ACTA VŠFS

Economic Studies and Analyses

SCIENTIFIC ARTICLES

· **MICHAEL PIRGMANN:**
Impact of Tokenisation on Economics Demographics
and Economics of Selected Crowdfunding Investments

· **INNOCENT CHILE NZEH, BENEDICT I. UZOECHINA,
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REVIEWED JOURNAL

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reviewed scientific journal

EDITORIAL

SCIENTIFIC ARTICLES

Editorial

JAN MERTL

Dear readers,

welcome to the first issue of year 2023, which continues to bring you interesting and carefully reviewed research articles. Since this issue ACTA VŠFS has updated its citation standards to widely recognized APA7 norm. While even up to now we have maintained high level of citation practice, I believe that this update will further strengthen working with literature in the journal's articles. Also, the journal's webpages were updated with current information and a refinement of its structure.

As for the actual content, we have got five research papers for you to read through.

The first one, *"Impact of tokenization on the economics of crowdfunding investments"*, came from German author and works with data from two German crowdfunding investments issued by one initiator in the real estate industry. It tries to find the impact on the demographics of the funds and the profitability for the initiator when making a structural change from a classical investment to a tokenised investment structure. The topic is interesting as current financial markets use these new techniques as a part of their evolution.

The second paper, *"Examining the Impact of Financial Openness on Domestic Interest Rate in Nigeria"*, as its name suggests is from African authors and investigates the impact of financial openness on domestic interest rate in Nigeria over the period from 1980–2020. The paper concludes that domestic interest rate in Nigeria was influenced positively by both FDI outflows and capital account openness. Based on these findings, the paper recommends that apart from the traditional policies used in the control of domestic interest rate, monetary authorities in Nigeria should also regulate capital outflows in their quest to direct interest rate to a desired direction.

The topic of the third paper *"Behavioural finance and how its behavioural biases affect German investors"* is from behavioural economics, which became a part of economic science and has got its implications on how financial markets work. It aims to evaluate the influence of behavioural biases on investing decision-making among German investors. The findings indicate that male investors are more susceptible to overconfidence and anchoring bias than female investors. However, women more likely than men fall victim to the herding bias. Generally, it shows that individual investors are prone to psychological mistakes.

In the fourth paper *"The Impact of the COVID-19 Pandemic on the German pension system"* the author returns to the covid-19 pandemic and analyses how it influenced the pensions in Germany. He takes the pandemic as an exogenous economic shock and makes comparisons of the pre-pandemic forecasts with actual development, evaluating the sustainability of the whole system.

Final, fifth paper *"Extended Workforce Ecosystems: Intelligent Bots and Freelancers with Employee ID Cards Are Changing the Workforce Paradigm"*, written by authors from two Czech universities, is focused on employment and changes in current workforce paradigms. The paper can provide organizations with comprehensive and research-based knowledge, enabling them to transition from reactive ad hoc remote work arrangements to a more sustainable and effective hybrid work approach.

I hope that you'll find the topics and their presentation in this issue interesting and valuable for your professional practice. Let me wish you a pleasant reading, as well as nice and sunny summer!

Doc. Ing. Jan Mertl, Ph.D.
executive editor

Impact of Tokenisation on Economics Demographics and Economics of Selected Crowdfunding Investments

MICHAEL PIRGMANN

Abstract

The text analyzed data from two German crowdfunding investments issued by one initiator in the real estate industry, involving a total of 1,692 investors. One fund has a classical investment structure while the initiator used an innovative approach with a tokenised investment product based on the Ethereum blockchain technology in the second one. This paper tries to find the impact on the demographics of the funds and the profitability for the initiator when making a structural change from a classical investment with a minimum investment size of EUR 1,000 to a tokenised investment structure with a minimum investment of EUR 1. The results show no impact from tokenisation on the structure of the investors´ gender and only minor impact on the age of the investors. But the findings highlight that lowering the minimum investment to EUR 1 via tokenisation to attract more investors, diminishes the profit margin for the initiator substantially. Because every investor comes at an acquisition cost, only a certain number of loss-making small investments in relation to profitable high investments can be compensated. Since it is not possible to precisely determine the density distribution of investment sizes in advance to placing a new investment, it is recommended to give up the minimum investment size of EUR 1 to avoid the risk of attracting too many investors at a deficit, hence diminishing the profit margin of the funds.

Introduction

The introduction of blockchain, tokenisation and other related distributed ledger technologies (DLTs) into the financial markets has enabled investors to exchange value without requiring the involvement of any trusted intermediary or central authority such as a bank or government (Stefanoski et al., 2020). In this context, the financial industry currently encounters the combination of two phenomena, each having the potential to change the way money is invested. One is crowdfunding, which gives retail investors access

to asset classes that were predominantly reserved for institutional and quasi-institutional investors and the second one is tokenisation which can, in principle, be used to digitize any real-world asset.

The idea of crowdfunding is simple and compelling: To fund a project or a venture, someone seeking funding, raises money from a larger number of predominantly private investors or companies instead of using traditional money sources like banks (J. Lee & Parlour, 2019). Today, these projects are always funded through internet platforms in order to manage the high numbers of participations in an efficient way. The platforms essentially act as intermediaries between the money source and the project and typically collect a fee for the service. Since the early 2000s, when internet-based crowdfunding started with an altruistic approach and was needed to finance charity projects, it has become a proliferating form for financing projects and assets, especially in recent years (Cai et al., 2021). In 2018, about 632 crowdfunding platforms collected a volume of EUR 6.5 billion. In 2020, crowdfunding platforms in Germany collected more than 1.25 billion of which the segment of real-estate crowdfunding was responsible for a volume of EUR 238.9 million (Kleverlaan et al., 2021).

One advantage of crowdfunding for investment purposes is the efficient access for retail investors to certain asset classes which commonly have a high entrance barrier due to the necessity of a minimum investment size and which are therefore dominated by institutional or quasi-institutional investors. Being able to participate in larger investments, e. g., in real estate transactions, with amounts as low as EUR 100 or even lower, can lead to higher diversification and a better risk/reward ratio for private investors. During the investment process, the investors' money will be invested in the equity or the debt position of a project, giving them some sort of share of the outcome in return (Sauermann et al., 2019). But these models come with a downside for the investors: Like most of the underlying assets, they are typically not liquid. The recent approach to tokenize investment opportunities enables a secondary market and the possibility to transfer investments among users at a low cost (James, 2019; Nassr, 2020).

The whole structure of crowdfunding combined with asset-tokenisation has striking advantages compared to conventional forms of investments. It is efficient and allows asset fractionality in a transparent and secure process (Adhami et al., 2018; Blemus & Guégan, 2020).

One of the first companies that issued such a tokenised investment via crowdfunding was the Exporo AG,[1] which is based in Hamburg, Germany. The market leader in Germany for real estate crowd funding started in 2014 as one of the first platforms in Europe to finance real estate developments through crowd investors. Until May 1st of 2023, Exporo has raised more than EUR 1 billion in equity from more than 34.500 investors across 566 Projects. In mid-2019, Exporo issued the first token-based bond on the Ethereum blockchain technology with real estate as the underlying asset in Europe. A volume of EUR 3 million was placed among private investors within a few hours (Finanzen.net, 2020).

Until today there is very little research about the effect of tokenisation on the demographics of investments. Also, despite the obvious advantages for tokenising real-world investments, there is a lack of investigations on how the investment behaviour is being influenced by the implementation of the technological innovation and its impact on the economics of an initiator when moving from a classical investment product to a tokenised investment.

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1 Please see www.exporo.com for further information

This paper utilizes available data from two funds and tries to measure the effect of asset tokenisation and lowering the entrance barrier for a real estate related investment from EUR 1,000 to EUR 1 on the demographics and tries to find the impact on the profitability for the issuer. The underlying assets for both funds are similar ground up real estate developments, located in urban areas of northern Germany. The proposed yield for both investments on an annual basis was 5.5%, while the runtime was 36 months (with the possibility to extend for 6 months). The product with the classical investment structure was marketed and closed in Q1 of 2020 while the tokenised product was marketed and closed in Q2 of 2020. The motivation for the initiator to move from a classical investment structure of a direct investment in subordinated loans in the real estate developments to a tokenised product, was the opportunity to attract more investors by lowering the entrance barrier to only EUR 1, the increased fungibility for the investors due to secondary market options and the lower administrative costs to manage the investors and their investments.[2]

This paper aims to examine the provided data for the two investments before and after tokenisation and evaluate the impact on the profitability for the initiator. It is anticipated that decreasing the entrance barrier to EUR 1 will attract more investors overall. On the other hand, the novelty of the investment form might lead to reservations regarding the tokenised product, especially among older investors. Since there is a large gender gap between male and female investors when it comes to financial innovations like e. g. cryptocurrencies (Bannier et al., 2019; I. Lee, 2021; Smutny et al., 2021), it can be anticipated, that the percentage of female investors will decline when tokenising the investment.

Overall, it is suggested that tokenisation will lead to a noticeable difference in the composition of the group of investors in both funds regarding sex, investment size, and age of the investors.

The following hypotheses are proposed:

H1: Investment amounts in the tokenised investment are in average significantly lower than in the classic investment due to a lower entrance barrier.

H2: The age of the investors of the tokenised investment is significantly lower than the age of investors of a standard investment product with a similar underlying investment.

H3: The percentage of female investors in the tokenised fund will be lower than in the classic fund.

H4: Older investors tend to invest larger amounts than younger investors, hence, a strong correlation between age and investment amount can be anticipated.

A potential change in the demographics and investment sizes has an impact on the economics. Every investor comes at a cost for acquisition and management of the investment. Hence, it is important to evaluate the change in the key performance data of the fund after tokenisation to ensure profitability for the issues as well as the investor.

The contribution of this paper is to give insights into the changing demographics and investment behaviour when significantly lowering the minimum investment amount through tokenisation and to highlight the impact on the economics for the initiator.

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2 *This information is based on correspondence with the initiator in April 2021.*

This paper is organized as follows: Firstly, it is important to understand the key components of the underlying technology. Therefore, the crucial components of the ecosystem like distributed ledger technology (DLT), blockchain, and tokenisation will be explained in the first chapter. In the second part, the available data and the assumptions will be described in detail. After that, the methods for the analysis will be explained, and the available data will be analyzed with the methods of descriptive statistics in the third chapter. The results will be presented in the fourth chapter before the discussion and conclusion of the research and its limitations in the remaining chapters.

1   Tokenisation of assets

The underlying technologies for tokenisation are DLT and the blockchain. DLT is defined as a digital ledger that allows users in a particular community to document transactions in a ledger accessible by the community in a way that cannot be altered once the transaction has been published, (Yaga et al., 2018). DLTs must have the ability to ensure multiple properties within its present system, or with very minor changes. These properties include joint recordkeeping (giving several parties the ability to collate and update verifiable records), shared-party consensus (multiple parties must be able to form agreements on the shared information to be approved), and the ability of parties to independently validate their transactional information and the integrity of the platform. Also, to provide parties with evidence (allowing individuals to discover if non-consensual adjustments have been made), and resistant to changes to the transaction history. All these properties allow a DLT system to be robust and provide a multitude of benefits to the digital currency and cryptocurrency industry (Rauchs et al., 2018). In addition, the total transaction history can be recorded in a chain, which users refer to as Blockchain (Glaser et al., 2014).

The Blockchain technology is an example of an all-purpose technology. It allows detailed and immutable tracking of transactions at low costs over a broad array of digital assets. Transactional data is stored in a sequential form across several computers simultaneously, allowing the data to be resistant to manipulation (Vagadia, 2020).

Tokenisation is a form of digitizing ownership rights over an asset using DLT, typically on a blockchain like Ethereum. All tangible and intangible goods can be tokenised by converting the value into a token. Tokens are specific objects that represent the real value of real estates, stocks, art, metals, goods and financial instruments, as well as patents and ownership rights (Kharitonova, 2021). However, a token usually does not reflect the value of the whole asset, it can be broken up and fractionalized (Stefanoski et al., 2020). The most common assets that are being tokenised are digital currencies, gold, energy commodities, securities and real estates (Forkast, 2021). Traditionally, the market for securities (equity and debt) has faced lengthy delays, excessive manual processes, and long settlement time. However, tokenisation of financial instruments can eliminate the occurrence of such issues (Heinzle, 2020; Stefanoski et al., 2020).

Tokenisation of real estate assets e. g., allows investors to obtain greater market participation as well as providing the issuers of tokens with additional capital (Laurent et al., 2018). Eventually, this can grow real estate investment markets tremendously and decrease the cost associated with the acquisition of real estate assets (Kelley, 2020).

One form of token is the security token. Security tokens, also known as asset tokens, represent assets such as debt or equity claims against the issuer as they promise the owner a share in the future profits or capital flows of the underlying corporate structure, such as dividends or interest. Security tokens are offered via so called Security Token Offerings (STO) and usually fall under regulatory compliance in their jurisdiction (Kharitonova, 2021). Because the issuer in an STO must prove ownership of the underlying asset and undergo a formal process, an STO can be compared to an Initial Public Offering (IPO) or the issuing of an asset backed security (ABS). Security tokens are expected to become the largest token market because of the benefits of fractional ownership and increased liquidity (Nassr, 2021; OECD, 2020a). One of the analyzed funds (Fund B) was issued via such an STO, and its token is based on the Ethereum blockchain according to the ERC-20 standard.

2 Data and Assumptions

The available data comprise two crowdfunding investor groups A and B which invested in different fund-like structures. Group A and group B both comprise male and female investors above the legally required minimum age of 18, who are domiciled in Germany. There were no further criteria for investors to fulfil to engage in the investments. Both groups invested in fractionalized unsecured real estate construction loans with a proposed interest rate of 5.5% p. a. and a lifespan of 3 years. Both investments were funded through the internet-based crowdfunding platform www.Exporo.de with a comparable real estate as the underlying asset. Only the age, sex and investment amount were available. Due to data protection laws in Germany, other data like income and free liquidity of the investors was not available for the analysis. The data for fund A was collected in Q1 while the data for fund B was aggregated in Q2 of 2020. The difference between both groups is that group A invested via a classical structure by buying shared interests with a minimum investment of EUR 1,000 while group B invested in a tokenised investment via a STO with a minimum investment of EUR 1. The data labelled as representative and non-confidential was kindly provided by Exporo in March of 2021 via an Excel Sheet and then imported by the author into R Studio for analysis.

Table 1: Summary of the available Data

	Number of investors	Total fund volume (in Euro)	Number of male investors	Number of female investors
Fund A	743	1,802,000	636 (85.6%)	107 (14.4%)
Fund B	949	2,107,320	780 (82.2%)	169 (17.8%)

To later interpret the data, we need to look at some of the Key Performance Indicators (KPIs) of the funds on the income as well as the expense side and put them into perspective with the received data.

On the income side, the gross profit margin (GPM) for the initiator is roughly 5% of the total fund volume.[3] The GPM can be used to cover costs connected to the emissi-

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3 The GPM of 5% is based on the analyzed information of the legally mandatory public information for both funds, the WIB (Wertpapier-Informationsblatt).

on of the funds, e. g. for setup and legal expenses. On the expense side, an initiator has Customer Acquisition Costs (CAC, for marketing, buying leads etc.), which in case of these crowdfunding products is close to EUR 350 per investor.[4] The CAC is unrelated to the investment amount and whether the investor chooses the standard or the tokenised product. Since an investor can make multiple investments, the average CAC per fund will go down as the number of investments increase. In average an investor invests approximately 5 times into different funds of the initiator.[5] This multiple applies to all investors in Funds A and B. Thus, the average CAC per investor per fund is EUR 70.

Obviously, with a fixed income (of 5% of the fund volume) on one side and the variable costs depending on the number of investors in relation to the fund volume on the other side, the goal is to fully place a fund with the fewest number of investors, hence, with investors investing amounts as high as possible.

The data comprised two funds, each with a significant number of investors. Still, the underlying data can be considered limited in relation to the whole industry.

3 Methods

The data were analyzed via descriptive statistical methods in R Studio (R Studio Team, 2015) using the tidyverse package ver. 2.0.0 (Wickham et al., 2019). The data were not altered in any way and all data were used to create data-frames for the analysis.

For the analysis the 3 variables age, gender, and *investment amount* for each fund were taken and the data were compared to evaluate whether there is a change from the classical product to the tokenised investment which could have an impact on demographics and the economics. The following descriptive statistical methods (Benninghaus, 2007) were used for the analysis:

1. Summary function to get the highest and lowest amount invested, median, mean, and first and third quartile of both funds separately.
2. Violin function to get a compact image of the continuous density distribution of the investment amounts of both funds.
3. Histogram to get an illustration of the age distribution of both funds in comparison.
4. Boxplot to get an image of the density distribution and the median of the amounts invested separated by gender for both funds.
5. Simple regression to see a possible correlation between age and the invested amounts for both funds.

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4 A total CAC of EUR 350 is - for confidentiality reasons - not the exact number for these two funds but an approximation based on email correspondence with the initiator in April 2021.
5 This number is based on correspondence with the initiator in April 2021.

4   Results

The summary function shows a mean of EUR 2,425 for fund A and EUR 2,221 for fund B. The median, which cuts the number of datasets in each data frame in half, shows the same median of EUR 1,000 while the first quartile for fund A is EUR 1,000, opposed to EUR 500 of the second fund, showing a lower amount for 25% of the data. The third quartile is the same for both funds, at EUR 2,000.

A visualization with the violin function (Figure 1) shows a more detailed picture. The mirrored density functions for the *investment amounts* for Fund A and Fund B show a clear difference in the distribution of individual *investment amounts*. The violin function also confirms the above results, that the overall shape above the third quartile is similar, while the lower part of the violin is shifted towards the 1 EUR mark.

Figure 1: Violin Diagram of the Investment Amount Distribution of Fund A and B
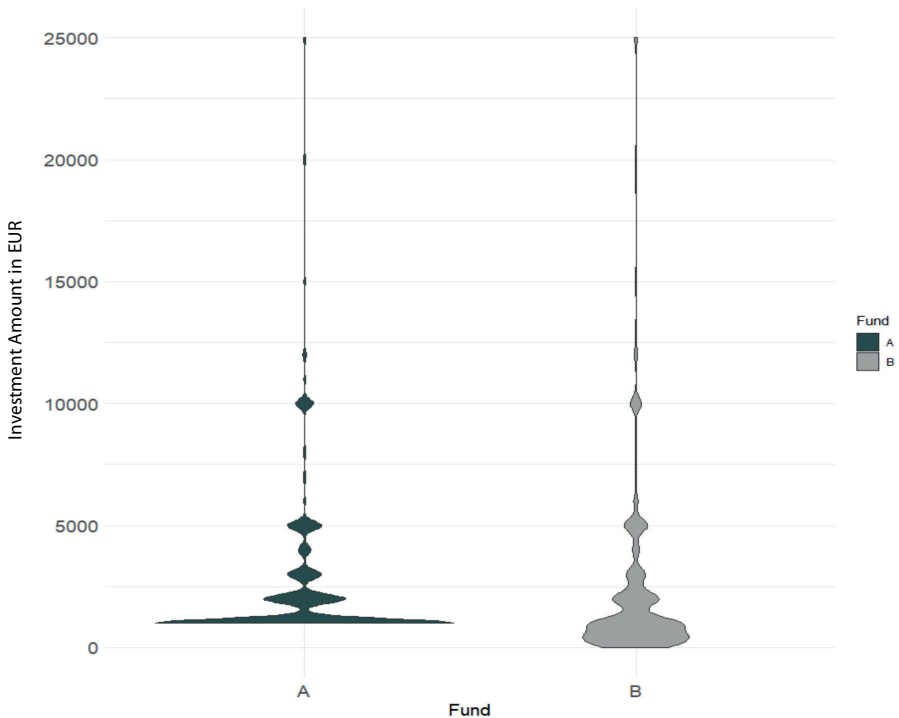
Fund A has the largest number of investments on and above the minimum *investment amount* of EUR 1,000. Fund B shows a different picture, showing a larger amount of investments below the EUR 1,000 mark, as the minimum investment for Fund B was set to EUR 1. Hence, the analysis of the data so far shows that the average amount invested in the tokenised product is lower than in the classic product. Thus, the first Hypothesis (H1) that *investment amounts* in tokenised investments are in average significantly lower than in classic investments due to a lower entrance barrier can – in the case of the analyzed projects – be confirmed.

Analysis of the Age Distribution

The analysis of the age structure in both funds highlights that the investors in the tokenised fund tend to be slightly older than those in the standard investment. A histogram (Figure 2) shows a good picture of the age distribution in Fund A versus Fund B. The histogram displays that the investors in Fund A were born later than those in Fund B. The summary function of the histogram shows that the mean of the investors in Fund A was born in 1971, while the mean in Fund B was born in 1967.

Figure 2: Histogram of the Age Distribution of Fund A and B
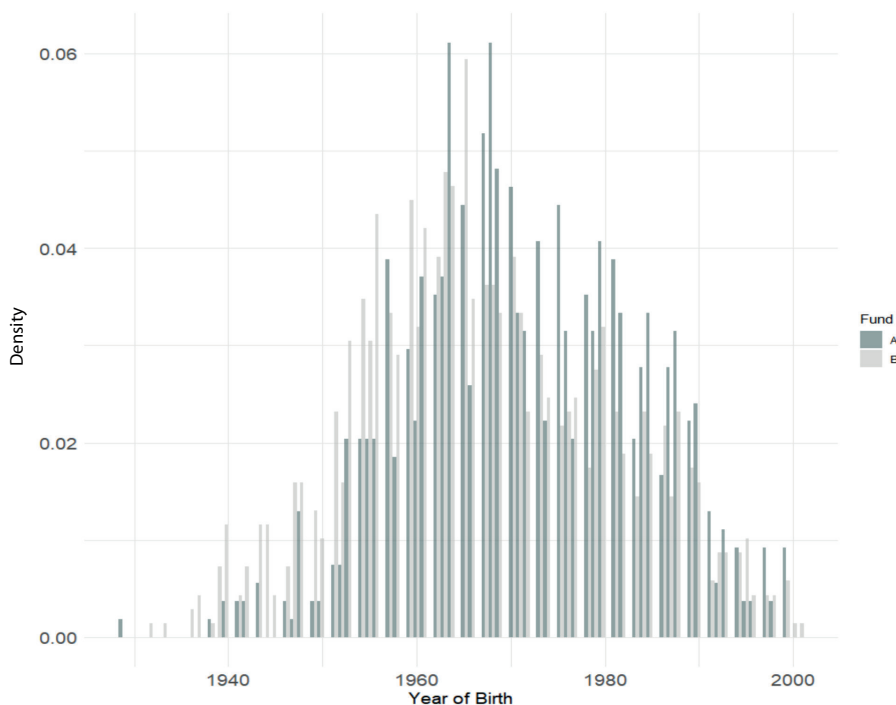
The second hypothesis (H2) suggests that the tokenised product will most likely attract younger investors due to the novelty of the investment form. However, as we can see from the analysis of the age distribution, the tokenised product has slightly older investors compared to the standard fund, so the second hypothesis – which assumes that tokenisation attracts younger investors than the standard product – could not be validated.

Boxplot of the investment amounts depending on gender

The analysis of the distribution in *investment amounts* of both funds depending on gender shows an evenly distributed picture. H3 assumes that the percentage of female investors might decline after tokenisation, but no relevant impact of the tokenisation on either gender could be found. Thus, the third hypothesis could not be supported by the data and can be stated as false.

Figure 3: Boxplot of Investment Amounts on Gender for Fund A and B
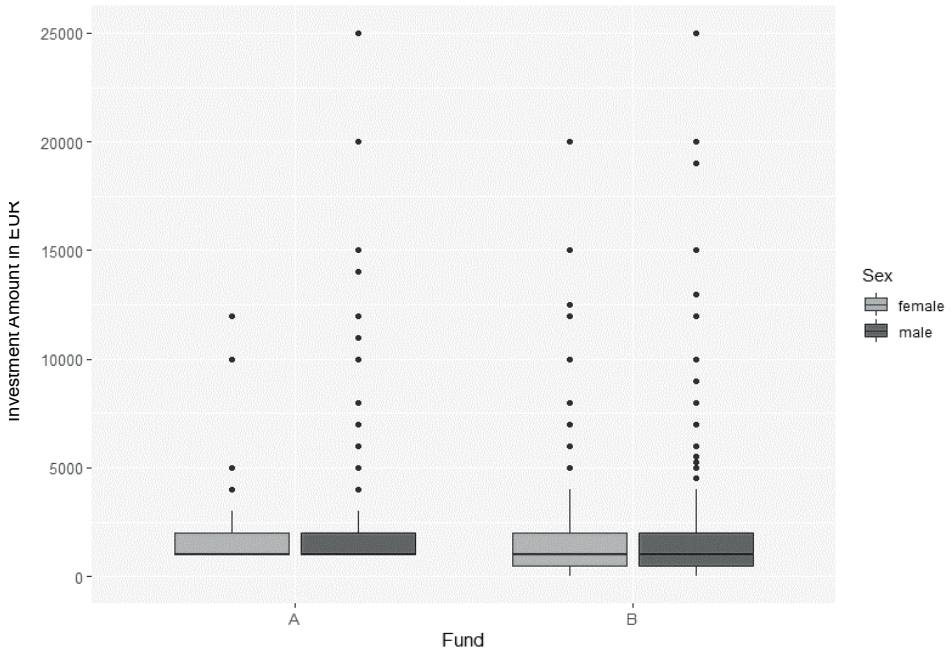
Regression of investment sizes depending on the age of investors

The simple regressions with the variable *investment amount* depending on the independent variable *age*, show that the older investors in both funds tend to invest significantly more than the younger investors (Figure 4; for better visibility the investment amount is on a logarithmic scale). The low *p-values* of 4.71^{-11} for Fund A and 4.885^{-11} for Fund B show that the null-hypothesis should be rejected. The test with the Spearman´s rank correlation coefficient shows results of -0.22 for Fund A and -0.38 for Fund B with *p-values* of 2.8^{-16} for Fund A and 2.2^{-16} for Fund B, confirming the significance of the results. The fourth hypothesis (H4) suggests that older investors tend to invest larger amounts than younger investors. The data clearly supports this hypothesis. Thus, H4 could be validated.

Figure 4: Simple Regression of Investment Sizes depending on Age on a logarithmic scale

5   Discussion

Modern technologies can increase access of investors to forms of investments that were not available in previous times. It becomes imperative for scientific research to understand the demographics of the individuals utilizing these investment forms. A nuanced understanding of their distribution across age, gender, and other demographic factors can shed light on the influences driving people towards specific investments. Furthermore, an exploration of the profitability for the issuer of the investments as well as the investors is necessary.

The differences and unique characteristics of the different investment forms like cryptocurrencies make it challenging to establish direct comparisons to the tokenised investment which we can find in the preceding analysis.

However, due to the novelty of this field, data availability is sparse, which limits our capacity to draw concrete conclusions at this time. Consequently, there are only a limited number of studies that align closely with our research focus. Nevertheless, we will briefly discuss a few that bear relevance to our topic, providing a broader context and framework for our investigation.

In this study, we assessed the differences between investments in two distinct funds: a traditional product (Fund A) and a tokenised product (Fund B). The results provide insight into the impact of tokenisation on investment behaviours, age distribution and the gender balance of the investors.

The first hypothesis (H1), which assumes that investment amounts in the tokenised product are on average significantly lower than in classic investments due to a lower entrance barrier, was validated. We found that the mean of the investment size of the tokenised product was much lower than the ones of the traditional product. This is consistent with conclusion of the OECD, which found that tokenisation enables fractional ownership, which permits lower investment amounts and thus increases accessibility (OECD, 2020b, 2020a). These finding aligns with the results from other researchers, which conclude that tokenisation allows smaller investment sizes, thus lowering entry barriers (Barnes, 2020; Chang, 2020; Smith et al., 2019; Tian et al., 2020).

Contrary to our expectations, the second hypothesis (H2), which suggests that younger investors would be more attracted to tokenised investments, was not supported. The mean of investors in the tokenised fund was born in 1967 while the mean of the investors in the classic investment was born in 1971, so the investors in the tokenised product were older. This seems to contradict the popular belief, which was also supported by various researchers, that younger investors are more inclined towards novel and digital investment forms. A survey by Bohr showed an average age of the Bitcoin user of 33 years (Bohr & Bashir, 2014) while a different survey in 2016 showed an average age of 38, with the youngest being 19 while the oldest Bitcoin user was 66 (Presthus & O'Malley, 2017).

A possible explanation for this surprising result can be deducted from the research by Arli et al. The researchers showed that trust in the issuer of an investment can lead to a higher trust in the investment itself and can positively influence the investment decision (Arli et al., 2021). Though the underlying technology is very similar, the nature of investing into cryptocurrencies significantly differs from an investment into a tokenised real estate investment. The results suggest, that in the case of the analyzed funds, investors rather concentrate on the underlying asset than on the underlying technology.

The third hypothesis (H3) proposes that the gender distribution between the traditional and the tokenised investment, might be skewed further towards male investors in the tokenised product. But no significant difference could be found between the classic and the tokenised product. In a related research regarding barriers of investing into cryptocurrencies, the researchers found, that the attitude of men and woman are very similar when it comes to investments where investors have a lack of information or experience with the investment (Smutny et al., 2021). In general, it is worth pointing out that there is still a large gender gap when it comes to investing in nascent asset classes like cryptocurrencies. A study from Bannier et al. assesses the financial literacy of women, especially for financial innovations like Bitcoin. They point out, that women in general have a much lower fintech knowledge (Bannier et al., 2019). Smutny et. al conclude, that women are discouraged by investment barriers more frequently than men (Smutny et al., 2021). A research from Presthus and O´Malley showed the percentage of female investors in Bitcoin to be around 24% (Presthus & O'Malley, 2017). A research from Sukumaran et al in 2022 among the Malaysian retail investors showed a similar result (Sukumaran et al., 2022).

The lack of significant change in gender distribution when moving from the classical product to the tokenised investment indicates that tokenisation alone may not be enough to further address gender imbalance in investing.

Lastly, the fourth hypothesis (H4) suggests that older investors in the funds tend to invest larger amounts than younger investors. A hypothesis that was supported by the results. This aligns with the lifecycle hypothesis of saving, which was formulated in 1954 by Modi-

gliani and his student Brumberg. It suggests that individuals tend to save and invest more as they age and as their income rises (Deaton, 2005). It could be assumed that the tendency to invest higher amounts with increasing age would be softened by the deterring effect on elder people of implementing a novel technology like tokenisation. But this does not seem to be the case. This interesting result was also concluded by researchers such as Smutny et al. who found, that older generations like the generation x (born 1965–1979) are also open to use new technologies like younger generations such as the millennials which were born between the early 1980s and the late 1990s (Smutny et al., 2021).

Overall, the above results suggest that, in alignment with the findings of Arli et al. (Arli et al., 2021), the trust of the investor in the underlying asset and the issuer seems to be more important in the researched case of tokenising a classical investment with a real estate development as the underlying asset, than the deterring effect of the novelty and potential risks of a tokenised product. So, the process of tokenisation alone does not seem to drastically influence the demographics of the funds as it could be shown by various research regarding investments in other asset classes with a common technological background such as cryptocurrencies. Still, future research should delve deeper into the motivations and deterrents for different demographic groups in relation to tokenised investments.

The demographics are also relevant for the economics of the funds. It is the intent of an initiator to maximize the profits generated from each fund. In our simplified model, the set gross margin (GPM) of 5% on the overall fund volume is EUR 90,100 for Fund A and EUR 105,366 for the slightly larger Fund B. With a set customer acquisition cost (CAC) of EUR 70 per investor for each fund, the maximum number of investors allowed was 1,287 for Fund A (while the actual number is 743) and 1,505 for Fund B (while the actual number is 949) before generating a loss. With the GPM and the CAC being the same for both funds, the average investment per investor to break-even is the same for both funds at EUR 1,400 (*CAC / GPM* = EUR 70 / 5% = EUR 1,400).

Our analysis showed that a significant number of investors took advantage of the possibility to invest a rather small amount, as low as EUR 1, in the tokenised product. There is a high density of investors in Fund B investing below the minimum investment of Fund A. The analysis also showed that while the minimum investment amount of EUR 1,000 is closer to break-even in Fund A, it is way off in Fund B with a minimum investment of EUR 1. The mean for the standard product is also higher at EUR 2,425 for Fund A vs. EUR 2,221 for Fund B, thus generating a lower margin in the tokenised product overall. Because of these findings, it is recommended to abandon the minimum investment of EUR 1 because it attracts too many investors which leads to a loss per investor. Increasing the minimum investment to the break-even point of EUR 1,400 instead, could lead to a barrier which is too high for most investors, scaring investors away that might increase investment amounts in future funds. The right number for a minimum investment cannot be determined with the available data because changing the eligibility criteria for investors would also lead to a shift of the other parameter and change in the investment size density function of the funds. But still, the analysis could show a distinct negative impact on the economics of a fund when using the possibilities of tokenisation and lowering the minimum investment amount to EUR 1. As the CAC stays the same when tokenizing an investment, and too many investors seem to invest significantly below break-even, the minimum investment needs to be increased to lower the risk of initiating funds at a loss for the initiator.

Conclusion

Over the course of this paper, two funds were analyzed, and the results were put in context with findings of existing research. Fund A had a classic structure with a minimum investment of EUR 1,000 while Fund B was a tokenised product with a minimum investment of EUR 1. Fund A has 743 investors while Fund B contains 949 investors. The tokenised product was based on the distributed ledger technology, with a security token according to the ERC-20 standard on the Ethereum blockchain representing the value. Despite this difference, the number of investors, the fund size as well as the underlying asset were comparable. The purpose of analysing the data of both funds was to get a better understanding of the demographics of both funds and insights into the economics of the difference between un-tokenised and tokenised investment vehicles.

The results of the analysis showed that older investors tend to invest more than younger investors, as it could be anticipated, due to various research regarding this topic. Also, it can be inferred that the act of tokenisation does not seem to have a huge impact on the age of the investors, though it could be concluded that the mean age of the investors in Fund B is slightly higher. Furthermore, due to the large gender gap in fintech investment, which some researchers attribute to the lack of literacy of women regarding financial innovations, the hypothesis was made ahead of the analysis that tokenisation would lead to an even lower percentage of women in Fund B. This hypothesis could not be verified. Together with the interesting result of the slightly higher mean age of the investors in the tokenised investment, it can be assumed, that tokenisation alone does not drastically influence the demographics of the funds. It can be suggested that the investors rather assess the underlying asset and the initiator than the underlying technology for the investment.

The results could also show that lowering the entrance barrier as low as EUR 1 lead to a high volume of investing amounts significantly beneath the break-even point for an initiator, which in the analyzed funds is an average investment of EUR 1,400 per investor. Since every investor comes at a certain acquisition and ongoing management cost, a fund can only accept a limited number of investors before turning into the red for the initiator. Also, the distribution of the investment amounts cannot be precisely predicted, making a high number of investors with a negative customer-lifetime-value for the initiator likely. Therefore, it is highly recommended for an initiator to increase the minimum investment amount of EUR 1 and move the entrance barrier closer to the break-even point, which in the portrayed case is EUR 1,400.

In summary, our research contributes to the understanding of the impact of tokenisation on investment behaviour, providing insights for both academics, and practitioners in the finance industry. But despite the interesting findings, this study was subject to certain limitations. The data was sourced from only two funds, which might not be representative of the broader landscape of traditional and tokenised investment products. Thus, the results cannot be generalized. Also, due to the lack of available data, other potentially important factors that might influence investment behaviours, such as investors' income level, occupation, or education, could not be considered. Thus, this study provides interesting insights into the emerging field of tokenised investments and underscores the importance of further research. Therefore, it is recommended that future research should conduct more comprehensive analyses by including a wider range of funds from different market participants and considering additional factors.

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List of abbreviations:

STO   - Security Token Offering

KPI   - Key Performance Indicator

CAC   - Customer Acquisition Costs

CLV   - Customer Lifetime Value

GPM   - Gross Profit Margin

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Examining the Impact of Financial Openness on Domestic Interest Rate in Nigeria

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Abstract

The sensitive role played by domestic interest rate in the economy has made studies on its determinants paramount. This study therefore used the autoregressive distributed lag (ARDL) bounds framework to investigate the impact of financial openness on domestic interest rate in Nigeria over the period from 1980–2020. The study included three de facto financial openness measures, namely: foreign direct investment (FDI) inflows, FDI outflows and portfolio investment as well as one de jure financial openness measure, namely: capital account openness. The short-run results revealed that while FDI inflows had a negative but non-significant impact on domestic interest rate, the impact of FDI outflows was positive and significant. The short-run results also indicated that while foreign portfolio investment had a positive but non-significant impact on domestic interest rate, the impact of capital account openness was positive and significant. In the long-run, the study revealed that FDI inflows had a negative but non-significant impact on domestic interest rate. In another vein, while FDI outflows was found to impact on domestic interest rate positively, the impact of capital account openness was also found to be positive. The study therefore concludes that domestic interest rate in Nigeria was influenced positively by both FDI outflows and capital account openness in the two time horizons and this has implications for monetary policy setting. Based on these findings, the study recommends that apart from the traditional policies used in the control of domestic interest rate, monetary authorities in Nigeria should also regulate capital outflows in their quest to direct interest rate to a desired direction.

1   Introduction

Financial openness has of recent times become a policy focus of many economies, especially less developed economies that need capital inflows to support their quest for growth. The increased financial integration resulting from financial openness has engendered global economic development as a result of cheap access to capital in international markets. The paradigm shift from financial repression to financial liberalization is upon

the realization that foreign investors will channel their investments to financial jurisdictions where returns on investment are guaranteed. Prior to the current surges in financial openness among countries, financial repression was the order of the day, especially in developing countries. As observed by Sulaiman, Oke and Azeez (2012), before the recent financial liberalization, the practice of financial repression was a major feature of governments of developing countries. The study noted that during this period, the role of resource allocation was vested in the government or its agencies, thus relegating the market forces to the background.

Notwithstanding the positive side of financial openness, some views have been expressed concerning its capability to cause some changes in the macroeconomic environment and domestic interest rate is among the macroeconomic variables likely to be affected. As contended by Aslanoğlu (2012), in order to avoid the appreciation of domestic currency in a period of rising portfolio investments, the monetary authorities could either embark on open market operations (OMO) or the purchase of foreign currency. The use of OMO to sterilize huge capital inflows leads to a rise in domestic interest rate as the open market sale of domestic bonds encourages the widening of interest rate differentials (Okpanachi, 2013). As observed by Ljubaj, Martinis and Mrkalj (2010), the rise in domestic interest rate owing to this policy could lead to further rise in capital inflows since foreign investors may try to take advantage of it by investing more in the domestic economy. The implication of this development is a repeated need to engage in further sterilization. On the other hand, if the monetary authorities embark on the purchase of foreign exchange rate to sterilize the rising inflows, such practice encourages a rise in money supply and consequently, a decline in domestic interest rate. Falling domestic interest rate in relation to foreign interest rate may lead to capital outflows which drains liquidity in the system. On the contrary, the fall in domestic interest rate has the tendency to boost domestic investment as the cost of capital becomes cheap.

With this brief scenario, it is obvious that financial openness could have dual impact on domestic interest rate as it could either raise it or reduce it. If financial openness encourages capital inflows, such phenomenon raises money supply and thus, lowers domestic interest rate. On the other hand, if it raises capital outflows, money supply reduces and such has the tendency to raise domestic interest rate. Worthy of note is that each direction the interest rate moves as a result of financial openness has implications for the macroeconomic environment. Past studies have focused on the impact of financial openness on the economic growth. These studies neglect the fact that the impact of financial openness on economic growth is not a direct process, but key variables such as interest rate are impacted before they transmit to economic growth. This paper therefore advances the frontier of knowledge on this topic by empirically examining the behaviour of domestic interest to fluctuations in the indicators of financial openness in Nigeria. The choice of the country is based on, among others, the fact that it is among the biggest economies in Africa and as such, major destination for capital flows. The rationale for disaggregating the indicators of financial openness and examining their individual impact on domestic interest rate is very germane for policy simulation in Nigeria.

The rest of the study is structured as follows: Section 2 deals with a review of relevant literature. In section 3 data and the methodology used in the study were presented

as well as model specifications and the technique of estimation. In section 4, the results of the analysis were presented and discussed. Section 5 presents the conclusion of the study with accompanying policy recommendations.

2 Literature Review

2.1 Theoretical Literature

Some theoretical views have been raised concerning the impact of financial openness on the economy. Jorgenson (1963) examined the influence of real interest rates on investment. By deriving the desired stock of capital, the study noted that this is a function of real output and the opportunity cost of capital. It was the conclusion of the paper that the desired capital stock has a positive link with output and inversely related to the cost of capital. Thus, a fall in the real interest rate leads to a decline in the opportunity cost of capital, while raising the desired capital stock and investment. In their study, McKinnon and Shaw (1973) postulated that both the quantity and quality of total investment can be lowered by financial repression, while financial liberalization has the tendency to raise investment; encouraging productivity. The scholars contended that the regulation of interest rate owing to financial repression results in low interest rate, retards savings and thus, reduces investment. The conclusion of the McKinnon and Shaw (1973) hypothesis is that deregulating interest rate raises interest rate which enhances both savings and investment, hence an improvement in economic growth.

In a different vein, Bacchetta (1992) observed that financial liberalization encourages capital inflows which raises capital stock. The study noted that higher domestic interest rate encourages inflows of foreign capital, causing domestic currency appreciation. However, rising domestic interest rate also results in arbitrage in foreign and domestic interest rates, causing capital outflows which end up resulting in domestic currency depreciation. To corroborate the positive impact of financial openness, Levine (2001) noted that financial openness helps to develop the domestic financial system, encouraging domestic investment and the efficient allocation of capital. Notwithstanding the hypothesized positive effects of financial openness, some scholars have raised concern that it may not actually encourage economic growth. Some scholars such as Stiglitz (2000) are thus of the view that financial openness does not actually guarantee welfare, especially in view of the inherent distortions among which are barriers to trade, weak institutions and imbalances in the economy.

2.2 Empirical Literature

The role of financial openness in the economy has sparked off research interests across different countries as empirical evidences have shown that financial openness affects the macroeconomic variables in different ways.

In Nigeria, Sulaiman, Oke and Azeez (2012) employed the Johansen co-integration in addition to the error correction model (ECM) to show that financial liberalization enhanced economic growth. In support of this, Orji, Ogbuabor and Orji (2015) adopted the ordinary least squares (OLS) and the cointegration technique to reveal that both financial liberalization and private investment influenced economic growth positively and significantly in Nigeria. On the other hand, the paper observed that real lending rate adversely impacted economic growth. In another study for Nigeria, Saifullahi and Nuruddeen (2015) used the vector error correction model (VECM) and Granger causality test to show that a negative relationship existed between real GDP and financial openness.

For Asian countries, findings by Wei (2015) indicated that, while de facto indicators of financial openness encouraged economic growth, de jure indicators adversely affected it. For sub-Saharan African countries, Egbetunde, Ayinde and Balogun (2017) employed both panel cointegration and panel error correction techniques to reveal that trade openness and price stability were important factors for interest rate liberalization. In another cross-country study involving 135 countries, Aizenman, Cheung and Ito (2017) observed that in developing countries, high nominal interest rate encouraged the substitution of the real interest rate on private savings. However, in industrial and emerging economies, when nominal interest rate was less than 2.5%, the substitution effect prevailed. In another study for Nigeria, Ajogbeje, Adeniyi and Egwaikhide (2018) revealed that capital mobility had significant effect on interest rate in the long run. More so, finding of the study indicated that exchange rate stability and monetary independence had no effect on interest rate.

In Pakistan, Hye and Lau (2018) investigated the impact of financial and trade liberalization on private savings using the ARDL approach to cointegration. The results indicate that public savings, deposit rate, private income and financial system liberalization had a positive impact on private savings. However, capital account liberalization, old age dependency and financial openness were found to negatively impact on private savings. Trade liberalization was also revealed to have negative impact on private savings even though the result was not significant. In another country-specific study, Fasanya and Olayemi (2020) used the autoregressive distributed lag (ARDL) bounds technique to show that a strong relationship exists between the indicators of financial liberalization and economic growth in Nigeria.

In another study for Nigeria, Afolabia (2020) used the dynamic ordinary least square (DOLS) estimation technique to investigate the effect of financial liberalization, trade openness and their interactive effects on the economy over the period from 1981 to 2018. Findings of the study showed that financial development, interest rate spread and exchange rate impacted on the real GDP significantly, but trade openness and its interaction with financial development were not found to significantly have an impact.

In sub-Saharan African (SSA) countries, Aremo and Arambada (2021) used the difference generalized method of moments (GMM) and system GMM to investigate the individual and joint impacts of financial openness and trade openness on economic growth over the period from 1980 and 2017. Findings of the study revealed that in low income countries, trade openness had a positive and significant impact on economic growth. On the other hand, financial openness and the joint trade and financial openness were not found

to have significant positive impact on economic growth. The result for middle-income countries showed that the impact of trade openness on economic growth was mixed, while both financial openness and the joint trade and financial openness were not able to improve economic growth.

Aman *et al.* (2022) employed annual panel data for 35 developed and emerging countries to examine if financial openness in the countries sampled can assist in preserving their external price competitiveness in the presence of trade openness and institutional quality. Findings of the study revealed that only financial openness can hardly assist export competitiveness, unless this is complemented with greater trade openness. Also stronger institutional quality was found to support financial openness in achieving export competitiveness at both cross country and regional analyses.

In a cross-country study, Nzeh *et al.* (2023) investigated the impact of financial liberalization and institutional quality on the economic performance of the Asian Tigers and the SANE countries. By using annual series that spanned the period from 1996–2020 under the framework of the fully modified ordinary least square (FMOLS), the study showed that while FDI outflows, capital account openness, governance effectiveness and FDI inflows had a positive and significant impact on GDP per capita in the Asian Tigers, the impact of political stability was negative and significant. On the other hand, results for the SANE countries revealed that trade openness and FDI inflows had a positive and significant impact on GDP per capita, while the impact of capital account openness was found to be negative and significant.

From the foregoing empirical studies, it should be noted that past studies on financial openness were silent on its role in influencing domestic interest rate. With the exception of Ajogbeje, Adeniyi and Egwaikhide (2018) which revealed the influence of capital mobility on interest rate in Nigeria, other studies reviewed concentrated mainly on the impact of financial openness on economic growth. This study therefore contributes to literature by disaggregating the measures of financial openness and evaluating their individual influence on domestic interest rate in Nigeria.

2.3 Trend analyses of Some Variables

In this sub-section, the study provides trend analyses of some of the variables used in the study. Evidence in Figure 1 shows that the trend of FDI inflows exceeded that of FDI outflows in Nigeria in all the sample period. The trend result indicates that prior to 1989, FDI inflows was very low and it should be noted that these periods coincided with the pre-structural adjustment programme (SAP) era when the country had not embraced fully financial openness. It should be noted that the SAP was implemented in Nigeria in1986 as an economic blueprint meant to realign the country's economy. The country had the highest FDI inflows in 1994 but after this period, there was a sharp decline. During the pre-SAP era, the trend of FDI outflows was flat all through until in 1989 when it experienced a rising trend. With the exception of 1989 and 1993 when the FDI outflows attained a peak, the trend for other subsequent years was almost flat. Evidence of the trend of FDI flows indicated that before the commencement of the SAP in 1986, the country practiced financial repression that hindered FDI flows but the emergence of the SAP liberalized

the financial sector and this resulted in improved capital flows. Evidence also indicated that in 2005 and 2009, FDI inflows rose high after which it trended low. The trend of FDI outflows however marginally rose from 2006 through 2009. The rise in the activities of the Nigerian capital market within these periods led to the rising trend in these variables, but the aftermath of the global financial crisis of that period caused the fall in their trend after 2009.

Figure 1: Trend in FDII and FDIO from 1980–2020
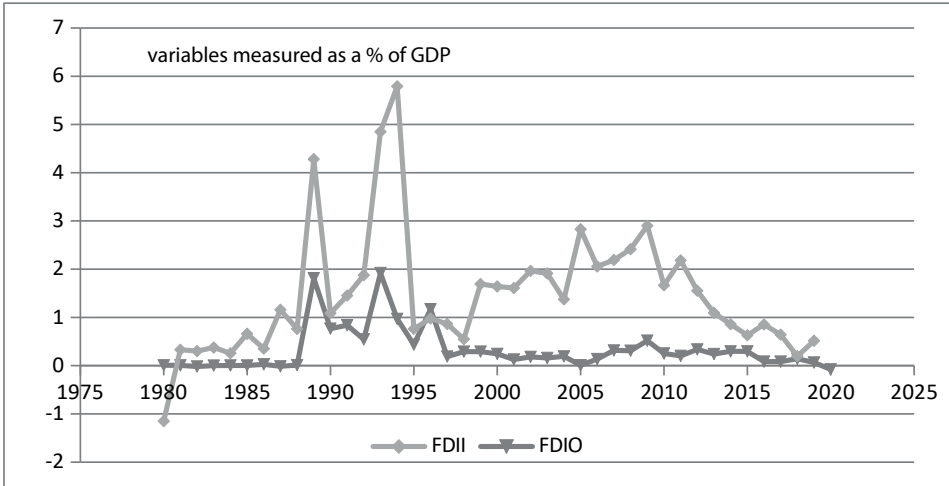
Note: FDII – foreign direct investment inflows, FDIO – foreign direct investment
Outflows
Source: WDI (2020)

With respect to the trend in the portfolio investment as shown Figure 2, evidence shows that the trend was flat up until 2008 when it rose relatively high. The Nigerian capital market experienced a boom within this period until the effect of the subprime mortgage crisis that hit the global financial markets. After 2008, there was a drastic fall in portfolio investment as the trend approached negative between 2012 and 2017. In 2019, the variable trended up but descended sharply within the same period. In a nutshell, the trend of portfolio investment for Nigeria is an indication of the extent of the capital market development in the country.

Figure 2: Trend of Portfolio Investment
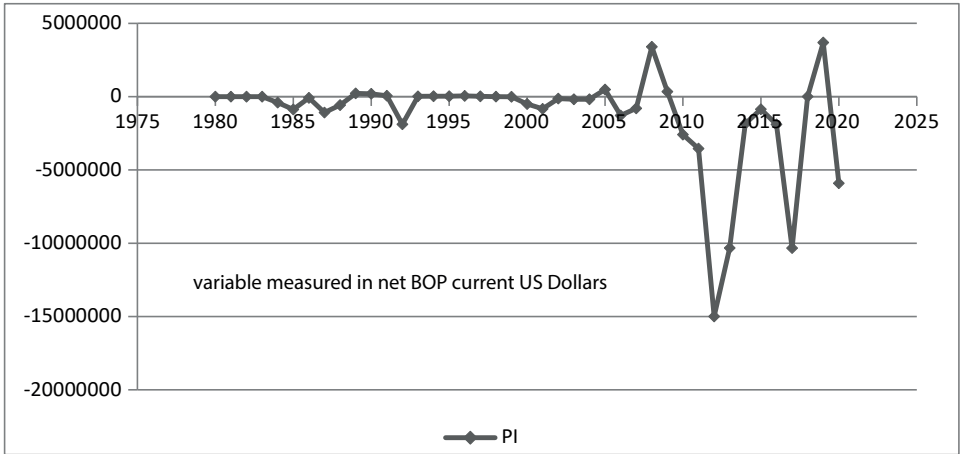
Note: PI – portfolio investment

Source: WDI (2020)

In Figure 3, the trend of real interest rate shows that the trend fluctuated heavily within the period. In 1980, 1992, 1994 and 1995 the trend of real interest rate was negative. Two scenarios played within these periods which can be argued to be responsible for the development. One is the impact of financial repression which shaped the interest rate regime of that period until the introduction of SAP which liberalized the interest rate. The second phenomenon that may have led to the negative trend of interest rate is the military regime which was in place within these periods. After 1996 the trend of interest rate became positive all through the sample period. Evidence reveals that interest rate was high around 2007 through 2009 after which it experienced a drastic fall. The impact of the boom and burst that occurred within this period can be held responsible for the trend.

Figure 3: Trend of Real Interest Rate
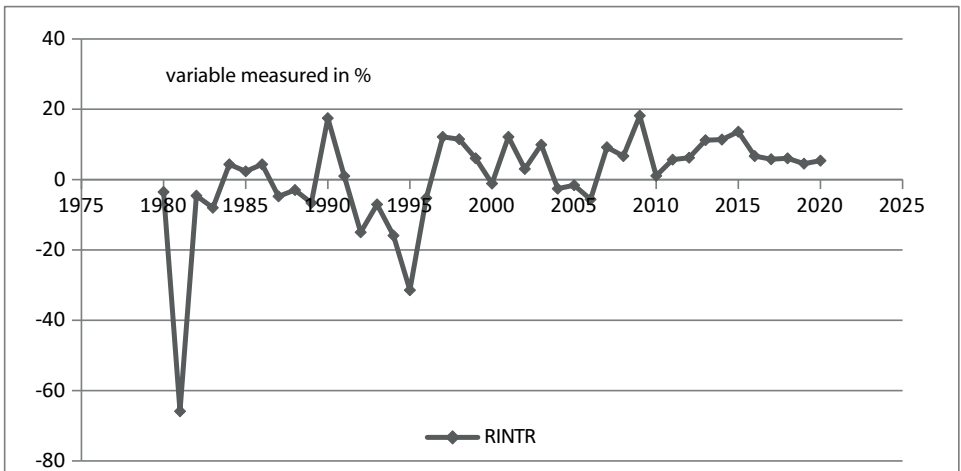
Note: RINTR – real interest rate

Source: WDI (2020)

3 Data and Methodology

3.1 Data

This study used annual series that covers the period from 1980 to 2020. Real interest rate is used as a proxy for domestic interest rate. The study decomposed financial openness indicators into *de facto* and *de jure* measures. The *de facto* measures included in the study are: foreign direct investment (FDI) outflows, foreign direct investment (FDI) inflows and portfolio investment, while the *de jure* measure included is the capital account openness (KAO) index. Exchange rate is also included to serve as a control variable. Foreign direct investment inflows is measured as net inflows (% of GDP), while foreign direct investment outflows is measured as net outflows (% of GDP). Portfolio investment is measured as net balance of payment in current US Dollars and real exchange rate is measured using 2010 as the base year. Data on all the series was obtained from the data bank of the World Bank Development Indicators, except data on capital account openness which was sourced from Chinn and Ito (2006).

3.2 Model Specification

As noted earlier, the study employed the ARDL bounds test by Pesaran, Shin and Smith (2001) to investigate the cointegration among the series as well as the short run and the long run impact of the independent variables on the dependent variable. The main strength of the ARDL is that it can be applied even though the series are integrated of order one *I(0)*, integrated at first difference *I(1)* or an admixture of *I(0)* and *I(1)*. Another strength of the ARDL cointegration approach is that it has superior properties in small sample (Pesaran & Shin, 1999). Also, even when the model's regressors are found to be endogenous, the ARLD approach provides long-run estimates that are unbiased as well as valid t-statistics (Narayan, 2005). As noted by Banerjee and Newman (1993), the ARDL leads to the derivation of the dynamic error correction model (ECM) by way of a simple linear transformation. From the ECM, the short run dynamics can be integrated with the long run equilibrium and still retains the long run information. The study employed both the augmented Dickey Fuller (ADF) and the Phillip-Perron (PP) unit root tests to examine the order of integration of the series and the cointegrating relationship among the series was examined using the autoregressive distributed lag (ARDL) bounds test. Having established that the series are cointegrated, the study investigated both the long run and the short run impact of financial openness on domestic interest.

The functional link between domestic interest rate and financial openness can be specified as follows:

$$RINTR_t = \phi_0 + \phi_1 FOPEN + \phi_3 CV + \varepsilon_t \qquad (1)$$

where $RINTR_t$ = real interest rate, $FOPEN$ = financial openness indicators: foreign direct investment inflows, foreign direct investment outflows, portfolio investment and

capital account openness. CV = control variable denoted by the real exchange rate and ε_i = error term. The ARDL form of equation 1 is specified as follows:

$$\Delta RINTR_i = \psi_0 + \sum_{i-1}^{p} \psi_1 \Delta RINTR_{t-1} + \sum_{t=0}^{p} \psi_2 \Delta FDII_{t-1} + \sum_{t=0}^{p} \psi_3 \Delta FDIO_{t-1} + \sum_{t=0}^{P} \psi_4 \Delta PI_{t-1}$$

$$+ \sum_{t=0}^{p} \psi_5 \Delta KAOPEN_{e-1} + \sum_{t=0}^{p} \psi_6 \Delta REXCHR_{t-1} + \psi_7 RINTR_{i-1} + \psi_8 FDII_{t-1} +$$

$$\psi_9 FDIO_{t-1} + \psi_{10} PI_{t-1} + \psi_{11} KAOPEN_{t-1} + \psi_{12} REXCHR_{t-1} + \varepsilon_t \tag{2}$$

where $RINTR$ = real interest rate (a proxy for domestic interest rate), $FDII$ = foreign direct investment inflows, $FDIO$ = foreign direct investment outflows, PI = portfolio investment, $KAOPEN$ = capital account openness and $REXCHR$ = real exchange rate.

The short-run parameter coefficients for Nigeria are: ψ_1, ψ_2, ψ_3, ψ_4, ψ_5, ψ_6, while the long-run parameter coefficients are: ψ_7, ψ_8, ψ_9, ψ_{10}, ψ_{11} and ψ_{12}. In order to test for the existence of co-integration, the computed F-statistic is compared with the critical bounds. That is, the upper critical bound *1(1)* and the lower critical bound *1(0)*. Cointegration exists in the series if the computed F-statistic is greater than the upper critical bound. However, the series are not co-integrated if the computed F-statistic falls below the lower critical bound. The existence of cointegrating relationship among the variables means that the ECM has to be specified. The ECM is specified as follows:

$$\Delta RINTR_t = \psi_0 + \sum_{i-1}^{p} \psi_1 \Delta RINTR_{t-1} + \sum_{t=0}^{p} \psi_2 \Delta FDII_{t-1} + \sum_{t=0}^{p} \psi_3 \Delta FDIO_{t-1} + \sum_{t=0}^{P} \psi_4 \Delta PI_{t-1}$$

$$+ \sum_{t=0}^{p} \psi_5 \Delta KAOPEN_{t-1} + \sum_{t=0}^{p} \psi_6 \Delta REXCHR_{t-1} + \lambda ECM_t + \ell_t \tag{3}$$

where λ = represents the coefficient of ECM

4 Results and Discussion

The two pre-diagnostic tests the study conducted are the unit root test and the cointegration test. The results of the ADF test in Table 1 indicated that real interest rate, foreign direct investment inflows and portfolio investment achieved stationarity at level at the 5% level of significance. However, exchange rate, foreign direct investment outflows and capital account openness achieved stationarity after a first difference. In Table 2, the results of PP test indicated that real interest rate, foreign direct investment inflows, foreign direct investment outflows and portfolio investment achieved stationarity at level at the 5% level, while exchange rate and capital account openness achieved stationarity at first difference. In summary, the unit root results indicated that the series exhibited a mixture of *I(0)* and *I(1)*, thus supporting the suitability of the ARDL.

Table 1: Result of ADF Unit Root

Variable	ADF Level t-stat	ADF Level Critical value at 5%	ADF First Diff. t-stat	ADF First Diff. Critical value at 5%	Order of Integration
RINTR	-4.61	-2.93	-12.85	-2.93	*I(0)*
EXCHR	-1.94	-2.93	-4.36	-2.93	*I(1)*
FDII	-8.19	-2.94	-8.19	-2.94	*I(0)*
FDIO	-2.52	-2.93	-5.38	-2.94	*I(1)*
KAOPEN	-1.40	-2.93	-5.68	-2.94	*I(1)*
PI	-3.79	-2.93	-3.17	-2.95	*I(0)*

Table 2: Result of PP Unit Root

Variable	PP Level t-stat	PP Level Critical value at 5%	PP First Diff. t-stat	PP First Diff. Critical value at 5%	Order of Integration
RINTR	-4.61	-2.93	-12.27	-2.93	*I(0)*
EXCHR	-2.05	-2.93	-4.35	-2.93	*I(1)*
FDII	-4.03	-2.93	-13.79	-2.94	*I(0)*
FDIO	-4.00	-2.93	-11.89	-2.93	*I(0)*
KAOPEN	-1.46	-2.93	-5.66	-2.94	*I(1)*
PI	-3.70	-2.93	-14.62	-2.93	*I(0)*

The result of the ARDL cointegration in Table 3 was evaluated by comparing the F-statistic with both the upper critical bound *I(1)* and the lower critical bound *I(0)* at the chosen level of significance. In retrospect, the condition for the existence of cointegration is that the value of the F-statistic should be greater than the upper critical bound. However, the series are not cointegrated if the value of the F-statistic is less than the lower critical bound. At the 10% level, finding in Table 3 revealed that the value of the F-statistic (3.78) is greater than the upper critical bound (3.35). Consequently, the study concludes that the series are cointegrated.

Table 3: ARDL Bounds Test Result

Test Statistic	Value	K
F-statistic	3.78	5
	Critical Value Bounds	
Significance	*I(0)*Bound	*I(1)*Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Since the cointegration result has revealed that the series are cointegrated, the study went ahead to examine both the short-run and the long-run impact of financial openness on domestic interest rate in Nigeria. The short-run ARDL results in Table 4 indicate that in the short-run, FDI inflows had a negative impact on interest rate, even though the result is not significant. This finding is in line with the apriori expectation as rising FDI inflows raises money supply which depresses domestic interest rate. Finding however revealed that FDI outflows impacted interest rate positively and significantly. One unit rise in FDI outflows led to a rise in interest rate by 24.40 percent. This finding is equally in line with apriori expectation as rising FDI outflows reduces money supply, leading to a rise in domestic interest rate. The study contends that the reason for the non-significant impact of FDI inflows on domestic interest rate could be because the institutional bottlenecks and other factors such as poor infrastructural facilities in the country discourage massive penetration of FDI. In recent times, instead of the country attracting FDI, some multinational companies have relocated to nearby countries owing to harsh business environment. Therefore, FDI inflows within the study period was not enough to raise the monetary aggregates which should exert a significant negative pressure on domestic interest rate. The positive and significant impact of FDI outflows on domestic interest rate finds support in the above contention as investors prefer to channel their investments to financial jurisdictions where the return on investment is guaranteed. Consequently, massive FDI outflows within the study period reduced money supply which transmitted positively to domestic interest rate.

In another vein, portfolio investment was found to positively influence interest rate; however the result was not significant. This outcome does not follow a priori expectation since portfolio investment is expected to raise money supply and hence, a reduction in interest rate. The study is of the opinion that one plausible reason for the outcome could be because of the possible capital reversal associated with portfolio investment in the short-run. The abrupt capital reversal nature of portfolio investment therefore led to the reduction in money supply instead of the investment raising the liquidity position in the country. Such phenomenon again is in support of our earlier argument that the investment climate in the country does not instill confidence on investors. The study did not find exchange rate to significantly impact on interest rate, but capital account openness indicated a positive and significant impact on domestic interest rate. One unit rise in capital account openness raised interest rate by 32.97 percent. The study argues that the reason for the positive impact of capital account openness on domestic interest

rate could be because the openness policy attracted more capital outflows than capital inflows. Such tendency could reduce money supply, exerting a positive influence on domestic interest rate. The contention of the study that capital account openness led to capital outflows equally finds support in our earlier arguments. The ECM result revealed a negative and significant coefficient, thus supporting the result of the cointegrating relationship among the series. The meaning of the ECM result is that the system adjusts to equilibrium after a shock at a speed of 98 percent.

Table 4: Results of Short-run ARDL (1, 0, 1, 0, 0, 0)

Short run Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDII)	-4.43	2.65	-1.66	0.10
D(FDIO)	24.40	9.83	2.48	0.01
D(PI)	0.00	0.00	0.34	0.73
D(KAOPEN)	32.97	9.56	3.44	0.001
D(EXCHR)	0.01	0.02	0.71	0.47
ECM(-1)	-0.98	0.17	-5.78	

The long-run ARDL results in table 5 revealed that FDI inflows had a negative impact on interest rate but the result is not significant. However, FDI outflows impacted positively on interest rate and the result was significant. If FDI outflows rose by one unit, interest rate rose by 42.54 percent. The two results are in line with the short-run results which revealed that similar scenarios played out the time horizons. Finding also revealed that capital account openness had a positive impact on interest rate in the long-run and the result was significant. One unit rise in capital account openness resulted in a rise in interest rate by 33.53 percent. However, both portfolio investment and exchange rate did not have significant impact on interest rate.

Table 5: Results of Long-run ARDL (1, 0, 1, 0, 0, 0)

Long run Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDII	-4.50	2.74	-1.64	0.11
FDIO	42.74	15.30	2.79	0.008
PI	0.00	0.00	0.34	0.73
KAOPEN	33.53	9.58	3.49	0.001
EXCHR	0.01	0.02	0.69	0.48
C	25.78	8.07	3.19	0.003

The post-diagnostic results in appendix 1 revealed that the model is well specified. Also, there is no presence of serial correlation and the error term is homoscedastic, but the errors are not normally distributed. The model stability test indicated that while the plot of CUMSUM revealed that the model is stable as the plot falls inside the critical bands of

the 5% confidence interval, the CUMSUM of squares result exhibited an outlier because the plot falls outside the critical bands of the 5% confidence interval.

5 Conclusion and Recommendations

The roles of interest rate in the economy cannot be over-emphasized as it influences savings, investment and economic growth. Therefore, studies directed at its determinants should be of utmost importance to policy makers. In this study, the study set out to examine the impact of financial openness on domestic interest rate in Nigeria over the period from 1980–2020. Key findings in the study are worthy of mention. The short-run results indicated that both FDI outflows and capital account openness had positive impact on interest rate. In the long-run, the study also confirmed outcomes similar with the short-run results. The positive impact of capital account openness on interest rate, in the opinion of the study could be that capital liberalization policy favoured more capital outflows than capital inflows which resulted in rising interest rate within the study period. Another peculiar finding in the study is that portfolio investment did not exert a significant influence on interest rate both in the short-run and in the long-run and this is an indication of the weak development of the capital market in Nigeria. In Nigeria, the monetary authorities often face the challenges of reducing interest rate in order to boost investment and at the same time raising interest rate in a bid to control the price level. Consequently, this study has shown the sensitivity of domestic interest rate to financial openness and hence recommends that in fashioning out monetary policy measures, the monetary authorities should factor in the impact of the various indicators of financial openness on the domestic interest rate. In particular, the monetary authorities should fashion out strategies to regulate capital outflows in order to direct the domestic interest rate to a desired direction.

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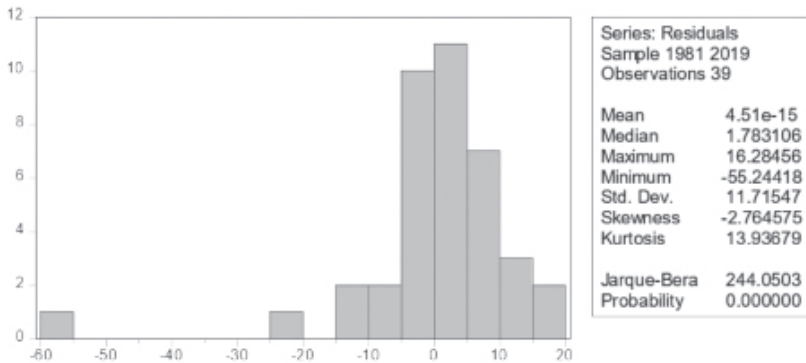
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Appendix: Post Diagnostic Results

Test	P-value	Null Hypothesis	Conclusion
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.7199	Ho: No Homoskedasticity	Cannot reject Ho
Serial Correlation: Breusch-Godfrey LM Test	0.7339	Ho: No Serial Correlation	Cannot reject Ho
Jarque-Bera (Normality Test)	0.000	Ho: Normally Distributed	Reject Ho
Model Specification (Ramsey RESET Test)	0.3427	Ho: Correctly Specified	Cannot reject Ho

Series: Residuals
Sample 1981 2019
Observations 39

Mean	4.51e-15
Median	1.783106
Maximum	16.28456
Minimum	-55.24418
Std. Dev.	11.71547
Skewness	-2.764575
Kurtosis	13.93679
Jarque-Bera	244.0503
Probability	0.000000
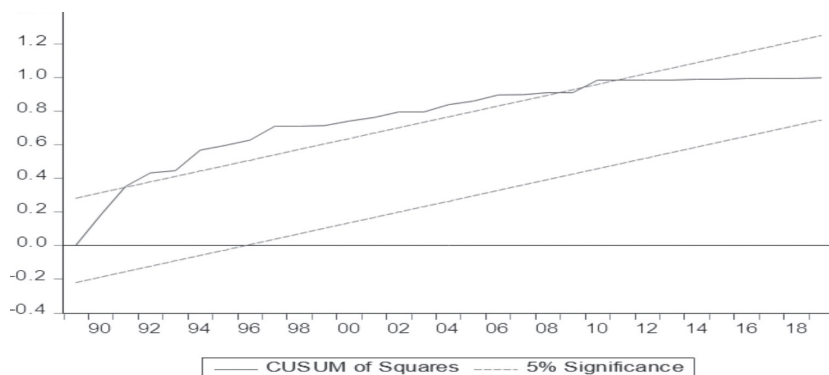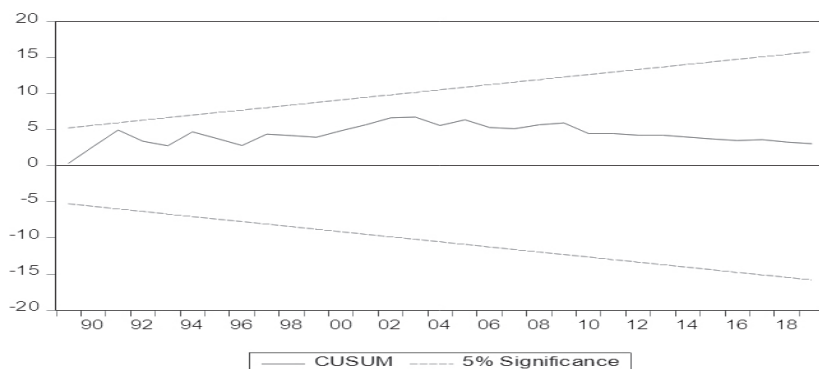
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Behavioral Finance and how its Behavioral Biases Affect German Investors

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Abstract

The growing discipline of behavioral finance has identified several biases that significantly impact individual investors' actions. This paper aims to evaluate the influence of behavioral biases on investing decision-making among German investors. A questionnaire is created, and survey results from 342 investors are collected. Three behavioral biases, namely overconfidence, herding, and anchoring behavior, have been examined in this study. Moreover, it was determined if gender influences these biases among German investors. The findings indicate that male German investors are more susceptible to overconfidence and anchoring bias than female German investors. However, women are more likely than males to fall victim to the herding bias. Overall findings show that individual investors are prone to psychological mistakes.

Introduction

FThe efficient market hypothesis is the cornerstone of traditional finance, and this theory allows investors to access market data and asset values (Madaan & Singh, 2019). According to the efficient market hypothesis, the stock price always properly represents all general information, and the stock market is always faultless and efficient (Putri et al., 2021). According to the efficient market hypothesis, no one can consistently beat the market and achieve a better long-term return.

Furthermore, traditional finance implies that capital markets are efficient and investors are rational (Fama, 1998). Investors decide to reduce costs and enhance benefits (Ahmad et al., 2018). The field of traditional finance has developed steadily, yet, it is still challenging to provide a scientific justification for why people act irrationally when dealing with money. People can only sometimes access all the necessary information to make potential judgments (Barberis & Thaler, 2003; Kinoshita et al., 2013). Numerous

research has questioned rationality, leading to the development of behavioral finance (Tversky & Kahneman, 1971). The disparity between how people make judgments that result in benefits and ones that result in losses can be explained by behavioral biases (Tversky & Kahneman, 1973). Behavioral finance posits that numerous behavioral biases impact investment decision-making, causing investors to depart from rationality and make irrational investment decisions (Niehaus & Shrider, 2014). The same person who is risk-averse to a decision that involves benefits becomes a risk-taker for a decision that avoids losses (Tversky & Kahneman, 1973). According to Shefrin and Thaler (1988), several biases, including overconfidence, herding, anchoring, cognitive dissonance, availability bias, self-attribution, mental accounting, framing, and representative bias, have a substantial impact on how individual investors make decisions (Singh & Nag, 2016).

The research on behavioral finance and biases is limited to non-existent in Germany, which explains the research gap and the need for this article. Therefore, the article aims to determine whether German investors are prone to behavioral biases and whether there are differences in genders' propensity for behavioral biases. The article is organized as follows. The first chapter shortly describes the field of behavioral finance and mainly the investigated biases (overconfidence, herding, anchoring), the second one the methodology. Results are presented in the third chapter and discussed in the fourth one. Conclusion summarizes main points.

1 Behavioral finance and behavioral Biases

Behavioral finance is distinct from traditional finance, predicated on expectations of how markets and investors would act (Pompian, 2012). Behavioral finance studies how psychology influences financial markets and decision-making (Shefrin, 2001). According to Thaler (1999), behavioral finance's assumptions begin to function in various situations since traditional finance theories cannot provide a solution. Behavior finance incorporates the importance of what investors should do and combines the fundamentals of traditional finance with what people do in terms of their investment decisions (Mitroi & Stancu, 2014). Behavioral finance is the study of the impact of psychological variables on the evolution of financial markets (Bogdan et al., 2018). In other words, the inefficiency of financial markets is examined through the lens of psychological ideas and viewpoints (Pompian, 2012). It is a new, high-impact paradigm offering an intriguing alternative to traditional finance. Within the subject of research of behavioral finance, the disciplines of psychology and sociology are seen as essential accelerators (Shiller, 1999). In addition to studying investor behavior rationally, behavioral finance examines various illogical psychological investing biases that traditional finance ignores (Sharma, 2016).

Biases, overconfidence, emotion, and social factors are only a few examples of the psychological foundations of behavioral finance (Kahneman & Tversky, 2013). Thaler (1980) contends that investors engage under the impact of behavioral biases, which frequently result in less-than-ideal outcomes, rather than considering investors operating rationally. For all investors, understanding why they make particular financial decisions or how they are likely to respond in typical situations of uncertainty is crucial when adopting the stance

of an investor (Bogdan et al., 2018). People have cognitive biases and limits that prevent them from making entirely rational decisions (Ahmad et al., 2017).

Biases are inclinations or tendencies that affect how investors behave. An investor, biased toward a company because he likes its spokesperson, could be influenced when deciding to buy the stock as an investment, overriding other factors that might be more essential to the stock's potential financial future. It is crucial to remember that each investment selection option has some level of risk and uncertainty while making individual investment decisions (Slovic, 1972). Many biases frequently influence both the behavior of the financial markets and the judgments made by people. Due to time restrictions and limited brain capacity, people tend to use shortcuts, which may be linked to this. Several scholars have tried to categorize these biases into different groups. However, because these biases have been usually evaluated in isolation, potential interactions or connections between them have been mainly overlooked (Agrawal, 2012). By considering these interconnections and creating a conceptual framework that includes the antecedents or causes of the biases and their outcomes or consequences, this research tries to present a comprehensive picture of behavioral biases. With this information, they create accurate predictions about what will happen, enabling them to make the best financial decisions (Fama, 1970; Jensen, 1978).

Since Tversky and Kahneman's (1974) pioneering work, the number of biases found by behavioral scientists has grown, heralding a behavioral revolution in economics, management, and the social and human sciences (Flyvbjerg, 2021). Psychologists contended that, while biases are well known, it is challenging to mitigate their impact (Pronin et al., 2002). In their study, Chen et al. (2007) discovered that several biases impact 43% of investors. Moreover, in his study on biases development, Lin (2011) claimed that individual investors are primarily interested in biases' potential repercussions.

In this study, three behavioral biases have been used to examine the effects of these biases on the way German investors make investing decisions. This approach indicates a desire to investigate numerous behavioral biases using the framework of the behavioral finance field. The following behavioral biases are addressed in this study:

- Overconfidence bias

- Herding bias

- Anchoring bias

1.1 The overconfidence bias

Overconfidence is a psychological characteristic in behavioral finance that significantly influences individual investing decisions. These choices might be stock market investments or other types of investments (Joo & Durri, 2017). Overconfidence is a prevalent psychological bias in behavioral finance, and it causes financial markets inefficient by causing mispricing in the form of enormous volatility and return variability (Odean, 1998;

Ko & Huang, 2007). Overconfidence is a judgment mistake whereby people exaggerate their competence, knowledge, perception of information, or subjective likelihood that a specific outcome will occur (Campbell et al., 2004; Glaser & Weber, 2010). Investors overreact because they are overconfident in comprehending or absorbing information (Fiscoff et al., 1977; Ricciardi & Simon, 2000; Daniel et al., 2002; Pompian, 2011; Zahera & Bansal, 2018; Park, 2023). According to the researchers, overconfidence bias is frequently caused by ignoring unknowns (Walters et al., 2017). Nearly all the repercussions of overconfidence are unfavorable regarding stock investing (Fieger, 2017).

Women are reportedly less confident than males in investing in the financial markets (Bayyurt et al., 2013). Further studies indicated that males are more susceptible to this because they seem overconfident in their capacity to trade and sell one and a half times as much as women supported this (Kliger et al., 2014; Liersch, 2015).

Example:

Aeropostale was one of the initial equities a Danish shareholder purchased when he began stock trading. The stock had plummeted dramatically, and the firm was in peril. He decided to acquire them because he thought they would increase again. The stock initially decreased for approximately a year until some encouraging news broke. He kept buying, and the stock increased, delivering him a 30% gain in weeks. However, the stock then quickly changed course. He maintained most of the stock in his portfolio and sold a modest amount to make a profit. After one year, the investment had decreased by nearly 90%, and the stock had practically lost its value (Rasmussen, 2017).

An overconfident Danish investor loses practically all of his investment since he cannot realize his gains due to his excessive faith in his capacity to access the market.

H1: Male German investors are less likely than female German investors to succumb to the overconfidence bias.

1.2 The herding bias

Herding is a typical occurrence in the financial market. Herding is described as behavior patterns common among individuals and can cause communities to make consistently bad decisions (Devenow & Welch, 1996). According to Cote and Sanders (1997), herding is modifying one's personal opinions to better align with those of others. During the irregular state of financial markets, it is a common human instinct to refer to, watch, and copy the conduct of others (Yu et al., 2018). Investors do not make rational investing decisions when herding is present, and they like to base their investment decisions on the beliefs and views of other investors. As a result, when investors herd, they tend to limit their own decisions and follow others.

Herding is mainly caused by the availability or absence of knowledge and an innate lack of trust in one's information (Venezia et al., 2011; Sinha, 2015; Fieger, 2017). There is also much evidence to suggest that herding is a sort of social control in humans, where people

want to connect with others and feel better about themselves when their behavior is in line with that of their friends (Andersson et al., 2014; Roider & Voskort, 2016; Spyrou, 2013). An individual finds more satisfaction in the herd's errors as a whole than in the errors of a single member (Ahmad & Mahmood, 2020).

It is also described as imitative behavior that results in associated patterns of conduct that are not rational and unsupported by core principles (Gleason et al., 2004; Hirshleifer & Hong Teoh, 2003; Babalos et al., 2015). The herding effect is more pronounced when market distress factors are present, such as anomalies in the market, price bubbles, and rumors (Mertzanis & Allam, 2018). Herding has been described as a confluence of motions caused by collective imitation (Philippas et al., 2013). Several research articles have demonstrated that herding behavior might lead to comparable movement patterns among individuals and significant welfare losses.

There is disagreement in the literature about which gender is more prone to the herding bias.

Kumar and Goyal (2016) investigated the link between rational decision-making and behavioral biases among Indian individual investors. The findings show that male investors in India are more prone to herding bias. However, Zainul and Suryani (2021) discovered in their study that female investors in Indonesia are more likely to fall prey to the herding tendency while making financial decisions. On the contrary, Jamil and Khan (2016) observed that male and female investors in Oman are equally prone to herd behavior, demonstrating that the investor's gender does not influence the investor's herd behavior.

Example:

As a young guy fresh out of college with money saved from his first paychecks, an American stockholder was enthusiastic about investing in stocks. He listened to a portfolio manager give his finest stocks on "Wall Street Week" with Louis Rukeyser. He took a mental note of one of them since it piqued his interest. Furthermore, he placed his order over the phone right away. The following Monday, when the market opened, he bought his first share, only to watch as it rapidly fell in value over the ensuing weeks. He needed to learn more about the prospects or worth of the firm before deciding whether to hold or sell the stock. As a 22-year-old, he had had enough and sold the shares for a loss of a few hundred dollars (Saldanha, 2021).

Herding bias affects an American investor as he blindly believes a so-called expert without conducting any independent investigation.

H2: Female and male German investors are equally prone to herd behavior.

1.3   The anchoring bias

Anchoring is among the best-studied psychological biases (Shin & Park, 2018). Anchoring bias influences investors' decisions (Wright & Anderson, 1989). It is known as the notion

that an originally offered value might influence decision-makers in favor of that value (Furnham & Boo, 2011). Anchoring is a cognitive bias that explains why the average person tends to rely heavily on the initial information while making judgments (Singh, 2016; Shin & Park, 2018; Ahmad et al.,2018).

Campbell and Sharpe (2009) found significant evidence that professionals participating in financial market forecasting were primarily anchored to historical data, especially recent data. Although anchors produced from an investor's knowledge are acknowledged to be imperfect, those generated from an external source are taken seriously at first (Epley & Gilovich, 2001).

Studies have shown that anchoring has a detrimental effect on the investment choices made by investors (Ahmad et al., 2018). When investors place an inordinate amount of importance on a superficial reference point that is statistically random and emotionally driven, they suffer from anchoring bias, which leads them to make poor judgments (Fieger, 2017; Tseng & Yang, 2011; Liang & Qamruzzaman, 2022). The investor then exploits the gains and losses relative to the benchmark, which is also the stock's selling price (Duxbury, 2015). Moreover, according to the literature, women are more susceptible to the anchoring bias than men (Owusu & Laryea, 2022; Kudryavtsev & Cohen, 2011).

Example:

One morning, when the market showed weakness, an Indian investor started a short position on the Bank Nifty. As a result, he took a short position at 35,300 but sold it too soon since he was not sure the market would fall.

Though he noticed the price of this option lowering, his mind was not ready to enter the trade at a lower price than 35,300, even after the market continued to exhibit symptoms of weakness (VRD Nation, 2021).

An Indian investor is susceptible to anchoring bias as he concentrates on a single reference point. He is aware that he oversold his position and is reluctant to return at this point because his former position was considerably larger.

H3: Female German investors are more susceptible than male German investors to be victims of the anchoring bias.

2   Methodology

A questionnaire is used to collect the data for this paper. The questionnaire, a set of questions provided to interview participants or survey respondents to obtain data suitable for analysis, is a crucial quantitative instrument in empirical research (Acharya, 2010). It is the most often used technique of getting information due to its low cost and wide application (Maier et al., 2000). When quickly acquiring information from a large group of people, questionnaires are an excellent option since they are a fantastic way to record their

opinions and thoughts. The questionnaire's standardization is essential. The same questions are asked, and the replies are coded consistently in a standardized questionnaire. This procedure ensures that the answers to the questions may be interpreted as representing fluctuations in the respondents' behavior (Siniscalco & Auriat, 2005). The questionnaire is accessible on conventional paper, online, and on computers. Therefore, data from several sources may be rapidly compared (Kirchhoff et al., 2010). So, it is more interested in winning something that has yet to be created. Information stimulates people to react.

For the study, an online survey was utilized. The average processing time and the number of pages were previously included in the welcome paragraph at the start of the questionnaire to prevent a high dropout rate and provide transparency to the respondents. However, many investors are in the population and only a tiny sample of people needed to be polled. So, the sub-survey units were precisely selected based on the known characteristics of the population (Homburg, 2017).

1. Investors who trade actively or passively.
2. Investors were required to trade on the German stock exchange.
3. The participants understood English.

The replies' compliance with the standards for the broader public was strictly monitored. The target audience for the study was reached through two methods:

- Professional Network: Considering the specified population, the link to the questionnaire was targeted and delivered to the professional network.

- Private Network: The link to the survey was sent to the personal network through email and WhatsApp. The network consisted of friends, family, and other doctorate students.

The questionnaire asked participants to choose the best and worst statements describing their investing decisions among several biases. As a result, the study assessed the behavioral biases prevalent in German investors' judgments based on their responses to the questions. The selections will be compared across genders to see if there are any differences. The mean value, represented among the biases in percentages, will be used by the author to compare the results.

3 Results

The study's 342 participants included 181 male and 161 female German investors. The participants were also divided into age groups. With 121 replies, the age group of 25–34 years was the largest among all age groups, while the age group of over 70-year-olds was the smallest, with five people. The table below shows the age groups and gender as demographic factors for this study.

Table 1: Investor's demographic profile

Demographic variables	Participants (in total)	Participants (%)
Age		
18–24 years	37	11%
25–34 years	121	35%
35–44 years	101	30%
45–59 years	60	18%
60–69 years	18	5%
>70 years	5	1%
Gender	342	
Male	181	53%
Female	161	47%

Source: Own illustration

The article will solely focus on gender as a demographic factor. After the presentation of the demographic factors, the behavioral biases discussed in Chapter 1 and how they were placed in relevance among German investors will be addressed. Before the three biases are assessed independently, they are first reviewed together.

The 342 German investors were asked to select one statement from a list of several statements about different biases that best represent their investment choice in the questionnaire. Their choice among the three biases is depicted in the following figure.

Figure 1: Which statement does describe your investment behavior?
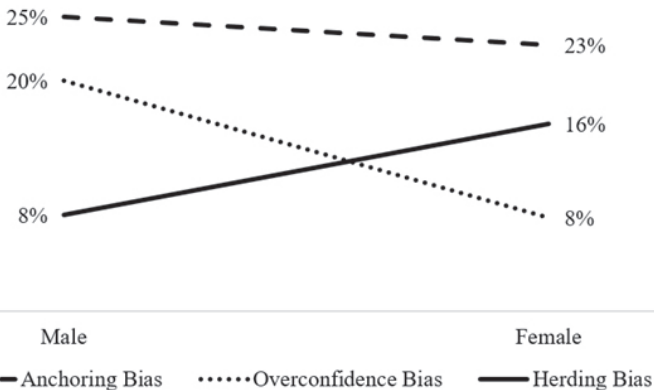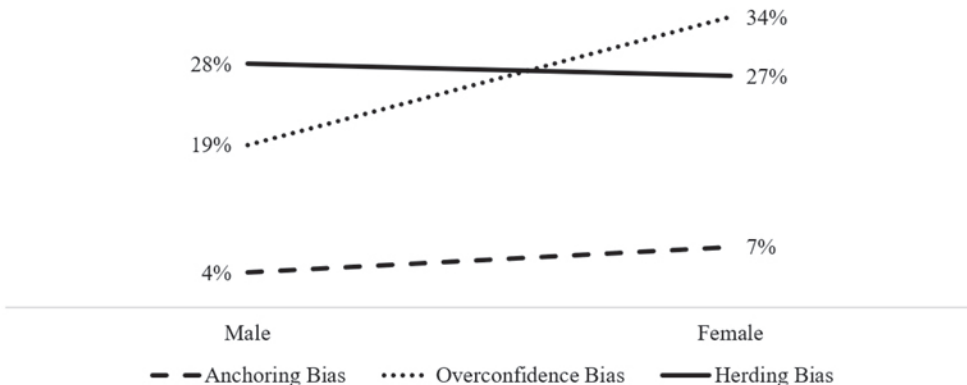

Source: Own illustration

The graph demonstrates that both genders have the most substantial anchoring bias. It is also evident that while the overconfidence bias affects women the least, the herding bias affects males the least.

The following figure shows the statement German investors chose when asked about the statement that does not describe their investment behavior.

Figure 2: Which statement does not describe your investment behavior?

Source: Own illustration

The graph illustrates that there is, once again, an agreement between the two genders on the anchoring bias. Both genders chose this in the last place. Men and women chose differently here about the statement that did not characterize either gender's investment activity, just as they did before regarding the statement detailing investment behavior. Thus, while describing a statement that does not describe their investment behavior, women picked the overconfidence bias first, whereas men chose the herding bias. It is clear from the two images that both genders have the strongest propensity for anchoring bias. There is no consensus on the least preferred bias, which is the herding bias for males and the overconfidence bias for females. As previously stated, the next step is to evaluate each of the three biases independently.

The overconfidence bias will be examined first. Figure 3 shows how genders rated the overconfidence bias.

Figure 3: Overconfidence bias – Gender
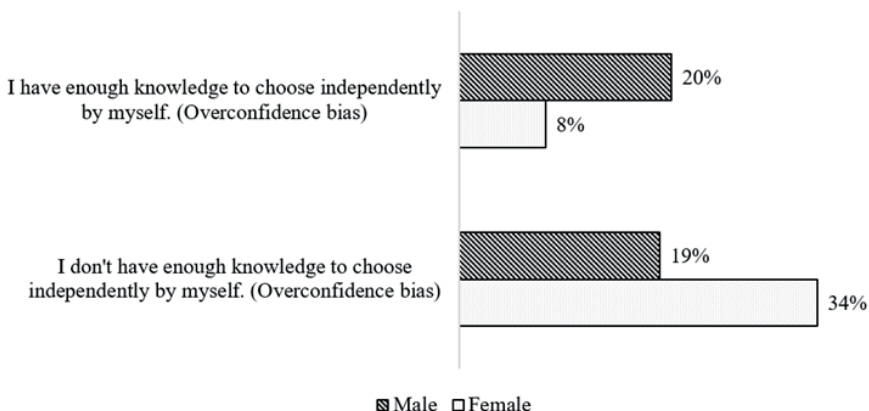
Source: Own illustration

Figure three shows that males agree more with the statement about the overconfidence bias. When asked to explain their investment behavior, 20% of German male investors picked this statement, compared to 8% of female investors. In order to test this, respondents were also asked to choose a statement that did not describe their investing behavior. In this case, 34% of female German investors judged the statement concerning the overconfidence bias not to match their investment behavior, whereas 19% of men did. The findings support the research discussed in Chapter 1.1 regarding the overconfidence bias and show that males are more susceptible to the overconfidence bias than women.

H1: Male German investors are less likely than female German investors to succumb to the overconfidence bias.

Hypothesis 1 can be verified as men are more susceptible to the overconfidence bias than women among German investors.

The herding bias and how the respondents felt about it will next be examined. Figure 4 displays the results.

Figure 4: Herding bias – Gender
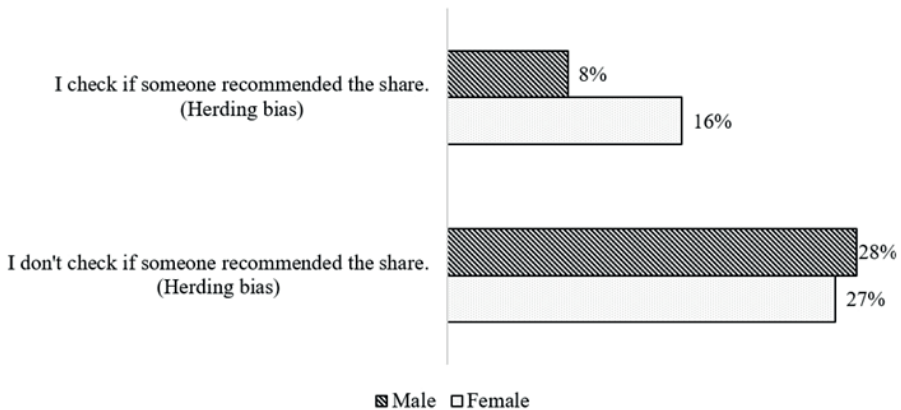
Source: Own illustration

The statement defining the herding tendency was chosen by 16% of the female and 8% of the male investors among the German investors to be consistent with their investment behavior. Hence, there is a distinct preference for female German investors regarding herding bias. However, what about the investment behavior that does not describe German investors' investment behavior? The initial expectations were validated, as 28% of male investors and 27% of women picked the statement concerning the herding tendency not to characterize their investment behavior. Nevertheless, these data do mildly corroborate the earlier conclusions concerning herding bias since fewer women than males participated in the study, implying a more significant percentage disparity between the results could be expected. Nevertheless, if not with conviction, women's propensity for herding is more significant.

H2: Female and male German investors are equally prone to herd behavior.

Hypothesis 2 can be falsified, as the tendency was proven higher for female German investors than male German investors regarding the herding bias.

Lastly, the anchoring bias and its tendency among genders were reviewed. The results are shown in figure 5.

Figure 5: Anchoring bias – Gender

I compare recent performances of a stock to make sure that I don't pay too much. (Anchoring bias) — Male 25%, Female 23%

I don't compare recent performances of a stock to make sure that I don't pay too much. (Anchoring bias) — Male 4%, Female 7%

☒ Male ☐ Female
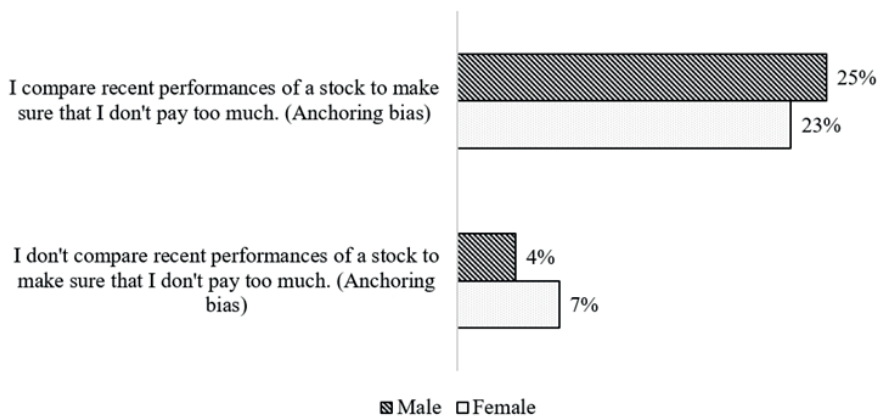
Source: Own illustration

According to the data, male German investors, with 25%, have a more significant potential for anchoring bias than female German investors, with 23%. Looking at the statement that does not explain the respondent's investing behavior further confirms these results. Compared to just 4% of males, 7% of female German investors chose the anchoring bias not to reflect their investment behavior.

H3: Female German investors are more susceptible than male German investors to be victims of the anchoring bias.

Hypothesis 3 can be rejected since male German investors are more prone to the anchoring bias than female German investors.

To conclude, the data revealed that the anchoring bias was the strongest propensity for both genders. However, regarding the least favorable bias, women selected the overconfidence bias, but men chose the herding bias. Among the three behavioral biases, males were more prone to anchoring bias and overconfidence bias, while females were more prone to herding bias.

# 4	Discussion

The findings from the last chapter will be discussed next, starting with the overconfidence bias before moving on to the herding bias and finishing with the anchoring bias.

## 4.1	The overconfidence bias

The research showed that males had a higher score for the overconfidence bias among German investors than women.

These results align with those of Lewellen et al. (1977), who found that men are more likely than women to be overconfident. Men are more overconfident than women, according to studies by Bruce and Johnson (1994), Barber and Odean (2001), Bhandari and Deaves (2006), Bayyurt et al. (2013), Kliger et al. (2014), Liersch (2015), Baker et al. (2018), and Metawa et al. (2018). Men also appear more overconfident in their trading ability, as they sell one and a half times more than women. These findings were further supported by Bakar and Ng (2016), who found that gender influences overconfidence and other behavioral biases among 200 Malaysian stock market participants between the ages of 18 and 60. In their study of whether a demographic profile affects investor behavior, Chitra and Jayashree (2014) revealed that individual investors suffer from psychological and emotional biases. Overconfidence, for example, has an impact on investor behavior. Apart from these biases, the researchers observed that gender interacts with behavioral factors in investment decisions. When Jaya (2014) investigated the influence of investors' behavioral biases on the Indian equities market, he observed that men are more overconfident than women—based on primary data from 309 respondents, Mishra and Metilda (2015) revealed that men are more overconfident than women among mutual fund investors in India.

According to other studies, there is no difference in the tendency for overconfidence between men and women. Hardies et al. (2011) used the mean and standard deviation to analyze primary data from 597 respondents to determine whether there is a gender difference in overconfidence within the auditor population. No evidence of a gender disparity among auditors was revealed during their study. In their study, Alquraan et al. (2016) found that behavioral finance traits like overconfidence significantly affect individual investors' stock investing choices on the Saudi Stock Exchange. In contrast, demographic factors like gender had little impact on investors' choices.

Moreover, this supports the finding of research by Kansal and Singh (2018) that the degree of overconfidence is unaffected by gender. Bashir et al. (2013) conducted a study with 100 graduate and postgraduate students and staff at the University of Gujarat (Pakistan). When it comes to overconfidence bias, this study revealed that there is no noticeable difference between male and female decision-making.

According to other studies, women exhibit greater overconfidence than males do. In an experiment by Fernandes et al. (2012), 92 students from the Universidade Católica de Brasil took part to investigate the effects of group influence on investment decisions and discover a connection between the two financial behavior tendencies of overconfidence and herding behavior. The results revealed that acting in a group tended to lower overconfidence and

that women expressed stronger overconfidence than males, even if this impact was not highly significant. Also, it was shown that the performance of the two genders together was more rational than when they performed separately. Kartašova (2013) discovered that female investors are more overconfident than male investors in the Lithuanian stock market.

4.2   The herding bias

The research showed that females are more prone to herding bias among German investors than men.

These results do align with Zainul and Suryani (2021), who discovered in their study that female investors in Indonesia are more likely to fall prey to the herding tendency while making financial decisions. Zheng et al., 2021 researched the herding tendency of individual Chinese investors using a unique dataset from a significant anonymous brokerage firm. According to empirical data, female investors in the Chinese stock market herd more frequently than male investors. From the behavioral finance literature, Rajdev and Raninga (2016) examined the variations in heuristic biases based on gender. Based on their personality characteristics and gender psychology, male and female investors display distinct behavioral biases, according to an examination of the literature. They discovered that female investors exhibit a stronger propensity for the herding bias than males.

The results contrast the findings by Kumar and Goyal (2016). In order to examine the impact of demographic factors on rational decision-making processes and how those differences manifest themselves in the form of behavioral biases, Kumar and Goyal (2016) looked at the relationship between rational decision-making and behavioral biases among individual investors in India. A total of 386 valid replies to a structured questionnaire have been gathered. The results demonstrate that male investors in India are more susceptible to the herding tendency. In order to determine if and to what extent the U.S. and Nigeria exhibit different behavioral biases, Wong and Nwude (2018) examined seven psychological biases in both nations. A survey is used to gather data. Only U.S. findings were included when comparing the herding bias between the two nations, and the impact of the herding bias on gender was explored. The findings indicate that American males have a more significant herding effect than American females.

On the contrary, Jamil and Khan (2016) observed that male and female investors in Oman are equally prone to herd behavior, demonstrating that the investor's gender does not influence the investor's herd behavior. Yuliawati et al. (2021) explored variations in investing bias depending on gender among Indonesian investors. Respondents in this study were 35 male investors and 30 female investors in the Indonesian capital market. The data found that female and male investors engaged in moderate amounts of herding. The findings of hypothesis testing revealed no significant variation in the amount of herding between the two genders. Talpsepp and Tänav (2021) utilized a dataset that included all real estate transactions from 2004 to 2012 from the Estonian government's official land register. The capital of Estonia, Tallinn, has the most liquid real estate market. Thus, they concentrated on residential home transactions there. Gender-based herding is not observed in real estate purchases. Herding was one of eight behavioral biases that Alrabadi et al. (2018) looked at

in the Amman Stock Market and its impact on investing success. Two hundred forty-two stock market investors in Amman were given a questionnaire, which was made. According to the findings, there are no statistically significant differences between males and females.

4.3   The anchoring bias

The findings showed that male German investors are more prone to the anchoring bias than female German investors.

These findings contrast with Owusu and Laryea's (2022) findings, which investigated how gender differences in anchoring influence investor decision-making dynamics regarding mutual funds. The results demonstrate that investors were generally susceptible to being considerably impacted by the anchoring bias, and it was shown that females were more likely to anchor than males. From behavioral finance research, Rajdev and Raninga (2016) examined the variations in heuristic biases based on gender. Based on their personality characteristics and gender psychology, male and female investors display distinct behavioral biases, according to an examination of the literature. Compared to males, female investors are more prone to anchoring bias. In particular, the disparities between genders in the strength of these biases were examined in Kudryavtsev and Cohen's (2011) analysis of the anchoring bias's function in the perception of economic and financial information. They experimented with several MBA students. According to the results, women are more susceptible to the anchoring bias than males. Individual investors' use of emotion and anchoring biases in making financial decisions were examined by Fernandes et al. (2014). Verifying if the gender component (male and female) interferes with the presence of this prejudice was another parallel aim. They discovered that women in this group were marginally more anchored when considering the findings of an inventive experiment. When consumers appraise and estimate the price of a product in experiencing scenarios, Zong and Guo (2022) performed an experimental study to investigate the presence of the anchoring effect and the elements that influence it. The results show that female consumers are more significantly impacted by the anchoring effect than male consumers.

Conclusion

This paper examined the impact of behavioral biases on investment decisions made by German investors. The overconfidence bias, herding bias, and anchoring bias were the behavioral biases that this study concentrated on. The behavioral biases were discussed and assessed using a questionnaire distributed to 342 German investors. The issue was whether gender influences behavioral biases and hence investing decisions made by German investors. The study's findings indicate that behavioral biases impact German investors. Also, this study demonstrated that male and female German investors had varied tendencies towards certain behavioral biases, demonstrating that behavioral biases do not equally impact genders. The findings revealed that women are more prone to herding bias than males. However, regarding overconfidence and the anchoring bias, male German investors are more vulnerable than female German investors.

The recent study further stressed that financial market participants' decision-making processes are not rational. An investor's subconscious mind is firmly embedded with biases, which affect practically every decision he makes. In order to assist individual investors in dealing with these biases, behavioral finance aims to deal with them.

It has also been demonstrated that biases among investors greatly influence how individuals spend, save, and invest. These biases are caused by the brain's shortcuts while processing information and by the emotional structure of society. Because of this, most investors suffer from the occurring biases, which lead them to act negatively, which may work against their best interests.

Additionally, the market fluctuations caused by the pandemic and inflation crisis demonstrate that investor behavior varies over time, making this research extremely difficult to do to gain a better knowledge of investor behavior. Moreover, investor behavior can be influenced by various circumstances that influence an investment or trading choice. As a result, factors such as the sector of the traded stock and the business cycle, among others, appear to influence investing behavior. It is thought that some biases feed off of one another, and the external environment and other biases in the process are two elements that affect bias intensity. However, although certain biases can be avoided in particular situations, they cannot be removed entirely.

The paper claims that behavioral biases have impacted human judgment, and further studies could also investigate different biases and demographic variables. It can also be argued that, for some reason, it can be challenging to make financial judgments, which can occasionally cause many individuals to act irrationally. The same people, however, are more likely to be at ease and in a better frame of mind while filling out a questionnaire, so they choose to react in a way that may paint them in a different light, especially in the context of questions that provide hypothetical scenarios.

The findings in this article can be helpful for investors in Germany and elsewhere to invest more thoughtfully and to be aware of the possibility of falling victim to behavioral biases in mind as it was shown in this article by the examples and results that investors tend to be irrational, so raising awareness of behavioral finance can assist in reducing unintentional mistakes and taking advantage of opportunities.

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The Impact of the COVID-19 Pandemic
on the German Pension System

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Abstract

The COVID-19 pandemic was declared over in April 2023. Like the financial crisis of 2008, the pandemic outbreak had an exogenous shock effect on Germany's micro- and macroeconomic environment. This mainly affected the labor market, and after that, the Bundesregierung took measures to stabilize the labor market to prevent a dramatic increase in unemployment. The German pension system is a pay-as-you-go system that is financed on a long-term basis by demographic and economic developments. Based on these factors, projections on the effects of the COVID-19 pandemic on statutory pension insurance in Germany were already made in 2020. This paper compares the forecasts from 2020 with the actual development, combined with whether German pension insurance can be assessed as sustainable after the pandemic.

Keywords

JEL classifications

DOI

Introduction

Similar to the 2008 financial crisis, the outbreak of the COVID-19 pandemic and the health policy measures required by the German government to contain it led to the worst economic slump in decades in Germany during the first half of 2020 (Bundesbank 2020). The macroeconomic effects on the labor market sparked by the lockdown significantly slowed economic performance. Even with the strong recovery in the summer, the actual gross domestic product reached a growth rate of -5 percent for 2020 (German Council of Economic Experts 2020). The unemployment rate reached a high of 5.9 percent (Federal Employment Agency).

To slow down the spread of COVID-19 infections on the one hand and to maintain economic activity as far as possible despite the necessary restrictions on the other, the federal government took a variety of measures. In particular, the expanded actions for short-time work were at the forefront of preventing unemployment (Ebbinghaus and Lehner, 2022). To this end, the conditions for short-time allowance were improved, and access was made more accessible to avoid the loss of numerous jobs in the labor market. Employed persons whose working hours are reduced by at least 50 percent receive 70 - 80 percent of their flat-rate net pay. The Federal Employment Agen-

cy reimburses companies for social security contributions (Federal Government 2020), ensuring the contribution payments of future pension claims (Geyer et al., 2021).

Ebbinghaus et al. (2020) considered the outbreak of the COVID-19 pandemic as an "exogenous shock" that also affected the pension system's stability. Jedynak (2018) defines a pension system's long-term financial stability and sustainability by its "sustainability." In." the German pension system, the statutory pension insurance is pay-as-you-go (PAYG), whose sustainability is reflected by the dependency ratio between the employed (contributors) and pensioners (recipients). According to Natalie (2020), the exogenous shock resulted in restrictions on economic performance on the one hand and massive effects on the labor market on the other. The decline in employment in the labor market reduced the contribution inflows of workers who need pay-as-you-go pension systems to be sustainable.

Börsch-Supan and Rausch (2020) predicted at an early stage that the outbreak of the COVID-19 pandemic would have an impact on statutory pension insurance in Germany. The assumptions were based on the relevant parameters 1. demographic development and 2. economic development and evaluated. For this purpose, economic development was considered under similar translation ratios from the 2008 financial crisis of GDP decline and employment decline under diversified scenarios. According to their analysis, the COVID-19 pandemic, identical to the 2008 financial crisis, will significantly impact statutory pension insurance.

The German Health Minister Karl Lauterbach considers the COVID-19 pandemic to be over in April 2023, about three years after the outbreak and draws a positive balance from a health policy perspective (Welt 2023).

This paper compares the forecast of Börsch and Rausch from the year 2020 with the actual developments of the demographic and economic parameters used during the COVID-19 pandemic in Germany. It takes stock from a pension policy perspective. The first chapter examines the demographic development indicators, and in the second chapter, the GDP development and employment level are discussed under the heading of economic growth. Likewise, the development of Germany's proportionate state pension expenditure to GDP is projected in international comparison to the OECD average.

Finally, the results of the comparison are presented in conclusion. Furthermore, the question is clarified whether the statutory pension insurance in Germany has withstood the effects of the COVID-19 pandemic and can be considered sustainable. In the course of answering the question, the paper will offer an outlook on the future of the German pension system.

The findings on the parameters are compared with the actual values in each chapter and evaluated. Current data from the OECD, the Federal Statistical Office, and the Federal Employment Agency are used. In addition, relevant literature is used.

Finally, the results of the comparison are presented in conclusion. Furthermore, the question is clarified whether the statutory pension insurance in Germany has withstood the effects of the COVID-19 pandemic and can be considered sustainable. In answering this question, an outlook on the future of the German pension system is given.

1   Demographic development in Germany

According to the assumptions of Börsch-Supan and Rausch (2020), demographic deve-
lopment is influenced by very long-term trends. These include long-term trends such
as the birth rate and life expectancy. Even if the duration of the pandemic is uncertain
for an indefinite period since the outbreak, it is not expected to have a significant long-
-term impact on demographic development. Even if pensioners as contributors in the
pay-as-you-go pension system are classified in the risk group, no significant influence is
to be expected due to increasing deaths. Approximately 932,000 deaths occurred in 2017.
Against this background, demographic development was not considered further during
the further study by Börsch-Supan and Rausch (2020) and thus will not achieve any effects.

The Organisation for Economic Co-operation and Development (OECD) has been analy-
zing and comparing pension systems in the OECD and G20 countries every two years since
2005 in the report "Pensions at a Glance" based on indicators, thus making a considerable
contribution to scientists and politicians. In this context, the OECD provides grants of hand
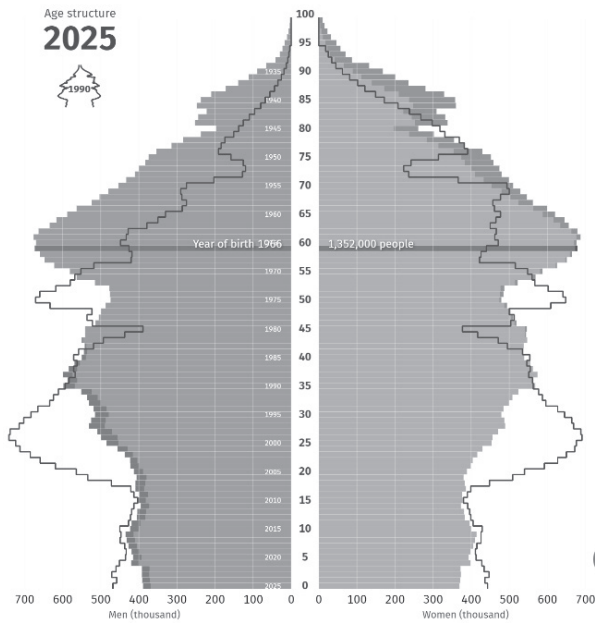in the demographic and economic context.

The 2021 edition of the report, Pensions at a Glance, discusses the impact of the COVID-19
pandemic on the pension systems of OECD member countries in two special chapters. The
report provides evidence that the COVID-19 pandemic had an effect on demographic de-
velopment and thus had a direct influence on the German pension system. Nevertheless,
it is clear from the report that with the continuation of the demographic trend, the age
pressure on pension systems requires urgent action (OECD 2021).

The assumption on demographic development by Börsch-Supan and Rausch (2020) was
compared with the OECD report "Pensions at a Glance" 2021. This confirms that demogra-
phic growth is not significantly influenced in the long term.

However, Fenge and Peglow (2017) research found that Germany will face a significant
population aging in the coming decades. The changes in the population structure lead to
a growing mismatch between the development of pension expenditure and contribution
income, raising concerns about the pension system's sustainability (Eilfort and Raffelhüs-
chen, 2010). This will further burden the German national budget (Blank et al., 2021).

Figure 1 below compares the age structure in 2025 with the year of German unification
in 1990 and illustrates the progress of demographic development, characterized by the
long-term trends of the decreasing number of people of younger age and the increasing
number of older people. This population calculation was made based on data from the
Federal Statistical Office, using reasonable assumptions on the development of birth rates,
life expectancy, and net migration.

Figure 1: Comparison of the German population calculation of 1990 and 2025

Age structure
2025

1990

100
95
90
85
80
75
70
65
Year of birth 1966   60   1,352,000 people
55
50
45
40
35
30
25
20
15
10
5
0

700 600 500 400 300 200 100 0   0 100 200 300 400 500 600 700
Men (thousand)   Women (thousand)

Source: Destatis, 2023

This confirms that the assumption in the forecast by Börsch-Supan and Rausch (2020) was correct in that demographic development is influenced by very long-term trends. Similarly, in its report, the OECD points to continuing the demographic trend, which increases the age pressure on pension systems and thus requires urgent action.

2   Economic performance

2.1   GDP

According to Börsch-Supan and Rausch (2020), in contrast to demographic development, economic performance is affected by the impact of the COVID-19 pandemic. As a result, they refer to initial assessments by German economic research institutes, which base their estimates of economic development on the experience of previous crises. In this context, the financial forecasts of the Ifo Institute (ifo), the Institute for Economic Research (DIW), and the Institute for the World Economy (IfW) were considered, resulting in six possible forecasts under risk considerations, which influenced the development of employment on the labor market. Against this background, we first examine German economic performance in this chapter and limit ourselves to the business cycle forecasts of Wollmershäuser (2020) from the Ifo Institute.

According to Wollmershäuser (2020), the internationally interconnected economy is collapsing due to the COVID-19 pandemic. The argument is that the virus originated in China and, due to the rapid development of the infection, the economy has come to a virtual standstill or collapsed due to the measures taken. As a result, Germany's economic output will shrink, substantially impacting the labor market. Moreover, Germany is closely intertwined economically with many countries worldwide, in addition to China, and the related interaction between imports and exports will be significantly disrupted.

As already mentioned, the first forecasts of the German economic research institutes on economic development were based on observations in China and previous crises. Wollmershäuser (2020) supported his forecast with the fact that, according to his observations in China, industrial production there slumped by 30 percent between December 2019 and February 2020. In March, the business climate index in Germany fell by 8.3 index points and business expectations by 11.2 index points. On this basis, Wollmershäuser (2020) developed 1. a mild forecast and 2. a risk forecast.

1. Mild forecast: The mild forecast assumes a 4.5 percent slump in GDP in the second quarter of 2020, which recovers quickly in the same quarter and resumes the original trend by the third quarter, without the COVID-19 impact. However, Wollmershäuser (2020) assumes downside risks to this forecast. Namely, if 75 percent of average capacity continues to be utilized, each month would lose about 2 percent of economic growth. Figure 2 below summarises the results of the indicator analysis and the scenario analysis. It is important to note that the GDP bars in the left-hand chart consider the pent-up economic demand and therefore turn, around in the third quarter after the slump in the second quarter.

Figure 2: Development of a gross domestic product for Germany according to mild forecast
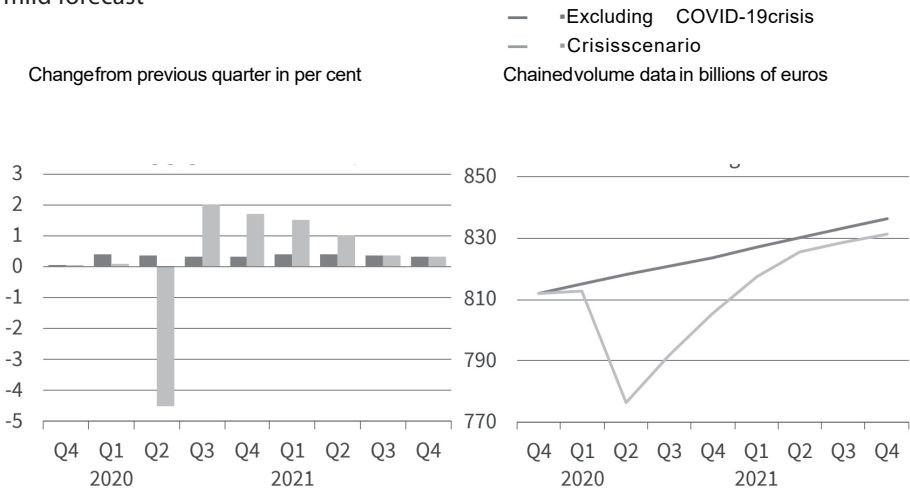
Source: Wollmershäuser, 2020

2. Risk forecast: Wollmershäuser (2020) assumes in his risk forecast that the decline in GDP will continue until the end of 2020, resulting in a contraction of around 6 percent. Only in 2021 is GDP expected to recover so that by the end of the year, GDP development will be 2.4 percent below the initial development, excluding the COVID-19 impact. Figure 3 below summarises the results of the indicator analysis and the scenario analysis.

Figure 3: Development of a gross domestic product for Germany according to risk forecast
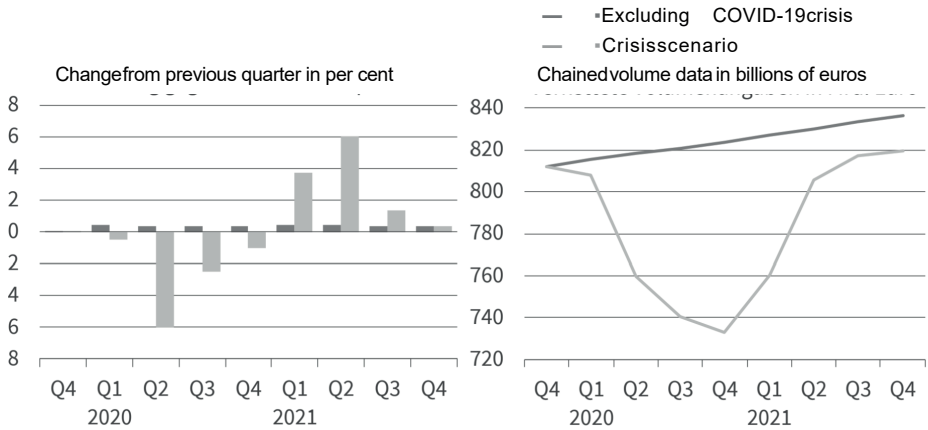
Source: Wollmershäuser, 2020

The Federal Statistical Office (StBA) is a German federal authority that collects, collates, and analyses statistical information on the economy, society, and the environment, thus making a significant contribution to science and politics. In this context, the StBA also provides grants to national accounts.

Figure 4 shows the development of GDP adjusted to the previous year's quarter according to data from the StBA (2023).

Figure 4: GDP development compared to the same quarter of the previous year in Germany
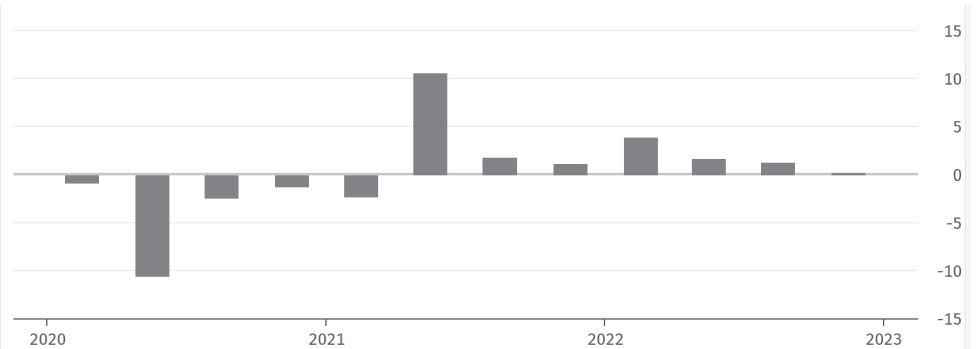
Source: Statistisches Bundesamt, 2023

According to the StBA (2023), adjusted GDP slumped by 10.5 percent compared to the same quarter of the previous year. Only in the second quarter did GDP recover from the same quarter of the last year and grow by 10.6 perce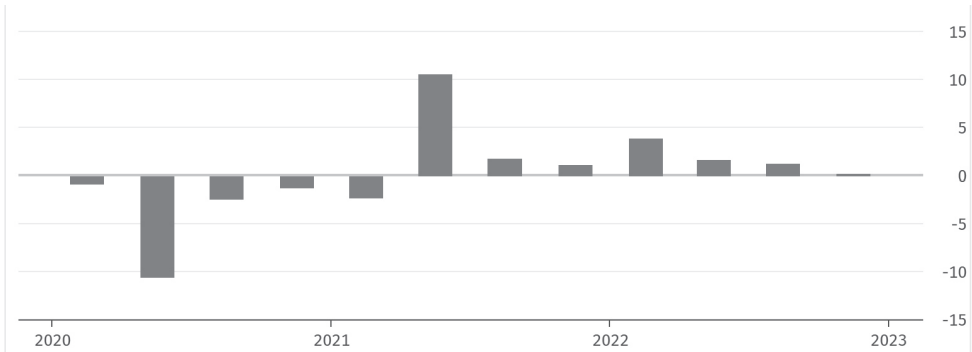nt. In the third quarter, growth fell to 1.8 percent compared to the same quarter of the previous year. On average, the level flattened to 0.3 percent at the end of 2022.

Figure 5 shows the price-adjusted change in GDP compared to the previous year.

Figure 5: Change in GDP compared to the previous year in Germany

Source: Statistisches Bundesamt, 2023

According to the StBA (2023), GDP slumped by 3.7 percent in 2020 compared to the previous year. In 2021, they llallowedositive economic growth by 2.6 percent compared to 2020. In 2022 they achieved economic growth of 1.8 percent overall compared to 2021.

The comparison between the effects of the COVID-19 pandemic on the statutory pension insurance in Germany examined by Börsch-Supan and Rausch (2020) based on the economic forecasts of Wollmershäuser (2020) with the data of the StBA (2023) show parallels to the risk forecast. Thus, GDP in the first quarter collapses dramatically compared to the same quarter of the previous year. In real terms, GDP shrinks by 10.5 percent instead of around 6.0 percent, as initially assumed. Moreover, GDP recovered in the second quarter of 2021 compared to the same quarter of the previous year, reaching economic growth of 10.6 percent and up to 6.0 percent initially assumed. From the fourth quarter onwards, the actual values and the forecasts are at the same level. In this respect, there are deviations between the estimates and the actual values up to the third quarter of 2021. Finally, it is noted that the comparison focuses on the impact of the COVID-19 pandemic on GDP.

2.2   Labour market

In Chapter 2.1, we examined the forecasts of Wollmersheimer (2020) used by Börsch--Supan and Rausch (2020) and focused on the GDP impact. According to Börsch-Supan

and Rausch (2020), the isolated consideration of GDP is only indirectly relevant to statutory pension insurance. In the German pension system, the statutory pension insurance is a pay-as-you-go system, the sustainability of which is reflected in the dependency ratio between employed persons (contributors) and pensioners (beneficiaries). Against this backdrop, employment in the labor market is of considerable importance. PAYG pension schemes are directly affected by the impact of the COVID-19 pandemic, with increases in the number of unemployed and reduced contribution income (Feher and Bidegain, 2020). According to Natalie (2020), the exogenous shock generated by the COVID-19 pandemic outbreak led to restrictions on economic performance on the one hand and massive impacts on the labor market on the other. The decline in llabormarketemployment reduced the contribution inflows of the working population, which depend on pay-as-you-go pension systems to be sustainable.

According to Börsch-Supan and Rausch (2020), the impact of the COVID-19 pandemic on the labor market depends on the measures the federal government takes. Measures must aim to prevent or cushion a surge in unemployment. Cantillon et al. (2021) note that similar to the financial crisis of 2008, the federal government has taken extensive measures, especially short-time work, to mitigate the adverse effects on the labor market. This measure proved to be a very effective labor policy instrument in 2008; therefore, Germany has a long tradition of short-time work.

The Bundesregierung implemented a number of measures to prevent the spread of COVID-19 infections on the one hand, and to sustain economic activity as much as possible despite the necessary restrictions on the other. Above all, the expanded actions for short-time work were in the foreground to prevent a sudden rise in unemployment (Ebbinghaus and Lehner,2022). To this end, the conditions for short-time allowance were improved, and access was made more accessible to prevent the loss of numerous jobs in the labor market. Employed persons whose working hours are reduced by at least 50 percent receive 70 to 80 percent of their flat-rate net pay. The Federal Employment Agency reimburses companies for social security contributions (Federal Government 2020), securing the contribution payments for future pension entitlements (Geyer et al., 2021).

Due to the parallel to the financial crisis and the associated measures of the German government, Börsch-Supan and Rausch (2020) assume a similar ratio of GDP decline and employment decline. Accordingly, it is assumed that a 1 percent decline in GDP caused by the COVID-19 pandemic will result in a decrease in the employment of 95,000 people and an increase in unemployment of 88,000 people. This assumption takes into account the 20% increase in employment since 2008.

Figure 6 below shows the development of the number of unemployed based on the calculations of Börsch-Supan and Rausch (2020) about the decline in GDP. Here we consider the economic forecast examined by Wollmersheimer (2020).

Figure 6: Number of unemployed about GDP decline
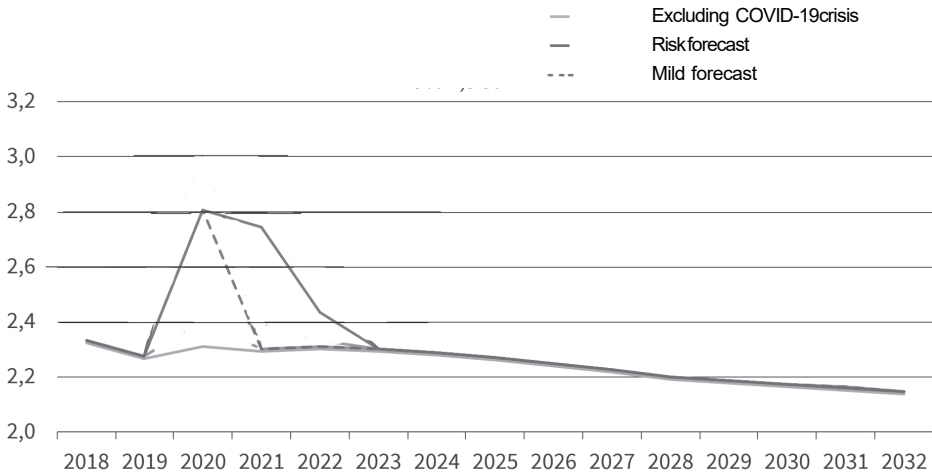
Source: Börsch-Supan and Rausch (2020) and adaptations by the author

In the year of the calculations by Börsch-Supan and Rausch (2020), it was unclear how long the COVID-19 pandemic would last. Two scenarios were assumed. On the one hand, a rapid recovery in 2021 that returns to the original pledge in the same year and, on the other hand, a slow recovery that returns to the initial deposit in 2023. In both cases, the number of unemployed increases by about 500,000 people to approximately 2,800,000 unemployed, especially taking into account short-time work.

According to the Bundesagentur für Arbeit (2023), the number of unemployed in March 2020 rose from 2,335,370 to 2,955,490 people by August 2020. This means that the unemployed increased by 620,120 people in real terms. The original level of 2,376,930 unemployed was reached for the first time in October 2021 and remained constant at an average of 2,400,000 unemployed until the end of 2022.

The comparison between the development of the number of unemployed examined by Börsch-Supan and Rausch (2020) about the decline in GDP based on Wollmershäuser (2020) and the data of the Federal Employment Agency (2023) shows parallels to the risk forecast. Thus, the assumptions of Börsch-Supan and Rausch (2020) regarding a rapid recovery in the number of unemployed in 2021 return to the original pledge. It must be assumed that the measures taken by the federal government, especially about short-time work, have contributed significantly to cushioning the sudden increase in the unemployed. Nevertheless, the number of unemployed, 620,120 people, is 120,120 people, higher than the forecast of 500,000 people. This makes a further difference of 120,120 contributors.

2.3   Comparison of the projection of state pension expenditure as a share of GDP

The following section deals with the proportion of Germany's GDP spent on public pensions and thus shows how much of the gross domestic product is spent on public pensions and how high the total share of public pensions in the national budget is in Germany. German public pension expenditure development is compared with the OECD average retrospectively from 2017 to 2050.

According to the OECD (2015), most OECD member states have increased public pension expenditure. From 2015 to 2020, public pension expenditure in all OECD member states averaged 9 percent of GDP. During this period, public pension expenditure in Germany increased from 10.0 percent to 10.3 percent of GDP.

The OECD (2021) expects public pension expenditure in all OECD member states to increase on average from 9 percent to 10.4 percent of GDP by 2050. On the other hand, the projections for Germany indicate an increase from 10.3 percent in 2020 to 12.5 percent of GDP by 2050.

Figure 7 illustrates the development of public pension expenditure as a percentage of GDP in Germany on average for the OECD from 2015 to 2050.

Figure 7: Forecast of state pension expenditure as a percentage of GDP, 2015-2050
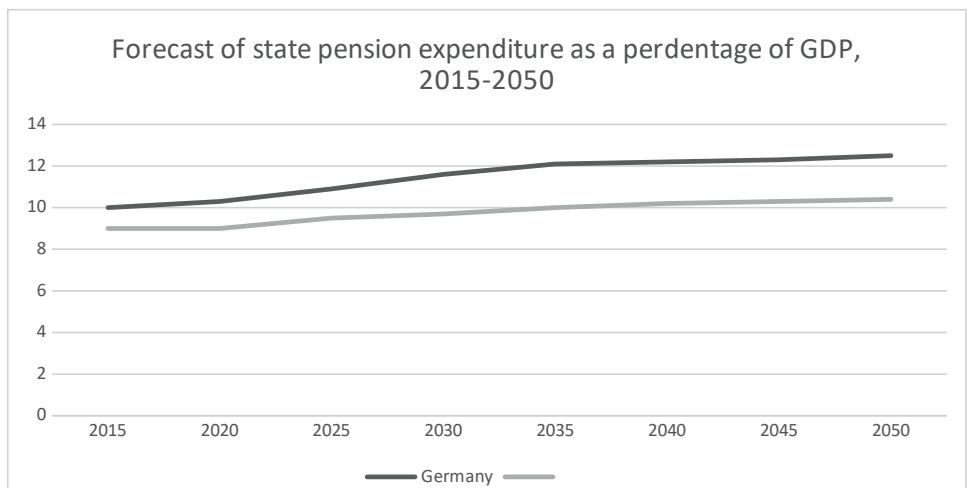
Source: OECD-Data (2015) and (2021) and adaptations by the author

Thus, state pension expenditure as a percentage of GDP in Germany is above the average of the OECD member states over the period under review. Furthermore, it can be seen that public pension expenditure is increasing significantly faster than the OECD average.

3 Conclusions

This article aims to compare Börsch and Rausch's 2020 forecast with the natural development of the demographic and economic parameters used during the COVID-19 pandemic in Germany and to draw a balance in terms of pension policy. For this purpose, the indicator of demographic development was examined in the first chapter, and the second chapter studied the economic performance regarding GDP and employment level under the hand. The aim is to clarify whether the statutory pension insurance in Germany has withstood the effects of the COVID-19 pandemic and can be considered sustainable. In answering this question, an outlook on the future of the German pension system will be given.

Regarding the economic performance indicators, it was found that the results between the forecasts and the actual values showed parallels and were close to each other despite conditional deviations. The results suggest that the impact of the COVID-19 pandemic, similar to the 2008 financial crisis, will significantly increase fiscal pressure and thus burden government spending. Even if the labor policy instrument of short-time work has proven to cushion the sudden increase in the number of unemployed, it should be noted that the sustainable viability of the pay-as-you-go pension system in Germany can only be compensated for in the short term by the public debt that is taking place. In this respect, it is confirmed that the pension system reacts sensitively to a massive contraction of the economy.

Against this background, the statutory pension insurance in Germany has withstood the effects of the COVID-19 pandemic. Once again, resilience has been proven when government spending compensates for an exogenous shock. The OECD supports this finding in the "Pensions at a Glance 2021" report. According to the OECD, pension systems have coped well with the COVID-19 pandemic.

From a demographic perspective, the COVID-19 pandemic did not impact the German pension system. However, Germany will be confronted with a significant population aging in the coming decades. The changes in the population structure lead to an increasing mismatch between the development of pension expenditure and contribution income, raising concerns about the pension system's sustainability. This will put further strain on the German national budget. From these circumstances, age pressure will again come to the fore. The OECD also emphasizes this.

In conclusion, from a pension policy perspective, German statutory pension insurance has withstood the effects of the COVID-19 pandemic and can thus draw a positive balance. Against the background of demographic change, however, it needs to be more sustainable in the medium term.

Looking to the future, the German pension system will have to face the challenges of demographic change to be sustainable. One possible approach at present is the Federal Government's well-funded pension.

For this purpose, examining the conclusions using more advanced methods is necessary.

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Extended Workforce Ecosystems: Intelligent Bots and Freelancers with Employee ID Cards Are Changing the Workforce Paradigm

LADISLAVA KNIHOVÁ, OTAKAR NĚMEC

Abstract

In today's digital age, organizations increasingly leverage an extended workforce ecosystem incorporating freelancers and even intelligent bots with employee ID cards to bolster their operations. This article examines the advantages and challenges of these ecosystems, offering a roadmap for organizations to effectively navigate the shift towards hybrid and fully remote working models. The successful realization of this transition heavily relies on the shared attitude towards education and learning within the extended workforce ecosystem. Drawing upon data obtained from the observational study MML-TGI, the aim of which is to assess and interpret the adoption levels of educational content and identify socio-demographic segments of consumers suitable for targeted educational content, this article presents insights into the current population attitudes towards education and learning, which hold crucial implications for designing employee training programs. The primary objective of this article is to provide organizations with comprehensive and research-based knowledge, enabling them to transition from reactive ad hoc remote work arrangements to a more sustainable and effective hybrid work approach. By acting as a bridge to the future, this study facilitates the transformation towards a strategic and intentional approach to hybrid working models that align with the needs of both employees and the organization.

1 Introduction

The concept of the extended workforce is gaining prominence in today's digital age due to various factors. The rise of the gig economy, the evolving nature of work, and the increasing demand for flexibility are just a few areas that are worth noticing. The emergence of new technologies, such as automation, artificial intelligence, and other digital tools, has facilitated these changes. Organisations can optimise their operations and enhance efficiency by incorporating intelligent bots, digital workers, and similar technologies into the extended workforce. Consequently, effectively managing the extended workforce

becomes critical as it enables organisations to tap into a broader talent pool, achieve greater efficiency, and respond swiftly to market demands, resulting in a competitive advantage.

1.1 The gig economy

The rise of the gig economy has no historical parallel. It has developed into an economy with a labour market characterized by the prevalence of short-term contracts or freelance work, often facilitated by digital platforms. The gig economy has created new opportunities for individuals to work as independent contractors, freelancers, or consultants and for businesses to hire talented individuals with expertise beyond their regular employees. In an attempt to focus on the diversity of work arrangements and contexts within the gig economy, Kuhn et al. argue that a more nuanced understanding of HRM practices is needed. It can be achieved by identifying common themes across different types of gig work (Kuhn et al., 2021). Enhanced responsibility of team leaders related to novel employment arrangements has been in the focus of researchers recently. Typically, they examine the intersection between traditional human resource management and the novel employment arrangements of the expanding gig economy (Wong, 2020). While there is substantial multidisciplinary literature on the digital platform labour phenomenon, it has been largely centered on the experiences of gig workers. As digital labour platforms continue to grow and specialize, more managers, executives, and human resource practitioners will need to make decisions about whether and how to utilize gig workers (Kuhn et al., 2021). In their research, Ray et al. argue that creative business models enabled by a modern marketplace technology platform, along with appropriate government rules and regulations, will dictate how the Gig Economy of the future develops (Ray et al., 2021). In their research, they focus on the home improvement sector demonstrating how gig workers could be enabled as entrepreneurs to run their gigs with new business models (Ray et al., 2021).

1.2 Adapting to a Changing Work Environment

In the process of adapting to a changing work environment, we have to take into consideration the role of the extended workforce and considerations for its successful management. In today's fast-paced business environment, organizations need to be agile and responsive to a range of factors, from shifting market demands to new technological developments and unforeseen disruptions. One solution to this *need for flexibility* is the *extended workforce*, which enables organizations to scale their workforce up or down as required without the fixed costs and long-term commitments associated with hiring regular employees.

Upon exploring the concept of the extended workforce, it becomes apparent that the nature of the traditional workforce is undergoing significant changes. The extended workforce expands the scope of individuals involved in organizational activities beyond the conventional employee paradigm. This shift acknowledges that the composition of the workforce now includes diverse entities, such as intelligent chatbots and freelancers, who play integral roles within companies and possess employee identification cards to access company systems. This evolution reflects the dynamic nature of modern work

arrangements and the expanding range of contributors working towards organizational objectives.

In their research, Altman et al. highlight that corporate diversity, equity, and inclusion practices and goals tend to be primarily focused on internal aspects and often do not extend to encompass external contributors. Surprisingly, their global executive survey reveals that over 90% of respondents acknowledge the presence of external contributors within their workforce. In fact, a significant number of organizations rely on external contributors to perform at least 30% of the work (Altman et al., 2023b). This finding underscores the importance of recognizing and incorporating the contributions of external individuals in fostering a comprehensive and inclusive approach to diversity, equity, and inclusion within organizations.

In this context, the extended workforce has emerged as a key tool for enabling organizations to adapt to unpredictable changing circumstances, remain competitive, and pursue new opportunities. According to the research conducted by Anna Pawlowska (2019), the decision of employees to change employers is not correlated with their employability market orientation. Instead, low pay and job insecurity, resulting from the lack of long-term contracts, are the primary reasons for changing employers. It may be due to a passive attitude and a preference for a relational psychological contract with the employer. As a result, employees may need help to take advantage of new opportunities offered by modern technologies in the world of work. Individuals with higher levels of cognitive flexibility are better positioned to navigate these challenges (Pawlovska, 2019). The results of Pawlovska's study illustrate that from workers' perspective, flexibility in work relationships is a key positive element of platform-enabled work. In a rapidly changing business environment, organizations need to be flexible and agile to respond to market demands, technological changes, and other disruptions. The extended workforce provides organizations with the flexibility to scale up or down their workforce as needed without the fixed costs and commitments of hiring regular employees.

Freelancers with employee identification cards

Freelancers with employee identification cards are an intriguing aspect of the evolving workforce landscape. Elizabeth J. Altman, an assistant professor of management at the Manning School of Business, University of Massachusetts Lowell, and Steven Hatfield, a principal with Deloitte Consulting LLP serving as its global Future of Work leader, shed light on this phenomenon in their contribution titled "Collaboration, Communication, and Virtual Innovation: Orchestrating Workforce Ecosystems." Their survey and research report, presented at MIT Technology Review's EmTech Next event in 2022, delved into the intricate dynamics of modern work arrangements (MIT Sloan Management Review, 2022).

Altman and Hatfield's research aimed to explore the implications and potential benefits of integrating freelancers into the workforce ecosystem. By examining the use of employee identification cards for freelancers, they sought to understand how organizations could effectively leverage these individuals while ensuring seamless collaboration, communication, and innovation within virtual work environments. Their findings shed light on the emergence of *a more inclusive workforce ecosystem, where freelancers are seamlessly*

integrated into company systems and processes. Providing employee identification cards to freelancers signifies a deeper level of integration and trust, enabling them to access company resources and contribute to projects as valued team members (MIT Sloan Management Review, 2022).

Altman and Hatfield's research contributes to our understanding of how organizations are adapting to the changing nature of work, embracing flexible talent pools, and fostering collaboration across a diverse range of contributors. Their work highlights the importance of effectively managing and orchestrating workforce ecosystems in an increasingly digital and dynamic business landscape.

Intelligent bots

The inclusion of intelligent bots with employee identification cards presents an even more complex and thought-provoking aspect of the evolving workforce landscape. While the concept may seem unconventional, advancements in artificial intelligence (AI) and automation have led to the emergence of intelligent bots that can perform various tasks traditionally carried out by human employees.

Intelligent bots equipped with employee ID cards signify a paradigm shift in how organizations conceptualize and integrate non-human entities into their workforce. These bots are designed to interact with company systems, access sensitive information, and perform assigned tasks autonomously. The challenge lies in effectively managing and integrating intelligent bots into the existing organizational structure. Ensuring that these bots adhere to established protocols, security measures, and ethical guidelines becomes crucial. It requires designing robust authentication mechanisms, monitoring their activities, and establishing clear boundaries to avoid potential risks and ensure accountability. Addressing the complexities associated with intelligent bots in the workforce requires collaboration between experts in fields such as AI, cybersecurity, and organizational management. It involves exploring the legal and ethical implications of assigning employee identification to non-human entities and establishing guidelines for their responsible use.

While the integration of intelligent bots with employee ID cards presents unique challenges, it also opens up new opportunities for efficiency, scalability, and innovation. Organizations can leverage the capabilities of these bots to streamline processes, automate routine tasks, and enhance overall productivity.

The future of the extended workforce may involve a harmonious blend of human employees, freelancers, and intelligent bots, working together seamlessly within the organizational framework. As the technology continues to advance, it will be imperative to adopt policies and practices to effectively harness the potential of intelligent bots while ensuring ethical and responsible integration into the workforce ecosystem.

Figure 1 below visually represents the extended workforce, showcasing the diverse entities contributing to organizational operations.

Figure 1: Inclusive Workforce Ecosystem
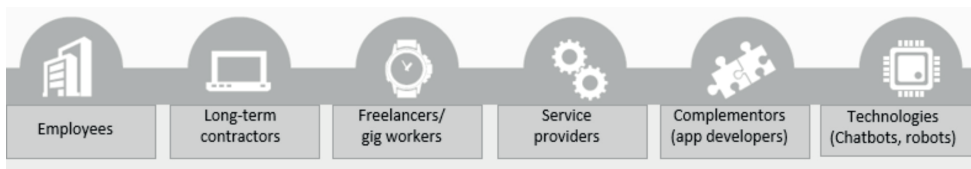
Source: own elaboration based on (Altman et al., 2023)

Defining an inclusive workforce ecosystem

In 2021, MIT Sloan Management Review and Deloitte provided a definition of workforce ecosystems, expanding the traditional understanding beyond full- and part-time employees to include a broader range of individuals and partner organizations. According to their definition, a workforce ecosystem is a structure that emphasizes value creation for an organization. It encompasses various actors, both internal and external to the organization, who work towards individual and collective goals. Additionally, it acknowledges the presence of interdependencies and complementarities among the participants within the ecosystem (Altman et al., 2023a).

Longitudinal careers

The old system of early retirement is quickly becoming obsolete. Instead, the idea of a career spanning five or six decades signifies a considerable duration of professional engagement. This extended timeframe reflects the evolving nature of work and the recognition that individuals may engage in various roles and pursuits over the course of their working lives. Such an extended career trajectory allows for multiple opportunities to pursue education, leisure activities, caregiving responsibilities, and sharing knowledge and experiences across the diverse generations present in today's workplace (Wittenberg-Cox, 2020). Embracing the concept of longitudinal careers encourages a broader personal and professional development perspective, fostering continuous growth and adaptability throughout an individual's working journey.

Changing nature of work

Another issue to consider is the changing nature of work. Work is no longer confined to a physical workplace or a traditional employment relationship. The extended workforce allows individuals to work from anywhere, anytime, and in a variety of roles and capacities. This new paradigm of work requires new approaches to management, communication, and collaboration, as well as new legal and regulatory frameworks to ensure fairness, safety, and compliance.

- *In management,* organizations need to find ways to effectively manage a dispersed and diverse workforce with different levels of experience, skills, and expectations.

- *In communication,* organizations must find ways to ensure effective communication and coordination among team members working remotely and in different time zones.

- *In collaboration*, organizations need to find ways to enable effective collaboration among team members, contractors, and other stakeholders, using technologies and tools that enable virtual teamwork and project management.

- *To ensure fairness, safety, and compliance,* organizations must establish clear policies and procedures for hiring, onboarding, training, and managing their extended workforce and ensure compliance with labour laws, data protection regulations, and other relevant standards. For example, they can use background checks, reference checks, and other screening procedures to ensure that workers have the necessary qualifications, skills, and credentials for the job and provide training on safety procedures, data privacy, and other relevant topics.

Managing dispersed teams and remote work can present challenges related to employee well-being and work-life balance (Appel-Meulenbroek et al., 2022). There are important points to consider from *blurring the lines between work and personal life,* leading to unsocial working hours and employee burnout. Along with these are onboarding challenges, barriers in the virtual environment, structural challenges, and new team roles such as change manager or chief officer of happiness (Vuchkovski et al., 2023). Apart from technology adoption and the need to master new IT skills, there is a growing recognition that digital transformational leadership and organizational agility play crucial roles in driving successful digital transformation initiatives. Digital transformational leaders, with their visionary mindset and ability to drive change, foster an environment of agility within the organization. On the other hand, an agile organization, characterized by flexible structures, empowered teams, and a culture of innovation, provides a conducive context for digital transformational leadership to thrive (AlNuaimi et al., 2022; Ly, 2023).

Last but not least, in harmony with the latest developments in decision-making and HR practices, it is essential to incorporate design thinking principles into these various aspects of the workforce. By doing so, organizations can foster innovation, collaboration, and employee engagement and create a more empathetic and user-centred work environment that addresses the unique needs and challenges of their workforce. This approach encourages creative problem-solving, enhances the employee experience, and promotes a culture of continuous improvement, ultimately driving organizational success in an ever-evolving landscape. Contemplating design thinking, Tim Brown, the Executive Chair of the international design consulting firm IDEO, wrote: *"Leaders now look to innovation as a principal source of differentiation and competitive advantage; they would do well to incorporate design thinking into all phases of the process".*[1]

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1 Brown, T. (2020), p. 2. Design Thinking. In On Design Thinking (1st edition, p. 167). Harvard Business School Publishing Corporation.

The situation is challenging for team leaders and managers on one side and team members on the other. Managers may find it more difficult to recognize signs of burnout and mental health issues in remote workers, which can lead to more serious consequences if not addressed.

The alarming increase in mental health issues in the workplace necessitates an informed response from managers and organizations, as emphasized in the article "Well-Being Intelligence: A Skill Set for the New World of Work" published in the MIT Sloan Management Review (Bhatti & Roulet, 2023). Many research studies have highlighted a focus on well-being (Shahriar et al., 2022; Bartmann et al., 2023; (Karakhan et al., 2023). However, Bhatti and Roulet propose a new approach in the form of the concept of well-being intelligence. *"We propose the concept of well-being intelligence for managers as a skill set and tool to understand and improve their own and employees' well-being. As workplace challenges increase, well-being intelligence is becoming an essential leadership skill. Effective managers must be able to detect when others are struggling with well-being and know when and how to offer support".*[2] To address well-being in remote workplaces, organizations can implement initiatives such as reshaping their culture and providing direct well-being benefits, including offering benefits such as meditation or well-being apps and providing access to counselling. One effective approach is providing a mobile app designed to support employee well-being (Bhatti & Roulet, 2023). Considering possible features of a specifically targeted mobile app designed to help with mental health issues, based on their experience, the authors of this article suggest areas of concern which should be addressed. A mobile app aimed at mitigating the negative effects of health issues in connection with remote work should ideally include features such as:

- Stress management tools
- Guided meditation sessions
- Exercise and wellness tips
- Sleep tracking and advice
- Access to counselling services
- Reminders to take breaks and disconnect from work

Additionally, it could provide resources for setting boundaries between work and personal life, as well as for maintaining social connections and combating loneliness. The app should also be user-friendly and easily accessible on different devices with various mobile operating systems. Further, remote workers may *feel isolated and disconnected* from colleagues, team leaders and the organization, leading to feelings of loneliness and decreased motivation.

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2   Bhatti, K., & Roulet, T. (2023). *Well-Being Intelligence: A Skill Set for the New World of Work. MIT Sloan Management Review.* https://sloanreview.mit.edu/article/well-being-intelligence-a-skill-set-for-the-new-world-of-work/

There are some specific signs or early manifestations of reduced motivation that a manager should be trained to spot:

- Decreased productivity or missed deadlines

- Lack of enthusiasm or interest in work

- Avoiding responsibilities or procrastinating on tasks

- Reduced quality of work or attention to detail

- Poor attendance or tardiness

- Increased irritability or negativity towards colleagues or the organization

- Lack of initiative or contribution to team projects

To recognize these early signs, managers should maintain regular communication with their remote team members and monitor their performance closely, showing a higher level of interest in their problems and any potential requests. It's important to have open and honest conversations about any challenges or concerns that may be affecting motivation and well-being. Regular check-ins, feedback, and recognition can also help prevent decreased motivation from becoming a larger issue. These check-ins can help managers stay informed about their team members' work, provide support and guidance, and address any issues or challenges in a timely manner. By maintaining open and frequent communication, managers can also show their team members that they are valued and appreciated, which can help boost motivation and prevent larger issues from arising.

There may also be *logistical challenges* in providing remote workers with the necessary equipment and resources to perform their duties effectively. In their study, Sull et al. identify the most crucial types of equipment helping remote workers to be efficient in their work. Organization should provide the necessary hardware, Internet connection support, and communication tool. In their research, when asked what helped their transition to remote work, 45% of all respondents mentioned company-provided or subsidized technology, including hardware, collaboration platforms like Zoom and Microsoft Teams, high-bandwidth home Wi-Fi, or office furniture (Sull et al., 2020).

New technologies have brought about significant changes to how work is performed and paved the way for new forms of employment relationships, including the extended workforce.

A well-planned review article by Morrison-Smith and Ruiz addresses this issue through 255 studies focusing on the use of technology in the workplace. Along with physical factors, the authors address cognitive, social and emotional challenges faced by leaders and members of virtual teams. The added value of this study lies in its structural approach to the analysed topic. The authors collated the emerging challenges into five categories: geographical distance, temporal distance, perceived distance, the configuration of dispersed teams, and diversity of workers (Morrison-Smith & Ruiz, 2020).

Collaboration between different groups of workers, such as freelancers and full-time workers, can be successful if managed effectively. One potential challenge is ensuring that all workers are aligned with the company's goals and values and have a shared understanding of their roles and responsibilities. Effective communication and clear expectations can help to address these challenges.

The attitude towards AI-driven co-workers may vary among different workers, depending on their age, experience, and job roles. Some workers may view AI-driven tools as helpful tools that can improve productivity and efficiency, while others may feel threatened by the potential for automation to replace human workers. To successfully integrate AI-driven tools, involving workers in the implementation process and providing training and support is essential to help them develop the skills they need to work effectively with these tools.

In summary, the concept of the extended workforce is becoming increasingly important in today's digital age due to the rise of the gig economy, the need for flexibility, the emergence of new technologies, and the changing nature of work. Organizations that can effectively manage their extended workforce can gain a competitive advantage by tapping into a wider talent pool, achieving greater efficiency, and responding more quickly to market demands.

1.3   Upskilling and Newskilling the Extended Workforce: Addressing Challenges and Unlocking Benefits for Organizations

The question of how organizations can upskill the future workforce is critical in today's rapidly changing landscape. With technological advancements, shifting job requirements, and evolving skill sets, organizations face the challenge of ensuring that their workforce possesses the necessary competencies to thrive in the future. This question is at the forefront of interest for many business leaders (Forbes, 2023). Academicians also examine this question from various perspectives, e.g., agile environment and freelancer-comprised teams (Ivan et al., 2019).

Training and development of the extended workforce ecosystem is one of the crucial elements of the success of organizations. It ensures that all workers, including those in the extended workforce, have the necessary skills and knowledge to perform their roles effectively. It also helps to promote employee engagement, retention, and career growth, which are essential for the success of any organization. A multitude of studies have focused on examining the challenges associated with technology adoption and integration. Some researchers have directed their attention towards the concept of "collective flexibility," which refers to the collective right of workers to personalize various aspects of their work. It includes the ability to customize their work schedule, workplace, workload, boundaries, connectivity, and employment mode in collaboration with their employer (Kossek & Kelliher, 2023).

Organizations may face challenges in funding the education and training of their extended workforce, including freelancers and contractors, as they may have a different level of

commitment to the organization than regular employees. However, organizations can consider different options to address this issue, such as offering online training courses that are accessible to all members of the extended workforce, providing incentives for completing training programmes or partnering with educational institutions to offer subsidized or discounted training programmes to their extended workforce. Additionally, organizations can consider the return on investment of training and development programs for their extended workforce, as it can lead to increased productivity, a better quality of work, and higher retention rates.

Upskilling and reskilling of the extended workforce are essential for the success of organizations in today's rapidly changing business environment. The justification for financial investment in training leads to creating preconditions that companies/ organizations will have better preconditions:

- *To stay competitive:* As new technologies and processes emerge, organizations must ensure that their extended workforce has the necessary skills and knowledge to remain competitive and adapt to changing market demands.

- *To enhance productivity:* Upskilling and reskilling can improve the productivity of the extended workforce by equipping them with new tools and techniques to perform their jobs more efficiently.

- *To attract and retain talent:* By investing in the development of the extended workforce, organizations can attract and retain top talent who value opportunities for growth and development.

- *To increase job satisfaction:* When employees feel that they are developing new skills and knowledge, they are more likely to be engaged and satisfied with their jobs leading to increased retention and productivity.

- *To future-proof the workforce*: By investing in the development of the extended workforce, organizations can ensure that they are prepared for future technological and market changes and have a workforce with the necessary skills and knowledge to thrive in a rapidly changing business environment.

However, as mentioned earlier, funding the education of freelancers can be a challenge. Organizations can consider offering training and development opportunities as part of their compensation package or negotiating training as a part of the contract. They can also explore the use of online learning platforms and other cost-effective training methods to provide education and development opportunities to their extended workforce.

It is important to take into consideration the fact that different age groups may have varying attitudes towards education, which can impact the success of managing an extended workforce. Younger workers, such as millennials and Generation Z, may be more receptive to learning new technologies or skills as they have grown up with rapid technological advancements and a focus on lifelong learning. They may also value career

growth and development opportunities, making them more likely to engage in training and development programs.

On the other hand, older workers, such as Baby Boomers and Generation X, may have more experience but may be less open to change and may prefer traditional learning methods. They may also value stability and job security over career growth and development opportunities, which can impact their willingness to engage in training programs.

It is essential to understand these differences and tailor training and development programmes accordingly to manage an extended workforce with diverse age groups effectively. Organizations can offer a mix of traditional and modern learning methods to accommodate different learning styles and preferences. Providing incentives for completing training programmes can also increase engagement and motivation among different age groups.

The Methodology part of this article will further explore this topic and provide insights on how organizations can effectively manage their extended workforce with different age groups taking into account their attitude to education in broad terms.

2   Methodology

In this study, the authors employ a cross-sectional analysis, an observational study designed to analyse entire segments of a population within a specified period. They utilize the sign scheme and chi-square as analytical tools.

The sign scheme is a visual identification method used to establish associations between row and column categories within a two-dimensional contingency table. It employs the use of + and - signs to indicate the level of significance and direction of interaction, based on residuals derived from the independence hypothesis. The sign scheme is designed in the shape and size of a table, with the signs positioned within the corresponding fields to represent their respective values. The sign scheme is of Czech origin; the authors are Linhart and Šafář, and the scheme was modified by Řehák (Nešpor, 2023).

The research data is sourced from MML-TGI research, a longitudinal study conducted since 1996 by a prestigious research agency Median, s.r.o., focusing on consumer and media behaviour and lifestyle issues and involving 15,000 respondents in the Czech Republic. The study covers over 3,000 brands and 300 product types, as well as data on media consumption and internet usage, and is supplemented with lifestyle questions. Data has been collected using the CAWI (Computer Assisted Web Interview) method since 2021.

The aim of the cross-sectional analysis is to assess and interpret **the adoption levels of educational content** and identify socio-demographic segments of consumers who are suitable for targeted educational content delivered through relevant formats of instruction. The study utilized annual data from 2021, and the authors analysed the data to gain insights into adopting educational content.

Considering the current legislative debate, it would be useful to know the attitude of the age cohort 60+ to education content adoption, especially in the context of the proposed increase in the retirement age in the Czech Republic. This information can help organisations and educational institutions tailor their training and development programs to meet this age group's needs and preferences and encourage them to continue learning and acquiring new skills beyond retirement. Understanding the attitudes of this demographic towards educational content adoption can also help policymakers and government agencies to design policies and programmes that support lifelong learning and ensure that older workers have the necessary skills and knowledge to remain productive and engaged in the workforce.

The MML-TGI research includes various statements that relate to learning and education, and among them, Statement No. 341 is suitable for assessing consumer attitudes towards education content adoption. It reads as follows:

341 Above all, I would like to achieve

as much knowledge and learning as possible in my life.

This statement expresses an individual's desire to acquire new knowledge and learn as much as possible in life. Understanding consumer attitudes towards education is crucial for formulating relevant educational content and designing training programs that effectively target specific consumer segments. Therefore, Statement No. 341 can provide valuable insights for organizations seeking to develop educational content and programs that meet the needs and interests of their target audience.

From an educational perspective, it is assumed that the adoption levels of educational content inherently influence levels of insight and knowledge. Therefore, consumers with a positive attitude towards acquiring knowledge and learning, in general, are more likely to have a positive attitude towards developing new knowledge and skills provided by their employers. It is particularly relevant for the success of hybrid work models, especially remote working modes, including the educational needs of the extended workforce.

Statement No. 341 and the reduced form data (R) were collected in the form of YES/NEITHER YES NOR NO/NO responses. The authors determined that only YES responses represent a positive attitude towards education and learning. It's important to note that knowledge acquisition is an active cognitive process. Respondents who answered NEITHER YES NOR NO do not express a proactive attitude towards acquiring knowledge and cognition. In fact, this ambivalent attitude leads to the same outcome as rejecting education.

The research question specifies the research objective: to identify the socio-demographic groups with a positive attitude towards educational content adoption and those with a negative attitude towards it.

RESEARCH QUESTION: **Which socio-demographic groups exhibit a positive attitude towards adopting educational content, and which groups exhibit a negative attitude towards it?**

The authors formulated the hypothesis, which corresponds to one-sided alternative hypothesis when testing the deviation of the observed value (E – expected) in the corresponding cell of the contingency table from the expected value (O – observed), assuming the independence of the variables listed in the contingency table – H0: E = O; H1: O > E.

To evaluate the hypothesis and statistical interpretation, the author worked with the following methods and tools in the cross-sectional analysis: chi-square test, sign scheme, affinity indices and frequency plots. Table 1 below states the evaluation of the hypothesis.

Table 1: Evaluation of the hypothesis

Hypothesis	Hypothesis formulation	Hypothesis testing result
H1	The demographic segments of the 60–69 and 70–79 age cohorts are more receptive to education and learning whole population disregarding the age.	**The hypothesis was verified.**

Hypothesis H1 was evaluated based on **the relationship between Statement No. 341 and demographic data item Respondent's age (R),** i.e., based on the reduced data (yes/ neither yes nor no/no).

The hypothesis of overall independence between the two variables mentioned above was rejected due to its significance being less than <0.001. Independence in this context refers to the situation where the ratios of "yes," "neither yes nor no," and "no" are the same for each age group, indicating that age has no relationship with the answers. Rejecting the hypothesis implies that there is a statistically significant difference in the answers across different age groups, as shown by the clear differences in ratios in Figure 1. Consequently, hypothesis H1 was tested using the sign scheme method, as shown in Table 2.

Table 2: Relationship between the Statement No. 341 and Respondents' Age

MML-TGI CR2021 Q1 – Q4 CONNECTED (04.01.2021 – 05.12.2021)	341 Above all, I would like to achieve as much knowledge and learning as possible in my life.					
Contingency table	+/–			Index		
CS:CS ALL	yes	neither yes nor no	no	yes	neither yes nor no	no
Respondent's age (R)						
12–19 years	+ + +	– – –	0	117	80	93
20–29 years	0	– – –	0	104	90	113
30–39 years	– – –	0	+ + +	90	100	141
40–49 years	– – –	+ + +	+ + +	86	113	120
50–59 years	–	+ + +	– – –	95	114	78
60–69 years	+ +	0	– – –	106	100	76
70–79 years	+ + +	– – –	– – –	123	83	58

Source: own elaboration using the DATA ANALYZER software tool of the MML-TGI research

Based on the + + sign in the cell for the combination of the age cohort 60–69 years and based on the + + + sign in the cell for the combination of the age cohort 70–79 years and positive attitude towards education and learning (Statement No. 341 = YES), **we accept the alternative hypothesis** at the 0.1% significance level.

Hypothesis H1 was confirmed; it holds for both the 60 – 69 and 70 –79 age cohorts.

The affinity index 106 in the YES group of Statement No. 341 for the studied age cohort of 60–69 years means that there are 6% more respondents in the segment of respondents with a positive attitude towards education and learning than in the population as a whole.

The affinity index 123 in the YES group of Statement No. 341 for the studied age cohort of 70–79 years means that there are 23% more respondents in the segment of respondents with a positive attitude towards education and learning than in the population as a whole.

The interpretation of data in the context of education and learning adoption

The cross-sectional analysis revealed several important facts regarding the appropriateness of targeting educational content.

In terms of age cohorts, consumers in the 60–69 and 70–79 age categories appear to be more suitable for educational content adoption (affinity index 106 and affinity index 123);

However, an interesting fact is a negative attitude towards knowledge and learning of the 30–39 and 40–49 age categories (affinity index 90 and affinity index 86).

Overall, it can be concluded that the potential of knowledge and learning adoption increases with the distance of the respondent's age category from middle age (i.e., the 40–49 age cohort) – see Fig. 2.

Figure 2: The Attitude of Respondents Towards Knowledge and Learning Depending on Age
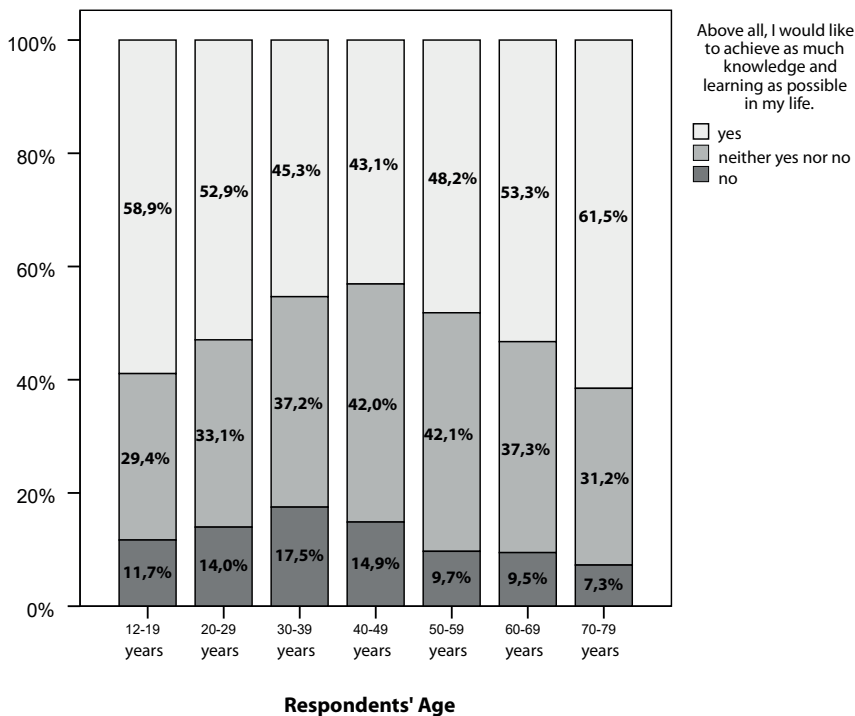
Source: own elaboration

A cross-sectional analysis of the data from Median's MML-TGI longitudinal research provides valuable insights into the potential for adopting knowledge and learning and identifying particular socio-demographic consumer segments suitable for targeted educational content and relevant training activities.

3   Results

The study investigated which socio-demographic groups exhibit a positive attitude towards adopting educational content and which groups show a negative attitude towards it. Hypothesis H1, stating that the demographic segments of the 60–69 and 70–79 age cohorts are more receptive to education and learning than the 30–39 and 40–49 age cohorts, was confirmed based on the cross-sectional analysis using the sign scheme method at the 0.1% significance level. The affinity indices for the age cohorts 60–69 and 70–79 were 106 and 123, respectively, indicating 6% and 23%, more respondents in these age groups with a positive attitude towards education and learning than in the population as a whole.

On the other hand, the 30–39 and 40–49 age cohorts exhibited negative attitudes towards knowledge and learning, with affinity indices of 90 and 86, respectively. The results suggest that the potential for knowledge and learning adoption increases with the distance of the respondent's age category from middle age. Overall, the study provides valuable insights into the potential for adopting knowledge and learning and identifying particular socio-demographic consumer segments suitable for targeted educational content and relevant training activities.

4   Discussion and suggestions for further research

Based on the results of this study, several potential avenues for further research could be explored.

Firstly, the authors suggest *investigating the reasons behind the negative attitudes towards knowledge and learning in the 30–39 and 40–49 age cohorts.* Are any specific factors contributing to this trend, such as work or family obligations, or is it a broader cultural trend?

Secondly, it would be useful to examine how *different educational content and training activities and platforms may be better suited to different age groups.* For example, are older adults more likely to benefit from certain types of online learning platforms or in-person training programs?

Thirdly, researchers might focus on *the role of socioeconomic status in attitudes towards knowledge and learning.* Are individuals with higher income or education levels more likely to have positive attitudes towards education, and how can this be leveraged in educational content development and delivery?

Last but not least, exploring *the relationship between attitudes towards education and the actual adoption of educational content and training activities* would be valuable. Do individuals with positive attitudes towards education really engage in more learning activities, or are other factors at play?

In conclusion, this study aimed to identify which socio-demographic groups exhibit a positive or negative attitude towards adopting educational content. Additionally, further research could be conducted to investigate the impact of other demographic factors, such as gender, education level, and income, on adopting educational content. Such research could provide more precise targeting of education and training activities, resulting in better outcomes for the individual, the employer and society as a whole. Overall, the findings of this study have significant implications for the design and delivery of educational content. However, specific future research is necessary to deepen our understanding of these issues.

5   Conclusions

The objective of this article was to provide comprehensive and research-based state-of-the-art information for organizations, facilitating the transition from ad hoc remote work arrangements to a more sustainable and effective approach to hybrid work.

The article offers analytical insights for companies looking to leverage the benefits of intelligent bots, external developers or other freelancers in their extended workforce ecosystems while addressing the unique challenges associated with managing and integrating these workers into the company's operations. Specifically, the authors examined the issues related to the gig economy, adaptation to a changing work environment and the need for upskilling and newskilling the extended workforce.

Companies looking to leverage the benefits of intelligent bots, external developers, or other freelancers in their extended workforce ecosystems can take several steps while addressing the unique challenges associated with managing and integrating these workers into the company's operations. Firstly, they can establish clear guidelines and expectations for communication, performance, and behaviour, which can help ensure everyone is on the same page and working towards the same goals. Secondly, they can provide training and support to these workers to help them understand the company's culture, values, goals, and the specific tools and technologies they will be using. Thirdly, they can leverage technology solutions, such as collaboration platforms and project management tools, to facilitate communication, coordination, and knowledge-sharing across the entire workforce ecosystem. Finally, they can establish mechanisms for monitoring and measuring the performance of these workers, including regular feedback and performance reviews, to ensure that they are meeting expectations and contributing to the company's success.

Implementing all these managerial approaches, knowledge and skills in effectively managing and integrating the extended workforce ecosystems of intelligent bots, external

developers, or other freelancers into a company's operations will help leaders navigate an uncertain and ever-changing future. It requires a strategic and proactive approach, effective communication, collaboration among team members, and an understanding the legal and regulatory frameworks that apply to these types of workers.

In conclusion, the extended workforce ecosystem is rapidly evolving and becoming a significant part of businesses in the digital age. With the emergence of intelligent bots and freelancers with employee ID cards, the traditional workplace model is being challenged, and companies must adapt to keep pace. This article has explored the benefits and challenges of such ecosystems and provided a roadmap for organizations to successfully navigate the transition to hybrid and fully remote working models.

The study has shown that the success of this journey largely depends on the attitude of all those involved in the extended workforce ecosystem towards education and learning. Based on the insights from the MML-TGI observational study, it is clear that there is a need for upskilling and reskilling the extended workforce to keep up with the rapidly evolving demands of the modern workplace. The study reveals a very positive attitude towards education and learning among the 60–69 and 70–79 age cohorts. This finding is particularly important given that many individuals in these age groups are facing extended working lives due to increases in retirement age in many countries, including the planned increase to approximately 68 years of age in this country. The affinity index for educational content adoption for these age cohorts was found to be 106 and 123, respectively, indicating a strong willingness to engage with learning materials. However, the study also uncovered a negative attitude towards knowledge and learning among the 30–39 and 40–49 age categories, with affinity indexes of 90 and 86, respectively.

The article has provided comprehensive and research-based state-of-the-art information for organizations, facilitating the transition from ad hoc remote work arrangements to a more sustainable and effective approach to hybrid work. It is hoped that this study serves as a bridge to the future by helping organizations transition from reactive ad hoc remote work arrangements to a more strategic and intentional approach to hybrid working models that are better suited to the needs of both employees and the organization.

The extended workforce ecosystem is an exciting and rapidly developing area that presents both opportunities and challenges. By embracing new technologies and being willing to adapt to changing work environments, organizations can create a more efficient, sustainable, and effective workforce that meets the needs of all stakeholders.

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