

The taxonomy development in the context of XBRL considering the academic literature follows the following aims:

- Offer transparent corporate information to investors, which is structured so that it becomes possible to process the information by software without the requirments to manually map or human intervention and comparable information based on country-by-country or sector analysis .
- Enable the preparers to fulfill compliance requirements set by regulators, in terms of disclosing information in accordance with local and international rules .

- Improve the financial and non-financial communication by enabling adoption of specific branch requirements of industry (banks, insurance etc.) and of business variations.

However, XBRL requires a taxonomy , as the main advantage of being able to compare can only be reached by a common used taxonomy . This is also relevant for sustainability, as without a holistic standardized approach it cannot be achieved to reach sustainable goals, as institutional and private investors would follow completely different metrics. Therefore, the aim of such a sustainability taxonomy is to provide a framework for classifying all potential assets or activities against a comprehensive set of sustainability goals –from climate change to broader environmental and social goals, including the Sustainable Development Goals. The starting point for the definition of sustainability goals are the three associated risks: physical, transition and liability risk.

Different types of finance are 1) used to finance different stages of a project or asset development (e.g. acquisition/ development, operation, refinancing) and 2) used to match varying levels of inherent risks in any investment, as this can affect ability to access different types of finance.

According to , there exists no standard way to build up a taxonomy. Taxonomies can be developed for several reasons and different approaches exist from software, knowledge and ontology development for XBRL engineering. There is a best practice release by XBRL International, the "Financial Reporting Taxonomy Architecture (FRAT)", which defines modelling rules for XBRL taxonomy development (Debreceny 2009). However, this model focuses on technical aspects of how business rules are implemented in a specific XBRL taxonomy, and aspects of software engineering are integrated within this model. From a holistic point of view, the taxonomy development process encompasses reporting elements, technical XBRL specification and testing.

Existing approaches for the methodology of the development and engineering of a taxonomy in the academic literature share a focus on the technical aspects of the taxonomy development process via engineering models . The following overview follows the objective to combine business-rule development and taxonomy development.

- In the preparatory phase, reporting elements need to be defined and the associated meta-data, including specifications of the taxonomy and its intended use.
- A building phase follows, which focus on technical considerations, application rules on the base taxonomy and the management of extensions.
- Finally, there is a maintenance and evolution phase for the management and development of the taxonomy on a continued basis.

Principles-versus rule-based Taxonomy

The development of an ethical taxonomy should also consider existing best-practice taxonomies for corporate reporting. Historically, either an inductive or deductive methodology to develop a taxonomy can also be referenced to the principles-based vs. rule-based debate in the academic literature about accounting taxonomies. The principles-based vs. rule-based debate in the U.S. was rediscussed after the Enron and WorldCom accounting scandal 2002. An intense discussion whether US GAAP should become more principles-based, as rules-based standards might give rise to "cook-book accounting", without considering a substance-over-form approach. So, if there is no discretion to the chef, the taste will always be the same. US GAAP tends to be mechanical and inflexible. Clear-cut rules have some advantages, but the risk is that this approach motivates financial engineering designed specifically to circumvent these knife-edge rules, as is very often given proof in the tax literature. According to a standard should not be seen as only principles or rule-based but should rather be regarded as more or less rule-based. According to a behavioral analysis, Nelson concludes that rules can improve the accuracy of the communication of the standard setter and reduce imprecision associated with aggressive reporting due to unawareness of existing rules (Nelson 2003). Nelson does not consider that rules increase imprecision but also enable companies to structure transactions to meet the accounting rule without following the true economic substance of the transaction. This is one of the main arguments by supporter of principles or concepts-based accounting. They point to the challenge when moving from

a rule-based to a concepts-based standard setting, as informed professional judgement and expertise for the implementation is increasingly required.

In the area of ethical taxonomies, it is important to mention that ethics concerns the study and explanation of moral beliefs, so what is right or wrong. There are in general three branches , in which ethics are differentiated. Normative ethic defines how we should live in forms of principles, which we have just explained. Applied ethics are the defined rules for specific areas such as medical ethics, bioethics or business ethics. This is like the rule-based taxonomy approach. The third branch is the meta ethics, which identify what is the general nature of morality, which will not be relevant for the process of the taxonomy development.

Research methodology and introduction to Roboadvice

The concept follows the idea of the development of a uniform classification system for artificial intelligence ethics ("AIE taxonomy"). It is essential for market participants that a common understanding of ethical standards regarding the application of artificial intelligence, labels, assets and financial products exist. In a next step market, a participant will be able to build trust by providing full transparency and precise information applying these developed ethical standards. This understanding needs to be derived from legally approved, clear, consistent, comprehensible and neutral definitions that should take into consideration existing international and regional standards, which are already applied by market participants. The application of the ethical taxonomy will also enable to provide transparency on potential chances as well as risks associated with Artificial Intelligence.

What is the research method, which is applied in this paper? In the following course of this paper artificial intelligence ethics will be defined with the term used in the academic literature of "Roboethics" based on the concept of Veruggio and Operto . Veruggio and Operto provide a roadmap with the aim to monitor roboethics from a cross-cultural interdisciplinary approach. Several authors deal with roboethics with different approaches: what we intend to derive from a roboethics, is there justice, what are conditions for a robot to be moral agent , what are fundamental differences of humans and robots.

This working paper follows the approach to analyse the ethics of those designing and using robots, and the ethics of robot use, so what is built inside the robots. For this an inductive approach is applied. The use case is the market for robo advisors in Germany. In addition to that professional standards for ethics are analyzed: NSPE Code of Ethics of Engineers, IEEE Code of Ethics, ASME Code of ethics of engineers and WPI Code of Ethics for Robotics Engineers, if it is possible to incorporate those standards applying a deductive approach into the taxonomy. The deductive method consists of a methodology that changes from the general to the specific content. The associated advantage of the deductive method is that hypotheses and expected findings are developed before the data collection ("a priori"). The underlying assumptions are often based on theoretical frameworks and therefore the subsequent analysis can be assessed as logical and focused. The inductive approach derives general statements on observations and facts. An inductive researcher considers variables and considers a fully developed prior research design consisting of a literature review, models and a set of data. The usual aim is to con-struct a new framework instead of testing existing concepts. The cornerstone of the inductive method is to set up a framework based on categorization of data. One of the main advantages of the inductive method is its flexibility and openness about alternative measures and relationships. Overall a mixed-method methodology is applied in this working paper. The reason for such a design is that the same findings are generated even with different design choices, therefore diminishing the determination of the design choice and the research conclusion. Increased variation of methods to examine a topic can lead to a more robust and generalizable set of findings. Recommendations could be provided with a greater level of detail if triangulation or a mixed-method approach were applied.

Roboadvice consists of online investment guidance and portfolio management services considering algorithms and models . The overarching principle, which deviates from non-robo advice is to eliminate or reduce human intervention and to rely only on computer programmes to identify the optimal investment strategy for each individual customer. Robo-advisors are fully automated online platforms that enable customers digital financial advice and portfolio allocation. Robo advisory process can be divided into three sub-processes: 1) initial investor screening; 2) implementation of

investment strategies; and 3) monitoring and evaluation of these strategies. Implementation of investment strategies follows customer profile, which is identified following an online questionnaire. Robo-advisors select specific assets that are commensurate with investors' individual preferences. Among the spectrum of investable assets exchange-traded funds (ETFs) are very often used asset class. Automation and passive investment strategies have an important value-added function: the elimination of internal agency conflicts that can arise between financial advisors and their customers considering Principal Agent Theory. Also, the remuneration structures of financial advisory services (both commission-based and fee-based models) can also trigger conflict interest as human advisory is very often not in the best interest of the client due to moral hazard. Robo-advisors usually allocate assets using algorithms based on mean-variance optimization. Based on modern portfolio theory, higher risk returns can be achieved by maximizing returns for a given level of risk. The variance implies the risk, so the lower the variance to the mean return the more an efficient portfolio is achieved.

- Robo-advisors undergo the same requirements regarding conduct standards as human advisory services apply to and traditional financial advisors alike. Robo-advisors have the same transparency rules in terms of costs, potential risks and limitations of their services. Despite its automatic rules the duty exists to fully and fairly disclose all information so that clients can clearly understand their investment practices and potential conflicts of interest. This needs to be understandable for an independent third party, who is not an expert in robo-advice.
- Secondly, robo-advisors need to give clear evidence how they handle operational and market risk both in normal times and in distressed market conditions. Investors must be informed about operational aspects of their services, i.e. regarding the assumptions and limitations of the optimization algorithm for portfolio allocation and rebalancing.
- Thirdly, Roboadvisors should ensure that their recommendations and strategies are fit for purpose of the client's profile. Suitability should be based on the client's financial situation and investment objectives. For this, robo-advisors depend on the information provided by clients in online questionnaires. This is also circumventing ethical questions, as wrong execution or misuse of client information for not acting in the best interest would imply ethical issues.

Customer screening is one of the most crucial elements of robo-advisory. It has proven beneficial to introduce vignettes and some human touch in the form of bionic advice. Cybersecurity and the protection of sensitive customer information is a last pivotal issue when it comes to automated online advice. Thus, robo-advisors must establish controls to protect client data and to maintain the public website/the client's log-in functionality.

As Roboadvice is a fast growing business area, regulators and policymakers, as unique business models and limited or no human interaction require some clarification in certain cases . In the US, to inform robo-advisory clients, the Securities and Exchange Commission (SEC) recently published a guidance report. The SEC emphasizes that, as registered investment advisors, robo-advisors are subject to the same requirements of the Advisers Act of 1940 as non robo-advisors. In a same manner, joint committee of the three European Supervisory Authorities (ESA) launched an assessment of robo-advice, aimed at gauging whether any action was required to harness its potential benefits and mitigate its risks. End of 2016, the ESA committee decided to continue monitoring robo-advisory services, but not to apply cross-sectoral regulatory or supervisory action. Digital advice services are subject to the same regulatory requirements as traditional financial advisors and are therefore supervised by similar authorities as traditional financial advisors, i.e. the SEC and FINRA in the US, the FCA in the UK, BaFin in Germany and AMF in France.

Robo advisor market in Germany

Robo advisor market in Germany can be differentiated along three basic types considering Finanztest 2017.

Type 1: Roboadvisors solely focus on providing information how to find for customers the best product. Those type 1 act as disintermediation, as companies following this business model do not take responsibility for the investment of the clients but simply provide more transparency to the yet rather new market and new market participants. Examples of such companies are JustETF or Moneyfilter in the Germany market.

Type 2: Roboadvisors follows the business model of a passive fund management strategy. Asset management is executed based on the customer

preferences, however no active portfolio selection is performed by the robo advisor. Examples of such offerings are vaamo, easyfolio, fintegro or growney.

Type 3: Roboadvisors apply an active fund management strategy, which includes the whole asset management cycle. Examples for such product characteristics are Scalable Capital, Liquid or Quirion.

Based on a study from Oliver Wyman about 40 start-ups are in the German market, while the assets under management could increase by 2020 from currently €100 million to €30 billion by 2020, but €440 billion is expected for the global market volume of robo advisor.

In a next step the existing robo advisors are analysed with regard to their ethical considerations.

Name	Approach	Ethical considerations	Minimum investment	Costs
Vaamo	Passive	Yes		0,79%
Scalable capital	Active	Yes	t€10	0,75%
Quirion	Active	Yes	t€5	0%
Fintego	Passive	Yes	t€2.5	0,75
Whitebox	Active	Yes	t€5	0,95%

Existing Professional Standards: National Society of Professional Engineers (NSPE), Institute of Electrical and Electronic Engineers (IEEE), American Society for Mechanical Engineers (ASME), code for robotics engineers (WPI)

Professional ethics reflect standards on the interaction between professionals. As this working paper assumes that it is not the ethics of robots or artificial ethics but the human ethics of the robot's designer, manufacturers and users, the focus is on existing standards of user manufacturer of robots.

National Society of Professional Engineers (NSPE)

Based on the ethics standards of the NSPE, the following guidelines are provided.

1. To accept responsibility in making decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment
2. To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist
3. To be honest and realistic in stating claims or estimates based on available data
4. To reject bribery in all its forms
5. To improve the understanding of technology, its appropriate application, and potential consequences
6. To maintain and improve our technical competence and to undertake technological tasks for other only if qualified by training or experience, or after full disclosure of pertinent limitations
7. To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others
8. To treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin
9. To avoid injuring others, their property, reputation, or employment by false or malicious action
10. To assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

These are very general ethical principles, which can be applied to any professionals implementing or manufacture new products applying new technologies. It provides a good foundation for the further development of the taxonomy.

Institute of Electrical and Electronic Engineers (IEEE)

Considering the IEEE, the following rather general code of conduct is formulated:

1. Using their knowledge and skill for the enhancement of human welfare
2. Being honest and impartial, and serving with fidelity their clients (including their employers) and the public; and
3. Striving to increase the competence and prestige of the engineering profession.

American Society for Mechanical Engineers (ASME)

The following code from ASME particularly focus on ethical issues arising for mechanical engineers:

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Engineers shall perform services only in the areas of their competence; they shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
3. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional and ethical development of those engineers under their supervision.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees and shall avoid conflicts of interest or the appearance of conflicts of interest.
5. Engineers shall respect the proprietary information and intellectual property rights of others, including charitable organizations and professional societies in the engineering field.
6. Engineers shall associate only with reputable persons or organizations.
7. Engineers shall issue public statements only in an objective and truthful manner and shall avoid any conduct which brings discredit upon the profession.
8. Engineers shall consider environmental impact and sustainable development in the performance of their professional duties.
9. Engineers shall not seek ethical sanction against another engineer unless there is good reason to do so under relevant codes, policies and procedures governing that engineer's ethical conduct".

Code for robotics engineers (WPI)

This code is specialized to robotics engineers and can therefore adequately address roboethics issues. "As an ethical robotics engineer, I understand that I have responsibility to keep in mind at all times the wellbeing of the following communities: Global—the good of people and the environment National—the good of the people and government of my nation and its allies Local—the good of the people and environment of affected communities

Robotics Engineers—the reputation of the profession and colleagues Customers and End-Users—the expectations of the customers and end-users Employers—the financial and reputation well-being of the company To this end and to the best of my ability I will:
1. Act in such a manner that I would be willing to accept responsibility for the actions and uses of anything in which I have a part in creating.
2. Consider and respect people's physical wellbeing and rights.
3. Not knowingly misinform, and if misinformation is spread do my best to correct it.
4. Respect and follow local, national, and international laws whenever applicable.
5. Recognize and disclose any conflicts of interest.
6. Accept and offer constructive criticism.
7. Help and assist colleagues in their professional development and in following this code".

Based on the analysis of the Roboadvisors of the sample of 5 companies and the professional ethics the following ethical taxonomy is developed.

Development of AI-ethics (Roboethics) Taxonomy

Below are described the reporting elements and the required meta data to form a taxonomy complying with XBRL requirements.

The following reporting elements define the two channel on transition and physical risks and also consider as a third source AI&robotics researchers best practice:

Roboethics/AI-Ethics Taxonomy — Transition risk:
— Risk of Operational Failure

- Safety: AI-system should be safe and secure throughout the operational lifetime and verifiably so where applicable and feasible
- Failure transparency: If an AI system causes harm, it should be possible to ascertain why and provide such transparency to the client
- Judicial Transparency: Any involvement by an autonomous system in judicial decision-making should provide a satisfactory explanation auditable by a competent human authority

- Human Control: Humans should choose how and whether to delegate decisions to AI systems, to accomplish human-chosen objectives and to ensure that human profiles are correctly interpreted by the machines

—Risk of Value Misalignment

- Principal-agent conflict: Designers and builders of advanced AI systems are stakeholders in the moral implications of their use, misuse, and actions, with a responsibility and opportunity to shape those implications
- Human Values: AI systems should be designed and operated to be compatible with ideals of human dignity, rights, freedoms, and cultural diversity
- Non-subversion: The power conferred by control of highly advanced AI systems should respect and improve, rather than subvert, the social and civic processes on which the health of society depends
- Common Good: Superintelligence should only be developed in the service of widely shared ethical ideals, and for the benefit of all humanity rather than one state or organization

—Risk of failure due to autonomous decision making

- Value Alignment: Highly autonomous AI systems should be designed so that their goals and behaviors can be assured to align with human values throughout their operation
- Human control: Human interaction is required to control internally functionality of autonomous systems
- AI-Arms Race: An arms race in lethal autonomous weapons should be avoided
- Recursive Self-improvement: AI systems designed to recursively self-improve or self-replicate in a manner that could lead to rapidly increasing quality or quantity must be subject to strict safety and control measures

—Risk of negligence

- Capability Caution: There being no consensus, we should avoid strong assumptions regarding upper limits on future AI capabilities.
- Importance: Advanced AI could represent a profound change in the history of life on Earth, and should be planned for and managed with commensurate care and resources

- Shared benefit: AI technologies should benefit and empower as many people as possible

Roboethics/AI-Ethics Taxonomy — Physical Risk

The following reporting elements define the second channel on physical risk

- Physical Risk
  - —Supply Chain Risk
    - Sales impact due supply chain risk impacted by AI-failure risk leading to distribution delays, supply shortage and high price sensitivity
    - Resource demand of dependency of natural resources leading to supply shortage and high input cost
  - —Operational Risk
    - Risks posed by AI systems, especially catastrophic or existential risks, must be subject to planning and mitigation efforts commensurate with their expected impact.
    - Socio-economic: Access to AI leading to migration and economic disruption leading to business interruptions, political instability and social license to operate
  - —Market Risk
    - Sales impacted by ethical risk leading to interruptions at point of sale, migration conflict and risk of political disruption
    - Autonomous systems might become uncontrollable and
    - Control measures might not be effective or also done by machines due to efficiency and leading to further risk of failure

Conclusions

Globalization led to an intricate set of interactive relationships between individuals, organizations and states and to an unprecedented correlation of massive global systems causing systemic risk to increase exponential. Unprecedented global interaction possibilities have made communication more complex than ever before in history as the whole has different properties than the sum of its increasing diversified parts.

This paper in the absence of a global Artificial intelligence or roboethics framework tries to put emphasis back on decision-usefulness of the investor and develops a Taxonomy considering the transparency technology Extensible Reporting Mark-up language (XBRL). The linkage to financial stability is provided by two channels of risk capturing: physical and transition risk. The study applies a mixed-method approach. Robo advice is selected as a growing market for the application of artificial intelligence in the online portfolio management without human intervention to analyze inductively existing ethical concepts and considerations. Considering professional standards on ethics for robots' manufacturer and engineers enables to derive deductively the final AI-Ethics (Roboethics) Taxonomy.

Alongside of providing an overview of behavioral sciences with an application in the corporate domain; future research should also take a critical approach to the economic analysis of the corporation. By drawing from the historical foundations of political economy, a critical stance on behavioral sciences' use for guiding on corporate concerns could also be adopted as a heterodox spin. Behavioral Economics insights should be used for improving economic analyses to improve the accuracy and efficiency of corporate sustainability reporting. The analysis could thereby also take a heterodox economics stance in order to search for interdisciplinary improvement recommendations of the use of economics for the corporate world.

Climate risk is an increasing risk to investors due to the possible value destruction of assets. High carbon emissions incur lower risks compared to physical risks like sea-level rise, extreme weather and water shortage, which we observed in the recent summer world particularly in Europe.

Investigations should feature a broad variety of research methods and tools to conduct independent projects in a truly multi-methodological approach. Overall, all these endeavors will help gain invaluable information about the interaction of economic markets with the real-world economy with direct implications for corporate decision makers.

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