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Preface

Dear Readers,

We are pleased to present the latest issue of the Research Papers in Economics and Finance published by the Poznan University of Economics and Business Press. To create this issue, we made a considerable selection of papers. As a result, we are sharing with you only the best articles. We believe that the papers we publish add significant value to science in the field of economics and finance.

The issue opens with an empirical paper entitled **Smart public goods: A smart bench does not necessarily a make smart city in the Czech Republic** written by Kamila Turečková and Jan Nevima from Silesian University in Opava, Czechia. The authors emphasise the importance of smart public goods in urban spaces that change our perception of place. Their research found that the majority of Czech residents are not familiar with innovative public goods and do not use them regardless of age. The authors recommend more promotion of these solutions to raise public awareness. A threat to the proper development of smart benches is their use by the homeless as well as drug or alcohol addicts.

The second paper entitled **The definition and taxonomy of collaborative housing as bottom-up and community-based forms of meeting housing needs in Poland** has been written by Zuzanna Rataj from the Poznan University of Economics and Business, Poland. In this paper the author emphasises that the key features of collaborative housing are: dwellers' participation in the costs of construction and design, extensive shared areas fostering social integration as well as democratisation of housing stock management through a non-hierarchical structure. According to the author, collaborative housing in Poland is mainly based on its narrower form, i.e. cohousing realised in housing cooperatives.

The third paper opens the second part of the issue and moves us to the discipline of finance. The paper entitled **The weak-form efficiency of cryptocurrencies** has been written by Jacek Karasiński from the University of Warsaw, Poland. The author examines the weak-form efficiency of 24 most capitalised cryptocurren-

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cies. According to his research, the cryptocurrencies under analysis were efficient most of the time, however, their efficiency turned out to be time-varying, which validates the adaptive market hypothesis. The author did not find any evidence for the impact of the COVID-19 pandemic outbreak and the Russian invasion of Ukraine on the weak-form efficiency of the examined cryptocurrencies.

The fourth paper entitled **Currency rate of the Cycle of Money** has been written by Constantinos Challoumis from the National and Kapodistrian University of Athens in Greece. According to the author, the current inflation is the result not only of rising prices but also of a mismatch between price growth and productivity. The author argues that inflation leads to a reduction in the money cycle, which is also reflected in the exchange rate, as it is also reduced. Small and medium-sized enterprises are a major part of any economy, and according to the theory of the money cycle, they should have lower taxes than larger companies that replace their operations.

The fifth paper entitled **Market beta coefficient and enterprise risk management: A literature review** has been written by Mike Skorupski, an independent researcher with US entrepreneurial experience. The author explores the relationship between the market beta coefficient (commonly utilised in the Capital Asset Pricing Model) and Enterprise Risk Management (ERM), with timing and focus being crucial elements of an effective ERM system. According to the author, those who can respond fastest with correct measures or countermeasures will mitigate or exploit those circumstances and preserve or enhance business value. The author identifies gaps in the literature on a specific cause-and-effect relationship between ERM and the market beta coefficient.

Last but not least, the final paper takes us into the field of sports economics. The article entitled **Does stock market take into consideration football players' injuries?** has been written by Mrhari El Mehdi and Hassouni Mohamed from the Ibn Tofail University in Morocco. The authors examine the consequences of football players' injuries to the market returns of six European clubs: Ajax, Borussia Dortmund, Manchester United, Olympique Lyonnais, Benfica and Juventus. They prove that the sensitivity of stock prices of the above-mentioned football clubs to the injuries of their football players is very low. According to the authors, injury date is statistically significant, whereas injury duration, player status and COVID-19 are insignificant variables.

Yours faithfully,

Piotr Lis
Editor-in-Chief

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Smart public goods: A smart bench does not necessarily make a smart city in the Czech Republic

Kamila Turečková[1] **Jan Nevima**[2]

Abstract

Our paper summarises the results of a study conducted at the turn of 2021 and 2022 on the awareness of the existence of smart benches in the public space of Czech cities and municipalities. Smart benches represent one of a number of smart features that are implemented as part of the practical application of the smart city concept into the real environment of these municipalities. As our research has shown, the experience and awareness of smart public goods, specifically Smart benches, is currently at a rather low level among the public in the Czech Republic. This finding may trigger a discussion on their public justification in the context of their acquisition costs, but also, on the other hand, accentuate the need for their greater promotion.

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Keywords

- smart city
- smart public goods
- smart bench
- Czech Republic

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Introduction

Awareness of the nature of public goods has its origins in the founders of classical political economy such as David Hume, Adam Smith or John Stuart Mill. Contemporary economic thinking is aware of the existence of goods that do not bring any profit, but are necessary for the life of civil society, the development of the economy and the support of the social system (Varadzin, 2016). The systematic investigation of public goods on the basis of contemporary standard economics is associated with the name of P. A. Samuelson, who relates two key properties to public goods, i.e. rivalry and excludability (Samuelson & Nordhaus, 2010). Thus, public goods, both tangible and intangible in nature, are now traditionally, and in the context of economic theory, characterised by irreducibility of consumption and non-excludability from consumption, which is complemented by the zero marginal cost condition (Buchholz & Sandler, 2021; Mankiw, 1999). Given the objective limits of these strict "pure public goods" conditions, public goods have been further categorised into mixed or club goods (see Sandler, 1998; Varadzin, 2017). In practice, then, varying degrees of excludability and rivalry apply to public goods. In our conception, we thus define a public good as "a product or service that is available to all those who subjectively want or objectively need it, in a rational quantity immediately or in sufficient numbers over a longer time horizon" (Turečková et al., 2022). Returning to our definition of public goods, the condition of non-excludability is reflected in "available to all" and non-diminishability in "a rational amount ... or a sufficient number ..." (Turečková & Nevima, 2022). Smart public goods are then specific pure public goods that have innovative specific characteristics and functions, thus creating additional utility added value that distinguishes them from conventional public goods (Turečková et al., 2022). Common smart public goods include, for example, smart public transport stops, dimmable lighting, sensor waste containers, smart parking systems or smart benches (Alizadeh & Irajifar, 2018; Slavík, 2017; Turečková & Nevima, 2022). The latter smart public asset, the smart bench, is the object of our research, which is presented in this paper.

Smart public goods form an important part of the implication of the tangible elements of the smart city concept into the public space of cities and municipalities. The question remains whether the society in question is (currently – now) confronted with them in a desirable way and has an objective and subjective need to use their additional functions. This is what we have tried to find out on the example of smart benches by means of a questionnaire survey, and it is the conclusions of our research that are presented in this article. Thus, the political and economic justification for the acquisition of these "fashionable" public goods may have an additional financial dimension – the cost dimension, where smart benches in the Czech Republic are up to twenty times more expensive than conventional benches

(Turečková et al., 2022). Thus, we encounter here the rationality, efficiency and limits of the economy of public finances (Wildasin, 2021).

The paper is conceived in a traditional way reflecting standard scientific texts. The Introduction is followed by a chapter on the definition of smart public goods, which has been missing in the scholarly sources so far. This notion of smart public goods is the authors' own and is based on the concept of the smart city. The object of the research, the smart bench, is also characterised. This is followed by the Methodology and Data, in which the methods used are presented, their justification in relation to the fulfilment of the stated objective, including a description of the data sources used in the text. The questionnaire survey is presented in more detail. The fourth part is fully subordinated to the evaluation of the questionnaire survey in order to clarify the attitudes and knowledge of the respondents towards the existence of smart benches in the public space of Czech cities and municipalities. The last section, Conclusion and Discussion, summarises the most important information presented in this paper, including a discussion reflecting the findings.

1. Smart public goods and smart bench

The topic of "smart public good(s)" has not been addressed before in the context of its definition. Our approach to defining smart public good(s) is thus based a priori on the concept of smart city, based on the logical and factual link between the public good and the public sector (municipality or city) that provides or finances the public good(s), reflecting the changes brought about by the fourth industrial revolution (for more see for example Brynjolfsson & McAffee, 2014; Chauhan et al., 2021; Ross & Maynard, 2021; Skobelev & Borovik, 2017) and the transformation of society (Society 4.0) and its demands, attitudes and needs (Kamensky, 2017; Mazali, 2018).

The concept of the smart city started to develop in the late 1980s (Anthopoulos & Vakali, 2012), but it was first described professionally only in 1998 (Mahizhnan, 1999; Van Bastelaer, 1998). A smart city can be defined as a city in which all sectors (public, private and non-profit) are actively connected and implement actions and activities to positively influence the quality of urban life (Manville et al., 2014). Such a city is technological, interconnected, sustainable, convenient, active and safe (Sansaverino et al., 2014). The smart city concept integrates elements of the concepts of smart and innovative cities, circular economy, sharing economy, Industry 4.0 (more also Angelidou, 2014; Caragliu et al., 2011; Dominici, 2012; Kourtit & Nijkamp, 2012; Kumar, 2017; Lee et al., 2014; Lom et al., 2016) and the concept of sustainable development (MacGregor Pelikánová et al., 2021;

Turečková & Nevima, 2018), whose underlying purpose is social responsibility (Pakšiová, 2016) with the aim of deepening the well-being and satisfaction of citizens while preserving cultural, historical and social traditions and ties (Turečková & Nevima, 2019) and the concept of resilience, e.g. in the context of economic, climatic, technological, security, health and migration risks (Vaňová, 2021), with the aim of ensuring the competitiveness of the city itself (Borseková et al., 2017). A smart city should provide better and higher quality services for its residents and visitors, a better environment, a more modern industry based on social and environmental responsibility that is also more citizen-friendly, smarter infrastructure, open local government, a dynamic, sustainable and innovative economy based on more efficient allocation and effective use of resources (Manville et al., 2014). Residents' satisfaction with life should increase with the quality of life, which in turn should lead to the competitiveness of the city in a globalising environment, also due to the high productivity of manufacturing factors and their compatibility and flexibility. A tangible reference to a functioning smart city concept is the offer of "Smart" public goods that are available in the public space of a smart city.

Reflecting on the smart city concept described above, attaching the term "smart" to any word will emphasise the thoughtful and innovative approach that is generally characterised by the use of highly sophisticated analytical methods, processes, communications and techniques for designing goals, procedures and planning, and applies to the entire field of transferring smart solutions into tangible and intangible innovations (Angelidou, 2014; Borseková et al., 2018). In the context of public goods, a smart good will be considered as one that, beyond its traditional and generally expected function, offers "something additional" that is reflected in technological and technical innovation, offers added value in terms of ecology, sustainability or utility, and/or has characteristics that promote the creation of additional positive externalities. In other words, these smart public goods have specific characteristics and utility-user functions, thus creating additional added value that distinguishes them from conventional public goods. Thus, the adjective smart in the context of public goods refers to the fact that the product or service has an additional – new – dimension that adds to the existing public good with "additional externalities, innovative and functional aspects offered and consumed in a responsible way and with a positive impact on society". By combining the above, smart public goods contribute to the quality of life of residents while increasing the satisfaction of non-residents and visitors (Turečková et al., 2022).

Based on the above, and in combination with our definition of public goods, we then define smart public goods as goods "that are available to all who subjectively want or objectively need them, in reasonable quantities immediately or in sufficient quantities over a longer time horizon, and which have (compared to standard public goods) additional externalities, innovative and functional aspects offered and consumed in a responsible manner and with a positive impact

on society" (Turečková & Nevima, 2022). We are not able to critically confront this conception of smart public goods with other definitions because, as already mentioned, we have not found any other specific economic definition of smart public goods. Let us add that smart public goods and their implementation in cities and municipalities are not conditioned by the application of the smart city concept in the respective municipality, i.e. even municipalities that do not label themselves as smart cities can have smart public goods available in their public spaces. In the context of smart public goods, we have chosen smart benches as the object of our research.

Smart public benches differ from the standard ones (see Fig. 1) in additional features, renewable energy use, material, design and price. Apart from the possibility to sit down, i.e. the basic seating function, smart benches usually have innovative features such as solar panels and a battery that can charge a phone or laptop via USB, conventional power sockets, a hotspot for local Wi-Fi, are equipped with LED lighting (dimmable and motion-sensitive), can include a small weather station (measuring temperature, humidity, air pressure, etc.), a station for recording the noise level, specific sounds (gunshots, breaking glass, calls for help and other) or the concentration of airborne dust or CO_2. They may also have sensors to measure the use of public space and the number of people, built-in LCDs for

Figure 1. Two smart public benches in Prague and "standard" benches in the Czech Republic

Source: smartprague.eu; lupa.cz; own; own (clockwise).

advertising or other information (e.g. via QR codes), and may include bike racks for cyclists, air compressors or chargers to recharge them. Some benches also have heat-regulated seats or a wireless charging system.

The smart benches are made energy-independent through built-in solar panels and batteries that enable them to operate even on days without sunshine; they are made of durable materials, easy to maintain, environmentally friendly, fulfilling the principles of social responsibility, supporting the local design character and reflecting the urban aspects of the metropolis. It is often stated that smart benches are a 100% self-contained system that operates 24/7 in all weather conditions and situations. As a matter of interest, let us add that prices of smart benches range from 100 thousand CZK (4,000 EUR) upwards (the usual price is about 200 thousand CZK, i.e. 8,000 EUR). The price of standard benches ranges between 5,000–10,000 CZK (200–400 EUR) (Turečková et al., 2022).

2. Methodology and data

The theoretical part is based on the synergy and synthesis of scientific knowledge from the research of expert sources on the issue of public goods, which are inductively combined with knowledge related to the concept of the smart city in order to innovatively define the concept of "smart public goods". This part is complemented by primary research carried out in the form of a questionnaire survey and a final summary, which is again inductive in nature with the aim of generalising the findings from the analysis of the questionnaires toward finding answers to the general experience of respondents with smart benches in the public space of Czech municipalities. The key for us in the implementation of the questionnaire survey was to "look" at the existence of these benches also from the perspective of rationality, functionality and effectiveness. In the introductory, theoretical part, the method of description is traditionally used, while in the analytical part, it is mainly the methods of analysis, comparison, synthesis and induction. Let us add that the number of publications and studies on smart public goods is still very limited, and we will therefore draw mainly on our own scientific experience in this area, which is based on our published outputs, see Turečková et al., 2022; Turečková and Nevima, 2022. The research is based on the confirmation of established hypotheses, but the main research question is the following: "What is the awareness of smart benches among the inhabitants of the Czech Republic?"

The survey was conducted online via Google Forms between November 2021 and April 2022 and was primarily addressed to university students in the Czech Republic and their family members. The method of online distribution and the pri-

mary choice of the respondents (university students) was deliberate, as it is proven that young people are the most knowledgeable about modern technologies, smart products and innovative features and naturally seek these goods (Wahler & Tully, 1991). A total of 390 respondents completed the questionnaire, with 246 young people aged 19–25. It should be added that the questionnaire contained a total of 10 questions, one of which was completely open-ended, and for three questions the respondents had the opportunity to add their opinion under the answer "other". In these cases, however, the respondents did not answer or did not give their opinion (except for 4 people whose answers are not objectively relevant). There was only one identification question and it concerned the age of the respondents. The dataset of the selected responses to the survey is available in absolute and relative terms in the Appendix.

3. Does the Czech public know smart benches?

According to the results of our research, 52% of Czechs are currently unfamiliar with smart benches, i.e. they have never encountered this term and before the research, they did not know what a smart bench is and in what additional features it differs from a conventional bench. In this context, it is interesting to note that even respondents under the age of 25, who make up 67% of the total number of respondents (260 people), are not familiar with smart benches in the same percentage (136 people; 52%). The familiarity with smart benches is also not significantly better among respondents with a higher age limit, where the result is only 1–2% more positive (see Figure 2 or the data in Appendix).

The questionnaire survey showed that only 48 respondents, i.e. 12%, actually used the smart bench, most often for recharging mobile devices (51%) and for connecting to Wi-Fi or downloading data (32%). If we analyse the functions used according to the age categorisation of the respondents, then people over 40 years of age (76 people) practically did not use the functions at all (only 2 people recharged their mobile devices). This shows that the additional functions are actually used by younger people under 40 years of age. 31% of the users were completely satisfied with the additional functions of the smart benches, 47% of them had minor objections to the additional functions and 22% of them condemned the functionality of the smart benches.

The time spent using the smart bench features was generally minimal or nonexistent. 91% of the respondents (353 people) had never used the features, 29 people (7%) had used them for less than 15 minutes and only 8 respondents had used the smart bench features for about an hour. Similarly, the question on the number

of times the smart bench had been used by respondents can be evaluated. 88% of them (342 persons) stated that they had never used it (i.e. in layman's terms, they never sat on it), 5% of the respondents had used it once, 6% had used it a maximum of five times and only 2 persons had used it repeatedly, more than 6 times. More frequent use of smart benches is widespread among the younger generation of people under 25 years of age. 18 of them (i.e. 5%) have used the smart bench

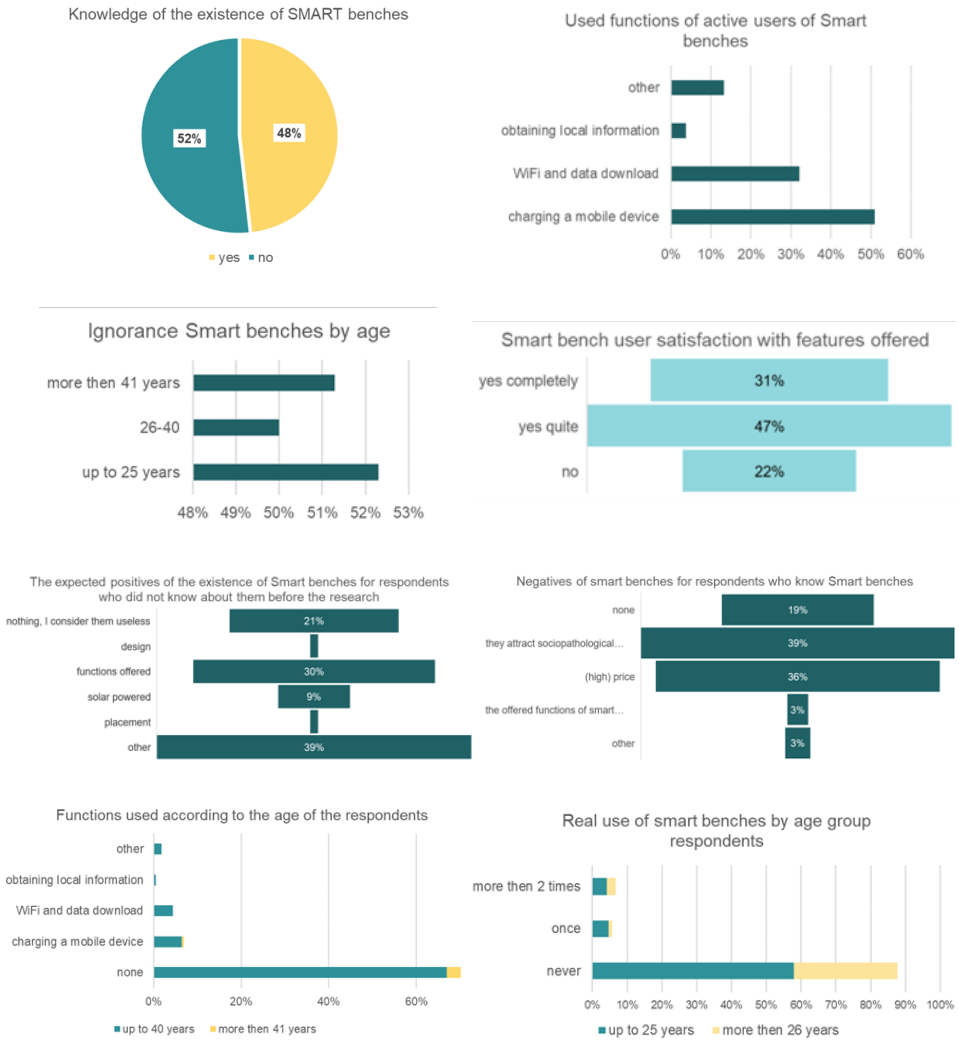

Figure 2. Selected answers to a questionnaire survey on the use of smart benches in the Czech Republic

Source: own study.

once, while only 4 respondents over 25 have used it. Furthermore, 16 persons under 25 and 10 persons over 25 used the bench repeatedly.

The last presented conclusions from the questionnaire survey concern the perceived positives and negatives associated with the existence of smart benches. The positives of smart benches include mainly the functions offered (48%) and solar power (17%). 18% of the respondents (61 persons) do not perceive any positives of smart benches at all and consider them as a completely unnecessary element of public space. The situation is slightly different if we look at the answers of the respondents who did not know about smart benches before this survey. In this group of respondents, 21% considered them unnecessary, 30% appreciated the features offered, solar power was addressed by 9% and 39% mentioned "others" without further specification. This particular answer refers to the actual ignorance of the respondents towards smart benches. As for the perceived negatives, these are most closely tied (37%, 146 persons) to sociopathological phenomena (homeless people, alcoholics, drug addicts, etc.) that are concentrated around or naturally seek out smart benches. This is also associated with more disorder and vandalism. The second most accentuated negative is the high cost, which is perceived negatively by 27% of the respondents. 69 respondents (18%) see nothing wrong with smart benches, 12% of people mentioned "others", and 22 respondents (6%) are concerned about their non-functionality. The respondents who were already familiar with smart benches before the survey were more specific on this question. In this group of 188 persons, 39% were concerned about the effects associated with sociopathological phenomena, 36% disliked the high price and 19% of the respondents chose no negatives. Only 6% gave a different answer.

The results of the 2021–2022 questionnaire survey point to the fact that citizens in the Czech Republic are largely unfamiliar with smart benches (52%), 88% have never used them and 86% have not used their functions. In general, they consider the integrated additional functions to be the biggest advantage of smart benches and, on the contrary, they are aware that smart benches are (potentially) a place of concentration of sociopathological phenomena, they attract more vandals and there is more clutter around them. More than a quarter of the respondents are bothered by their relatively high price. An interesting, and surprising finding from the research conducted is that ignorance of the existence of smart benches is not related to the age of the respondents.

Conclusion and discussion

The presented paper focused on smart public goods, the use of which should enhance the user experience by combining a greater number of otherwise sepa-

rate functions or by being environmentally friendly. These smart public goods and their provision should be the backbone of the smart city concept, which, however, must be constrained by the requirement for cost-effectiveness in their acquisition and the public need to use these public goods. The definition of the term smart public goods is quite new and innovative, and our concept has a reference to the smart city concept.

The aim of the paper was to present the results of a questionnaire survey to determine the attitudes and experiences of respondents towards smart benches, which are now gradually "settling" in the public space of cities and municipalities across the Czech Republic, and which are significantly more expensive than traditional benches. Is it therefore in the public interest to acquire them? In response to the evaluation of our research, we must conclude that at present it is rather not. The citizens of the Czech Republic to a greater extent do not know them at all (52%) and do not use them (88%), regardless of age. Better promotion, media coverage and information would be beneficial to increase awareness of smart benches. A real and potential problem is the interest in these smart benches from homeless people, drug addicts or alcoholics, for whom the additional functions of smart benches are more attractive. Smart benches are nowadays more of a fashionable thing, which in the future seems (from our point of view) rather uncertain due to technological innovations, which are reflected e.g. in technical parameters of mobile devices (battery life) or general availability of public Wi-Fi. Thus, these most valued functions of smart benches (mobile device charging, Wi-Fi usage and data downloading) will face new innovative challenges in the future.

However, let us add that the opinion presented by us about the temporary unpreparedness of the inhabitants of the Czech Republic to fully use the functions of smart benches is based on research, which is limited by the number and structure of respondents (see Appendix).

It is also proposed to integrate smart benches into "smart kiosks" (e.g. in the form of roofed buildings), which will combine other smart elements – smart information platforms and boards, lighting and heating, contactless charging, waste bins, various sensors, etc., e.g. in combination with public transport stops.

The presented conclusions from the conducted research could be an argument for strengthening communication between public sector institutions and citizens in terms of awareness of the implementation of changes within the smart city concept and the setting of urban marketing in terms of the promotion of innovative elements implemented in the public space of cities and municipalities.

Since the topic of smart public goods or smart bench research is not supported by other publications, critical discussion and confrontation with other publications are not possible. It would certainly be interesting to carry out similar research in countries with a deeper implementation of the smart city concept into the functioning of the public sector, where the experience with smart elements is

greater, or to make a correlation between the practical implementation of smart city activities and citizens' attitudes towards smart public goods in general or on a specific level, possibly across regions or countries. Additionally, objective assessment of the effectiveness of the acquisition and maintenance of a smart bench on the background of cost-benefit analysis would be more than interesting from the perspective of the economy of public finances.

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Appendix

Data sources

	Question	Absolute and relative number of responses (%)	
1	Age of respondents		
	• up to 18 years old	14	4
	• 19–25 years old	246	63
	• 26–40 years old	52	13
	• 41–65 years old	60	15
	• more than 65 years old	18	5
2	Knowledge of the existence of smart benches		
	• yes	188	48
	• no	202	52
3	Real use of smart benches by respondents		
	• never	342	88
	• once	22	5
	• 2–5 times	24	6
	• more than 6 times	2	1

Question		Absolute and relative number of responses (%)	
4	Time spent using the functions of the smart bench		
	• no time	353	91
	• within five minutes	14	3
	• within fifteen minutes	15	4
	• to one hour	8	2
5	Used functions of smart benches		
	• none	337	86
	• charging a mobile device	27	7
	• Wi-Fi and data download	17	4
	• obtaining local information	2	1
	• other	7	2
6	Satisfaction with the functions used		
	• yes completely	15	4
	• yes quite	23	6
	• no	11	3
	• functions were not used	341	87
7	Perceived pros of smart benches		
	• nothing, I consider them useless	61	18
	• design	10	3
	• functions offered	171	48
	• solar powered	62	17
	• placement	54	15
	• other	32	9
8	Perceived negatives associated with smart benches		
	• none	69	18
	• they attract sociopath logical phenomena, face vandalism more often and there is a bigger mess around them	146	37
	• (high) price	105	27
	• the offered functions of • smart benches do not work	22	6
	• other	48	12

Source: own questionnaire research, *n* = 390.

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The definition and taxonomy of collaborative housing as bottom-up and community-based forms of meeting housing needs in Poland

Zuzanna Rataj[1]

Abstract

The concept of collaborative housing emerged in Poland less than a decade ago. From the historical perspective, living in a community has a long tradition. In Poland, the first projects operating similarly to collaborative housing initiatives emerged right after World War I, when destroyed cities experienced scarcity of flats and houses. Currently, the form and conditions to be met by projects in order to be classified into collaborative housing as understood nowadays are changing. The concept is based on collaborative housing projects successfully operating in the countries of Western Europe. In Poland, only few such investments have been established (Nowe Żerniki, Kooperatywa Mieszkaniowa Pomorze and Kooperatywa Mieszkaniowa Konstancin – this project is constructed with support of Habitat for Humanity Poland). In the face of the ongoing socio-economic changes, however, they might become an interesting alternative to commercial housing construction. The aim of this article is to summarise the current knowledge on collaborative housing, including its definition and taxonomy. The author conducted desk research and analysed the works of leading researchers investigating co-housing in Europe. The article takes the form of a review.

Keywords

- collaborative housing
- bottom-up housing
- community-based housing
- sharing economy
- economy and finance

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Introduction

Housing plays a vital role in the life of every person, and the right to housing has been incorporated in many international regulations (Rataj, 2018, Lis, 2008). An example of the oldest international deed recognising the right to housing among the fundamental rights is the UN Universal Declaration of Human Rights of 1948 (United Nations, n.d.). Article 25(1) of the Declaration emphasises the need to provide for adequate housing to everyone.

In Poland, this area has been dominated for years by the ownership trend. Research conducted by Rubaszek and Czerniak in 2016 in a group of 1005 adult Poles showed a low share of commercial tenancy in Poland. Over 60% of the respondents claimed that owning a home was more cost-effective than renting one and gave greater sense of freedom and independence (Rubaszek & Czerniak, 2017). Research conducted by Lis, Rataj and Suszyńska in 2021 in a group of 407 students at Polish universities confirmed the trends observed by Rubaszek and Czerniak (Lis et al., 2022). The authors noted that strong preference for ownership appears as early as in the 18–25 age group: the answer 'I prefer owning a home, regardless of any other incentives' was chosen by 46% of the respondents, while 83% of the respondents planned to buy/build their own flat or house by 2030. The socio-cultural changes observed over the last two decades affect many economic sectors, including residential housing construction. Trends such as sharing, community, democratisation, the ethical aspect of human activity, caring for sustainable development and the natural environment are all gaining on importance. Their incorporation into the area of housing has offered a chance for the development of a new[2] paradigm – collaborative housing (CH). The contemporary collaborative housing is a revived idea of an old movement. For ages, people have organised themselves together to pursue various social goals, including raising children or eating meals. Technological advancement as well as social and cultural changes have resulted in abandoning group life in favour of individualism. In the late 20th century, however, people started to discover anew the potential of community, including in the place of residence.[3]

The concept of collaborative housing is based on projects successfully operating in the countries of Western Europe. In Poland, only few such investments have

[2] In the context of international research, the contemporary form of collaborative housing is a new paradigm. The first CH-like movements, though, emerged in Poland as early as in 1970.

[3] In the literature on the subject referring to the history and sources of collaborative housing, authors discuss utopian visions of Plato or More (e.g. McCamant & Durrett, 1989; Twardoch, 2017a; Vestbro, 2000). The author of this article, however, decided to focus on the 20th century housing initiatives, as they belonged to the first actually completed investments, which also served as an inspiration for the contemporary collaborative housing.

been established so far (Nowe Żerniki, Kooperatywa Mieszkaniowa Pomorze). They might, however, become an interesting alternative to commercial housing.

The works of Polish researchers aimed at systematising the knowledge about collaborative housing are mainly based on the taxonomy proposed by A. Twardoch in 2017 (Twardoch, 2017a). The research in this area, however, has developed significantly since then. Furthermore, in March 2023, the Act of 4 November 2022 on Collaborative Housing Projects and Rules of Transferring Real Property Belonging to Municipal Housing Stock to Support Housing Investment (Journal of Laws of 2023, item 28) entered into force in Poland. In the author's opinion, systematising the definitions found in the literature on the subject will allow us to carry out research in this area, including determining the potential and limitations involved in the new forms of cohabitation, and it will additionally enable cross-country comparisons among countries.

This article aims at situating Polish collaborative housing within the domain of European research on cooperation-based housing. It is thus a summary of the current knowledge on collaborative housing, including its definition and taxonomy. The article takes the form of a review.

Literature review

Collaborative housing – definitions

The reasons for the semantic inconsistency of the term "collaborative housing" may be sought in its translations and varying interpretations. The term is often used interchangeably with the term "cohousing" which has a much narrower meaning. The efforts of Polish authors and practitioners to adapt the term "collaborative housing" to the Polish context have resulted in a variety of equivalents, such as: *kooperatywy mieszkaniowe* (~collaborative housing), *budownictwo wspólnotowe* (~community housing), *budownictwo kooperatywne* (~cooperative housing), *budownictwo partycypacyjne* (~participatory housing), *oddolne budownictwo mieszkaniowe* (~bottom-up residential housing), *współzamieszkiwanie* (~co-living) or *współdzielenie* (~sharing). Each of those equivalents embodies certain elements of the CH definition but, in the majority of cases, they convey meanings that correspond to other forms of collaborative housing, which is a narrower semantic category (see: Collaborative housing – taxonomy).

The first projects of this type appeared in the 1970s in Liverpool (Czischke et al., 2020), but the literature on the subject most often refers to Danish initiatives

from 1988. These communities are called “bofalleskskaber” in Danish, which may be translated (word for word) as “living communities”, and for which the term “cohousing” was proposed. They were a response to the limited ability to meet housing needs, isolation and impractical nature of the existing housing stock (McCamant & Durrett, 1989).

Later works in which the phenomenon of living together was discussed indicated that cohousing is a specific section of the broad area of collaborative housing. In 2010, Vestbro (2010) proposed the term “co-housing” as an umbrella term for community initiatives, and distinguished the following: cohousing, collaborative housing, collective housing, communal housing, commune and cooperative housing. Vestbro (2010) defined cohousing as a housing with common space and shared facilities, collaborative housing as housing oriented towards collaboration by residents, in collective housing he emphasised the collective organisation of services, communal housing was characterised as housing for togetherness and sense of community, commune as living without individual apartments and cooperative housing as cooperative ownership without common space or shared facilities.

In the foreign literature, CH is treated as an umbrella term that encompasses a variety of housing forms with different degrees of collective self-organisation (Czischke et al., 2020; Lang et al., 2020). Depending on the definition, various characteristics are underlined, which usually include: shared areas, non-hierarchical decision making, social interactions and activities undertaken together (Czischke et al., 2020). Other important characteristics also include the creation of private areas in addition to shared ones (Fromm, 2012; Lietaert, 2010; Marcus, 2000; Vestbro, 2000), broad participation in organisation, decision making and financial processes (Bamford & Lennon, 2008; McCamant & Durrett, 1989; Tummers, 2016). A review of the most important definitions may be found in Table 1.

In Table 1, the author refers to international definitions of collaborative housing, because this trend has been present in Europe for years and is relatively well investigated. As an effect of exchange of international experience, a working group has been established, led by Czischke, which meets at annual European Network for Housing Research (ENHR) conferences as well as numerous academic seminars for CH. However, publications on this topic in Poland are scarce and narrow in scope.

Furthermore, Table 1 also demonstrates how the definition of collaborative housing has been evolving over years, which has been impacted by the popularisation such projects as well as development of research in this area. The last definition, proposed by (Czischke et al., 2021), was discussed in detail at the ENHR conference in 2021. In the opinion of the author of this article, it is a definition which may be adapted to the Polish context. Some of its elements only start to develop in Poland, such as the environmentally-friendly approach to housing investments, but research conducted by Lis, Rataj and Suszyńska reveal that this type of approach is gaining on importance among the young generation (Lis et al., 2022).

Table 1. Review of collaborative housing definitions over the years

Source	Definition
McCamant & Durrett, 1988	Co-housing: Each household has a private living space but also shares extensive common areas with a larger group, such as a kitchen and dining room, children's playrooms, workshops, guest rooms or laundry rooms.
Fromm, 1991	Collaborative housing includes various types of housing with shared facilities.
Vestbro, 1997	Cohousing is a part of collective housing, cohousing (Danish: bofœllesskab), where a group of people initiate and plan their housing cluster collectively, and where indoor communication is not required; often with other communal facilities than a central kitchen.
Fromm, 2000	Cohousing has private dwellings and common facilities, and is planned and managed by residents. Cohousing's innovations put a greater emphasis on shared evening meals, common house use and design for social contact. A cohousing community consists of individual households with private dwellings and shared common facilities. The layout and design of the community strive to enhance social contact.
Vestbro, 2000	Collective housing is defined as housing with more communal spaces or collectively organised facilities than in conventional housing.
Fromm, 2012	Aside from autonomous housing units and the provision of shared common facilities, including – but not limited to – a kitchen, dining hall and meeting room. This housing type includes a strong social dimension. Before moving in, residents have the intention to balance the privacy of their independent households with the creation of a community in which they will participate.
Vestbro, 2010	Collaborative housing means housing with more space and services for communal use than are to be found in conventional housing. Households from several generations and relationships, who prefer to share spaces and facilities such as meals, may live in such housing.
Tummers, 2016	Contemporary co-housing is wider than the community-oriented model designed by the co-housing movement in the 1970s. Contemporary co-housing is a resident-led practice that provides a realistic and qualitative solution for highly committed citizens. Co-housing is promoted as an opportunity for more sustainable urban development, and top-down urban development may perceive co-housing groups as resilient agents of change, specifically for brownfield development and gentrification. Furthermore, co-housing is part of a wider movement looking for new practices to mediate local identity and globalisation, self-reliance and state-provision, introducing pluri-value instead of monetary-based economic models.
Lang at al., 2020	CH represents an umbrella term, less restrictive and broader than classic co-housing (Fromm, 1991; McCamant & Durrett, 1994), inclusive of many international models and variations. The term 'co-housing' or 'cohousing' is widely used to refer to different versions of the housing model that originated in Denmark in the 1960s, called bofællesskab, which was translated into English by McCamant and Durrett as 'cohousing' in the late 1980s. Over time, however, the use of this term has become conflated with other distinct forms of collective self-organised and self-managed housing. In this paper, we subscribe to the original, narrower definition of co-housing as a specific housing form, to differentiate it from other forms of collaborative housing.

Table 1 continued

Source	Definition
Czischke at al., 2021	Collaborative housing can be understood as an umbrella term that encompasses a variety of housing forms with different degrees of collective self-organisation. Central to this type of housing is the presence of a significant level of collaboration amongst (future) residents, as well as between them and external actors and/or stakeholders, with a view to realising the housing project. In this sense, the term collaboration stands for coordinated action towards a common purpose. This collaboration can take place at different stages of the project – sometimes from the conception, design and development – and may extend to the daily maintenance and management of the housing. Collaborative housing forms can vary in terms of tenure, legal and organisational characteristics. Common attributes include a high degree of social contact between the residents and the presence, to different extents, of shared goals and motives in relation to the housing project, such as ecological sustainability and social inclusion. In many cases, these values also extend to the project's external environment.

Source: own work based on referred literature.

On 1 March 2023, the Act of 4 November 2022 on Collaborative Housing Projects and Rules of Transferring Real Property Belonging to Municipal Housing Stock to Support Housing Investment (the Collaborative Housing Act) entered into force in Poland. The authors of the Collaborative Housing Act took international experience as a model. Pursuant to the Act, the goal of establishing a collaborative housing project is an investment and construction project aimed at meeting the housing needs of the members or their children, whether biological or adopted, and of their household members (Journal of Laws of 2023, item 28). The housing needs are to be satisfied generally by purchasing a plot of land and constructing a multi-family building or several single-family houses there (if the total number of dwellings is more than two), or, alternatively, by purchasing a plot of land with at least one building erected and carrying out construction works there so that after the completion of such works the said land property will have a building or buildings consisting of several residential dwellings or a single-family house or houses with no converted dwelling (if the total number of such dwellings or single-family houses with no converted dwelling is more than two). The Act also underlines the necessity for the collaborative housing project members to work together for the purpose of pursuing the residential project, so it introduces the aspect of active involvement of the future dwellers along with the joint and several liability for the obligations incurred in connection with the project.

Collaborative housing – taxonomy

One of the first authors who has dealt with the topic of contemporary collaborative housing in Poland is Twardoch (2017a). In her articles and conference lectures, she has focused on the bottom-up residential housing and its three types: small housing cooperatives, construction groups and cohousing (Twardoch, 2017b). International research, however, suggests that bottom-up residential housing is a much broader phenomenon, encompassing also other initiatives. A classification of collaborative housing proposed by (Czischke et al., 2021) reveals an abundance of bottom-up initiatives. The semantically broadest collaborative housing is divided into two large groups: community housing, the main goal of which is to live together, and collective self-provision, the aim of which is to create affordable housing by future users. Community housing encompasses three sub-groups: cohousing, eco-villages and living groups. Cohousing is one of the most popular initiatives, including in Poland. An example thereof is Kooperatywa Mieszkaniowa "Nowe Żerniki". Furthermore, cohousing also shows potential in its specific variety: senior cohousing, which allows older people to live together, share some areas and increase social interactions. Another community housing type, eco-villages, assumes living within an environmentally-friendly community. An example of such a place in Poland may be the project created by the organisation Fundacja Pomocy Wzajemnej Barka in Chudobczyce, where an eco-farm is run. The last type of community housing, the living group, means living together as a single household. In Poland, an example of this type of initiative may be squats. One of the most recognisable squats in Poland was the (now closed) squat at the Old Town Square in Poznań.

The second group, collective self-provision, includes such initiatives as: collective self-development (building groups), the goal of which is to build flats together, in Poland exemplified by Kooperatywa Mieszkaniowa Pomorze, collective self-help, aimed at remodelling uninhabited buildings, non-profit housing, housing cooperatives and community land trusts. Housing cooperatives are further divided into rental housing and ownership-based housing.

In Polish conditions, collaborative housing is mainly based on its narrower form – cohousing. The specific features defining this type of housing differ from those adopted in the international classifications. The differences are mainly due to limited common spaces, while the similarities are related to tenant participation during the investment process. Since the definition proposed by Czischke is broad, it is also worth applying it to the Polish context, which is also due to the fact that the Act on Housing Cooperatives (Journal of Laws of 2023, item 28) does not define a cooperative as such, but only the rules of cooperation between members of a housing cooperative and the rules of disposal of real estate belonging to the municipal real estate stock to support the implementation of housing investments.

Let us note that the taxonomy of collaborative housing as proposed by (Czischke et al., 2021) is an ideal type, which is to help classify new bottom-up housing projects and allow international comparative research. The social reality, however, may differ from the ideal type, so it is possible that this taxonomy will evolve further.

Findings

Collaborative housing is increasingly more often discussed by the academia, and steadily begins to find its place in the mainstream discussion as well. The definition of collaborative housing developed over years by authors investigating this topic underlines that these are housing initiatives demonstrating various degrees of sharing (space, equipment, actions) among individual households, with considerable participation of dwellers in the conceptual, planning, construction management and revival processes (Tummers, 2015; Vestbro, 2000). The key features of CH include: dwellers' participation in the costs of dwelling construction and design, infrastructure fostering social integration, and democratisation of housing stock management (Tummers, 2016). Other features that are characteristic of this type of investment include: extensive shared areas, non-hierarchical structure as well as separate sources of income of the particular households (McCamant & Durrett, 2011).

Conclusion

Collaborative housing is a broad term within which a number of other, narrower terms may be found. Depending on the goal and motivation of the future dwellers, the form of the project, or ownership type, the area of research may be narrowed to a specific section of CH. The projects pursued in Poland, despite a common name of Kooperatywa Mieszkaniowa ("collaborative housing project"), belong to different CH categories: cohousing (Kooperatywa Mieszkaniowa Nowe Żerniki) and construction group (Kooperatywa Mieszkaniowa Pomorze).

From the perspective of international comparative research, it seems interesting to explore differences in the definition and understanding (also by tenants) of the concept of collaborative housing, as well as barriers to the possibility of developing such initiatives. In addition, it would be interesting to see if historical, social and cultural conditions influence the conceptualisation of collaborative housing.

According to the authors' previous research, it is important to underline that in Poland we have limited possibility to implement collaborative housing (Lis et al., 2023). The research shows the barriers to collaborative housing in Poland from the perspective of young people. The ownership of a dwelling is still a synonym of success for young people in Poland, which shows that the concept of collaborative housing is still not broadly known or desired by young people in Poland. The above-mentioned study (Lis et al., 2023) indicates that collaborative housing in Poland is incidental, but this form of residence can nevertheless be relevant for the development of affordable housing in this country.

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The weak-form efficiency of cryptocurrencies

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Abstract

This study aimed to examine the weak-form efficiency of some of the most capitalised cryptocurrencies. The sample consisted of 24 cryptocurrencies selected out of 30 cryptocurrencies with the highest market capitalisation as of October 19, 2022. Stablecoins were not considered. The study covered the period from January 1, 2018 to August 31, 2022. The results of robust martingale difference hypothesis tests suggest that the examined cryptocurrencies were efficient most of the time. However, their efficiency turned out to be time-varying, which validates the adaptive market hypothesis. No evidence was found for the impact of the coronavirus outbreak and the Russian invasion of Ukraine on the weak-form efficiency of the examined cryptocurrencies. The differences in efficiency between the most efficient cryptocurrencies and the least efficient ones were noticeable, but not large. The results also allowed to observe some slight differences in efficiency between the cryptocurrencies with the largest market cap and cryptocurrencies with the lowest market cap. However, the differences between the two groups were too small to draw any far-reaching conclusions about a positive relationship between the market cap and efficiency. The obtained results also did not allow us to detect any trends in efficiency.

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Keywords

- efficient market hypothesis
- adaptive market hypothesis
- weak-form efficiency of cryptocurrencies
- martingale difference hypothesis
- cryptocurrency markets

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Introduction

Despite a relatively short history of cryptocurrencies, the issue of their weak-form efficiency in the sense of Fama (1970) attracted much interest from the academics. Researchers willingly verify the weak-form efficiency of cryptocurrencies that are considered speculative and high yield assets traded on online platforms, and (mostly) not in organised, law-abiding venues (Arouxet et. al., 2022). According to the weak form of the efficient market hypothesis (EMH), first proposed by Fama (1965) and Samuelson (1965), it is impossible to predict asset returns on a regular basis, as asset prices reflect all available and relevant information fully and instantaneously. A properly functioning market is believed to be informationally efficient, as under the conditions of informational efficiency market participants have equal chances (Mensi et al., 2019). Early studies devoted to the examination of the weak-form efficiency in cryptocurrency markets (e.g., Urquhart, 2016) proposed that the efficiency of different cryptocurrencies may vary and evolve over time. The inconsistent results obtained in those studies led to the adaptive market hypothesis (AMH) proposed by Lo (2004). According to Lo (2004, 2005), the efficiency of markets can change due to changing market conditions. Thus, efficiency should not be considered a stable feature of the market, as it can change over time. The foregoing studies directly addressing the AMH in cryptocurrency markets appeared to validate it (e.g. Khursheed et al., 2020; López-Martín et al., 2021; Noda, 2021).

This study aims to examine the weak-form efficiency of some of the most capitalised cryptocurrencies. Additionally, the study employs dynamic methods to weak-form efficiency testing in order to verify the AMH in cryptocurrency markets. Taking into account the occurrence of globally relevant crisis events in recent years, such as the coronavirus outbreak and the Russian invasion of Ukraine, this study also examines the impact of these events on the weak-form efficiency of cryptocurrencies. The possible change in the weak-form efficiency in the examined cryptocurrency markets directly relates to the AMH, which assumes that efficiency may change in response to such extreme events. Issue-related studies pertaining to the impact of the coronavirus outbreak on the weak-form efficiency of cryptocurrencies mostly suggest that the pandemic onset negatively affected the weak-form efficiency in cryptocurrency markets (e.g. Alvarez-Ramirez & Rodriguez, 2021; Kakinaka & Umeno, 2022; Mandaci & Cagali, 2022; Naeem et al., 2021; Usman & Nduka, 2022). Due to the recency of the Russian invasion of Ukraine, not many studies on the impact of this crisis event on the weak-form efficiency of different markets managed to be published. The existing literature suggests that the impact of the Russian invasion of Ukraine on the weak-form efficiency of markets was mostly negative; however, these studies do not pertain to cryptocurrency markets (e.g. Aslam et al., 2022; Gaio et al., 2022).

The first assumed research hypothesis states that the AMH is valid in relation to the weak-form efficiency of the examined cryptocurrencies. The second assumed research hypothesis states that most of the time the examined cryptocurrencies were efficient. The third research hypothesis states that the latest crisis events, such as the coronavirus outbreak and the Russian invasion of Ukraine, decreased the weak-form efficiency of the cryptocurrency markets examined. What is more, this study tries to find out whether there were any significant differences in efficiency between the examined cryptocurrencies, as well as whether there were any significant differences in efficiency between the cryptocurrencies featured by the largest and the lowest market caps.

In order to examine the behaviour of the weak-form efficiency of selected cryptocurrencies, the martingale difference hypothesis (MDH) was verified with the use of two robust MDH tests, namely, the automatic Portmanteau test for serial correlation proposed by Escanciano and Lobato (2009) and the wild bootstrapped automatic variance ratio test under conditional heteroskedasticity proposed by Kim (2009). With the use of the rolling window method, these tests were conducted for 24 cryptocurrencies selected out of 30 cryptocurrencies with the highest market capitalisation as of October 19, 2022. The research sample did not include stablecoins. The MDH tests were conducted for daily returns in 2-month windows with 1-month rolling. Other studies related to this issue usually applied longer windows; however, in the case of this study, the application of longer windows could disenable the observation of a possible reaction of cryptocurrency markets on crisis events. This study covers the period from January 1, 2018 to August 31, 2022. This relatively short research period, which includes just several recent years, was selected in order to examine a broad sample of cryptocurrencies.

1. Literature review

In several studies raising the issue of the weak-form efficiency of cryptocurrencies, researchers pointed out that efficiency should be examined dynamically, as it can vary over time (e.g., Chu et al., 2019; Khuntia & Pattanayak, 2018; Khursheed et al., 2020; López-Martín et al., 2021; Noda, 2021; Sensoy, 2019; Tran & Leirvik, 2020). Some of the studies directly referred to the adaptive market hypothesis (e.g. Chu et al., 2019; Khuntia & Pattanayak, 2018; Khursheed et al., 2020; Noda, 2021). According to Khuntia and Pattanayak (2018), López-Martín et al. (2021), Sensoy (2019), Tran and Leirvik (2020) and Urquhart (2016), the efficiency of cryptocurrencies may increase over time. Bundi and Wildi (2019) proposed the op-

posite. Some of the studies indicated that the cryptocurrency markets were inefficient in the entire research period (e.g. Hu et al., 2019; Palamalai et al., 2021; Yonghong et al., 2018; Zhang et al., 2018). The studies proposing the opposite results seem to be in minority (e.g. Hawaldar et al., 2019; Nadarajah & Chu, 2017). Apopo and Phiri (2021) received inconsistent results dependent on the frequency of the examined returns.

Several papers on the reaction of the weak-form efficiency of cryptocurrency markets on the coronavirus outbreak have already been published. They all seem to suggest that the weak-form efficiency of cryptocurrency markets was affected by this crisis event (Alvarez-Ramirez & Rodriguez, 2021; Arouxet et. al., 2022; Assaf et al., 2022a, 2022b; Kakinaka & Umeno, 2022; Mandaci & Cagali, 2022; Naeem et al., 2021; Usman & Nduka, 2022). Most of them directly suggest a negative impact, namely, a decrease in efficiency after the onset of the coronavirus pandemic (Alvarez-Ramirez & Rodriguez, 2021; Kakinaka & Umeno, 2022; Mandaci & Cagali, 2022; Naeem et al., 2021; Usman & Nduka, 2022). Kakinaka and Umeno (2022) propose that the negative impact was limited just to a certain short term. In the long run, the impact was insignificant. Due to the recency of the Russian invasion of Ukraine, at this time, the body of knowledge is limited to the studies on the impact of this crisis event on the weak-form efficiency of other markets, such as equity markets or energy markets. The existing literature mostly suggests a negative impact of this crisis event (Aslam et al., 2022; Gaio et al., 2022).

Hawaldar et al. (2019) examined the weak-form efficiency of Bitcoin and Litecoin in the years 2013-2017 with the use of some popular stationarity tests such as the ADF test, PP tests and KPSS test. On the basis of the results obtained, the authors suggested that the daily returns of the examined cryptocurrencies followed a random walk and they were efficient in a weak form. A similar set of tests was applied by Apopo and Phiri (2021) in the study on the weak-form efficiency of Bitcoin, Ether, Bitcoin Cash, Litecoin and Ripple. However, the researchers supplemented their study with some more advanced stationarity tests such as the DF-GLS test, Ng-Perron test, KSS test and LM test with the flexible Fourier form. The tests were conducted for daily and weekly returns in the years 2009–2019. The tests conducted for daily returns suggested the weak-form efficiency of the examined cryptocurrencies. In the case of weekly returns, the opposite was true. Urquhart (2016) examined the weak-form efficiency of Bitcoin in the years 2010-2016 with the use of a battery of randomness tests. The obtained results suggested that, when considering the entire research period, the daily returns of Bitcoin did not appear to be random. The entire research period was also divided into two even subperiods. Some tests indicated that Bitcoin was efficient in the latter part of the period. The author suggested that Bitcoin might move towards efficiency. A study by Nadarajah and Chu (2017) constitutes the discussion with the aforementioned

study by Urquhart (2016). The authors replicated it and proposed that a simple power transformation of daily returns was sufficient to satisfy the efficient market hypothesis. The authors also proposed that the transformation did not cause any loss of information.

Zhang et al. (2018) made an attempt to examine the efficiency of nine cryptocurrencies, i.e. Bitcoin, Ripple, Ether, NEM, Stellar, Litecoin, Dash, Monero and Verge, in the period between April 2013 and January 2018. The researchers applied many different tests to daily cryptocurrency returns, including the generalised multifractal detrended fluctuation analysis and multifractal detrended cross-correlation analysis. Based on the results obtained, the researchers proposed that all examined cryptocurrencies were inefficient. Yonghong et al. (2018) investigated a long-term memory in the time series of Bitcoin returns. They applied the generalised Hurst exponents to daily returns of Bitcoin in the period between December 2010 and November 2017. The researchers proposed that the long-term memory was observed and the Bitcoin market was featured by high inefficiency. Bitcoin did not become more and more efficient over time. Hu et al. (2019) examined daily returns of 31 cryptocurrencies between August 16, 2017 and January 16, 2019. The examined cryptocurrencies were selected from the top 50 cryptocurrencies considering the market cap. According to panel unit root/stationarity tests, the examined cryptocurrencies turned out to be inefficient. Palamalai et al. (2021) focused on the top ten cryptocurrencies in terms of market capitalisation as of August 5, 2019, which had been traded for more than 2 years. To examine the efficiency of the selected cryptocurrencies, the researchers applied several non-parametric tests such as the Runs test, Kolmogorov-Smirnov test and parametric tests such as unit root tests, a multiple variance ratio test and GARCH-type models. The examined research period varied across cryptocurrencies. The results of the study suggested that the examined cryptocurrencies were weak-form inefficient. In order to examine the weak-form efficiency of Bitcoin, Bundi and Wildi (2019) applied trading strategies based on moving average filters, classic time series models and non-linear neural nets. The study conducted for the period between April 2014 and January 2019 suggested that the trading performance of the applied strategies was significantly positive. The researchers proposed that Bitcoin was becoming less efficient.

Sensoy (2019) examined the weak-form efficiency of Bitcoin at the high-frequency level with the use of permutation entropy. The study was conducted in the period between January 2013 and March 2018. The results of the study suggested that Bitcoin became more efficient since the beginning of 2016. Moreover, the researcher proposed that the increase of frequency decreased efficiency. Additionally, it turned out that liquidity had a positive effect on the informational efficiency of Bitcoin. The opposite was true in the case of the effect of volatility. Tran and Leirvik (2019) proposed a method to quantify the

level of the weak-form market efficiency, that is, Adjusted Market Inefficiency Magnitude. This measure was used in their study (Tran & Leirvik, 2020) on the efficiency of the top five cryptocurrencies in terms of market cap. The authors examined daily returns of Bitcoin, Ether, Ripple, Litecoin and EOS in the period between April 2013 and February 2019. The authors proposed that the level of efficiency was highly time-varying. The cryptocurrencies turned out to be mostly inefficient, especially before 2017. However, their efficiency increased over time in the period between 2017 and 2019. López-Martín et al. (2021) aimed to examine the weak-form efficiency of Bitcoin, Litecoin, Ether, Ripple, Stellar and Monero. Daily returns from the period between August 2015 and December 2019 were tested with the use of five different tests commonly applied in studies related to this issue, including the automatic variance test of Choi and the Hurst exponent. The tests were applied in a dynamic context as well. A clear increase in efficiency over time was observed in the case of Bitcoin, Litecoin and Ether. In the case of the remaining cryptocurrencies, the efficient periods alternated with inefficient periods.

Khuntia and Pattanayak (2018) made an attempt to verify the adaptive market hypothesis in relation to the weak-form efficiency of the Bitcoin market in the period between July 2010 and December 2017. The researchers examined daily returns using the MDH tests such as the Dominguez-Lobato test and Generalized Spectral test in rolling windows. The researchers proposed that the efficiency of Bitcoin tended to evolve over time. Chu et al. (2019) aimed to examine the adaptive market hypothesis with reference to the weak-form efficiency of Bitcoin and Ether in the period between July 2017 and September 2018. The martingale difference hypothesis was verified with the use of the Dominguez-Lobato test. The test was applied to high-frequency data. The researchers proposed that their results were consistent with the AMH, as the efficiency of both examined cryptocurrencies varied over time. Khursheed et al. (2020) aimed to verify the adaptive market hypothesis in relation to the time-varying market efficiency of such cryptocurrencies as Bitcoin, Monaro, Litecoin and Steller over the research period of 2014–2018. To examine the martingale difference hypothesis, they applied the Generalized Spectral test, Dominguez-Lobato test and automatic portmanteau test. The researchers proposed that the efficiency changes were noticeable and that Bitcoin, Monaro and Litecoin had the longest periods of efficiency. Steller turned out to have the longest inefficiency periods. Noda (2021) aimed to examine the adaptive market hypothesis with reference to the weak-form efficiency of Bitcoin and Ether in the period between April 2013 and September 2019. The researcher applied the GLS-based time-varying autoregressive model to daily returns. The results of the study suggested that the efficiency of both cryptocurrencies varied over time, and over most periods, Bitcoin was more efficient compared to Ether.

2. Data and research methodology

This study examines the weak-form efficiency of 24 cryptocurrencies selected out of 30 cryptocurrencies featured by the highest market capitalisation as of October 19, 2022, according to Yahoo Finance. The selected cryptocurrencies are as follows: Bitcoin, Ether, Binance Coin, XRP, Cardano, Solana, Dogecoin, Polygon, Polkadot, TRON, HEX, Shiba Inu, Uniswap, Wrapped Bitcoin, Avalanche, Lido Staked ETH, UNUS SED LEO, Litecoin, Cosmos, Chainlink, Ether Classic, FTX Token, Stellar and Cronos. They were listed in descending order in terms of market cap. The research sample does not include stablecoins. This study covers the period from January 1, 2018 to August 31, 2022. In order to examine the weak-form efficiency, this study verifies the martingale hypothesis, according to which, the returns of cryptocurrencies should constitute martingale increments. Taking into account the stylised facts of cryptocurrency returns, the assumption that cryptocurrency returns constitute martingale increments is much more general and better suited to their distribution compared to the strict assumption stating that returns are i.i.d. with a 0 expected value (Campbell et al., 1997; Linton, 2019).

This study employs two tests for the martingale difference hypothesis (MDH), namely, the automatic Portmanteau test for serial correlation proposed by Escanciano and Lobato (2009) and the wild bootstrapped automatic variance ratio test under conditional heteroskedasticity proposed by Kim (2009). According to Charles et al. (2011), both tests constitute significant recent contributions to the group of the MDH tests. The tests were applied to daily logarithmic returns calculated for closing prices related to USD retrieved from Stooq.pl and Finance.yahoo.com.

Both MDH tests were performed for each cryptocurrency with the use of the rolling window method. This method allows to examine the behaviour of efficiency over time. The tests were conducted for two-month windows with one-month rolling, that is, the next window began one month after the beginning of the previous window. The calculations were made only if a given window had at least 80% of the maximum number of daily returns. Most studies related to this issue applied longer windows. However, the application of longer windows could disenable the observation of a possible impact of crisis events on the weak-form efficiency in cryptocurrency markets. Shorter windows should not constitute a problem, as the applied MDH tests show no size distortion in small samples. The first window stared on January 1, 2018. The last window ended on August 31, 2022. In the case of some cryptocurrencies, not all windows were examined. Markets for some cryptocurrencies were launched after January 1, 2018. In some cases, it was also due to the limitations of the applied databases.

The applied MDH tests were performed in R. The automatic Portmanteau test for serial correlation proposed by Escanciano and Lobato (2009) was applied with

the use of the function Auto.Q from the package vrtest. The wild bootstrapped automatic variance ratio test under conditional heteroskedasticity proposed by Kim (2009) was applied with the use of the function AutoBoot.test from the package vrtest. 500 wild-bootstrap iterations using a standard normal distribution were applied. Both MDH tests used a significance level of $\alpha = 0.05$.

3. Results and discussion

Table 1 presents the summary results of the MDH tests for each cryptocurrency, taking into account all windows tested in the entire research period. The results of the MDH tests are presented as the percentage of efficient windows, i.e. the percentage of windows in which the wild bootstrapped automatic variance ratio test (AVR) and the automatic Portmanteau test for serial correlation (AP) indicated the efficiency of cryptocurrencies. The table also presents the number of windows tested and some descriptive statistics pertaining to daily returns, averaged across all windows tested. The order of cryptocurrencies is related to their market cap. The order is descending, that is, Bitcoin had the highest market cap, and Cronos the lowest.

Substantial differences between mean and median daily returns do not allow to unambiguously indicate the most profitable and the least profitable cryptocurrencies. Clear differences between the mean and median suggest that the distributions of cryptocurrency returns were mostly non-normal. Thus, the randomness tests assuming the i.i.d. returns with a 0 expected value are non-applicable in the case of this study. Regarding the obtained standard deviations, cryptocurrencies such as Polygon, Shiba Inu and Solana can be considered to be the most volatile ones. On the other hand, UNUS SED LEO, Bitcoin and FTX Token can be considered as the least volatile ones.

The percentages of the efficient windows (windows in which the MDH tests indicated the efficiency) in the majority of cases were high and exceeded 90%. This suggests that most of the time, the majority of the examined cryptocurrencies remained weak-form efficient. The differences between the results of both tests do not appear to be substantial.

Figure 1 presents the percentage of windows in which the MDH tests indicated the efficiency of cryptocurrencies. However, in order to further investigate the differences in efficiency between cryptocurrency markets, the figure shows only results for four most efficient and four least efficient cryptocurrencies, taking into account the results of both MDH tests in the entire research period. Only cryptocurrencies with data beginning at least in January 2020 were considered.

Table 1. Descriptive statistics of daily returns, percentage of efficient windows and number of windows tested

No.	Cryptocurrency	Mean (%)	Median (%)	Standard deviation (%)	AVR (%)	AP (%)	Windows tested
1	Bitcoin	0.04	0.15	3.74	98	96	55
2	Ether	0.04	0.12	4.82	100	98	55
3	Binance Coin	0.21	0.08	5.33	100	96	55
4	XRP	–0.09	–0.18	5.33	95	98	55
5	Cardano	–0.01	–0.24	5.67	98	98	55
6	Solana	0.45	0.20	7.64	100	96	28
7	Dogecoin	0.13	–0.40	6.14	89	93	55
8	Polygon	0.38	0.01	7.78	97	92	39
9	Polkadot	0.06	–0.07	6.49	100	96	23
10	TRON	0.02	0.07	5.62	98	96	55
11	HEX	–0.26	0.49	7.29	100	100	2
12	Shiba Inu	0.13	–0.54	7.68	92	92	13
13	Uniswap	0.13	0.13	6.92	100	95	22
14	Wrapped Bitcoin	0.08	0.06	5.68	76	74	34
15	Avalanche	0.25	0.03	7.52	95	82	22
16	Lido Staked ETH	0.25	–0.02	5.86	100	100	2
17	UNUS SED LEO	0.12	0.09	2.67	92	89	37
18	Litecoin	–0.07	–0.07	5.13	98	96	55
19	Cosmos	0.07	–0.05	6.32	100	97	39
20	Chainlink	0.15	–0.05	6.54	96	95	55
21	Ether Classic	0.02	–0.05	5.83	95	98	55
22	FTX Token	0.26	0.31	4.49	94	94	36
23	Stellar	–0.08	–0.24	5.44	98	95	55
24	Cronos	0.07	0.25	5.40	98	88	40

Source: author's own study.

Taking into account all windows tested, Ether, Cosmos, Solana and Binance Coin turned out to be most efficient. The differences between these cryptocurrencies are not substantial, the same as the differences between the results of the two MDH tests for particular cryptocurrencies. It looks a bit different in the case of the four least efficient cryptocurrencies, i.e. Dogecoin, UNUS SED LEO, Avalanche and Wrapped Bitcoin. The differences between these cryptocurrencies are more clear. In the case of Avalanche, the difference between the results of the two MDH tests is substantial. Regarding the differences in efficiency between the two compared groups, they are noticeable, but they are not large.

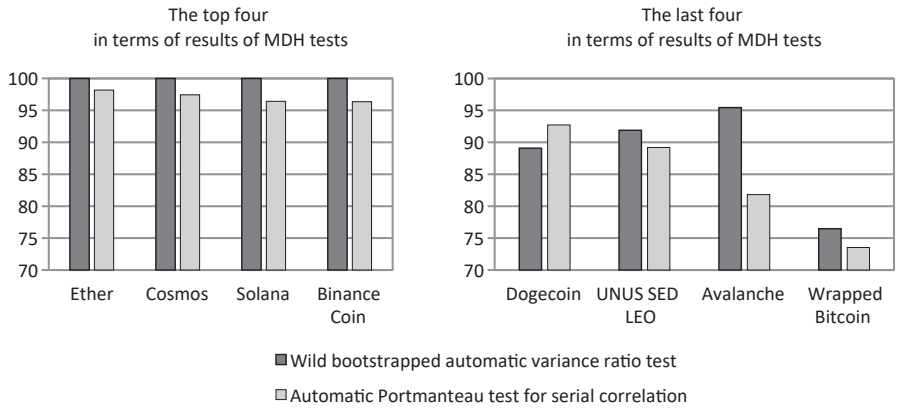

Figure 1. Percentage of efficient windows. Results only for four most efficient and four least efficient cryptocurrencies (in %)

Source: author's own study.

The presentation of data in Figure 2 is similar to the presentation of data in Figure 1. However, this time, in order to investigate possible differences in efficiency between the most and the least capitalised cryptocurrency markets, the data refer to four cryptocurrencies with the largest market capitalisation and four cryptocurrencies with the lowest market capitalisation. Some differences can be observed in the level of efficiency between the two groups. Cryptocurrencies with the largest market cap seem to be slightly more efficient compared to cryptocurrencies with the lowest market cap. However, it should be noticed that the differ-

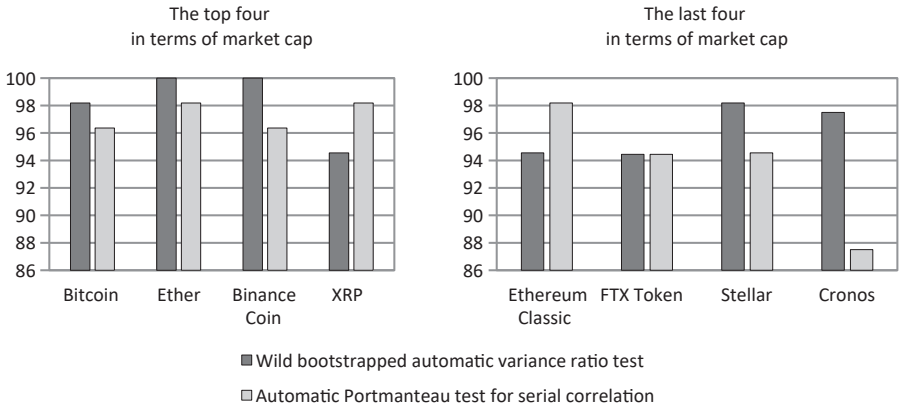

Figure 2. Percentage of efficient windows. Results only for four cryptocurrencies with largest market cap and four cryptocurrencies with lowest market cap (in %)

Source: author's own study.

ences between the two groups are too small to draw any far-reaching conclusions about the positive relation between market cap and efficiency.

Figure 3 allows us to observe the time-varying behaviour of the mean and median daily returns, as well as the standard deviation of daily returns of the examined cryptocurrencies. The statistics were averaged across all examined cryptocurrencies and windows ended in each quarter of the research period (for a clearer presentation of results). It is difficult to find any long-term trends in the performance of the cryptocurrency market. However, it is possible to distinguish several peaks and plunges. A very clear increase of risk-unadjusted returns can be observed in the 2nd quarter of 2019 and 1st quarter of 2021. Nevertheless, they were followed by severe plunges. Some of the largest decreases in risk-unadjusted returns can be observed from the 4th quarter of 2021 to 2nd quarter of 2022. This period was also related to the beginning of the Russian aggression against Ukraine. In the following quarter, the returns recovered rapidly. At the beginning of the research period, the volatility of the cryptocurrency market decreased substantially. It seemed to be at a stable level over the examined research period, except for the aforementioned 1st quarter of 2021 and the quarter that followed it, when the volatility clearly increased.

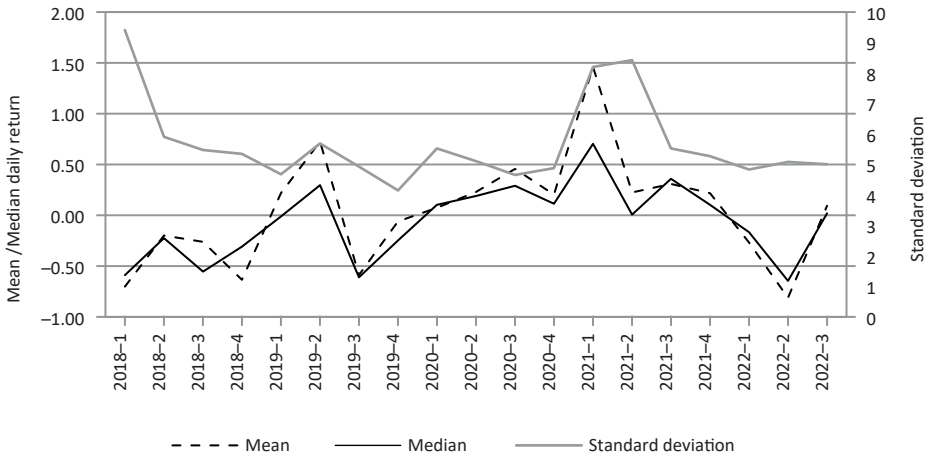

Figure 3. Descriptive statistics of daily returns averaged across all examined cryptocurrencies and windows tested in each quarter of research period (in %)

Source: author's own study.

Figure 4 shows how the efficiency of all examined cryptocurrencies behaved over particular quarters. In the majority of considered quarters, the differences between the results of both MDH tests were not substantial. However, some periods of clear divergence between the results of the MDH tests can also be observed.

For instance, the 1st quarter of 2019 and 4th quarter of 2021. The percentages of efficient windows, according to both tests, were in range between 85% and 100%. The results obtained allow us to state that the cryptocurrency markets were efficient in the great majority of cases. According to the results of this study, the efficiency was time-varying. However, it is very difficult to observe any long-term trends. In addition, no significant changes in the percentage of efficient windows could be observed in the periods related to the outbreak of the coronavirus pandemic and the Russian aggression against Ukraine.

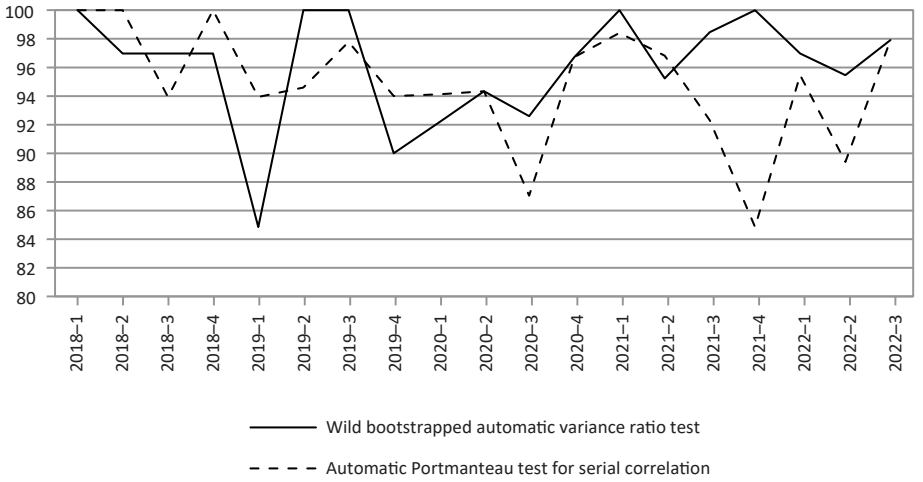

Figure 4. Percentage of efficient windows considering all examined cryptocurrencies (in %)

Source: author's own study.

In order to investigate possible differences in efficiency between the most and the least capitalised cryptocurrency markets, Figure 5 refers to the results of the MDH tests, but only for the top four and last four cryptocurrencies in terms of market cap. Cryptocurrencies with the lowest market cap suffered decreases in efficiency slightly more often. Again, the obtained results for both groups allow us to state that, in the great majority of cases, the cryptocurrency markets were efficient. In addition, the efficiency in both groups was time-varying. However, it is difficult to observe any long-term trends. In addition, no clear evidence can be found for the impact of the coronavirus pandemic and the Russian aggression against Ukraine on the weak-form efficiency of both groups.

The results of this study validate the adaptive market hypothesis, as the efficiency of the examined markets was time-varying, similarly as in the studies by Chu et al. (2019), Khuntia and Pattanayak (2018), Khursheed et al. (2020) and Noda

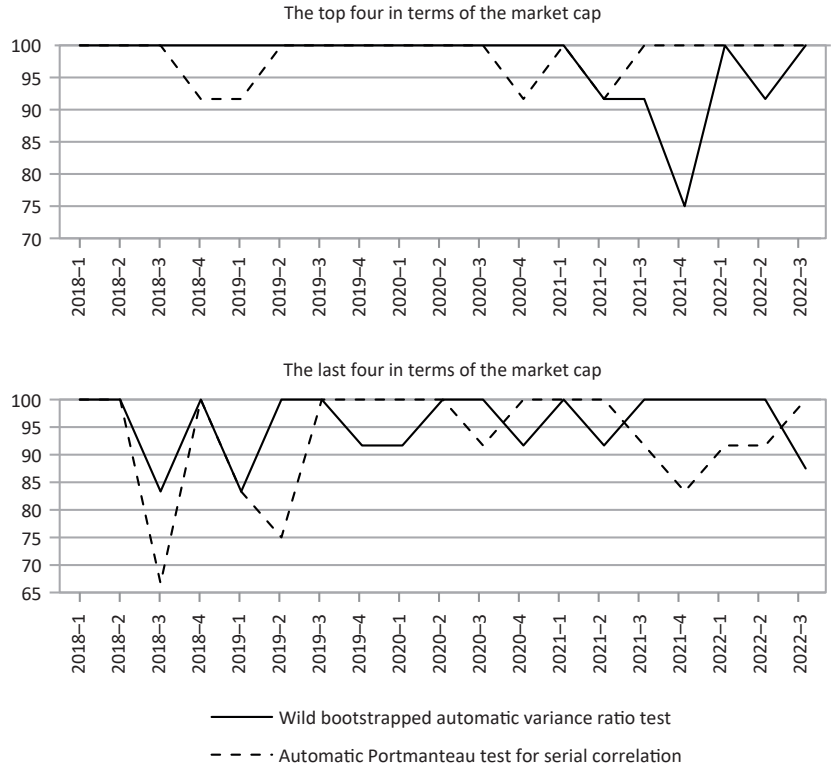

Figure 5. Percentage of efficient windows for top four and last four examined cryptocurrencies in terms of market capitalisation (in %)

Source: author's own study.

(2021). In line with the studies by Apopo and Phiri (2021), Hawaldar et al. (2019) and Nadarajah and Chu (2017), the examined cryptocurrencies turned out to be efficient most of the time. However, these results are not in line with the studies by such authors as Hu et al. (2019), Palamalai et al. (2021), Yonghong et al. (2018) and Zhang et al. (2018), according to whom, cryptocurrencies were inefficient.

The results received in this study may be associated with the results of the studies by Khuntia and Pattanayak (2018), López-Martín et al. (2021), Sensoy (2019), Tran and Leirvik (2020) and Urquhart (2016). According to these researchers, some cryptocurrencies tended to become more efficient over time. The end of their research periods was usually earlier compared to the beginning of the research period examined in this study. Thus, this study may examine the period of relatively high efficiency of cryptocurrencies. In addition, as opposed to the studies by Bundi and Wildi (2019), Khuntia and Pattanayak (2018), López-Martín et al.

(2021), Sensoy (2019) and Tran and Leirvik (2020), the obtained results did not allow to detect any trends in efficiency. However, this may result from the examination of different research periods.

Referring to the impact of the coronavirus outbreak on the weak-from efficiency of the cryptocurrency markets, this study provided no evidence of any clear reaction of the weak-from efficiency in the examined cryptocurrency markets. Thus, the results obtained in this study are not in line with most studies related to this topic (Alvarez-Ramirez & Rodriguez, 2021; Arouxet et. al., 2022; Assaf et al., 2022a, 2022b; Kakinaka & Umeno, 2022; Mandaci & Cagli, 2022; Naeem et al., 2021; Usman & Nduka, 2022). However, some similarities can be found in the study of Kakinaka and Umeno (2022) who examined hourly returns and found no significant impact of the coronavirus onset in the long run. It is also worth noting that many related studies focused on shorter intervals than daily (Arouxet et. al., 2022; Assaf et al., 2022a; Kakinaka & Umeno, 2022; Naeem et al., 2021). Thus, they could observe some short-term intra-day changes in efficiency. In addition, this study found no evidence for a clear impact of the recent Russian invasion of Ukraine on the weak-from efficiency in the examined cryptocurrency markets. These conclusions are not in line with a few other studies on other markets (Aslam et al., 2022; Gaio et al., 2022).

Conclusions

This study aimed to examine the weak-form efficiency of some of the most capitalised cryptocurrencies. The results of this study suggest that the examined cryptocurrencies were efficient most of the time. However, their efficiency turned out to be time-varying, which validates the AMH. The weak-form efficiency of the examined cryptocurrencies seemed to be immune to the latest crisis events, such as the coronavirus outbreak and the Russian invasion of Ukraine. The results obtained suggest that Ether, Cosmos, Solana and Binance Coin were the most frequently efficient cryptocurrencies. On the other hand, Dogecoin, UNUS SED LEO, Avalanche and Wrapped Bitcoin were the least frequently efficient ones. The differences in efficiency between the most efficient cryptocurrencies and the least efficient ones were noticeable, but not large. The results also allowed us to observe slight differences in efficiency between cryptocurrencies with the largest market cap and cryptocurrencies with the lowest market cap. However, the differences between the two groups were too small to draw any far-reaching conclusions about a positive relation between market cap and efficiency. The obtained results also did not allow us to detect any trends in efficiency.

The research period examined in this study covers just several recent years. It is caused by the intention to include a relatively large sample of cryptocurrencies. The selection of the research period could have affected the obtained results, as some related studies that covered earlier periods suggested the increase in efficiency of some cryptocurrencies. This may justify obtaining a relatively high rate of efficient windows. Future studies may implement other robust methods of efficiency evaluation. In addition, they may also examine data of higher frequencies. Further investigations related to the efficiency of cryptocurrencies should consider finding factors of efficiency and important variables which are correlated with it.

This study contributes to the development of a body of knowledge pertaining to the adaptive market hypothesis in relation to weak-form efficiency of the cryptocurrency market. It may be valuable to regulators and market participants who want to learn about the recent behaviour of efficiency on the cryptocurrency markets. The weak-form efficiency of a numerous sample of cryptocurrencies was examined with the use of robust MDH tests in several recent years, in which the efficiency could have been affected by some crisis events such as the coronavirus outbreak and the Russian aggression against Ukraine.

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Currency rate and the Cycle of Money theory

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Abstract

This paper explains the fundamental concepts of the Cycle of Money theory. It examines an economy as a whole; therefore, the structure of the economy and the distribution of money in the economy are evaluated in terms of how they interact. The objective of this paper is to show the relationship between the Cycle of Money theory, the exchange rate, and inflation. Inflation is the result not only of rising prices but also of a mismatch between price growth and productivity. Productivity in the Cycle of Money theory refers to the distribution and reuse of money in an economy. The depiction of an economy is made through its function and structure, something that is reflected in the money cycle, i.e. problems in the functioning of the economy appear in the structure of the economy and vice versa – productivity and the structure of the economy are two sides of the same coin, which means that they are inextricably linked to each other. Inflation leads to a reduction in the money cycle, which is also reflected in the reduced exchange rate. In deflation, the previous pattern is the same. In the case of Domism, meaning that the economy has appropriate function and structure, it is plausible to decrease inflation and increase the currency rate together with productivity.

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Keywords

- currency rate
- exchange rate
- inflation
- the Cycle of Money Theory

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Introduction

The paper evaluates the economic functionality of an economy through the distribution and reuse of money, allowing us to comprehend the structure of each economy. The final scope is to define the affiliation between the currency rate and the cycle of money from the view of the money that is in an economy (i.e. how it functions in it). In many circumstances, a sum of money is transferred from one economy to another through external banks or other economies. The basic perspective during the money cycle is that in most cases large, international corporations save their money in external banks and financial havens.

Therefore, according to this theory, the tax authorities should impose an additional tax on such a type of corporation to reduce losses in the economy. In addition, smaller companies and freelancers should be taxed at lower tax rates. This way, it would be possible to increase the dynamics of the economy (Challoumis, 2018b, 2019a, 2019b, 2019e, 2021a, 2021f). Factories and know-how services are exceptional situations of the economy since they belong to those circumstances where taxes improve the economy's quality (Adhikari et al., 2006; AICPA, 2017; Al-Ubaydli et al., 2021; Altman, 2008; Amanor-Boadu et al., 2014; Anderson et al., 2020; Andriansyah et al., 2019; Androniceanu et al., 2019; Anguera-Torrell et al., 2020). Factories and huge know-how firms improve the money cycle if they do not replace the activities of small and medium-sized businesses and self-employed people. Education and healthcare systems improve the quality of the economy, generally improving the whole economy (Anderson et al., 2020; Evans et al., 1999; Hausman et al., 2016; Jia et al., 2020; Kiktenko, 2020; Schram, 2018). This study aims to demonstrate that inflation is caused not only by rising prices but also by a mismatch between price growth and productivity growth. In the theory of the money cycle, productivity refers to the distribution and reuse of money in an economy. The depiction of an economy is made through its function and structure, something that is reflected in the money cycle, i.e. problems in the functioning of the economy appear in the structure of the economy and vice versa – productivity and the structure of the economy are two sides of the same coin, i.e. they are inextricably linked to each other. Inflation reduces the money cycle, which is reflected by lowering of the exchange rate by.

Some of the theses of the Cycle of Money theory (Challoumis, 2018c, 2022b):

1. The credibility of a tax system affects its stability by influencing business behavior in general. Companies engaged in controlled transactions are encouraged to do so, i.e. an unreliable tax system favors companies engaged in controlled transactions to avoid being taxed. In contrast, companies that are consistent and operate without making controlled transactions avoid being fully taxed.

2. GDP includes the value of the final product without the added value of each stage, but never of the intermediate stages. GDP is the total added value of production of all enterprises in the economy.
3. GDP does not include the value of production related to own consumption because it is not traded. However, this is addressed by CM, since saving is taken into account not only in the context of investment but also in all forms of consumption.
4. GDP is a quantitative indicator and not a qualitative one. The Cycle of Money theory makes a breakthrough in this context because it shows the economy as a single economic body that reflects society, i.e. it concerns first of all the qualitative elements shown by the money cycle index.
5. GDP ignores the composition and distribution of output. Small and medium-sized enterprises should have lower taxes than large ones. Larger companies should not replace activities that smaller companies can do. This strengthens the local and domestic banking system and does not save money outside a country's economy. Large corporations usually save money in tax havens because of super-profits, reducing the liquidity of an economy.
6. GDP does not include the value of goods in the shadow economy. The Cycle of Money theory solves this issue because tax evasion and black money, as long as they do not escape the economy, do not cause any damage to the economy. It is simply postponed in time as at some point it will be taxed either by direct or indirect taxes. At the same time, black money related to tax evasion is cash that will be reused without reducing the dynamics of an economy. On the contrary, tax avoidance concerns large companies, which usually save their money in tax havens reducing the liquidity of an economy.
7. The Cycle of Money theory is an evolution of GDP, as it is the marginal state of GDP, which reveals that an economic system is like a body, with money to be its blood.
8. The Cycle of Money theory reduces inflation because there is no need to raise prices to address structural problems of an economy, thus relieving the economy of the need for additional liquidity through currency devaluation. In addition to the structural problems faced by the theory in question, it also affects the stability of an economy by ridding it of inflationary problems.
9. The implementation of the money cycle enables improving the structure of the economy, which is reflected in the distribution and reuse of money in an economy.
10. It is found that tax avoidance mainly causes economic damage to the distribution of money, while tax evasion mainly delays the distribution of money.

1. Literature review

The trustworthiness of a tax system affects its stability, which influences corporate conduct in general. If there is no trustworthiness, corporations engaged in controlled transactions are incentivized to engage in this activity, i.e. an untrustworthy tax system encourages companies engaging in controlled transactions to avoid being taxed. On the other hand, companies that are consistent and do not engage in controlled transactions are completely taxed in this case (Figure 1).

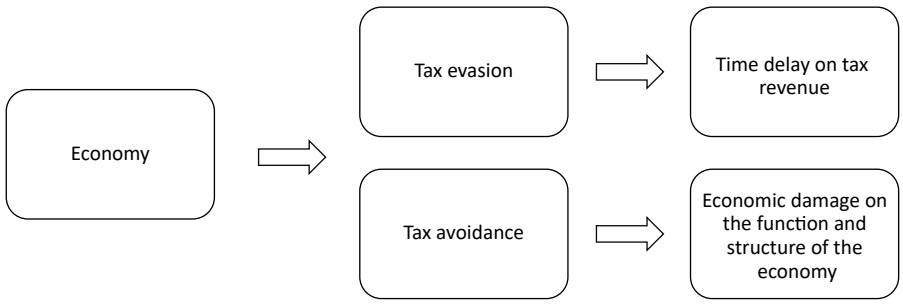

Figure 1. Tax evasion and avoidance in the Cycle of Money theory

Source: author's own elaboration.

The concept of the money cycle indicates that taxes return to the economy in the case of education and the health care system (these are exceptions to the dominant approach of the money cycle where taxes do not support the economy). However, the consensus is that tax authorities should keep taxes as low as possible (Challoumis, 2018a, 2019c, 2019d, 2020b, 2020c, 2021b, 2022b). The government should protect small and medium-sized businesses with exceptionally low taxes while imposing higher taxes on larger corporations. However, some huge and international enterprises should pay lower tax rates because their operations are not a substitute for those of smaller businesses. Large enterprises with technological know-how are examples of this category.

The general international Money Cycle Index (0.5) represents the global average. Countries whose index amounts to 0.5 or above have an adequate money allocation in their financial system (Challoumis, 2018c, 2018e, 2019f, 2019g, 2021c, 2021g, 2021h). The authorities by lowering taxes on small and medium-sized enterprises achieve the best reuse of money in a country's economic system. Additionally must be raised the taxes on large and international corporations that proceed to controlled transactions and save their money in banking systems outside the countries in which they operate. Empirically the CM defines that every 0.1 corresponds to 2–4 years of an economy to recover from a crisis. For in-

stance, an economy with an index of the cycle of money amounting to 0.9 needs two years to recover. A stricter approach corresponds to the value of 0.1 to 3–5 years (empirically achieved by prior depressions and paradigms from countries that faced financial crises).

The Cycle of Money theory is a hypothesis that can disclose the economic dynamics of an economic system and its ability to deal with a crisis. The circle of money theory is an economic system from a holistic perspective of economics. This is accomplished by using GDP to define the concept of money as well as how it circulates throughout the economy. Money could be compared to "blood" in an "organism", and economic units to "parts of the body" in an allegorical metaphor. Then, just as medical tests for "blood", money indicates reasonable abnormalities in the economy. The same thing occurs from a different perspective (Béland, 2017; Castaño et al., 2016; Challoumis, 2020b; de Queiroz & Capelari, 2020; Forson, 2020; Hartz & John, 2009; Haskel & Westlake, 2021; Jeon et al., 2020; Khan & Liu, 2019; Nowlin et al., 2020; Schwartz, 2019; Waardenburg et al., 2020).

As a result, the money cycle theory offers a comprehensive picture of the performance and condition of an economy and then demonstrates whether it can respond to a potential economic catastrophe (e.g. the indicator of the money cycle in the case of Greece can explain why the economy was able to cope with its ten-year economic crisis when other indicators did not manage to do this) (Baldwin et al., 2011; Cascajo et al., 2018; de A. Dantas et al., 2018; Evans et al., 1999; Ginsburgh & Weber, 2020; Grove et al., 2020; Kreft & Sobel, 2005; Limberg, 2020; Maxwell, 2020; Miljand, 2020; Mohindra, 2007; Naudé & Dimitri, 2020; Ng, 2018; OECD, 2020; Rizzo & Throsby, 2006; Romme & Meijer, 2020; Wangsness et al., 2020).

The way money moves and is allocated in an economy reveals how well that economy is structured. When a body loses a lot of "blood" (money in the economy), the "body parts" grow weaker and the "organism" (the economy) weakens. The opposite happens when money enters an economy. In this instance, the "blood" (money) gets only to a section of the "organism", the body part which will be much better, but the "organism" will be weaker overall, i.e. the economy will be weaker. That is why the theory of the circle of money was successful in "predicting" years ago the existence of an international minimum tax rate for corporations involved in internationally controlled activities.

The current findings, which are based on the theoretical approach of the theory of the money cycle, demonstrate that in the economy taxes benefit primarily, or even solely, the health and education systems. In addition, the basic tenet of the CM theory is that governments should keep taxes on medium and small economic entitles (i.e. any type of economic entitle, such as freelancers, companies, etc.) and businesses as low as is reasonable. Furthermore, the examples of Poland, Latvia, Serbia, Bulgaria, Greece, Thailand, and Ukraine show that they are above the cutoff of 0.2 and nearly at the average rate of 0.5, indicating that

these countries may experience a crisis (Bhuiyan & Farazmand, 2020; Biernaski & Silva, 2018; Blekesaune, 2007; Blundell & Preston, 2019; Bourdin & Nadou, 2018; Bowling et al., 2019; Brownell & Frieden, 2009; Burstein, 2020; Cai, 2017; Camous & Gimber, 2018).

The money cycle is a good place to apply the FLP (Fixed Length Principle). The Arm's Length Principle (ALP), on the other hand, is the principle under which tax authorities levy taxes on global groups of firms. Tax authorities determine the tax obligations of businesses engaged in overseas transactions using the ALP principle. Since multinational businesses conceal their transactions to avoid paying taxes, they provide data that is identical to those of unregulated transactions, making it impossible for the authorities to distinguish between the two using this principle. Therefore, the FLP concept should be used by the authorities (Bartels, 2005; Béland, 2017; Bento, 2009; Berchin et al., 2019; Berg et al., 2020; Bergquist et al., 2020; Bernasconi & Espinosa-Cristia, 2020; Carattini et al., 2018; Carfora et al., 2021; Cascajo et al., 2018; Cruz-Castro & Sanz-Menéndez, 2016; Dancygier & Laitin, 2014). According to the FLP concept, controlled transaction corporations successfully handle transactions while evading taxes. International corporations will therefore be required to pay a fixed amount of tax plus the minimum under the FLP principle (AICPA, 2017; Challoumis, 2019g; Grove et al., 2020; Maier, 2012; Muñoz & Flores, 2020). Therefore, the money cycle is strengthened, as larger companies generally receive money from society and the economy and save it in international banks. As a result, society loses this money, which lowers spending. According to the FLP principle, local and domestic companies that save their money in local banks should have lower tax rates.

The FLP principle supports the Cycle of Money theory which states that small and medium-sized businesses must pay less in taxes than larger corporations that take over their commercial operations. On the other hand, the ALP principle evaluates imposed taxes using the same techniques used by businesses engaging in cross-border business. The operations of smaller businesses are then covered by larger businesses. In the end, the general trend is that small and medium-sized businesses improve the distribution of money inside an economy since they frequently do not save their money outside the country's economic system but reinvest it within the system instead. As a result, the money cycle is determined by the distribution of money within the economy. Empirical papers on the theory of the cycle of money are about the cases of Poland, Montenegro, Greece, England, Thailand, Canada, etc. (Challoumis, 2021b, 2021d, 2021f, 2022b, 2023a, 2023b).

2. Mathematical background

The mathematical background for the Cycle of Money theory is presented below. Money cycle calculations are defined by the following mathematical formulas:

$$c_y = c_m - c_\alpha \tag{1}$$

$$c_y = \frac{dx_m}{dm} - \frac{dx_m}{da} \tag{2}$$

$$i_{cy} = Y \cdot b_d \tag{3}$$

$$g_{cy\ Country} = \frac{c_{y\ coyntry's}}{c_{y\ Average} + c_{y\ coyntry's}} \text{ or } \frac{i_{cy\ coyntry's}}{i_{cy\ Average} + i_{cy\ coyntry's}} \tag{4}$$

$$g_{cy\ Average} = \frac{c_{y\ Average}}{c_{y\ Average} + c_{y\ Average}} \text{ or } \frac{i_{cy\ Average}}{i_{cy\ Average} + i_{cy\ Average}} = 0.5 \tag{5}$$

It is the velocities of c_m and c_α that determine the cycle of money, c_y. The cycle of money determines the flow of money in an economy. The c_m is about the financial liquidity, it is the velocity of transactions, and c_α is the velocity of escaped savings. The i_{cy} indicator of the money cycle, it is GDP, and Y is the bank reserves of each country represented by b_d. In addition, the general indicator of the money cycle of each country is represented by the indicator $g_{cy\ country}$ and $i_{cy\ coyntry's}$ or $c_{y\ coyntry's}$ is the international indicator of $i_{cy\ Average}$ or $c_{y\ Average}$. In conclusion, it is the international $g_{cy\ Average}$ indicator and is perceived as an international constant. The appropriate assumption is c_y aimed at establishing the link between the indicator of the international (global) average, c_y bank holdings and GDP per capita, considering econometric approaches. Subsequently, the initial assumption of the money cycle is verified in the context of real economic scenarios in most countries internationally, divided by the international average of the money cycle index. Eq. (4) and (5) mean that if an economy is approximately 0.5 can directly address an economic crisis. The perfect economy takes a value of 1. Every 0.1 that an economy loses from the unit means that it takes 3 to 5 years for that economy to recover from an economic crisis (this was identified based on the results obtained from this research). The results approaching the value of 0.5 represent an appropriate indicator of the money cycle, revealing an adequate economic structure for society and proper distribution of money among citizens – consumers. Eq. (1) The money cycle, used to define it $c_{y\ coyntry's}$ and $c_{y\ Average}$.

In the light of GDP, the money cycle in quantitative analysis is an expression of $\frac{\partial(\text{GDP})}{\partial(S+I+X)}$, according to $\frac{dx_m}{dm}$ and $-\frac{\partial(\text{GDP})}{\partial(S'+I'+M)}$, according to $\frac{dx_m}{da}$. Next,

$$c_y = d(GDP) = \frac{\partial(GDP)}{\partial(S+I+X)} d(S+I+X) - \frac{\partial(GDP)}{\partial(S'+I'+M)}\ d(S'+I'+M),$$

$c_y = \frac{dx_m}{dm} - \frac{dx_m}{da}$ of Eq. (2), where S means savings, I is investments and X is exports. Then, S' is savings directed to banks outside the financial system, I' is investments directed to banks outside the financial system and M is about imports. Hence, the money cycle expresses GDP under the following relationship:

$Y = S_T + I_T + (X - M)$, or $Y = (S - S') + (I - I') + (X - M)$ or
$Y = \Delta S + \Delta I + (X - M)$.

According to the theoretical background for the Cycle of Money theory, money lost from an economy as a result of economic transactions can be controlled and supervised by an agency that will observe money transfers between the economies of different countries by comparing economies internationally through ΔS, ΔI and $(X - M)$.

The cycle of money indicator is:

$$c_{ytotal} = \sum_{i=1}^{n}\sum_{t=1}^{m} c_{yi,t} = \sum_{i=1}^{n}\sum_{t=1}^{m}\left[\frac{\partial(GDP)}{\partial(S+I+X)} d(S+I+X) - \frac{\partial(GDP)}{\partial(S'+I'+M)} d(S'+I'+M)\right]_{i,t}.$$

The money cycle is an expression of the difference between the differential equations of the amount of money used in an economy and the quantity of money lost from the economy. That is why the money cycle theory advocates higher taxation of companies.

3. Quantified estimations on the currency rate

The inflation in the Cycle of Money theory is the following:

$$c_y = \frac{dx_m}{dm} - \frac{dx_m}{da} = c_{ytotal} = \sum_{i=1}^{n}\sum_{t=1}^{m} c_{yi,t} =$$
$$= \sum_{i=1}^{n}\sum_{t=1}^{m}\left[\frac{\partial(GDP)}{\partial(S+I+X)} d(S+I+X) - \frac{\partial(GDP)}{\partial(S'+I'+M)} d(S'+I'+M)\right]_{i,t} \quad (6)$$

Therefore,

$$\frac{\partial c_{ytotal}}{\partial t}=\sum_{i=1}^{n}\sum_{t=1}^{m}(c_{yi,t}-c_{yi,t-1})=$$
$$=\sum_{i=1}^{n}\sum_{t=1}^{m}\left[\frac{\partial(GDP)}{\partial(S+I+X)}d(S+I+X)-\frac{\partial(GDP)}{\partial(S'+I'+M)}d(S'+I'+M)\right]_{i,t}-$$
$$-\sum_{i=1}^{n}\sum_{t=1}^{m}\left[\frac{\partial(GDP)}{\partial(S+I+X)}d(S+I+X)-\frac{\partial(GDP)}{\partial(S'+I'+M)}d(S'+I'+M)\right]_{i,t-1} \quad (7)$$

Then, the result is the following:

$$x=\frac{\partial c_{ytotal}}{\partial t}=x_t-x_{t-1} \quad (8)$$

where x is the amount of money in the economy.

Furthermore,

$$\pi=p_t-p_{t-1} \quad (9)$$

where π is inflation and p is price.

$$c_y=\frac{dx_m}{dm}-\frac{dx_m}{da}=c_{ytotal}=\sum_{i=1}^{n}\sum_{t=1}^{m}c_{yi,t}=$$
$$=\sum_{i=1}^{n}\sum_{t=1}^{m}\left[\frac{\partial(GDP)}{\partial(S+I+X)}d(S+I+X)-\frac{\partial(GDP)}{\partial(S'+I'+M)}d(S'+I'+M)\right]_{i,t}$$

Namely,

$$\frac{\partial c_{ytotal}}{\partial t}=\sum_{i=1}^{n}\sum_{t=1}^{m}(c_{yi,t}-c_{yi,t-1})=$$
$$=\sum_{i=1}^{n}\sum_{t=1}^{m}\left[\frac{\partial(GDP)}{\partial(S+I+X)}d(S+I+X)\ -\frac{\partial(GDP)}{\partial(S'+I'+M)}d(S'+I'+M)\right]_{i,t}-$$
$$-\sum_{i=1}^{n}\sum_{t=1}^{m}\left[\frac{\partial(GDP)}{\partial(S+I+X)}d(S+I+X)\ -\frac{\partial(GDP)}{\partial(S'+I'+M)}d(S'+I'+M)\right]_{i,t-1}$$

where $\Delta t=1$, since the difference between the times is $t-1$ and t.

It is therefore assumed that:

$$x = \frac{\partial c_{ytotal}}{\partial t} = x_t - x_{t-1} \tag{10}$$

where x is the sum of the quantity of money in an economy.

Therefore,

$$\pi = p_t - p_{t-1} \tag{11}$$

where π is inflation and p is price.

As a result, we receive the following relationships (Table 1):

Table 1. Relationship between inflation and money cycle

Calculation	Result	Cycle of Money (CM)
$\pi = x$	zero inflation	constant money cycle
$\pi > x$	inflation	declining money cycle
$\pi < x$	deflation	declining money cycle
$\pi \leq x$	no inflation/domism	increasing money cycle

Source: author's own elaboration.

In support of the above equations, the following result takes place:

$$e = \frac{x_t - x_{t-1}}{p_t - p_{t-1}} \tag{12}$$

Therefore,

$$e = \frac{x}{\pi} \tag{13}$$

where e becomes parity.

The Table 2 is given on the question of parity.

Table 2. Currency rate in the theory of the Cycle of Money

Calculation	Result	Parity	Cycle of Money (CM)
$\pi = x$	zero inflation	fixed exchange rate, $e = 1$	constant CM
$\pi > x$	inflation	exchange rate reduction, $e < 1$	reduced CM
$\pi < x$	deflation	exchange rate increased, $e > 1$	reduced CM
$\pi \leq x$	no inflation/domism	exchange rate increase, $e \geq 1$	increased CM

Source: author's own elaboration.

In the Cycle of Money theory, the quantity of money is increased, but no inflation is mentioned. Furthermore, the currency rate is increased because of the increase in productivity of the economy, meaning an increase in the distribution and reuse of money. As a result, it shows better function and structure of the economy. Domism is the case where an increase in the money cycle comes from a better structure and function of the economy.

The Table 3 presents a QE analysis of the data.

Table 3. QE method application

Variables	Value
x (cycle of money)	0.7
i (inflation)	0.4
e (currency rate)	1.75

Source: based on: (Challoumis, 2019e).

The blue line depicts the money cycle in the scenario where it is higher than inflation. Similar findings apply to the remaining two situations in Table 3. Due to the high cycle of money and the appropriate distribution and reuse of money in this economy, there is little inflation and a high currency rate (Figure 2).

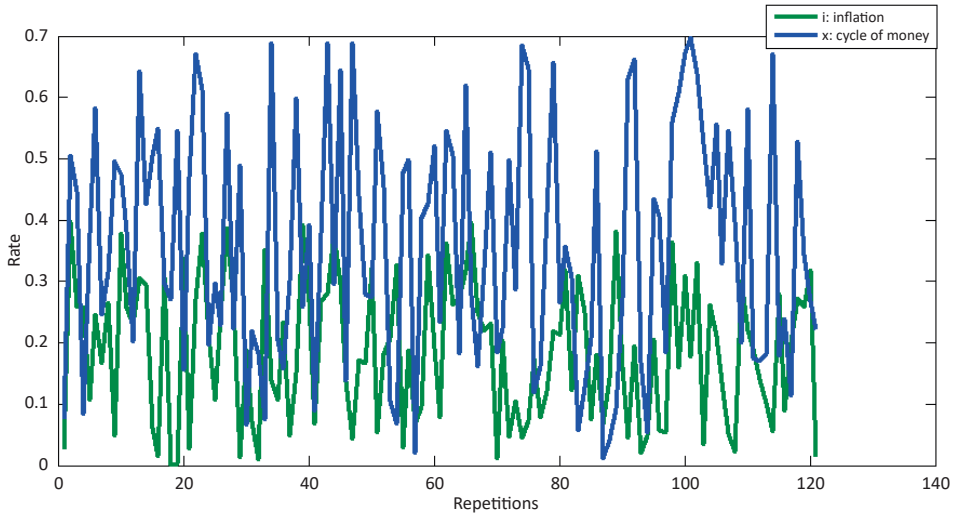

Figure 2. The Cycle of Money in comparison with inflation

Source: author's results.

Conclusions

This study has shown that inflation is caused not only by rising prices but also by a mismatch between price growth and productivity growth. In the theory of the money cycle, productivity refers to the distribution and reuse of money in an economy. An economy is represented by its function and structure, which is reflected in the money cycle, i.e. problems in the functioning of the economy are reflected in the structure of the economy and vice versa – productivity and structure of the economy are two sides of the same coin, i.e. they are inseparable. Inflation reduces the cycle of money, which is reflected in the exchange rate by lowering it.

Key aspects of inflation as they relate to the Cycle of Money theory have been discussed in this paper. The findings highlight the significance of the money cycle if economies experience inflation. Any economic crisis can be handled by economies with efficient money allocation and recycling. The economy now has an acceptable economic structure as a result of the efficient allocation of financial resources (Challoumis, 2018d, 2018f, 2020a, 2020d, 2021e). This means that the economy has no international and large companies that substitute the economic activities of the smaller ones.

The SMEs (Small and Medium Enterprises) are the main body of each economy, and according to the Cycle of Money theory should have lower taxes than bigger companies that substitute their activities. In conclusion, the high cycle of money leads to lower inflation, offering a higher currency rate. This happens because of better distribution and reuse of money, meaning at the same time better economic structure, as SMEs have a full economic function because the high capital companies have transferred their activities to factories and high technological units (Challoumis, 2019g; Porter, 2007; Sikka, 2018; Van de Vijver et al., 2020; Woody & Viney, 2017).

Appendix

The following program in Matlab has been used to receive the prior results:

```
%Q.E. currency rate Constantinos Challoumis 2023 (c)(r) all rights reserved


t=0;
while t<10
t=t+1;
if rand()<9
x=0.7*rand();
end

if rand()<9
i=0.4*rand();
end

e=x/i;

tab=[x,i;tab]; %initially remove tab


end
```

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Market beta coefficient and enterprise risk management: A literature review

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Abstract

One of the significant factors in the valuation of publicly listed firms is their market beta coefficient, commonly utilised in the capital asset pricing model (CAPM) as a proxy for stock volatility directly affecting market value. This article's primary purpose is to explore the theoretical basis for future empirical research into the relationship between the market beta coefficient and enterprise risk management (ERM). The author explores academic literature about various researched variables affecting the market beta coefficient in the context of the neoclassical capital asset pricing model, which was founded on the premise of an efficient market hypothesis. The review starts with the works of orthodox theorists and moves on to the works of less orthodox ones who argue that neoclassical models might be flawed due to inherent market inefficiencies. Next, the article takes us to the works of proponents of radical theorems of a world of multidimensional risk and return relationships clashing outright with neoclassical views. Lastly, the author explores a relatively new and evolving modern ERM practice as a potential endogenous and idiosyncratic variable of indirect influence on a forward-looking market beta and its impact on the firm's value, from a somewhat novel angle in the CAPM controversy. The review identifies gaps in the literature about a specific cause-and-effect relationship between ERM and the market beta coefficient. This paper adds to the literature by exploring controversies surrounding the market beta coefficient and ERM viewpoints disparity and bridging the two subject matters with the aim of further research study.

Keywords

- CAPM
- market beta
- beta coefficient
- systematic risk
- ERM

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Introduction

When assessing the value of a business, an income approach is often utilised, anticipating the level of cash flows a company will generate in the future. As unforeseen future events impact those projected cash flows, the net present value of future value streams will significantly depend on the employed discount rate. A lower discount rate is indicative of a higher value, whereas a higher discount rate is indicative of a lower value, all other things being equal. In general terms, larger companies with economies of scale and predictability of growth tend to enjoy lower discount rates, and the inverse holds for smaller companies. The important component of the discount rate is the systematic risk or beta coefficient.[2] Since the level of control a company has over a systematic risk is limited, this literature review will first concentrate on beta's exogenous factors and then take a somewhat less orthodox approach to examine endogenous factors in the context of the capital asset pricing model (CAPM).

Since CAPM is indeed one of the most controversial areas of modern business valuations and beta plays a significant role in the model's controversy, this literature review is important because we need to understand what other factors might co-play a part in skewing the beta coefficient. This article will introduce yet another novel element into the beta puzzle after first reviewing the CAPM's theoretical background, including its beta component and its latest stance on the subject-matter by the academic community. Once that is established, the article will explore possible endogenous effects on beta, specifically a relatively new risk management practice of enterprise risk management (ERM) as an element of potentially having indirect observable effects by lowering a firm's systematic risk, even though it is deemed not controllable from the individual firm's perspective. Accordingly, this article is organised into five sections by topic area: literature review structure; CAPM; a related market beta component of the CAPM and the widely-published controversy surrounding it; a relatively new and evolving risk management practice, i.e. ERM, and its potential value; and lastly, a synthesis of the market beta with an ERM system.

Conceptually, an effective ERM system should reduce the variability of the firm's earnings and lower the volatility of its stock price. Thus, it should have a positive impact on the firm's value. To support this notion, using the financial results and share market performance of nearly 400 publicly traded companies from around the world that have participated in the Risk Maturity Index survey, Aon analysts

[2] The market beta, beta or beta coefficient is used as a proxy for the "systematic risk" of the individual stock in the context of CAPM. Thus, those terms are used interchangeably throughout this article. Albeit, such a proxy is subject to much controversy (Harrington & Korajczyk, 1993).

have compiled the data necessary to identify the correlations between advanced risk management capabilities and company stock price performance. According to the 2017 Aon's Risk Maturity Index Insight Report, they have continued to find a positive correlation between stock price performance and company profitability and higher risk maturity ratings since their initial research was conducted in 2011 (Aon, 2017).

This article aims to probe if ERM creates value by affecting the most critical beta component of the discount rate for equity or the cost of equity capital utilised for business valuation purposes of those companies from a somewhat different angle than Aon's research. If a successful ERM strategy can reduce variability, thus lowering the market beta coefficient, more conservative investors will naturally choose lower-beta stocks over high-beta stocks, supporting the company's expenditures in ERM to increase shareholders' value. Therefore, the aim will be to test the theoretical relationship between the market beta coefficient and ERM once a theoretical ERM impact model is established in further study.

The market beta controversy has been widely debated in modern literature since the neo-classical model was established. Some of the more recent research proposes novelties, such as a new joint model of expected return and volatility forecasting, namely the two-component beta (Haddad et al., 2023). Another research offers duration-adjusted betas for the three-factor model betas, including risk associated with the firm's dividend policy (Varela, 2022). Also adding to the more recent controversy among many other research papers is "Time-varying beta – The case study of the largest companies from the Polish, Czech and Hungarian Stock Exchanges," indicating that in many cases, the Kalman filter estimates outperform the estimate of the beta parameter obtained based on the linear Sharpe model (Dębski et al., 2021). This controversy review continues in section three of this article.

Equally valid is the value of ERM as a widely published subject matter. Some researchers argue that ERM potentially creates value for firms from theoretical and empirical perspectives (Bohnert et al., 2017). Others find that ERM and investment decisions positively influence firm value, with investment decisions mediating the relationship between ERM and a firm's value (Faisal et al., 2021). Somewhat mixed results have been shown in yet another study, with ERM having a negative effect on the expected growth rate, thus adversely affecting the fundamental value. However, on the positive side, that same study also revealed that ERM is associated with higher free cash flows (Marc et al., 2018). Still, another study found that ERM positively affects financial performance and firm value (Chairani & Siregar, 2021). ERM's value creation capabilities debate continues in numerous other studies, more thoroughly discussed in section four of this article.

1. Literature review structure

The initial focus of this literature review will be on beta in the context of the capital asset pricing model (CAPM) and other potential variables which capture volatility associated with market beta. Since the beta coefficient is a measure of a stock's systematic risk and since systematic risk refers to external market forces,[3] what makes security A over security B, or firm A over firm B, more able to withstand those forces by keeping its trading or stock volatility in check? In other words, what makes them less volatile than market averages, and consequently, with all other things being equal, results in a higher incremental value? The search for the "Holy Grail" or "Holy Grails" seems never-ending, as discussed in the following sections. This literature review will also briefly touch on some of the beta anomalies and plausible factors contributing to those anomalies, such as firms' leverage constraints and margin requirements, certain unfavourable market conditions, as well as market-driven premiums and discounts for overperformance and underperformance, respectively, that are exhibiting residual skewness. It will also consider exogenous events such as regulation effects on a firms' beta, among other factors.

Subsequently, this article will explore potential venues of correlation of good governance practices such as ERM with firms' performance, and ultimately, the effect on firms' values, culminating in a provocative question: does a proprietary ERM system have any degree of influence on the beta? Theoretically, the answer should be no, as beta is a measure of stock volatility compared to its market average, and there is very little controllability from the individual firm's perspective. Yet, some firms tend to do better than others during the so-called non-controllable events such as geopolitical crises, financial crashes, changes in law and natural disasters. What if a tailor-made ERM strategy could be, to some degree, a unique advantage resulting in a positive beta anomaly?

2. Capital asset pricing model

Ceteris paribus, the efficient-market hypothesis (EMH) states that asset prices fully reflect all available information (Fama, 1965). This theory is also one of the basic tenets of the original CAPM[4] and a method, albeit modified, of determining a discount rate commonly applied in the appraisal of larger companies for business valuation purposes (Trugman, 2016). The basic premise is that expected re-

[3] Broad external factors unrelated to individual investment-specific factors.

[4] The model was originally developed in the context of portfolio theory to measure the risk an individual stock contributes to a well-diversified portfolio (Trugman, 2016).

turns on investment portfolios are directly correlated with expected risks. Thus, the higher the risk is, the higher the reward will be, and vice versa. In the efficient-market hypothesis, under the equilibrium assumption, prices that are indeed rational reflections of value will gravitate toward the stable centre (McNally, 2011). The same equilibrium assumption holds for the diversified stock portfolios. Prices of securities that are indeed rational reflections of value will congregate toward stability of their true value, even though they are subject to intermittent swings. This relationship was originally described by William F. Sharpe, who posited that prices have adjusted so that the investor, primarily through diversification, can only attain a higher-than-expected rate of return over pure interest or a risk-free interest rate by incurring additional risk (Sharpe, 1964). Sharpe was one of the founding fathers of modern CAPM, together with (Lintner, 1965), (Mossin, 1966), and (Black, 1972), building on the earlier work of (Markowitz, 1952), as well as (Markowitz, 1959). The main difference is that the former works assumed a risk-free lending and borrowing rate, whereas the latter did not (Reinsel & Velu, 1998). This long list of forefathers of CAPM would not be complete without Jack L. Treynor, who also deserves credit for the original CAPM because of his revolutionary manuscripts – Market value, time, and risk (Treynor, 1961) and Jack Treynor's "Toward a theory of market value of risky assets" (Treynor, 1962), which were circulated during the 1960s in a mimeographed draft form but have never been published in an academic or practitioner journal (French, 2002).

The mathematical formula for the modified CAPM model used to determine a discount rate[5] applicable to the firm's equity valuation is as follows:

$$ke = Rf + \beta\,(Rm - Rf)$$

where (ke) is the expected return (market) or the so-called discount rate for equity, applied in valuing large companies, (Rf) is the risk-free interest rate, and (β) beta is a systematic risk. Lastly, ($Rm - Rf$) is the long-term average risk premium of the whole market less the long-term average risk-free rate, also known as the equity risk premium (ERP).

3. Market beta controversy

Much has been written about the beta (or systematic risk) in both academic and non-academic literature. In fact, its viability has been widely debated among

[5] It was modified to determine the discount rate, commonly used in the appraisal of larger companies (Trugman, 2016).

scholars and the business community alike. Some argue that the standard CAPM model does not hold under certain constraint conditions, such as investors' leverage constraints and margin requirements. For example, Frazzini and Pedersen affirm that under those conditions, high beta portfolios produce lower alphas[6] and vice versa, in the US as well as in the international equity markets. This anomaly is attributed to the fact that the constrained investor will bet on riskier assets, artificially bidding-up high beta assets. Thus, they conclude that the security market line (SML) is flatter than predicted by the traditional CAPM model, and the deviation from the standard can be explained by what is known as betting against beta factors (BAB) (Frazzini & Pedersen, 2014). Figure 1 serves to illustrate the traditional CAPM model. The SML intersects the y-axis at the risk-free rate (Rf), and the slope of the line is the market risk premium ($Rm - Rf$). The expected (market) return of (Rm) from a balanced market portfolio (M) will correspond to the beta value of 1.0 since the portfolio cannot be more or less risky than the market as a whole.[7] It is useful to show this graphically: the SML line is an upwardslope shown in Figure 1, and the slope gradient depends on the risk premium.

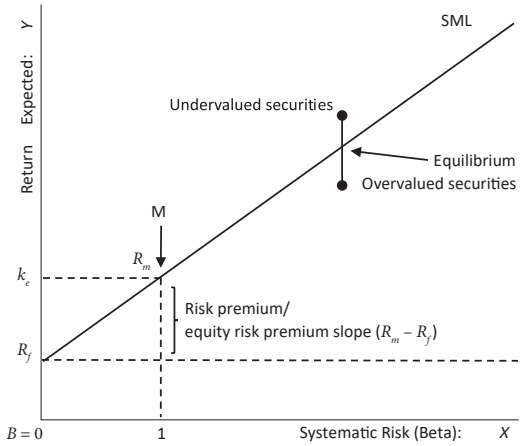

Figure 1. Security Market Line – SML is the graphical representation of CAPM

Source: (Sharpe, 1964).

This anomaly was also disseminated more recently in the "beta risk in the cross-section of equities" working paper. Researchers in that study extended the standard CAPM model to allow beta to vary stochastically (Boloorforoosh et al.,

[6] Alpha is used interchangeably with "excess return" or "return" throughout this article.

[7] A completely diversified market portfolio with only systematic risk and expected return equaling expected market return.

2020). In that model, low betas tended to increase during turbulent market times, resulting in what they describe as "wrong-way" beta risk. Their model's first prediction was that part of the equity risk premium corresponds to compensation for risky betas. The second prediction was that the SML's deviations are related to low beta firms co-moving more positively with the stochastic discount factor (SDF) and negatively with market returns. Furthermore, the risk is compensated by the additional premium earned beyond SML by those firms.

Others have observed that deep value events (periods of highest spreads between least expensive and most expensive securities) might explain the irrational behaviour of return patterns compared to market betas (Asness et al., 2017). Some authors found strong correlations between beta risk and returns by utilising a proprietary equity option valuation model, which predicts that firms with higher market betas have higher implied volatilities, steeper moneyness slopes, and a term structure that co-varies more with the market. Still, they note that further research is required in this area (Christoffersen et al., 2018). Others concluded that pricing errors in the traditional CAPM model exhibit residual co-skewness. Thus, high and low beta stocks appear to underperform and outperform, respectively, reflecting compensation demanded by investors for negative skewness (Schneider et al., 2016). More recently, one study found that there are considerably more variations in expected returns than previously acknowledged over time and across stocks. Pointing to the risk and return relationship that is better reflected by deriving predictive variables from real-time option prices than historical information such as historical market betas (Martin & Wagner, 2019).

Specific scrutiny is given to historical betas utilised as robust measures for forward-looking betas when markets are turbulent. A similar analogy can be drawn from the financial institution sector, whereby quantitative methodologies and tools to manage and stress test financial risks rely on historical data. In one study on the subject matter, the author argues that there is a risk of seriously underestimating the probability and magnitude of tail events[8] when frequency distributions of nominal exchange-rate changes are derived on the basis of fairly short data samples (Abildgren, 2014).

Yet another perspective was taken in the Consumption-Based Equity Valuation paper (Bach & Christensen, 2016), whereby the traditional CAPM model was adjusted: risks were adjusted in the forward-looking residual income returns and aggregate consumption (numerator), rather than in historical stock returns (denominator), to calculate the cost of equity discount rate for valuation purposes, as per the modified Consumption-based CAPM (CCAPM) model. This study is perhaps another indicator that historical betas are not reliable in predicting future performance. What if you

[8] By their very nature, tail events are hard to quantify with traditional models, which pay little heed to rare events (Bhansali, 2008).

could compare various market beta estimation techniques and determine which is the most accurate? A study of several historical, time-series models and option-implied estimation approaches concluded that a hybrid approach to combine historical return data with forward-looking information from the options market was shown to produce the lowest number of errors (Hollstein & Prokopczuk, 2016).

Finding the proper interval for measuring the rates of return is among some of the challenges with calculating beta (Feder-Sempach, 2017). One of the studies concluded a positive development of stationarity of distribution of the monthly logarithmic rate of return for all companies studied in the sample, which presents a great hope for the favourable statistical properties of the results for further studies, particularly relating to the beta parameter (Dębski et al., 2017). Last but not least, an adequate time horizon of rates of return in those further studies becomes paramount, as not adjusting for periods of instability (e.g. the COVID-19 pandemic) may produce abnormal results, proving that using beta to measure market risk at times of instability may lead to significant calculation errors (Lisicki, 2022).

Some earlier revolutionaries have already argued that (a) beta does not seem to help explain the cross-section of average stock returns and (b) the combination of size and book-to-market equity appears to absorb the roles of leverage and earning-price ratio in average stock returns, at least in the 1963–1990 sample period selected (Fama & French, 1992). Thus, variables such as size and the book-to-market value of equity explain cross-sectional variations in average stock returns associated with beta. Contradicting Fama and French, another empirical work suggested no correlation between beta risk and expected returns and describing markets as essentially not rational at all (Dempsey, 2013), which directly disputes Sharpe's CAPM model. Furthermore, the author suggested that crowd psychology plays a powerful role in abolishing any risk-return relationship. Mike Dempsey indeed proposed that other models, which were refined to produce more sophisticated CAPM models, indeed represented a radical departure from the essential risk-return premise of CAPM. This radical conclusion was partly corroborated in the "ß" study (Benson & Faff, 2013). In the authors' assessment, the model and the subsequent enhanced versions have weaknesses and should be used cautiously. So, where does this leave us?

First, let us look at exogenous and idiosyncratic events, such as the effect of regulation in the English electricity distribution industry on beta instead of broader variables or anomalous effects discussed in preceding paragraphs. Based on empirical findings in the electric power industry, Paleari and Redondi (2005) argued that regulatory events affect both overall risk and market correlation in the same direction. Let us break this down. First, two components were considered determinants of the systematic risk, or beta, under CAPM: the company's overall risk and market correlation. In Paleari and Redondi's model, it has been deemed that if regulation becomes tighter, abnormal returns will turn negative.

In contrast, beta will increase because both market correlation and overall risk increase, and vice versa. There is an underlying assumption that the model is static, meaning that all other exogenous and endogenous effects have already been considered. Thus, specific exogenous effects, such as regulatory events, can distort the risk and reward relationship under the CAPM model, at least on the short-term basis considered in that modified model.

"Well, what about endogenous and idiosyncratic effects?" one might ask. One relevant study was undertaken to address two questions: are accounting earnings numbers useful in the assessment and pricing of a firm's risk, and secondly, are accounting numbers incrementally-associated with the market's assessment and pricing of a firm's risk beyond other observable risk factors, such as those in the three-factor model (Fama & French, 1992): beta, firm size and book-to-market ratios (Baginski & Wahlen, 2003)? The study concludes that the capital markets price systematic risk in the residual income[9] and that the market beta is, in fact, a weak indicator of systematic risk, at best. If beta itself is not the best proxy for systematic risk, what else can it be? That question alone is a big "Pandora's Box" involving many years' worth of existing research, as well as that which remains to be done. What else could be a proxy for stock volatility? Before we go any further, let us summarise the outcomes of the review thus far.

Inevitably, market beta might not be the best proxy for systematic risk, but it is still widely used given the lack of better indicators. While some researchers are still giving it mixed scores, others no longer feel compelled to do so, as markets are becoming ever more complex and less perfect than when the idea was originally conceived. Colloquially, "it takes a model to beat a model." Thus, further studies might create something truly revolutionary, in tune with Mike Dempsey's assertion that CAPM and related beta are long overdue for a complete overhaul (Dempsey, 2013). There is a widespread debate about this, with alternative models and approaches being explored, in an attempt to make sense of the maze of variables and factors that are shaping stock volatility in today's markets.

To encapsulate this part of the cross-sectional literature review, a sample of subject matter studies were reviewed, beginning with those founded on neo-classical theorems, all the way up to modern ones, in order to shed light on the multitude of different variables theorised as capturing volatility associated with the market ß in the entire spectrum: from full explanatory powers to partial explanatory powers, to none at all. The earlier studies imply market efficiency. However, more recent studies suggest otherwise, moving in the opposite direction along the spectrum. Please note that studies in the sample under review were based predominantly on US equities, though some international and UK equities were

[9] It also stands for abnormal earnings or residual return on equity (Baginski & Wahlen, 2003).

included. However, the aim was to illustrate the broader spectrum of the beta-related debate.

In recent years, the emergence of new risk management strategies such as ERM has become a popular tool for a firm's performance variability. It makes sense conceptually: the better the firm is at managing risk, the better it will be at managing earnings, and consequently, conceptually, its stock variability should positively reflect that. Thus, an antidote such as ERM might increase firms' value and build resilience. If such a relationship exists, firms with an effective ERM system might experience less stock volatility, which could be proven accordingly via their beta coefficient. First, let us explore what constitutes an effective ERM and why it should be taken into consideration as one of the factors on the broader beta spectacle.

4. The value factor of ERM

Before jumping into the ERM as a novel idea, let us start with its origins. The word "risk" has its roots in the early Italian "risicare", which means to dare (Bernstein, 1995). In the past millennia, the traditional risk management programs considered only pure loss exposures of simply addressing two possible outcomes: a loss or no loss scenario. The next significant milestone added speculative financial risks[10] as a new trend emerging during the 1990s, with ERM becoming a natural choice, thereafter including strategic and operational risks into the mixture as a holistic approach to a risk management practice. George E. Rejda and Michael McNamara define ERM as: "a comprehensive risk management program that addresses an organization's pure risks, speculative risks, strategic risks, and operational risks" (Rejda G. E., & McNamara, 2014). In September 2004, the Committee of Sponsoring Organizations of the Treadway Commission (COSO) published their *Enterprise risk management – Integrated framework*, expanding on a previously issued framework.[11] The expanded version defined ERM as "a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives" (COSO, 2004). This framework was disseminated to the business community due to heightened concern

[10] Speculative financial risks are commodity price risk, interest rate risk and currency exchange risk.

[11] *Internal Control: Integrated Framework* to help businesses and other entities assess and enhance their internal control systems.

about risk management practices in the field in the wake of high-profile business scandals and failures that plagued business communities across the world in the years preceding the new publication.

However, since "one size does not fit all", identifying the right blend of ingredients of what constitutes an effective ERM system is in itself, just like CAPM and beta, a widely debated subject. The right "formula" will likely depend on the organisation's unique circumstances and the level of its business complexity, among other factors. Smaller organisations that face great external pressures might be tempted to concentrate more on short-to-midterm goals or objectives to fulfil their immediate obligations towards stakeholders and postpone addressing longer-term objectives.

On the other hand, when external pressures are lower, larger organisations might allow themselves the luxury of looking ahead to a wider time horizon with greater precision. These organisations execute this by anticipating either positive or negative deviations from their objectives, properly assessing these deviations, prioritising them, and mitigating or exploiting them as needed. Furthermore, the tendency to concentrate on one particular time horizon or another will significantly depend on the governance structure, experience level and objectivity of those managers at the helm who will steer the organisation through the vast oceans of uncertainty. Equally important, if not more so, are the specific individual elements needed to function collectively to elevate the ERM system as a management tool to the level at which it can enhance informed decision-making and reduce variability, thus reducing adverse outcomes and maximising favourable ones. There are undoubtedly many organisational variables or nuances that will contribute to its overall success.

Now, let us look into the basic premise of ERM and its effects since the inception of the framework. The fundamental premise is that "value is maximized when management sets strategy and objectives to strike an optimal balance between growth and return goals and related risks, and efficiently and effectively deploys resources in pursuit of the entity's objectives" (COSO, 2004). The framework established eight interrelated components derived from how management runs an enterprise to be integrated with the management process. So far so good regarding the conceptual framework, but how it weathered the storm of reality since its beginnings?

One study put this to the test by following 112 US equities across a variety of industries and concluded that the relationship between ERM and firm performance is contingent upon five variables: environmental uncertainty, industry competition, firm's size, firm's complexity and monitoring by the board of directors (Gordon et al., 2009). In this context, environmental uncertainty relates to the increasingly unpredictable environment within which the firm must operate. Industry competition relates to the competitive rivalry as the level of concentration risk a firm is

confronted with is a determinant of ERM system robustness. The firm's size relates to its ability to allocate necessary resources to governance programs such as ERM. A firm's complexity refers to the notion that the more complex organisations are, the more likely they are to be willing to establish an effective ERM system. The final variable – monitoring by the board of directors was measured by dividing the number of directors by a natural logarithm of sales as a proxy for a firm's size in their observations. As an alternative measure, the frequency of board meetings was also used. A positive correlation was found between ERM and a firm's performance contingent on that last variable in both cases.

So, what could this tell us? If there is sufficient coverage of management board members to the organisation's size, and if they meet regularly, ERM could have an effect on a firm's performance. This simple conclusion is too simplistic because we do not know anything about the management board members' level of qualifications, meeting attendance or the extent of their involvement in ERM monitoring activities. Nevertheless, it gives us an idea that board members play an essential role in risk management activities, a role which may be equal to, or more important than, other factors.

As we can now point to references suggesting there is indeed some positive correlation between ERM and a firm's performance, how does this translate into value creation? The 2007–2008 financial crisis, originating in the US market, had a ripple effect that swept over economies worldwide. There were investigations to identify the "culprits", and some identified the lack of effective risk management programs as the root cause, so a scrutiny of ERM was called for (Mishra & Rolland, 2011). One of the main conclusions from the OECD's report on the issue was that, in some of the companies analysed, risk management was simply an activity rather than a collective and holistic approach (Kirkpatrick, 2009). In other words, some companies had not been taking it seriously. Other studies concluded that ERM contributes to little if any incremental value-added, compared to the more sophisticated traditional risk management practices, with the caveat that further research is needed in this somewhat unchartered territory (McShane et al., 2011).

If the relationship between ERM and a firm's value is negligible, what then is ERM's benefit? (McShane et al., 2011) pointed out that, since 2007, Standard and Poor (S&P) began to use an ERM assessment rating to complement its already existing credit ratings, focusing first on the insurance industry. Eight years later, S&P developed a new framework for the evaluation and scoring of ERM in three areas: risk culture, risk exposure management and risk optimisation. S&P would assess each insurance firm on the three areas and then combine their assessments to derive an overall ERM evaluation score for each firm (S&P Global Ratings, 2019). This forward-looking use of ERM scoring as a performance proxy constitutes a benchmarking platform and might help researchers evaluate ERM's real value creation capabilities. One small piece of that value creation element was put un-

der the microscope by researchers studying the relationship between the default risk and ERM implementation at 78 of the world's largest banks. The researchers concluded that the higher degrees of ERM implementation are negatively correlated to the default risk (Lundqvist & Vilhelmsson, 2018). Thus, this one measure could indicate ERM's success and its impact on a firm's value. The same seems to hold for family enterprises. Large family firms that have not implemented ERM could be missing an opportunity to create value (Hiebl et al., 2019).

Reverting to the maturity of ERM, which can also be bridged to the degree of implementation discussed in the preceding paragraph, ERM aims to treat each risk in a holistic manner, not in "silo" isolation (Gordon et al., 2009). What that implies is that when risks are identified within a particular division or department, or function, a certain degree of silo thinking is inevitable to maximise the benefit or minimise the risk for that area of responsibility. This narrow view could lead to risks or opportunities being identified related to a specific business area rather than the enterprise as a whole, which traverses to the system's maturity. The more mature the system is, the more all-encompassing and truly "enterprise" it will become – rather than merely silo-based. In a study of 225 publicly listed firms across various sectors subjected to the RIMS Risk Maturity Model (RMM)[12] assessment over the 2006–2011 period, a significant valuation premium was associated with enhanced ERM maturity (Farrell & Gallagher, 2015). The study further concluded that the most substantial valuation factors are the organisation's engagement from the executive level downwards and integrating the ERM process into their strategic activities and everyone's practices.

Thus, sponsorship from the Board of Directors and senior management as well as their commitment to the program will likely be crucial to implementing the process. Without the right tone from the top, the integration of risk and strategy is unlikely to succeed with potentially damaging consequences. Management must be committed to embedding explicit risk considerations in critical business areas related to strategy and "walking-the-talk" themselves, i.e. demonstrating their focus through active participation and engaging others in the process. Nevertheless, companies find integrating risk into strategy to be a significant challenge, according to research conducted as part of the Association of International Certified Professional Accountants and North Carolina State University's Enterprise Risk Management Initiative for the *2017 Global risk oversight report*. Fewer than 20% of the European, UK or US based organisations surveyed for the report believe their risk management processes provide a unique competitive advantage. Only about 50% of respondents from around the world agreed with the statement: "Risk exposures are considered when evaluating new strategic initiatives" (CGMA, 2017).

[12] The RIMS Risk Maturity Model (RMM) for enterprise risk management is a tool to help auditors evaluate the ERM system's effectiveness.

Let us now explore the theoretical question of whether the value creation is enhanced by any particular risk management techniques or a combination thereof, such as those discussed in the preceding paragraphs. For example, according to the Irrelevance Proposition Theorem, the firm's valuation will remain the same regardless of its capital structure if income taxes, bankruptcy costs, agency costs and asymmetric information are absent (Modigliani & Miller, 2009). This theorem implies that markets are efficient because the firm cannot alter its valuation as the share price is only affected by future expected cash flow streams and the required return by equity investors.

This finding can also be applied to risk management in general, as risk management practices would have no bearing on value under this theorem. Nevertheless, a significant body of research has found that markets are imperfect and that risk management practices may create value by reducing or exploiting market imperfections (Grace et al., 2015). Grace et al. took another angle on whether more sophisticated risk management techniques such as ERM can improve performance and increase a firm's value. They studied specific ERM initiatives and found them to be correlated with a firm's performance for both public and private organisations. The results of their study suggest that ERM practices result in an economically and statistically significant increase in cost and revenue efficiency. Yet, the greatest increase in a firm's value was attributed to a simple economic capital model, a dedicated "risk manager that is indeed part of a cross-functional committee and a requirement that this risk manager reports directly to the Board of Directors or the Chief Executive Officer. Another study corroborated this result, having found significant evidence that a value premium is associated with effective ERM programs (Zou et al., 2019). The finding implies that an effective ERM program adds value to manufacturing firms by mitigating cost and enhancing efficiency. However, the study points out that ERM's full benefit is more likely to be enjoyed by larger diversified firms with flexible capital structures. One of the pioneering studies on the subject laid the groundwork for ERM proponents by concluding that the ERM premium is statistically and economically significant (Hoyt & Liebenberg, 2011). They did so by estimating ERM's effect on Tobin's Q ratio[13] as a standard proxy for firm value.

What about the opposing views, then? Some argue the reverse completely: that ERM is negatively correlated with firm value, and it erodes it because a poorly implemented ERM program can be detrimental to the firm (Lin et al., 2012). Meanwhile, others fail to find tangible evidence to support the notion that ERM has any effect on performance or at least an impact that can be measured from the financial statement user perspective (Pagach & Warr, 2010).

[13] Tobin's Q is the ratio between a physical asset's market value and its replacement value.

To fine-tune the ERM concept and provide greater clarity as to its value creation capabilities, COSO updated the framework in 2017. *Enterprise risk management – Integrating with strategy and performance* (COSO, 2017) offers ideas on how a business' value can be preserved or enhanced by incorporating and examining risks right from the strategy formulation stage. This approach elevates ERM from an operational- and compliance-focused information-gathering and reporting model by making it much more strategy-focused to add tangible value for organisations. It is perhaps too early to tell whether this update will provide a more decisive answer to the value creation dilemma. Since the COSO publication came out, more and more studies have been looking into the cause-and-effect relationship. One such study found that strategic planning plays a vital role in the success of ERM, and that ERM and strategy are not "substitutes" for one another, but rather complementary processes, and that when those two processes work hand-in-hand, profitability can be enhanced while financial leverage is kept in check (Sax & Andersen, 2019). We can expect new angles and ideas on this subject-matter to be proposed in the future, as the emergence of artificial intelligence, the exponential growth of data, automatisation of processes, and the further globalisation of trade, among other aspects, make things even more complicated for organisations. The search for factors contributing to value creation may prove to be never-ending. To summarise a sample of research into ERM, there is a high degree of disparity among the scientific and business communities worldwide over the decisive factor or a combination of factors potentially influencing firms' performance/value, if any.

While some researchers conclude that ERM implementation has positive effects on performance/value, some authors identify specific conditions under which the system can achieve its full potential and have some relevance. Others still conclude that it is irrelevant and makes no difference whatsoever, and it may even be detrimental to performance/value if not implemented properly.

5. Synthesis of market beta and ERM

If market beta and ERM both affect a firm's value, albeit to a debatable level, perhaps there is some observable level of correlation between ERM and the individual firm's market beta coefficient? Well, let us unravel this first. Under the traditional CAPM – EMH, a specific firm's risk (unsystematic risk)[14] is irrelevant because that risk is deemed to be eliminated in a well-diversified portfolio. Thus, the residual factor is that an individual firm's share price co-varies with its market

[14] Also known as idiosyncratic risk or diversifiable risk.

portfolio. That covariance is reflected by its beta coefficient, and that coefficient is indeed one of the ingredients in the cost of capital formula under CAPM. Thus, it has a direct and observable effect on the firm's value. On the other hand, ERM has a direct and observable impact on the firm's performance as a shareholder value maximisation mechanism, in line with its basic premise according to the relatively large number of empirical studies undertaken to prove that premise since it was initially conceived. Those studies further imply that ERM affects a firm's share price variability through the impact on the firm's performance, so ultimately the firm's market value could be affected.

According to some researchers, EMH may no longer hold, as some of the studies mentioned above have demonstrated. Therefore, other variables have been identified to decipher stocks' volatility associated with beta or systematic risk. On the other hand, some of the research reviewed shows that an effective ERM system influences firm performance/value solely on its merit or under certain conditions. If ERM can affect systematic risk, it might be another "culprit" in the never-ending beta controversy. One study supports such a nexus of ERM as a value creation mechanism that reduces systematic and unsystematic risk in tandem. The theoretical framework for that value enhancement is theorised by a "strategic conceptualisation of the risk premium model".[15]

It is a far-fetched idea, but firms' endogenous and idiosyncratic variables, such as their ERM systems, could have some explanatory power for residual variance in the beta coefficient. As such, ERM and beta could have some degree of correlation. By the way, this is not such a revolutionary idea as some other idiosyncratic and exogenous variables were proven to have a similar relationship in the past (Paleari & Redondi, 2005). One particular study had already provided that theoretical basis quite clearly a long time ago but explicitly focused on endogenous financial (accounting) variables. That study has indeed conceptualised the relationship between systematic risk defined as beta parameter and the firm's leverage (debt-to-equity ratio) and accounting beta[16] under certain assumptions, but not a theoretically related (directly) to the earnings variability, dividends, size or growth of a firm (Bowman, 1979). Thus, if a clear link does exist between a firm's financial variables (accounting) and market variables (systematic risk), a similar relationship could exist between the ERM system directly or indirectly impacting financial (accounting) variables and market variables (systematic risk). Fundamental questions remain to be answered as to what constitutes effective risk management in the context of ERM. Answering these questions would enable us to identify variables that may have some relationship with the market beta.

[15] The Strategic Risk Premium Model (Lai, 2015).

[16] Accounting beta is expressed as the coverability of a firm's accounting earnings with the accounting earnings of the market portfolio (Ball & Brown, 1969).

Conclusions

The neoclassical finance theories clash with some of the subsequent research developments in finance and economics (modern finance theories) and are being debated more widely than ever. The precise boundaries are still being drawn, but those boundaries may never be absolutely defined as new developments are inevitably fuelling more controversies. It is essential to realise that the mechanisms that interact within capital markets are much more complex and intertwined than can be interpreted by one model or another alone. The multitude of variables might have to be analysed individually in isolation and perhaps in some multivariate aggregation to assess risk and return relationships that became modern CAPM's foundation. By shedding more light on this crucial subject, we can better understand at least one variable and its effect on forward-looking market beta parameter. That variable is the ERM system and its evolving influence on organisations, and perhaps to a greater extent, markets themselves. The challenging part might be finding the right formula for an effective ERM system. That successful ERM formula could determine the coefficient of influence on the market beta and, ultimately, its impact on the firm's value if any. Therefore, the further study's primary purpose will be to explore the relationship between ERM and beta coefficient co-variability and to probe whether the implementation of ERM and its level of maturity reduces the market beta coefficient to some statistical degree. Once that relationship is established, a value creation impact could be theorised, with all other things being equal.

An effective ERM system will help to gather relevant and vital information for decision-makers, to enable them to respond to and manage risks and opportunities appearing on the horizon, stemming either from negative or positive internal and external circumstances, as soon as they become relevant. The key is timing and focus. Those who can respond fastest with the correct measures or countermeasures will mitigate or exploit those circumstances and preserve or enhance business value. The numerous recent high-profile organisational failures highlight the need for further research in this critical area. In too many cases, the business value was eroded in the marketplace without any early warning signs. This literature review paper provides a theoretical introduction to a future empirical study on ERM's efficacy from a somewhat novel angle as a value factor. It seeks to propose ERM as a potential variable in the market beta controversy. To test the theoretical relationship between the market beta coefficient and ERM, a theoretical ERM impact model must be established first to test potential causality further. Maturity and integration might be a good indicator of a well-functioning ERM system (model) that has an impact, or there may be other surrogates that prove more relevant. Consequently, the secondary aim of the further study will be to

establish which theoretical ERM impact model will have the most significant influence potential or the greatest impact on value as a value creation mechanism.

Furthermore, since the traditional market beta is a relative measure of a systematic risk, it might be necessary to decompose individual stock's risk, when measured either by standard deviation or by variance, in the studied sample, into its separate unsystematic and systematic risk components. This decomposition will provide an absolute measure of systematic risk rather than a relative measure for any individual stock within the sample (Marshall, 2015). Hence, the precision of the study might be enhanced by utilising the decomposition approach.

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Does stock market take into consideration football players' injuries?

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Abstract

Injuries are a frequent risk in sports. This article analyses the repercussions of football players' injuries on the market returns of six European clubs: Ajax, Borussia Dortmund, Manchester United, Olympique Lyonnais, Benfica and Juventus over a period of three years. The originality of this study comes from the absence of scientific articles in this field. Based on the event study methodology, the results indicate that the sensitivity of stock prices to injuries is very low. Furthermore, the results show that the date of injury is a significant variable causing the effect on returns (Borussia Dortmund). However, injury severity, player status and COVID do not influence the price share.

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Keywords

- economics of sport
- injury
- stock return
- event study methodology
- football
- sport finance

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Introduction

One of the major characteristics of sport is physical confrontation. It represents a professional hazard that affects the performance of sports organisations. As the number of competitions has multiplied over time, injuries to players have become

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increasingly frequent. For example, professional football players suffer between 2.5 and 9.4 injuries for every 1,000 hours of effort (Pfirrmann et al., 2016), which can result in either physical inaptitude (Van Basten, Sergio Aguero, etc.) or death (Youssef Belkhouja, Marc-Vivien Foé, etc.). The focus of this article is on football since it is the most popular sport in the world.

Football integrated financial markets early on. Tottenham was the first club listed on the stock exchange in 1983, and investments in football have been on the rise worldwide ever since. The interest of investors in football has garnered the attention of the academic world.

The aim of this article is to validate the hypothesis that injuries to footballers have a significant effect on the stock market prices of football clubs, using the event study methodology. In other words, we will examine the market's response to the risk of injury. The importance of this risk also stems from the context marked by the rise in players' transfer prices and the consecutive financial crises that clubs are facing.

To our knowledge, no article speaks directly about the impact of football players' injuries on stock returns. This study may be of interest to risk-sensitive investors seeking predictably safe equity, sports finance researchers aiming to study informational market efficiency as well as club managers dealing with player injuries; the article may assist them in making decisions related to "injury announcements, physical training, etc." A heightened risk could impact the club's ability to secure funding.

The remainder of the paper is organised as follows: in Section 1, we will present the theoretical frameworks linking both a player's injury and a club's stock return. In Section 2, we will discuss our model specification along with the data and variables. In Section 3, we will interpret the results to identify the explanatory factors.

1. Literature review

The uniqueness of this paper arises from the lack of direct articles in this field. However, multiple manuscripts address this topic, albeit indirectly or briefly. Moreover, general financial theories can illuminate this specific phenomenon.

First, it is pivotal to define the concept of an efficient stock market. Probably the foremost definition in literature is that of (Fama, 1970) who describes an efficient market as "A market in which prices always 'fully reflect' available information". Indeed, a market for football clubs that remains unaffected by critical public information, such as player injuries, would unmistakably be an inefficient one. Over time, the literature has identified three forms of market efficiency. This

article zeroes in on the semi-strong form, which posits no time lag between the release of information and its reflection in stock prices.

According to Aglietta et al. (2008), the football club stock market exhibits signs of efficiency. However, its diminutive size and the liquidity paucity of the stocks hinder true efficiency. After analysing the impact of goals scored (Croxson & James Reade, 2014) inferred that markets manifest semi-strong efficiency.

Ball and Brown (1968) discern between good and bad information, correlating it with anticipated price increases or declines, respectively. Boya and Monino (2011) introduced the notion of information colouring. Given that an injury might precipitate a decline in both sports and commercial performance, such information is perceived negatively. In a semi-strong market, stock prices would instantly mirror this news with a slump commensurate with the injury's repercussions. To illustrate this, Bedir et al. (2022) found that COVID-19 significantly and adversely affected the football index revenue.

The prosperity of a sports club is anchored in its intangible assets, predominantly player values (Benkraiem et al., 2012). For instance, intangible assets constitute over two-thirds of the total fixed assets value for the French Ligue 1 clubs (Aglietta et al., 2008). Numerous studies highlight the influence of football player transfers on market returns (Allouche & Soulez, 2008; Fotaki et al., 2023; Gimet & Montchaud, 2016). Football players' value grapples with uncertainties and monumental devaluation due to injuries whose occurrence and intensity remain unpredictable (Benkraiem et al., 2012). In a parallel vein, Tunaru et al. (2005) formulated a Poisson model underscoring the relationship between injuries and player worth.

Regarding direct costs, Ryan et al. (2019) estimated the average hospitalisation and emergency room costs for football players aged 5 to 18 in the United States to be $5,502 and $248, respectively. Similarly, Ross et al. (2022) found that joint sprains incurred the highest direct costs amounting to $6,665. Additionally, they reported that the average indirect costs – "drop in player income…" – are ten times greater than the direct costs.

Moreover, Herm et al. (2014) observed that clubs sometimes face substantial expenses when recruiting a replacement for an injured player, representing a significant financial commitment. Furthermore, Garcia-del-Barrio & Pujol, (2007) pointed out that a player's financial value is contingent upon the minutes they play. It follows that an extended absence due to injury results in a depreciation of this intangible asset.

On the one hand, we underscore the indirect relationships between injuries, sporting performance and stock prices. Several studies examine the impact of injuries on sporting performance (Figure 1). For example, Hägglund et al. (2013) noted a marked influence of injuries on the sporting achievements of clubs in the UEFA Champions League. Likewise, Sarlis et al., (2021) found a link between injuries and the sporting success of basketball clubs.

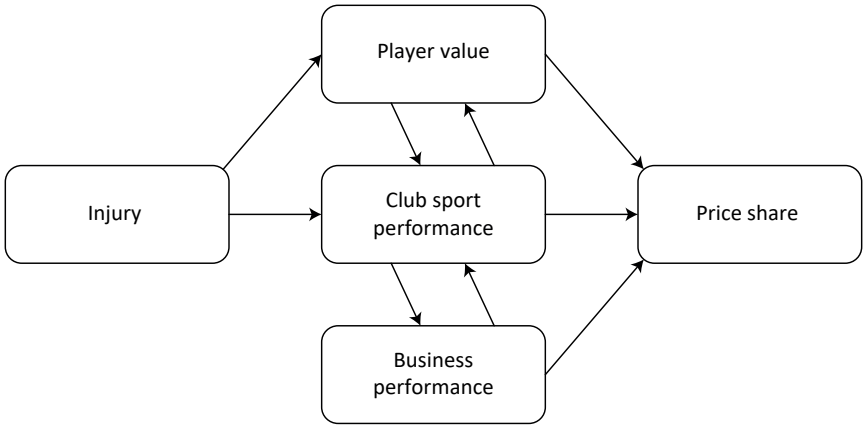

Figure 1. Influence of injuries on stock prices

Source: own elaboration.

However, Dauty and Collon (2011) alluded to the impact of absence of injury on the rankings of French football clubs in the league. The reasons for this observation might be inferred from the insights of Frick and Simmons (2008) who stressed the significance of pivoting from individual talent to team synergy. This collective performance relies on the coach's aptitude to manage the team as a unit and devise effective strategies. Thus, while injuries undoubtedly impact an individual's performance, their effect on the team's overall success is uncertain.

On the other hand, we aim to compile the literature concerning the influence of sporting performance on financial performance. Based on several studies (Callejo & Forcadell, 2006; Chadwick & Thwaites, 2005; Vrooman, 2007), sporting achievements shape indirect revenues, encompassing sponsorships, TV rights and other related products. Consequently, injuries that impair sporting outcomes can diminish stadium attendance and lead to a drop in the club's commercial income.

Additionally, fans are often regarded as the "12th player" due to their supportive roles (Davies et al., 1995). Therefore, their absence might intensify the team's underperformance. Gimet and Montchaud (2016) also verified that stadium attendance significantly influences stock prices.

Furthermore, the impact of sporting performance on stock market performance has been extensively studied. In this context, Morrow (1999) was the first to establish this connection in football. Aglietta et al. (2008) illustrated the pronounced effect of the "Rank" variable on stock prices. Benkraiem et al.(2012) detected abnormal volatility in stock prices following matches. They revealed that the market's reaction is twice as pronounced following defeats as it is in the case of victories. From this, we can infer the magnified effects of injuries on stock market performance. Floros (2014) verified the influence of match outcomes on stock prices,

highlighting variations in sensitivity, especially in the event of a draw – positive for Benfica and Ajax, but negative for Juventus.

Additionally, numerous studies highlight the inefficiency of football clubs' stock markets (Benkraiem et al., 2012; Ferreira et al., 2017). Several factors contribute to this phenomenon, including:

1. Bounded rationality (Simon, 1978). It reflects the reduced capacities of man to process information. In other words, the imperfect informational analysis process sometimes leads to misinterpretation or even ignorance of important data. This process is influenced by media coverage and behavioural factors. For example, analysis of good news in football is faster than that of bad news (Palomino et al., 2009).
2. Shareholder profile. One of the particularities of listed clubs is the diversity of investor behaviour, which is reflected in the stock price. Prigge and Tegtmeier (2019) distinguish four types of investors: financial investors, strategic investors, patron investors and fan investors. This implies that certain club shareholders prioritise financial dividends, while others are motivated by emotional dividends. The behaviour of the latter group is influenced by psychological elements, such as allegiance bias (Benkraiem et al., 2012; Kaplanski & Levy, 2010).
3. Lack of liquidity. Many clubs have small capital which affects stock prices (Bell et al., 2012). In other words, low capital creates an imbalance between supply and demand, causing stock prices to become detached from relevant information.

2. Method

The objective of this article is to validate the hypothesis of a significant effect of injuries on market return. The analysed phenomenon of "injury" is marked by unpredictability (injuries occurring on different dates, varying numbers of injuries), complicating its projection and making it challenging to measure quantitatively using a panel model. Indeed, this study relies on a methodological framework tailored to these nuances, specifically the "event study methodology". This approach is prevalent in finance for examining phenomena that could impact a company's value. The analytical process can be divided into five steps presented below.

First, it is essential to ascertain the announcement date of the event. In this context, the Transfer Market website displays the injury date. Occasionally, injuries happen when the market is inactive (on game days during the weekend, for instance), and the medical assessment that reveals the injury's severity typically takes a few hours. In such instances, the subsequent business day following the injury date is examined.

Second, defining the event periods is crucial. A defining trait of the sports realm is the plethora of events (like game outcomes, transfer speculations, coaching changes, etc.) that can occasionally coincide with the injury date. As a result, this paper opts for a brief window of "one day to sidestep the informational clutter". Moreover, the estimation period spans 60 working days, excluding the windows of preceding events.

Third, it is pivotal to model the stock returns. In this respect, the Period Mean Adjusted Model was chosen because of the weak correlation between football clubs' stock prices and the European market index (Aglietta et al., 2008; Prigge & Tegtmeier, 2019).

Fourth, the methodology involves calculating the abnormal return (ARt).

Finally, this research employed a one-tailed 5% Student test:

$$t_{Student} = \frac{AR_t}{\sigma(AR_t)} \tag{1}$$

Subsequently, we performed logistic regression to determine the sensitivity factors of stock return to injury:

$$y_i = \sum_i a_i x_i + b \tag{2}$$

where:

y_i – "binary" sensitivity,

x_i – factors "missed games, COVID, star, quarter",

a_i – regression coefficient,

b – intercept.

In 2019, there were only 22 European Football Clubs being publicly traded (see STOXX Europe Football Index composition). Hence, the selection criteria for the clubs in the sample are:

1. Liquidity: many clubs are illiquid; as a result, we have excluded FC Porto, Ruch Chorzow, etc.
2. Economic interest: we have analysed the clubs that attract international investors with a large fan community and important market capitalisation.
3. Sport performance: we have chosen clubs playing on top European levels (Champion's League) with media issues. We have ruled out clubs having a sporting crisis to avoid biased results.
4. Data availability: injury information must be accessible.

Therefore, six liquid clubs have been selected: Ajax, Borussia Dortmund, Manchester United, Olympique Lyonnais, Benfica and Juventus. Each club belongs to a different stock market and country.

Based on the event study methodology, the data have included 791 observations. The study period was from 1 July 2019 to 30 June 2022. The data was taken from Yahoo Finance, Transfer Market and The Guardian websites.

3. Results and discussion

The first reading shows a high prevalence of injuries amounting to 791 cases. Indeed, the club must manage this frequent risk. Furthermore, a great disparity in the number of injuries per team was detected from Olympique Lyonnais (39) to Borussia Dortmund (192) the high standard deviation at 53.58 confirms this observation. This finding deserves a detailed analysis to determine the causes and find some remedies to them.

As for the injury's duration, a player misses an average of 4.99 games. The Table 1 suggests a possible negative correlation between the number of injuries and the duration of absence, with the exception of Manchester United, which suffered many injuries with long durations. The medical staff and personal trainers must solve this problem. Furthermore, the results show very low sensitivity of stock market returns to injuries. Specifically, 67 events have a significant effect on returns, i.e. 8.47% of all injuries as shown in Table 1.

Table 1. Distribution of injuries per club

Team	Total injuries	Effect		Missed games	COVID		Star injury		Quarter			
		yes	no		yes	no	yes	no	Q1	Q2	Q3	Q4
Olympique Lyonnais	39	4	35	6.46	5	34	6	33	13	1	5	20
Ajax	124	4	120	4.54	5	119	9	115	39	13	35	37
Benfica	128	4	124	5.54	31	97	0	128	50	16	25	37
Manchester United	131	15	116	5.60	11	120	29	102	45	14	26	46
Juventus	177	24	153	3.89	22	155	51	126	59	28	34	56
Borussia Dortmund	192	16	176	3.89	10	182	26	166	50	31	47	64
Total	791	67	724		84	707	121	670	256	103	172	260

Source: own elaboration.

Most injuries affecting the return are related to Juventus, Manchester United and Borussia Dortmund. In other words, the Italian, American and German stock markets punish these clubs for their bad injury management.

To understand the explanatory factors of the sensitivity, we used the Logit model on all 791 events.

Table 2. Relationship between injury type and stock return

Variable		b	E.S.	Wald	ddl	Sig.	Exp(ai)
Step 1	games	–0.041	0.030	1.881	1	0.170	0.959
	star (1)	–0.182	0.324	0.315	1	0.574	0.834
	team	–	–	13.513	5	0.019	–
	team (1)	–1.356	0.582	5.426	1	0.020	0.258
	team (2)	–1.385	0.590	5.517	1	0.019	0.250
	team (3)	–0.347	0.384	0.817	1	0.366	0.707
	team (4)	0.163	0.355	0.211	1	0.646	1.177
	team (5)	–0.095	0.601	0.025	1	0.875	0.910
	quarter	–	–	2.272	4	0.686	–
	quarter (1)	–19.513	40192.970	0.000	1	1.000	0.000
	quarter (2)	0.293	0.314	0.868	1	0.351	1.340
	quarter (3)	–0.382	0.485	0.618	1	0.432	0.683
	quarter (4)	0.084	0.366	0.052	1	0.819	1.088
	COVID (1)	–0.066	0.418	0.025	1	0.875	0.936
	constant	–1.746	0.570	9.381	1	0.002	0.175

Source: own elaboration.

Despite the poor results from Table 2, the variable (team) explains the effect of injuries on abnormal returns, so the club's socio-economic environment "stock exchange, media, league, investors..." and its internal factors "business model…" determine the impact of injuries.

On the other hand, the duration of the injury is not a significant variable. Thus, the injury severity does not influence the price share, which contradicts the sports logic. Furthermore, COVID has no real effect on returns even though this infectious disease can cause several games to be postponed or championships to be stopped if it spreads.

Furthermore, the status of the injured player (star or not) is not reflected in the stock price, which contradicts the sporting reality since stars contribute to sporting victories and to the club's income. The data also refutes the relationship between the injury date and return. Given that the variable (team) is significant, we utilised regression for each club.

The Table 3 shows that the date of injury affects stock returns. In other words, an injury occurring on the eve of major playoff games, "usually in the second quarter", will have greater impact on the stock price.

Table 3. Relationship between injury type and stock return "Borussia Dortmund"

Variable		b	E.S.	Wald	ddl	Sig.	Exp(ai)
Step 1	games	–0.081	0.096	0.715	1	0.398	0.922
	star (1)	–0.693	0.715	0.939	1	0.332	0.500
	quarter	–	–	4.539	3	0.209	–
	quarter (1)	1.706	0.839	4.137	1	0.042	5.506
	quarter (2)	0.842	1.032	0.666	1	0.415	2.321
	quarter (3)	1.422	0.871	2.667	1	0.102	4.144
	COVID (1)	–1.036	0.884	1.374	1	0.241	0.355
	constant	–1.715	1.252	1.879	1	0.171	0.180

Source: own elaboration.

These signs of inefficiency can be explained by the following assumptions:

1. In line with bounded rationality (Simon, 1978), investors are inundated with a large information flow related to injuries. The analysis of this data is difficult because of the informational asymmetry, as only the club doctor has the complete information and the skills to assess the injury. Faced with this gigantic flow of information, we propose the concepts of "relative injuries" – to qualify the comparison of the club's injuries with those of its opponent at a given time, as well as "concurrent injuries" – to designate the injuries of players from the same club at the same time. Failure to take these concepts into account in this study would be the cause of weak results.
2. The behavioural factor (Benkraiem et al., 2012; Prigge & Tegtmeier, 2019) of investors since the fan shareholder acts according to emotional mechanisms at the expense of rational rules. They support their clubs regardless of the results and incidents. These phenomena can occur when the floating stock is small, so fan investors are the majority, to the detriment of other investor profiles.
3. Coach intervention can theoretically minimise the effect of injury (Frick & Simmons, 2008). He can use football tactics to fill in the absences, especially if he has high level substitutes.

Conclusion

This paper discusses the effect of football players' injuries on the stock performance of six European clubs. Referring to an event study methodology, this work raised a small impact of injuries on stock prices during the three years under analysis, mainly for Borussia Dortmund.

Moreover, the date of injury explains the effect on return, but the duration of injury, player status and COVID are insignificant variables. Furthermore, we proposed hypotheses that could explain this lack of efficiency.

In addition, we recommend a study to confirm or refute these hypotheses. Furthermore, the present article invites researchers to analyse the relative injuries and recurrences. It is important to improve the injury prediction and prevention system on the eve of major games (especially in the second quarter) for Borussia Dortmund. We also recommend that rational speculators take injuries into consideration in their strategies for the shares of Borussia Dortmund, Juventus and Manchester United.

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