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Implications of Financial Literacy on Entrepreneurship in Germany

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THESIS SUPERVISORS' AUTHORISATION
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Which I hereby sign in compliance with Spanish Royal Decree 99/2011, of 28 January, in Murcia on 4th of February of 2024.

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ABSTRACT

Purpose – The recent COVID-19 pandemic and previous economic crises have highlighted the importance of financial forecasting and planning in the business environment. Both start-ups and established companies need to convince potential investors and lenders by demonstrating the expected return on their investment through correct calculations for their business model. These examples illustrate the fundamental importance of financial literacy for entrepreneurs. Research has focused almost exclusively on measuring and interpreting the financial capability of individuals and households. Research on the financial literacy of entrepreneurs is limited. This dissertation addresses the research questions of how financial literacy of entrepreneurs can be measured, the effects it has on entrepreneurial success and analyses the causal relationship between financial literacy and entrepreneurship. So far, there is no sufficient scientific dataset for Germany that adequately measures the financial literacy of entrepreneurs, especially with regard to business success, risk-taking and willingness to be an entrepreneur. This dissertation fills this scientific gap.

Methodology – In the past, compound interest, inflation and diversification (the "Big Three") were the leading academic measures of financial literacy for individuals and households. In addition, questions about risk, return and expected return (the "Big Five") have been asked. The OECD has defined an additional framework of disciplines to measure the financial literacy of entrepreneurs and the self-employed. However, there is no valid, scientifically tested measure of financial literacy for entrepreneurs. This dissertation investigates a suitable measurement method to provide scientifically accurate research results on the financial literacy of entrepreneurs. It uses a mixed methods approach.

An explorative qualitative approach presents the current state of knowledge on the impact of financial education in the entrepreneurial environment. This qualitative approach is based on an extensive literature review and is complemented by expert interviews from the banking environment (financing side

for entrepreneurs). In addition to the academic literature, three quantitative empirical studies with a total of 930 participants from Germany, including 389 entrepreneurs/self-employed, are integrated. Matching methods were used for the statistical analysis. This comprehensive combination of qualitative and quantitative research produces scientifically novel, valuable and meaningful results.

Findings – The mixed methods approach using quantitative studies and qualitative expert interviews provides scientifically reliable results and is therefore an appropriate scientific measurement method. The extraction of questions from the "Big Three", "Big Five" and the OECD Entrepreneurial Financial Literacy Framework provides a scientifically valid questionnaire for the statistical measurement of the financial literacy of entrepreneurs/self-employed. Including qualitative expert interviews supplies further scientific evidence from the perspective of financing entrepreneurs. The inclusion of socio-economic backdoor variables such as age, gender, education or income verifies that entrepreneurship is not dependent on higher financial literacy, but that factors such as education, gender or income are statistically significant. Risk tolerance, measured objectively and quantitatively, was found to have no significant effect on the propensity to become an entrepreneur. However, the assessment of personal - and therefore subjective - risk tolerance or risk aversion is of central importance and decisive for entrepreneurship. A moderate to slightly above-average risk tolerance is statistically significant for successful entrepreneurship. Matching and Doubly-Robust methods show a correlation between higher financial literacy and entrepreneurial success (measured by net income) for entrepreneurs and self-employed. The results of the statistical analysis show that entrepreneurs with higher financial literacy have higher business success/higher income than entrepreneurs with lower financial literacy.

Keywords: Entrepreneurship, Financial Literacy, MSMEs, Risk Literacy, Start-ups.

RESUMEN

Propósito: La reciente pandemia de COVID-19 y las anteriores crisis económicas han destacado la importancia de la previsión financiera y la planificación en el entorno empresarial. Tanto las nuevas empresas como las empresas establecidas necesitan convencer a posibles inversores y prestamistas demostrando el rendimiento esperado de su inversión mediante cálculos precisos para su modelo de negocio. Estos ejemplos ilustran la importancia fundamental de la educación financiera para los emprendedores. La investigación se ha centrado casi exclusivamente en medir e interpretar la capacidad financiera de individuos y hogares. La investigación sobre la educación financiera de los emprendedores es limitada. Esta disertación aborda las preguntas de investigación sobre cómo se puede medir la educación financiera de los emprendedores y los efectos que tiene en el éxito empresarial, y analiza la relación causal entre la educación financiera y el emprendimiento. Hasta ahora, no existe un conjunto de datos científicos suficiente para Alemania que mida adecuadamente la educación financiera de los emprendedores, especialmente en relación con el éxito empresarial, la asunción de riesgos y la disposición a emprender. Esta tesis completa esta brecha científica.

Metodología – En el pasado, el interés compuesto, la inflación y la diversificación (los "Tres Grandes") fueron las principales medidas académicas de la educación financiera para individuos y hogares. Además, se han planteado preguntas sobre el riesgo, el rendimiento y el rendimiento esperado (los "Cinco Grandes"). La OCDE ha definido un marco adicional de disciplinas para medir la educación financiera de los empresarios y los autónomos. Sin embargo, no existe una medida válida y científicamente probada de la educación financiera para los empresarios. Esta tesis investiga un método de medición adecuado para proporcionar resultados de investigación científicamente precisos sobre la educación financiera de los empresarios. Se utiliza un enfoque de métodos mixtos.

Un enfoque cualitativo exploratorio presenta el estado actual del conocimiento sobre el impacto de la educación financiera en el entorno empresarial. Este enfoque cualitativo se basa en una extensa revisión de la literatura y se complementa con entrevistas a expertos del ámbito bancario (que suponen la financiación para los emprendedores). Además de la literatura académica, se integran tres estudios empíricos cuantitativos con un total de 930

participantes de Alemania, incluidos 389 empresarios/autónomos. Se utilizaron métodos de emparejamiento para el análisis estadístico. Esta combinación integral de investigación cualitativa y cuantitativa produce resultados científicamente novedosos, valiosos y significativos.

Resultados - El enfoque de métodos mixtos utilizando estudios cuantitativos y entrevistas cualitativas a expertos proporciona resultados científicamente confiables y, por lo tanto, es un método de medición científica adecuado. La extracción de preguntas de los "Tres Grandes", los "Cinco Grandes" y el Marco de Educación Financiera Empresarial de la OCDE proporciona un cuestionario científicamente válido para la medición estadística de la educación financiera de los empresarios/autónomos. La inclusión de entrevistas cualitativas a expertos suministra evidencia científica adicional desde la perspectiva de los empresarios en cuanto a financiamiento. La incorporación de variables socioeconómicas de fondo como la edad, el género, la educación o el ingreso verifica que el emprendimiento no depende de una educación financiera más alta, sino que factores como la educación, el género o el ingreso son estadísticamente significativos. La tolerancia al riesgo, medida de manera objetiva y cuantitativa, no mostró un efecto significativo en la propensión a convertirse en empresario. Sin embargo, la evaluación de la tolerancia al riesgo personal, y por lo tanto subjetiva, es de importancia central y decisiva para el emprendimiento. Una tolerancia al riesgo moderada a ligeramente superior al promedio es estadísticamente significativa para el éxito empresarial. Los métodos de emparejamiento y de doble robustez muestran una correlación entre una mayor educación financiera y el éxito empresarial (medido por los ingresos netos) para empresarios y autónomos. Los resultados del análisis estadístico indican que los empresarios con una educación financiera más alta tienen un mayor éxito empresarial / mayores ingresos que los empresarios con una educación financiera más baja.

Palabras clave: Emprendimiento, Educación Financiera, Micro, pequeñas y medianas empresas (Mipymes), Educación sobre riesgo, Start-ups.

ACKNOWLEDGEMENTS

"An investment in knowledge always pays the best interest".

Benjamin Franklin (1706 - 1790).

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ACRONYMS AND ABBREVIATIONS

ATE	Average Treatment Effect
AUC	Area Under the Curve
BGB	Civil Code [Bürgerliches Gesetzbuch]
B2B	Business-to-Business
B2C	Business-to-Consumer
BVR	Federal Association of German Cooperative and Raiffeisen Banks [Bundesverband der Deutschen Volksbanken und Raiffeisenbanken]
CC	Corporate Customer/Client
DESTATIS	Federal Statistical Office [Statistisches Bundesamt]
DHS	DNB Household Survey
DSM	German Startup Monitor [Deutscher Startup Monitor]
ECB	European Central Bank
Ed.	Editor
Eds.	Editors
e.g.	exempli gratia [for example]
ELSA	England Longitudinal Study of Ageing
et al.	et aliae ["and others"]
etc.	et cetera ["and so on"]
EU	European Union
EUR/€	Euro
FINRA	Financial Industry Regulatory Authority
FL	Financial Literacy
FSA	Financial Services Authority

GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GFLEC	Global Financial Literacy Excellence Center
G20	Group of Twenty [Governments and Central Banks Governors of 19 Countries and the EU]
H	Hypothesis/Hypotheses
H$_0$	Null Hypothesis
H$_A$	Alternative Hypothesis
HFCN	Household Finance and Consumption Network
HFCS	Household Finance and Consumption Survey
HRS	Health and Retirement Study
i.e.	id est [„that is to say"]
INFE	International Network on Financial Education
IO	Industrial Organisation
IPW	Inverse Probability Weighting
ISCED	International Standard Classification of Education
Jr.	Junior
KPI(s)	Key Performance Indicator(s)
KWG	German Banking Act [Kreditwesengesetz]
M	Mean
MACS	Management Accounting and Control Systems
MDM	Mahalanobis Distance Matching
MEA	Munich Center for the Economics of Aging
MSMEs	Micro, Small and Medium Enterprises
NBER	National Bureau of Economic Research
NFCS	National Financial Capability Study
NFEC	National Financial Educators Council
NFER	National Foundation for Educational Research
No.	Number

OECD	Organization for Economic Co-operation and Development
PC	Private Customer/Client
PHF	(German) Panel on Household Finances
PSM	Propensity Score Matching
PISA	Programme for International Student Assessment
Q	Quarter
RBV	Resource-Based View
ROA	Return on Assets
ROI	Return on Investment
RQ(s)	Research Question(s)
SAVE	Private Households' Saving behaviour in Germany
SD	Standard Deviation
S&P	Standard & Poor´s
SHARE	Survey of Health, Ageing and Retirement in Europe
SMEs	Small and Medium-sized Enterprises
SOEP	Socio-Economic Panel
SSI	Survey Sampling International
TEA	Total Early-Stage Entrepreneurial Activity
TNS	Taylor Nelson Sofres (now WPP Group)
UNESCO	United Nations Educational, Scientific and Cultural Organization
US/USA	United States/United States of America
USD/$	US Dollar
VC	Venture Capital
VGSD	Association of Founders and Self-Employed People Germany e.V.
Vol.	Volume
vs.	versus
WebBTs	Web Based Trainings

COUNTRY CODES:

AT	Austria
BE	Belgium
CH	Switzerland
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FR	France
GR	Greece
HR	Croatia (Hrvatska)
IT	Italy
LU	Luxembourg
NL	Netherlands
PL	Poland
PT	Portugal
SE	Poland
SI	Slovenia
UK	United Kingdom

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I – INTRODUCTION

I - INTRODUCTION

"Financial literacy for entrepreneurs is the combination of awareness, knowledge, skills, attitudes and behaviour that a potential entrepreneur or an owner or manager of a micro, small or medium-sized enterprise should have in order to make effective financial decisions to start a business, run a business, and ultimately ensure its sustainability and growth".

(OECD, 2018)

1.1. ACADEMIC INTEREST IN FINANCIAL LITERACY AND ENTREPRENEURSHIP

In 2002, the importance of financial literacy was officially recognised by OECD governments with the launch of the first financial literacy project and further expanded with the establishment of the International Network on Financial Education (INFE; OECD, 2018).

INFE established a dedicated expert subgroup in 2014 to address the financial literacy of potential entrepreneurs and self-employed individuals. As a result of INFE's research regarding financial literacy for MSMEs and prospective entrepreneurs, an official definition for the publication of a core competency framework for financial literacy of MSME entrepreneurs and self-employed persons emerged in 2018 (OECD, 2018).

Based on this framework, concrete survey-based measures of entrepreneurs' financial literacy levels should be developed. The overarching goal is to improve or supplement the financial knowledge of owners, potential entrepreneurs and self-employed persons when starting, managing or expanding a business (OECD, 2018). Given the declining rates of business start-ups and the overall low share of entrepreneurs and self-employed in Germany, research on the relationship between financial literacy and entrepreneurial activity is particularly relevant for an industrialised country like Germany, which is currently in a state of stagnation. An extensive literature review of global and German-focused research, as well as own empirical studies and expert interviews, will be used to gather a valid

database for evaluating the research topic. The following Figure 1 shows the different research modules:

Figure 1. Overview of the Research Methodology
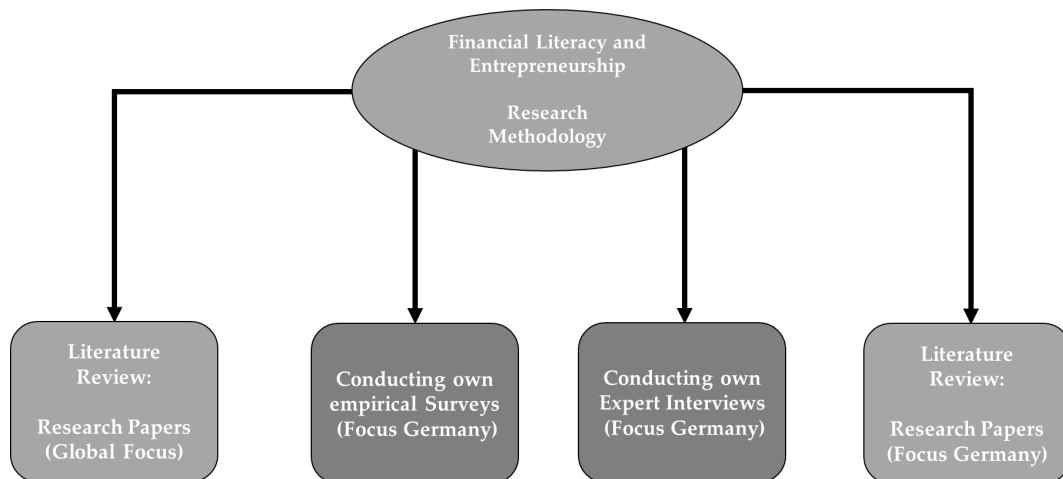
Source: Illustration by the author.

1.2.   THEORETICAL FOUNDATIONS OF FINANCIAL LITERACY

Extensive definitions and studies on financial literacy have been produced in academic research over the last two decades. The following chapters provide a scientific overview of the basic research and the corresponding connections of financial literacy.

Financial literacy is considered a subfield of economic (general) education (Reifner, 2003). Economic general education aims to understand economic issues in economically shaped life situations and make better decisions accordingly (Loerwald, 2020). Economic education includes vocational and general economic education (Reifner, 2003). The following Figure 2 illustrates this relationship between economic and financial literacy:

Figure 2. Financial Literacy as a Subfield of Economic Education
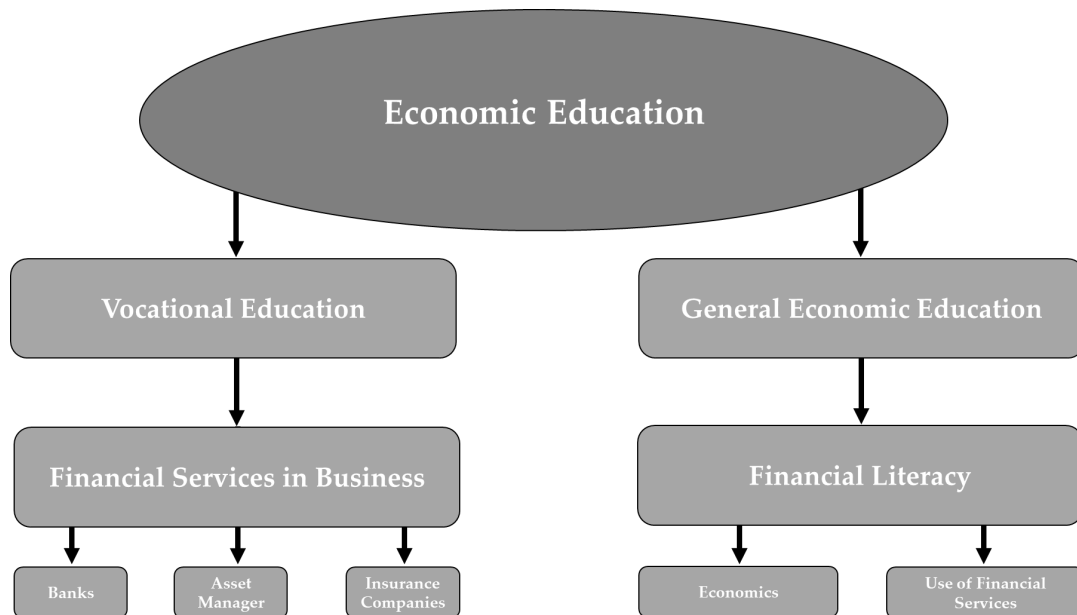
Source: Own presentation based on Reifner, 2003, p. 21.

Financial education leads to financial literacy and financial capability. Financial literacy is seen by many academics and institutions as an essential core component of an individual's financial empowerment. However, the programs and initiatives for effective action in this area vary widely globally. Moreover, the terms have been used differently and have different meanings by different organisations and authors. Financial literacy often refers to knowledge, skills, attitudes, behaviour, abilities and motivation that can be effectively used to achieve personal financial well-being. Financial education provided by parents, schools or media is essential to achieve financial prosperity. Financial education and financial literacy are essential for households to help them plan their personal income, establish efficient saving behaviour and avoid becoming victims of fraud. Beyond employees and (private) households, financial literacy is of interest to entrepreneurs and self-employed in order to be able to manage liquidity, business growth and innovation financing for competitiveness (Hammer & Siegfried, 2023). Financial education is becoming increasingly crucial as households take on more responsibility in financial decision-making, especially for their pension schemes. In Europe, many young adults aged 18–25 years are over-indebted. Over-indebtedness frequently

results from poor household management, unfavourable mobile phone contracts, too many online orders, unpaid loans or persistently low income. Financial education at school should better prepare young people for life's challenges and help them avoid over-indebtedness (Hammer et al., 2022; Świecka et al., 2019). In this context, researchers Erdem and Rojahn also examined the impact of financial literacy on resilience during the pandemic. They found that a high level of financial literacy also leads to greater resilience in such crises (Erdem & Rojahn, 2022).

Consumers are facing new and complex challenges due to the dynamics of change in their socio-economic framework conditions, such as digitisation and increasing flexibility in all areas of life, as well as the resulting heterogeneous needs in the effective and productive handling of money and financial services (European Commission, 2007). Due to the heterogeneity in content and conception, many terms and concepts have become established in connection with the ability of large parts of the population to make informed financial decisions. Most of these terms and concepts are used synonymously or at least to describe similar situations without further differentiation (Reifner, 2003). In Germany, the terms "Financial Literacy" (Kaminski & Friebel, 2012) or analogously "Financial Education" (Reifner, 2011) and also "Financial Competence" (Kaminski & Friebel, 2012) are used in this context. Internationally, and especially in English-speaking countries, the terms "Financial Education" (OECD, 2005) or synonymously "Personal Finance Education" (FSA, 2005), "Financial Literacy" (Hung et al., 2009), "Financial Knowledge" (Hogarth & Hilgert, 2002) and "Financial Capability" (FSA, 2005) are used. Especially in the English language, other terms are also in use that either describes particular skills in dealing with money, such as "Financial Numeracy" (Huhmann & McQuitty, 2009) about the ability to calculate in financial matters, or conversely are very general, such as "Financial Sophistication" (Lusardi et al., 2009), "Consumer Education" (FSA, 1998), "Financial Awareness" (Hung et al., 2012).

The first known use of the term financial literacy is dated back to 1992, when a study commissioned by Australia's NatWest Bank for the National Foundation for Educational Research (NFER) described financial literacy. It defined financial literacy as "the ability to make informed judgments and effective decisions about the use and management of money" (Noctor et al., 1992). Later, financial literacy

was further explored and outlined by Jump$tart Coalition for Personal Financial Literacy in its first study 1997. Jump$tart defined financial literacy as "the ability to use knowledge and skills to manage one's financial resources for lifelong financial stability effectively" (Jump$tart, 2023). The academic literature operationalises financial literacy with a variety of meanings. For example, it is applied to the review of knowledge about financial instruments (such as stocks, bonds or loans), financial concepts (inflation, accumulation, diversification), mathematical skills required for financial decision-making and financial planning (Hastings et al., 2013).

The first studies to measure financial literacy were initiated in the 1990s when the Consumer Federation of America surveyed "consumer knowledge" of various population groups. The respondents were asked questions on various personal financial topics (e.g., credit and insurance) and critical areas of spending (e.g., food, automobiles and housing). The survey of Jump$tart has been repeated every two years and college students were included in 2008 to the survey (Hastings et al., 2013; Mandell, 2008).

The OECD was the first major institution to introduce the concept of financial literacy on a large scale. The International Network on Financial Education (INFE) defined financial literacy as "a combination of awareness, knowledge, skills, attitudes and behaviour necessary to make sound financial decisions and ultimately to achieve individual well-being". This definition of financial literacy has since become globally established and was officially confirmed by the G20 leaders in 2012 (G20, 2012). The definition underlines that financial literacy is more than knowledge, it also encompasses attitudes, behaviour and skills. It highlights the importance of decision-making - i.e., applying knowledge and skills to a real process. Furthermore, the definition indicates that financial literacy's impact should improve individuals' financial well-being (Atkinson & Messy, 2012). According to PISA (2017), "Financial literacy is the knowledge and understanding of financial concepts and risks, and the skills, motivation and confidence to apply this knowledge and understanding to make effective decisions in a range of financial contexts in order to promote the financial well-being of individuals and society and participation in economic life". When defining financial education, PISA first considers the type of thinking and behaviour and, in a further area, the

importance of developing respective literacy skills. In this context, "literacy" is understood to mean besides the ability to apply knowledge and skills in a key subject, also the ability to argue, analyse and communicate as well as to interpret and solve problems. PISA refers in its study to 15-year-old students and not to adults (PISA, 2017).

The National Financial Educators Council interprets financial literacy as "having the skills and knowledge in financial matters to confidently take effective action that best meets the personal, family and global community goals of the individual" (NFEC, 2014). Through INFE, the OECD has defined various terms that reflect similar perceptions of reality. These include financial literacy and capability also financial culture. For this reason, the comprehensive term "financial literacy" was used for the international study of measurement (OECD/INFE, 2011).

Financial literacy means understanding financial concepts and their application to financial decisions, considering available resources and each person's situation (Delgadillo, 2014). Financial behaviour is the second component that creates financial skills in addition to financial competence. This basic financial behaviour includes behaviour related to earning, spending, saving and protecting money (Xiao, 2016).

It should be noted that there is no single, generally accepted definition in the entire scientific literature on the subject. The different definitions of financial literacy (an overview is provided in the appendix) also have an impact on the (uniform) measurability and comparability of available scientific studies. The search for a suitable definitional standard for the financial literacy of entrepreneurs and the self-employed is therefore an essential focus of this dissertation. Since such a uniform definition and measuring framework is still lacking, the following research chapters of this dissertation deliberately approximate a scientifically relevant survey and measuring framework with each survey wave (altogether 3 quantitative empirical studies are conducted). This could then also be used for future research.

1.3. FINANCIAL LITERACY AND ENTREPRENEURSHIP

Research on entrepreneurship has revealed that entrepreneurship education is a learning process to acquire entrepreneurial skills and thus to be successful in self-employment and entrepreneurship (Lilleväli & Täks, 2017; Morris et al., 2013). In this context, entrepreneurial competence is particularly understood as the combination of competencies that result from existing or acquired knowledge, but also skills and attitudes that lead to entrepreneurial action (Lilleväli & Täks, 2017). Financial literacy is always incorporated into these entrepreneurship-focused competency models (Morris et al., 2013). Financial literacy is scientifically defined as a competency that can be learned, but is crucial for the survival and success of companies and start-ups in a competitive market environment (Sucuahi, 2013). However, past research has conducted very limited empirical studies that focus on the impact of financial literacy on the success of small and medium-sized enterprises (SMEs). At the same time, scientific evidence has been found that entrepreneurial success can be attributed to increased financial literacy (Anderson et al., 2018; Suparno & Saptono, 2018). Empirical evidence that financial literacy impacts entrepreneurial competence and risk preference or intention to become an entrepreneur is still lacking (Lilleväli & Täks, 2017).

The correlations between entrepreneurship education, financial literacy and the likelihood that people tend to become entrepreneurs or self-employed have already been studied in academia (Elert et al., 2015). Related to Germany, scientific evidence could be found that financial knowledge positively affects the probability of becoming self-employed (Ćumurović & Hyll, 2019). In this study, however, the risk aversion of the respondents was not separately investigated. In the further course of this thesis, the aspect of risk literacy will be particularly important. Quantitative empirical research will be used to examine the scientifically validated relationship between financial literacy and risk-taking.

1.4. STRUCTURE OF THE DOCTORAL THESIS

Due to the extensive literature and existing empirical studies on the topic of financial literacy, the thesis was divided into chapters, which bring about a logical deduction to the thesis topic of financial literacy and entrepreneurship. Essential is

with the Thesis and the own empirical research, resulting in the chapters after the extensive literature review. The following outline in Table 1 illustrates the structure of the thesis and gives an overview of the contents.

Table 1. Overview of the Individual Chapters and Structure of the Thesis

Chapter	Chapter Description	Chapter Contents
1	Introduction	Derivation of the relevance of the research topic as well as the basics of financial literacy and an overview of the structure of the thesis.
2	Justification	Extensive literature research on the research topic of financial literacy as well as entrepreneurship. Inclusion of existing scientific (empirical) studies to derive a framework for this thesis.
3	Objectives	Deduction of the research gap, formulation of the research questions and hypotheses.
4	Material and Methods	Description of the methodology, quantitative and qualitative research methods within the thesis and data collection. Explanation of the use of the Doubly-Robust and Matching statistical method to ensure the scientific causality of the factor influencing financial literacy on entrepreneurship and self-employment (measurement of backdoor variables).
5	Results	Evaluation and assessment of the results of the quantitative as well as qualitative research in relation to the research questions and hypotheses.
6	Discussion	Discussion of the findings with regard to the research questions, the hypotheses and the

Chapter	Chapter Description	Chapter Contents
		existing academic literature on financial literacy.
7	Conclusions	Conclusions from the research results as well as interpretation.
8	Limitations and Future Work	Limitations of the research conducted and recommendations for future research.

Source: Own presentation.

II – JUSTIFICATION

II - JUSTIFICATION

2.1. SOCIO-DEMOGRAPHIC FACTORS INFLUENCING FINANCIAL LITERACY

Based on the scientific studies analysed, it is possible to define, empirically robustly, key factors that significantly impact the financial capability of private individuals. The findings often extend beyond Germany to Europe or the rest of the world, making the influencing factors significant. In the following, the individual influencing factors are discussed again in detail from the point of view of the scientific literature and are supported by it.

Influencing Factor: Educational Level

The level of education plays a vital role in determining the level of financial literacy (Bachmann, 2021), which is confirmed by studies by Lusardi and Mitchell (2014), Lusardi et al. (2010) and Stolper and Walter (2017), among others. For Germany, Lusardi and Mitchell (2014) analyse that only one in five people with a lower qualification than the "German Abitur" (corresponds to a high school diploma and is equivalent to the entitlement to study at a university) can answer all the "Big Three" questions. For those with secondary education, the proportion is 50%. For people with a university degree, the ratio is significantly higher at over 70% (Lusardi & Mitchell, 2014). However, the study does not show whether these differences are exclusively due to the intellectual abilities of people with higher educational qualifications (Bachmann, 2021). Differences in the education system may also be a reason for higher financial literacy (OECD, 2020). However, not many studies examine the relationship between cognitive skills and financial literacy. Academic research is scarce in this area. However, Lusardi et al. (2010) show that even after controlling for cognitive skills, educational attainment still has a relevant impact (Lusardi et al., 2010). In a study in the US, Lusardi and Mitchell (2011b) found that financial literacy was higher among the employed than among the unemployed. Although this study did not distinguish between levels of education, financial education, which is most commonly provided in US firms,

is thought to increase financial literacy (Lusardi & Mitchell, 2011b). Ownership of stocks and other investment securities is also positively associated with higher levels of financial literacy. Some researchers have concluded that the higher the level of education of college students in the US, the more likely they are to be active in the stock market (Jappelli & Padula, 2015). Financially "educated" people are seemingly better able to relate inflation, return, and risk. They are, therefore, better prepared to invest in equities. For example, there is a positive correlation between financial literacy and ownership of shares and complex financial products (Lusardi & Mitchell, 2011a). When comparing financial literacy with general education, three correlations are important, which are explained and described below:

(1) General educational attainment and financial decisions: Several international studies provide mixed results on the relationship between general educational attainment and financial decisions. Regardless of the level of education, a large part of the population, both nationally and internationally, often makes short-term decisions based on emotions. Positive emotions lead people to invest in a risky financial asset and vice versa (Grable & Roszkowski, 2008). In addition, both academics and non-academics find it challenging to make decisions. As a result, they are typically postponed, delegated to others or made impulsively. Many people are worried about making mistakes, especially when it comes to financial decisions. Postponing decisions are intended to counter the threat of self- or external evaluation, which negatively correlates with self-esteem. This is particularly the case for people who suffer from perfectionism, in most cases people with a high level of education. Nevertheless, there is broad agreement in the scientific literature that general education increases the likelihood of making better financial decisions. This diagnosis is based, among other things, on the fact that a higher level of general education correlates with the level of financial literacy (Sauerland & Gewehr, 2017).

(2) Financial literacy and financial decision-making: Other studies compare financial literacy with participants' willingness to make financial decisions. According to these studies, high levels of financial literacy are positively correlated with private pension planning and higher wealth (Alessie et al., 2011; Arrondel et al., 2014; Bucher-Koenen & Knebel, 2021; Bucher-Koenen & Lusardi, 2011; Lusardi & Mitchell, 2011b; Sekita, 2011; van Rooij et al., 2011a). Empirical evidence shows

that financial literacy is highly correlated with an individual's ability to make independent financial decisions tailored to their life situation. It can also be scientifically demonstrated that a high level of financial literacy tends to lead to better financial decisions (Tang & Peter, 2015).

(3) General education and financial literacy: Another finding in the scientific literature is the positive correlation between general education and the level of general financial literacy, as empirically demonstrated by, among others, the Deutsche Bundesbank study "Private households and their finances" (PHF) from 2017. The PHF study is Germany's most scientifically relevant study, as its 4,500 participants reflect a representative cross-section of the German population (regarding socio-demographic factors). The proportion of correctly answered questions - related to the "Big Three" questions - increases with growing education. In this study, the level of general education is divided into three groups: "low education", "medium education," and "high education". Of the participants with a low level of education, only 37% were able to answer all three questions correctly, while 61% of the participants with a medium level of education managed to do so, and among the respondents with the highest level of education, almost 80% answered the "Big Three" questions correctly (Schmidt & Tzamourani, 2017). Looking at Germany, there seems to be empirical evidence of a positive correlation between general and financial education levels, as also shown by the OECD/INFE survey (OECD, 2020). However, other studies provide mixed evidence of differences between general and financial education levels. In particular, country studies show differences in financial literacy measures, partly due to differences in education systems (OECD, 2020). US empirical studies have shown that general educational attainment does not impact financial literacy. But, only relevant education in finance, banking or accounting leads to higher financial literacy. In the context of this study, however, not only financial knowledge but also financial behaviour about everyday financial transactions were examined and assessed (Rudeloff, 2019). Consequently, it can be hypothesised that the general level of education in Germany is positively correlated with the level of financial literacy.

Influencing Factor: Gender

When comparing women's and men's levels of financial literacy, subjective self-perceived and "Big Three" survey results make scientific sense:

(1) Subjective self-assessment: Using a representative data set for Germany from April 2021, with 3,082 participants between the ages of 16 and 69 years, researchers Hammer, Krahnhof and Zureck came to the following conclusion: men rate their financial knowledge significantly better than women. 67% of male respondents said they had "good" to "very good" financial knowledge. By contrast, only 33% of women rate their financial knowledge as "good" or "very good" (Hammer et al., 2022).

(2) Objective numerical assessment: Several international studies confirm that women are less likely to answer all three ("Big Three") financial literacy questions correctly. They are also more likely to select the "don't know" category. The results of Stiftung Finanztip (2021) are comparable to those of Tang and Peter (2015). The two authors' researchers show that men achieve a score of 1.93 for the "Big Three" questions, while women only achieve a score of 1.09 - with an overall score of 3 (Tang & Peter, 2015). Almost half of women ticked "don't know" for at least one question, compared to only a third of men. This finding is consistent with subjective self-assessment. According to this, men tend to overestimate themselves, while women are less financially literate and, at the same time, have a lower self-assessment. The reasons for this gender gap are not yet fully understood. However, there are several possible explanations. Bucher-Koenen et al. (2017) hypothesise that women who participate in financial literacy tests may perform significantly better, as "I don't know" doesn't necessarily mean that women don't know the answer. It could also mean that they are unsure of what they think is the correct answer to the narrowly worded question (Bucher-Koenen et al., 2017). Fonseca et al. (2012) offer another theory that could explain the divergence. This is based on the different processes of knowledge acquisition. According to this theory, women specialise in various topics related to the household than financial decisions in the traditional model. Depending on the social context, a specific difference in financial literacy can thus be considered as rational, as partners within a household specialise in specific skills. However, in Germany, this thesis only concerns women with a low level of education (Fonseca

et al., 2012). Older women, in particular, often have lower levels of financial literacy. In previous generations, the female gender was not familiar with financial matters, as the role of the financier always fell to the man. As a result, women were not involved in the household's financial planning and were only marginally involved in private financial management, taking care of the household. However, this gender role distinction cannot fully explain low financial literacy, as studies show that not only married or older women have low financial literacy, but also single women who manage their finances. There is therefore a hypothesis that women invest less time and educational resources in their own financial education. This hypothesis is based on the assumption that women have fewer assets and therefore believe that they do not need to deal in depth with their financial education (Jappelli & Padula, 2013).

The German Institute for Economic Research (DIW) examined gender differences in financial literacy in the US, the Netherlands and Germany. It concluded that women are less likely to answer all three questions correctly in all three countries (Grohmann, 2016). The most recent OECD study comes to the same conclusion (OECD, 2020). Shih and Ke (2014) studied risk-taking in stock market investments among university students in Taiwan. They concluded that males with generally higher financial literacy are more likely to invest in low-risk assets. Conversely, women tend to invest in riskier assets (Shih & Ke, 2014). This negative effect and lower average incomes lead to lower wealth accumulation and jeopardise retirement provisions (Jappelli & Padula, 2013). Accordingly, gender can be seen as an essential source of influence on financial literacy globally (Bucher-Koenen et al., 2017). Consequently, it can be hypothesised that women have lower levels of financial literacy than men.

Influencing Factor: Income

Higher economic education often leads to higher income and is crucial, especially in risk assessment (Cox et al., 2015). In their study, Cox et al. (2015) find that low-income households are significantly more likely to take risks than those with high levels of financial education, for example, when taking out loans for housing. One explanation is that low-income individuals believe they have less to lose and are, therefore more risk-tolerant (Cox et al., 2015). Bachmann et al. (2021)

analysed and evaluated data collected by the Bundesbank in 2017 to determine the relationship between income and financial literacy levels. Income was categorised as "low", "medium" and "high". The analysis shows a strong positive correlation between the two determinants - as the level of financial literacy increases with both rising income and rising wealth. The data demonstrated that only 49% of participants in the lowest income group can answer all three "Big Three" questions correctly. In the highest income group, however, the proportion is 78%. In terms of wealth distribution, the result is almost identical. Bachmann et al. (2021) hypothesise that higher wealth, which refers to income and assets, positively impacts financial literacy (Bachmann et al., 2021). The issue of income is of particular socio-political relevance in the current social debate on poverty among low-income earners and also among the sole self-employed.

Influencing Factor: Residence

Differences in financial literacy according to a person's geographical location or residence are examined, among others, in a study by Fornero and Monticone (2011) in Italy. In this study, people living in smaller towns scored lower on the "Big Three" questions than people living in large cities. The study also shows a relationship between financial literacy and GDP per capita as well as the unemployment rate (Fornero & Monticone, 2011). These findings are in line with those of Jappelli (2010), who found a positive relationship between the share of the urban population and the total population of the country. Financial literacy is more accessible to acquire in large cities than in smaller places and therefore depends on the size of the place of residence (Jappelli, 2010). Also of particular interest is the Bundesbank's PHF survey with data from 2014, which measures the level of financial literacy between Eastern and Western Germany. While 61% of respondents in Eastern Germany answered all three questions correctly, the corresponding figure for Western Germany was 62%. The place of residence - divided into old and new federal states - therefore does not make a significant difference. However, this result only applies to the data collection in 2014. For 2010, the difference was still 5% (Schmidt & Tzamourani, 2017).

Influencing Factor: Practical Training

An empirical study by Riebe (2018) examined students' financial literacy using the "Big Three" questions. A total of 32% of respondents were able to answer all three questions correctly. Comparing this result with the proportion of students who had completed an apprenticeship before studying, 38% were able to answer all three questions correctly. This proportion is higher than among business students who acquire financial literacy during their studies. Their share is only 14% (Riebe, 2018). In contrast, a recent study in 2022 that focused exclusively on high school students, graduates, and young professionals provided no significant evidence that prior practical training positively impacts financial literacy (Hammer & Zureck, 2022).

Influencing Factor: Educational Level of Parents

Lusardi et al. (2010) demonstrate a positive correlation between parents' educational attainment and their children's financial literacy. Financial literacy increases for children with an academic background. For example, if parents invest in equities during their children's teenage years, this also positively affects their offspring's financial literacy (Lusardi et al., 2010). As a result, it can be hypothesised that the financial literacy of individuals whose parents have a university degree themselves will be higher than that of individuals whose parents do not have a university degree.

Influencing Factor: Origin

The academic literature confirms the dependence of the level of financial literacy on origin. In this context, the empirical study by Kandutsch and Klinglmair (2019) analyses the relationship between financial literacy and origin in the Austrian province of Carinthia. The study proves that the origin of a person has an impact on the level of financial literacy. The study shows a difference between persons with a migration background of the first generation and persons without a migration background. People without a migrant background have a higher level of education than people with a migrant background. However, the difference in financial knowledge only proves to be significant at the 10% level (Kandutsch & Klinglmair, 2019). Reasons for these differences in financial literacy between

people with and without a migration background could be language deficits that make it difficult to understand and answer the "Big Three" questions. Hammer and Zureck's (2022) study of high school students, graduates and young professionals also shows statistical significance in the correlation between immigrant background and financial literacy (Hammer & Zureck, 2022). Investment behaviour, which is essential for old-age provision and the prevention of old-age poverty, has also been examined in several studies. It has been shown that a migration background also has a significant influence on investment behaviour. People with a migration background make less provision for old age and save less in high-return investments such as shares (Krahnhof et al., 2020; Zureck & Jager, 2018). It can be hypothesised that people without a migrant background have a higher level of financial knowledge than people with a migrant background.

2.2.   MEASURING OF FINANCIAL AND RISK LITERACY

The results of previous studies provided clear evidence that measuring the level of financial literacy is crucial to determine the actual impact on individuals' financial behaviour and also to identify potential needs and gaps (Schmeiser & Seligman, 2013). However, financial literacy has been defined and measured in very different ways in academic studies (Huston, 2010) and the instruments used have not defined general and comprehensive measures (Lusardi et al., 2010), so there is still a lack of meaningful academic clarification of standardised measurement tools (Lusardi & Mitchell, 2014). As a result of this lack of standardisation, the studies that have been conducted show a wide range of interpretations of the instruments (Servon & Kaestner, 2008). Financial literacy can be measured through achievement tests (objective) and self-report methods (subjective). However, there is a predominance of existing measures of financial literacy for objective measures of knowledge (Fernandes et al., 2014). The existing literature provides clear evidence of a significant difference between objective (achievement tests) and subjective (self-report) assessment methods. Recent studies have therefore combined objective measures with subjective assessments of financial literacy. This should provide stable and accurate insights into the interaction of these two different assessment methods (Lusardi & Mitchell, 2014).

It is scientifically relevant to assess how well people are financially literate, but it is challenging to study in real life how people process financial information and use it to make informed financial decisions about their household finances. Researchers Lusardi and Mitchell (2011c) measure financial literacy according to the following principles:

1. **Simplicity**. The aim is to assess financial literacy similar to an ABC for reading literacy.

2. **Relevance**. All questions asked must relate to concepts that are relevant to people's everyday financial decisions throughout the life cycle.

3. **Brevity**. In order to keep the time required for representative surveys on financial literacy low and to achieve broad acceptance, the number of questions is kept to a minimum.

4. **Capacity to differentiate**. The questions must capture distinct levels of knowledge in the financial sector so that the respondents are comparable based on a score from a standard questionnaire.

The questions developed by Lusardi and Mitchell (2011b) were based on economic savings and portfolio selection methods. In total, three economic approaches are asked, which an individual must understand. These are

1. Compound interest,

2. Inflation and

3. Risk diversification.

The first question aims to measure the respondents' ability to calculate, i.e., the ability to perform a simple calculation concerning the compounding of interest rates. Question two is about understanding how inflation works in connection with a decision on financial matters. The third question aims to gain knowledge about risk diversification and is a good measure of respondents' ability to put together the right portfolio of assets in the context of individual pension provision (Lusardi & Mitchell, 2011b). In addition to the "Big Three", the questions have been

supplemented over time, mainly about risk formation (see the Allianz/Lusardi survey questionnaire in the appendix).

Other studies complemented the questions on measuring the numeracy of respondents (Lusardi & Mitchell, 2007). These numeracy questions were asked in modified form in the ELSA (England Longitudinal Survey of Ageing) and the SHARE (Survey of Health Ageing, and Retirement in Europe) surveys (Banks & Oldfield, 2007; Christelis et al., 2010). Numerical skills play an essential role, but the ability to make sound financial decisions is even more critical. Therefore, short modules on financial literacy should ideally be included in national surveys since then, the responses on financial literacy can be associated with other factors and impacts and correlations can be made if necessary. The measurability of financial literacy is essential for research. However, measurement errors cannot be completely ruled out, as there is a possibility that the questions may be misunderstood or even randomly answered correctly. It is therefore crucial how the question is asked. A significant measurement error due to formulation of the question has been shown in comparing US American Life Panel and the Dutch DNB Household Survey (DHS; Lusardi & Mitchell, 2007; van Rooij et al., 2011b). In the DHS survey there were only a small number of correct answers when people were asked whether "buying an equity investment fund generally provides a more secure return than a corporate share" (DHS, 2011; detailed information on the questionnaire in the appendix). The number of correct answers doubled when the question was asked in reverse order: "The purchase of a company share usually yields a more secure return than an equity fund" (US American Life Panel; Lusardi & Mitchell, 2007). In this case, it can be assumed that some respondents did not understand the question and basically did not know what shares, bonds and investment funds are. As a result, it can be concluded that some correct answers are due to assumptions made by the respondents. Therefore, these discrepancies and measurement errors should be considered when analysing the questions on advanced financial literacy (Lusardi & Mitchel, 2011b). The questions used by Lusardi and Mitchell (2011b) were also used for a comprehensive national survey of the adult population in the US as part of the National Financial Capability Study (NFCS) and were combined with two other questions on mortgage interest rates and bond prices, collectively known as the "Big Five" (Hastings et al., 2013; the detailed questionnaire can be found in the appendix).

Allianz (2017), in their study conducted with Lusardi, found that participants struggled with risk assessment questions due to a lack of risk literacy. However, as risk assessment is essential for the optimal selection of financial products for asset accumulation, Allianz developed two additional questions in the International Pension Paper (2017) that address the topics of expected return and risk and return. The Figure 3 below gives a good overview of a possible combination of questions from well-established scientific studies that provide a robust test of financial and risk literacy.

Figure 3. Measuring Financial and Risk Literacy
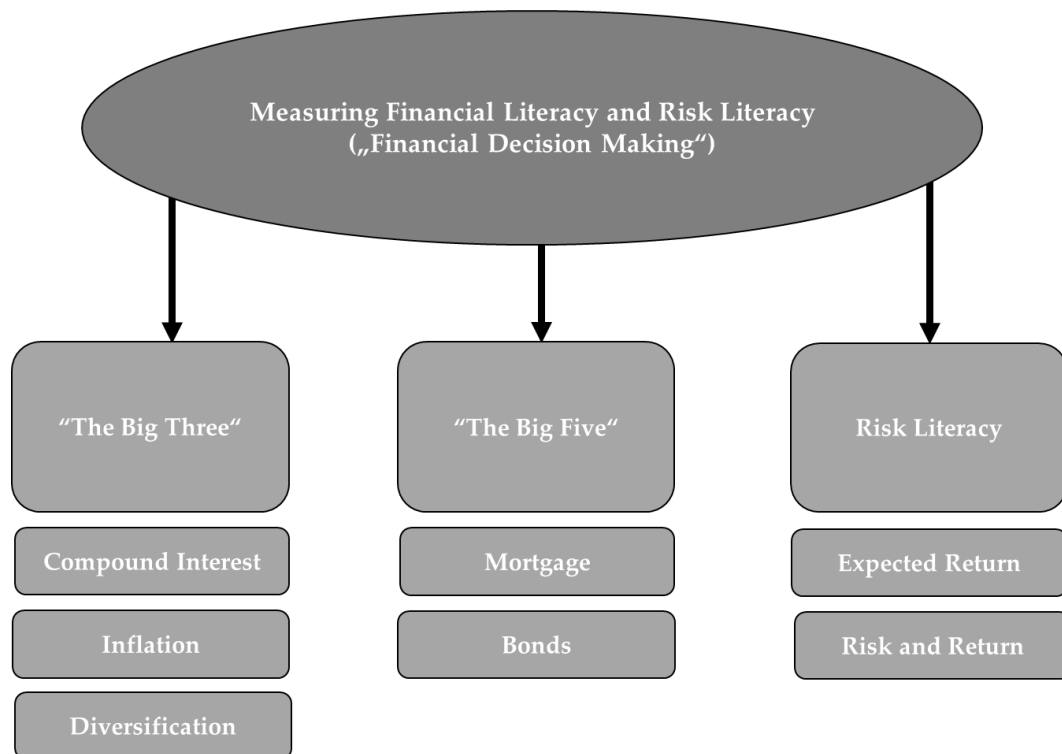
Source: Own presentation based on Allianz International Pension Paper 01/2017, "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age" and OECD/INFE Core Competencies Framework on Financial Literacy for MSMEs (OECD, 2018).

Another tool for assessing progress in financial literacy is the OECD/INFE Toolkit (2018). This was initially developed to measure financial education and inclusion and is based on the OECD Financial Literacy Framework (Kempson,

2009). It was endorsed by the G20 Leaders in September 2013. The toolkit consists of questions on financial knowledge, behaviour and attitudes to assess levels of financial literacy and financial inclusion (OECD, 2018). These methods have been used in OECD and INFE studies, such as the OECD/INFE International Adult Financial Literacy Survey (2020).

Specific questions on entrepreneurship and financial literacy are needed to capture entrepreneurs' financial literacy. In order to formulate these questions, it is essential to define the core competencies of entrepreneurs. To this end, the OECD/INFE has developed a financial literacy framework tailored explicitly to micro, small and medium-sized enterprises and aspiring entrepreneurs. The OECD/INFE Financial Literacy Framework for MSMEs is based on previous OECD frameworks. It describes the type of financial knowledge and skills from which entrepreneurs and potential entrepreneurs can benefit. The framework includes behaviours that can improve the financial management of enterprises, as well as attitudes that support this process. The purpose of such financial literacy is to complement and deepen general entrepreneurial skills and the broader financial literacy that young and adult consumers need to succeed in the financial world (OECD, 2018).

Figure 4. OECD Areas of Competency Financial Literacy and Entrepreneurship

Source: Own presentation based on OECD/INFE Core Competencies Framework on Financial Literacy for MSMEs (OECD, 2018).

When considering all existing measurement methods and questionnaires, it must be taken into account that especially the target group of entrepreneurs and self-employed persons is not willing or spend the time to answer very (time) extensive questionnaires. It is, therefore, appropriate to compile an extract from the existing questions that deal in particular with the measurement of risk literacy, which is especially relevant for entrepreneurs and the self-employed.

2.3.   STATE OF FINANCIAL AND RISK LITERACY IN GERMANY

In Germany, austerity is considered a virtue. Despite low-interest rates and existing inflation, the German "savings world champions" still invest a large part of their assets for old age provision on the savings book, i.e., certainly but not profitably. This leads to the fact that the average German financial assets in the international comparison are only in the middle field. The prevailing reluctance in Germany to invest savings on the capital market in shares, bonds or funds is thus

increasingly becoming a challenge in terms of asset accumulation - especially for retirement planning. Many studies on the effects of financial literacy investigate this connection in the USA and in developing countries. Significantly less empirical evidence can be found for European countries and specifically for Germany (Kaiser & Menkhoff, 2017).

In the scientific literature, the knowledge of financial literacy is usually tested using the example of financial skills. Three questions are often used to measure financial literacy ("Big Three"), which were first used by Lusardi and Mitchell (2011b).

In cooperation with several teams of authors in different countries, these questions were also applied in other countries outside the USA, including Germany. Overall, the researchers conclude that financial knowledge is relatively low in all eight countries (Lusardi & Mitchell, 2011a). In Germany, this survey was conducted as part of the SAVE Household Survey on saving behaviour in 2009. All three questions could only be answered correctly by about half of the respondents. Every tenth person answered all three questions incorrectly. The highest proportion of correct answers, over 80%, was found in question 1 (on interest rates). Since independent surveys were conducted in the respective countries, the results cannot be directly compared with each other. However, there are indications that some other countries, such as the USA or Japan, perform worse than Germany. The Netherlands also performs slightly worse than Germany, while the results in Switzerland are almost identical to those of Germany. The results were presented in more detail in the following Table 2 ("Big Three" questions in the appendix).

Table 2. SAVE Survey Results on Financial Literacy ("Big Three" Questions)

	Germany	USA	Japan	Switzerland	Netherlands
Question 1					
More than $102	**82.4**	**64.9**	**70.5**	**79.3**	**84.8**
Exactly $102	**3.0**	11.3	6.0	11.1	3.4
Less than $102	**3.7**	9.2	9.4	6.9	1.7
Do not know/ Refuse to answer	**11.0**	14.5	14.1	2.8	10.0

	Germany	USA	Japan	Switzerland	Netherlands
Question 2					
More than today	**0.9**	11.2	5.8	6.3	2.7
Exactly the same	**3.8**	9.0	5.0	11.1	5.7
Less than today	78.4	64.3	58.8	78.4	76.9
Do not know / Refuse to answer	**17.0**	15.6	30.4	4.2	14.7
Question 3					
True	**5.9**	51.8	39.5	13.5	13.3
False	61.8	13.3	2.8	73.5	51.9
Do not know / Refuse to answer	**32.3**	34.9	57.8	13.0	34.8
Total					
All answers correct	53.2	30.2	27.0	50.1	44.8
All answers wrong	10.3	12.3	17.6	3.4	10.5

Source: Illustration by the author based on Brown & Graf, 2013; Bucher-Koenen & Lusardi, 2011; Lusardi & Mitchell, 2011c; Sekita, 2011. **Data in %. Correct answers marked in bold and highlighted in grey.**

A closer look at the results for Germany indicates that all three questions were answered correctly more often in the 36-50 age group than in the younger or older persons over 50. In addition, men perform significantly better than women. 59.6% of men answered all three questions correctly, but only 43.3% of women. Furthermore, the proportion of correct answers increases significantly with increasing educational level.

Finally, people in West Germany answered the questions correctly more frequently than people from East Germany. Differences here are mainly between people with a low level of education. In Eastern Germany, however, the difference between the sexes is less significant than in Western Germany (Bucher-Koenen & Lusardi, 2011).

2.4.   FINDINGS OF FINANCIAL LITERACY IN EUROPE AND OECD COUNTRIES

The fundamental changes brought about by deregulation, globalisation and technological progress are, on the one hand, providing the population with a wide range of financial choices and, on the other, leading to greater personal responsibility. In European countries, demographic change and the associated ageing of the population are leading to greater individual responsibility for health and retirement planning. Therefore, using an inappropriate financial instrument or strategy to build wealth during working life can have severe consequences in retirement planning. These "opportunity costs" (of lost wealth) have not only an individual aspect for the individual citizen, but also for the whole social (solidarity) community, which may have to pay for these costs. It is vital for policymakers and the financial industry to identify those groups whose financial literacy, particularly risk literacy, is inadequate. The research was conducted with Professor Annamaria Lusardi and the Allianz Group and is one of the most comprehensive studies in Western Europe on financial and risk literacy (Allianz International Pension Paper, 2017).

Regarding the structure of the survey, the Allianz Group surveyed 1000 people in 10 Western European countries (Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal, Spain, Switzerland and the United Kingdom) in November 2016. The survey was conducted online using a random sample by the online survey institute SSI (Survey Sampling International). The samples represent each country's population regarding age, gender and geography. The questionnaires were translated into the local languages of each country by professional native translators and communication experts and scientifically supported by Professor Lusardi (Allianz International Pension Paper, 2017).

Financial literacy was based on the questionnaire developed by Lusardi and Mitchell in 2004 to measure financial literacy for essential financial decision-making concepts (Lusardi & Mitchell, 2007). The risk questions were adapted by Lusardi and Tufano (2009) from the TNS Global Economic Crisis 2009 survey (Lusardi, Schneider & Tufano, 2011). The academic literature well documented the relationship between financial literacy and financial performance. In this study, questions on the concept of risk were added to test whether this would make the

respondents better equipped to choose the right financial product in real life (Allianz/Lusardi, 2017).

According to scientific studies, risk is the most difficult concept for people to understand. The Allianz/Lusardi study, therefore, examines the understanding of risk in Europe and Germany. Two questions on risk concepts (expected value and the relationship between risk and return) were asked in addition to the three basic questions on financial literacy. The detailed structure of the questionnaire can be found in the appendix.

The first studies on financial literacy were conducted sixteen years ago (Lusardi & Mitchell, 2007) and found a widespread financial literacy deficit. The results of the 2017 Allianz/Lusardi study show little change. There are still significant gaps in understanding financial concepts that form the basis of sound financial decisions (Allianz/Lusardi, 2017).

The following Figure 5 provides an overview of financial and Risk Literacy in Europe and Germany.

Figure 5. Status of Financial and Risk Literacy in Europe

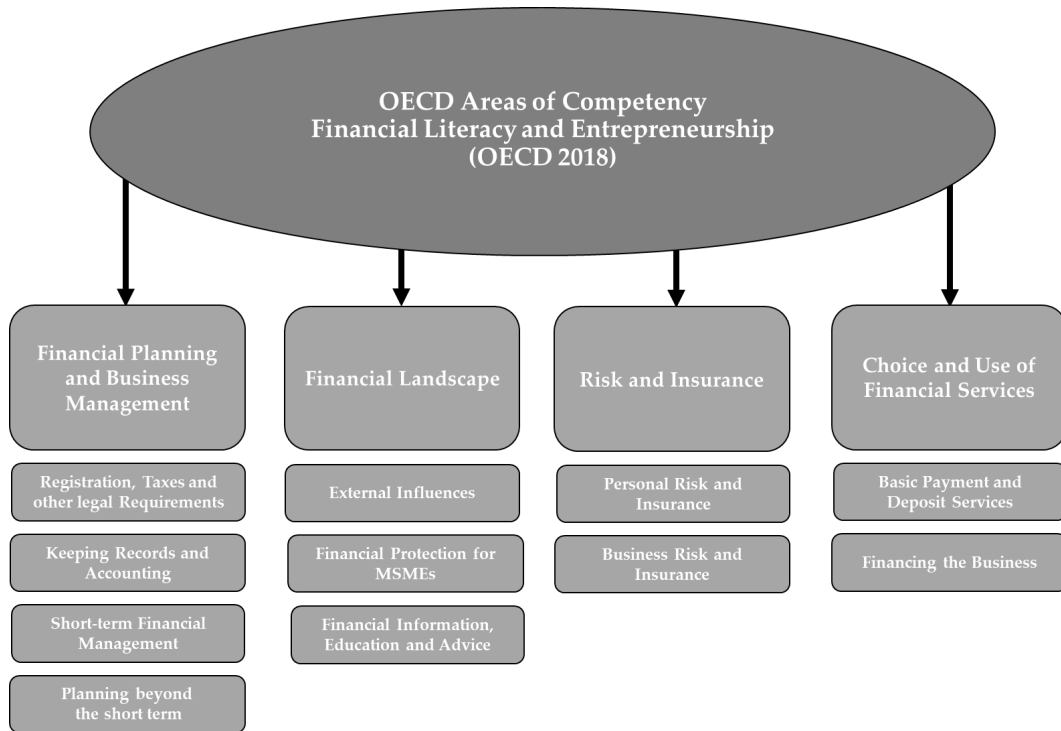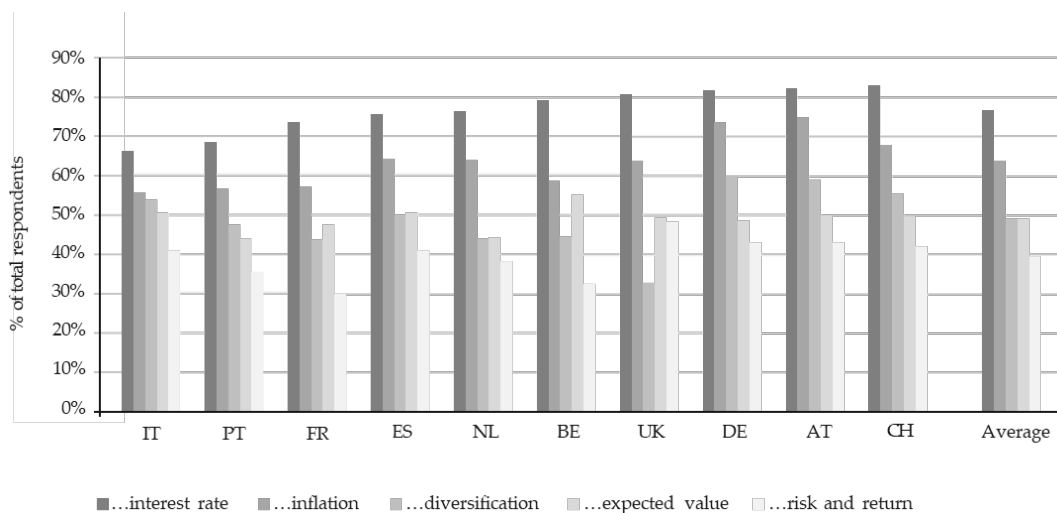*Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 8.*

The study results provide interesting insights into the development of financial literacy in Europe recently. Accordingly, three-quarters could answer the question of interest rates and 63% the question of inflation accurately. It is

remarkable, however, that the proportion of correct answers is almost at the same level as before the financial crisis (Allianz/Lusardi, 2017).

2.4.1. Knowledge Gaps in Risk Literacy

It is worth noting that when asked about risk, the results deteriorate significantly. Less than 50% can answer the question correctly. Even respondents in Germany achieve a low level of correct answers here. Assessing and correctly answering the risk-return ratio is the most difficult question for respondents. A particularly striking aspect of the survey results was that the low percentage of correct answers to the risk questions was due to a large group of respondents who answered "don't know" instead of "wrong". This result gives a very worrying trend about the financial literacy of the respondents, as existing studies have already confirmed that answering "don't know" represents a much more significant lack of understanding than answering a question incorrectly (Lusardi & Mitchell, 2014). The survey results strongly suggest a lack of understanding of risk among the respondents and a clear knowledge gap in risk functioning. When asked about risk diversification, most responses were "don't know". There are significant differences across Europe. The lowest number of "don't know" responses was recorded in Germany (24%) and the highest in the UK (56%). One possible explanation for the poor results may be found in the question's wording. The question explicitly referred to financial market instruments such as "shares" and "equity funds". The question can be used to measure knowledge about shares, investment funds and risk diversification (Allianz/Lusardi, 2017). The Figure 6 below illustrates the significantly lower scores in the areas of risk literacy and risk and return.

Figure 6. Widespread Gap across Europe in Financial and Risk Literacy

% of "Don't know" answers to the question on…

■ …interest rate   ■ …inflation   ■ …diversification   ■ …expected value   ■ …risk and return

Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 9.

2.4.2.   Gender-specific Differences in Financial and Risk Literacy

A further finding of the survey was to focus on gender. For example, women were significantly more likely to answer "I don't know" in the survey. This result was demonstrably observed in all countries surveyed and is also consistent with the findings of previous studies on financial literacy (Lusardi & Mitchell, 2014).

The Allianz/Lusardi study also confirms that gender differences persist across countries, ages and education groups. Gender differences are significantly higher for risk-related questions than for basic financial literacy questions. The average number of correct answers men give to financial literacy questions is 14% higher than for women in all countries surveyed. The difference between the three risk-related questions is even more pronounced, with men giving 31% more correct answers than women. There are also marked differences between countries. The gender gap is particularly pronounced in Italy for the basic financial literacy questions. Here, on average, 25% more men than women answered correctly. This gender difference is comparatively small in Austria, where men gave only about 8% more correct answers. For risk competence, Belgium and Germany show the most significant gender gap. The following Figure 7 provides a good overview of the gender differences in basic financial and risk literacy in the

European countries surveyed (Allianz/Lusardi, 2017). The results for Germany strongly suggest that women's risk literacy is very low, confirming the findings of other academic studies in this thesis.

Figure 7. Gender-specific Gap in Financial and Risk Literacy
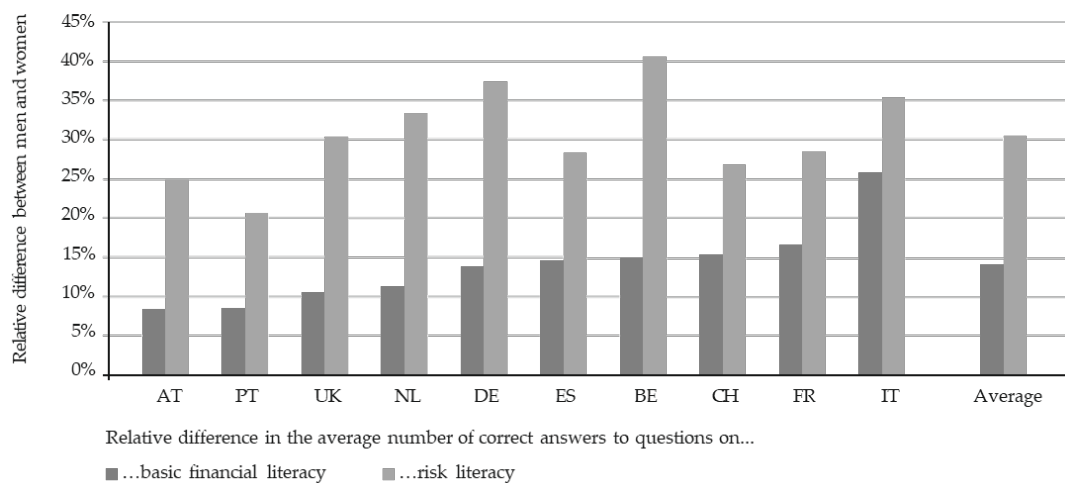
Relative difference in the average number of correct answers to questions on...
■ ...basic financial literacy   ■ ...risk literacy

Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 10.

Looking more closely at gender differences, the gap in financial education is much less distinct for young people aged 18-35 than for the population as a whole. This educational gap is even more pronounced when the three risk-related questions are considered. Several conclusions can be drawn from the interpretation of these survey results. On the one hand, it could be assumed that the generation of young women (younger than 35) is more involved in financial education, is more aware of the importance of understanding financial matters and wants to close this knowledge gap with men. On the other hand, the result could have a less optimistic implication. It could also be the case that women's skills in old age adapt less quickly to the dynamic development of financial skills. Men in this age group develop their financial skills to a greater extent, thus widening the gender gap (Allianz/Lusardi, 2017).

Figure 8. Gender-specific Gap in Financial Literacy across Age Groups
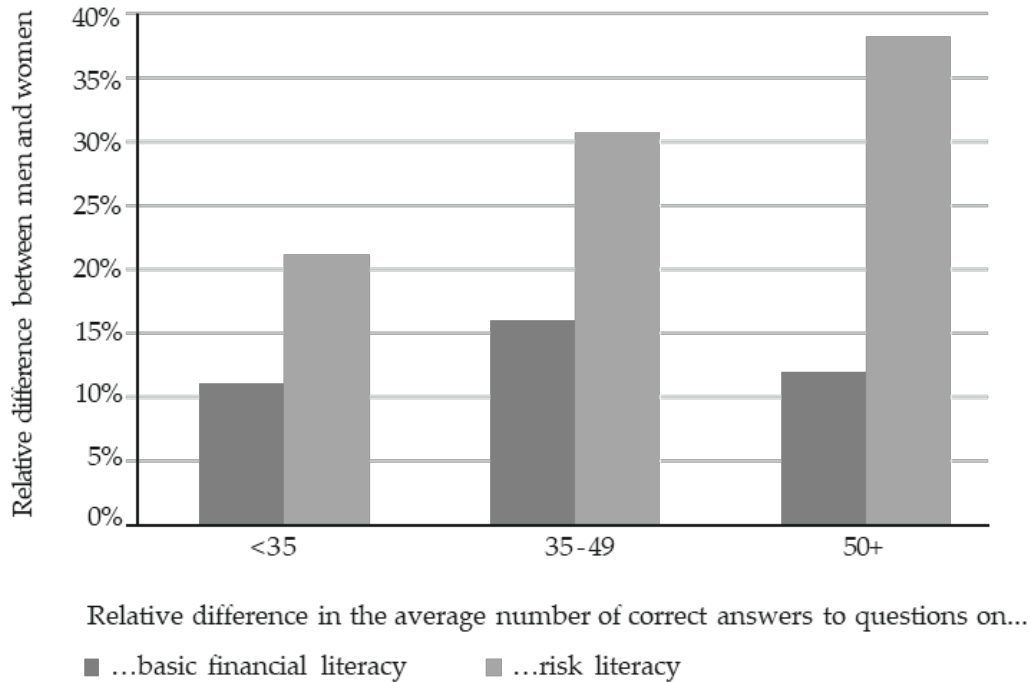
Relative difference in the average number of correct answers to questions on...

■ ...basic financial literacy   ■ ...risk literacy

Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 11.

2.4.3.   Age-related Differences in Financial Literacy

The Allianz/Lusardi survey shows a significantly lower knowledge gap in the younger population concerning gender differences between women and men. In that case, the status of financial literacy among the younger population is deficient overall. All 10 European countries analysed have a significantly lower rate of correct answers among millennials under 35 than those aged 50 and older. The issue of inflation is explicitly complicated for the millennials to answer. Across all the countries surveyed, only 49% of respondents were able to answer the term correctly. By contrast, 65% of 35-49-year-olds and 75% of those over 50 responded to this question correctly. The questions on risk were answered correctly only, to a lesser extent among those under 35 years of age than among the older age groups. However, younger respondents answered the expected value and risk/return ratio correctly to a higher degree than older respondents. The under-35-year-olds

performed consistently worse than the group of over 50-year-olds in the question of risk diversification (Allianz/Lusardi, 2017).

One interpretation of the results could be that millennials have had limited experience with financial products because of their age. Financial decisions about, for example, buying a property, a car or the contract of a private life insurance policy do not yet concern this group due to their age. Only 20% of respondents in this age group think about their pension provision and how much money they will need in old age. This is reflected in the use of financial products in that group. In Germany and Austria, for example, 41% and 38% of millennials respectively indicate that they do not have long-term financial savings products such as time deposits, funds or life insurance (Allianz/Lusardi, 2017).

Figure 9. Basic Financial and Risk Literacy in the different Age Groups
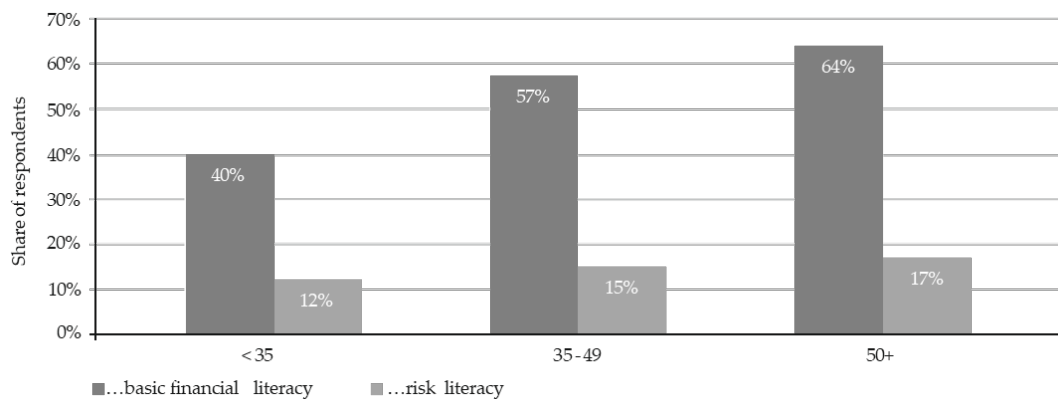
Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 14.

2.4.4. Impact of Education on Financial Literacy

In addition to gender differences, the analysis of the survey results also revealed findings that can be attributed to the respondent's level of education. For example, respondents with a low level of education had the highest rate of incorrect answers to questions on basic financial literacy (the first two questions in the Allianz/Lusardi survey). The differentiation of educational levels was based on the UNESCO ISCED. In this context, a low level of education is defined as up to 10 years of schooling, a medium level of education as higher education or vocational training and a high level of education as university education. While the

proportion of correct answers to the fundamental questions on general financial literacy is around 41% for low education, it rises to around 54% for medium education and 68% for higher education (Allianz/Lusardi, 2017).

Figure 10. Basic Financial Literacy depends on Educational Attainment
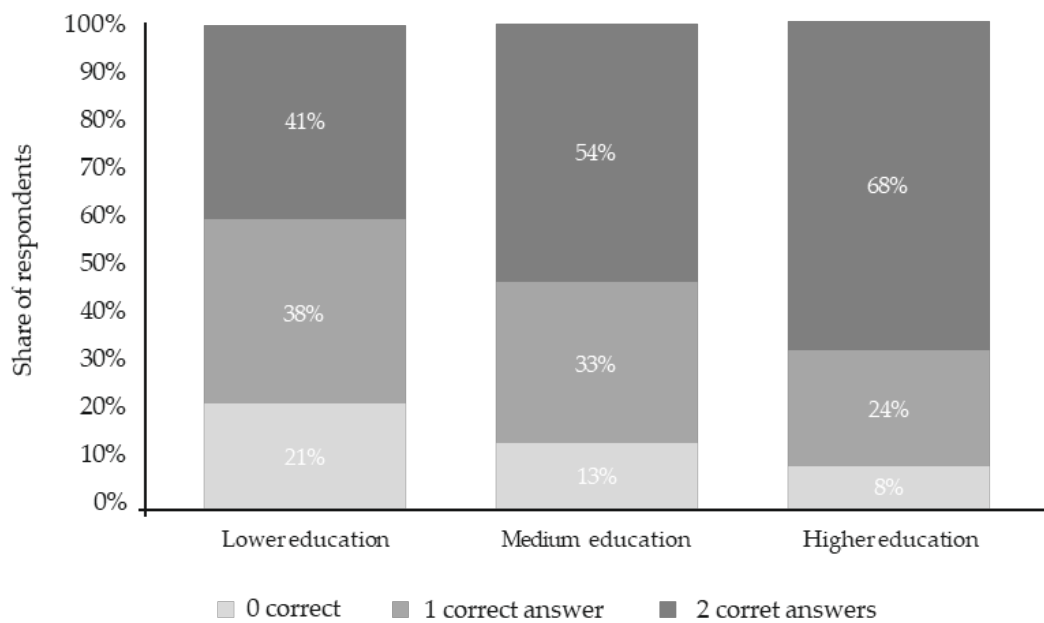
Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 13.

The respondents' difficulty in assessing risk and return is most striking in the survey results. Many respondents with low, medium and high levels of education have a poor understanding of volatility as a risk factor. Less than 60% of highly educated respondents answered this question correctly. This is an indication of weak risk literacy. Overall, only 21% of the respondents with a higher educational level could answer these three questions correctly. The lack of understanding of risk and return, or volatility, can have an impact on the right choice of retirement products as well as an impact on the willingness of individuals to start a business. Respondents with a high level of education had the best understanding of risk. A correlation can be observed here concerning start-up behaviour. This is because most founders have a high level of education. The result is illustrated in the following Figure 11.

Figure 11. Risk Literacy Questions by Educational Attainment
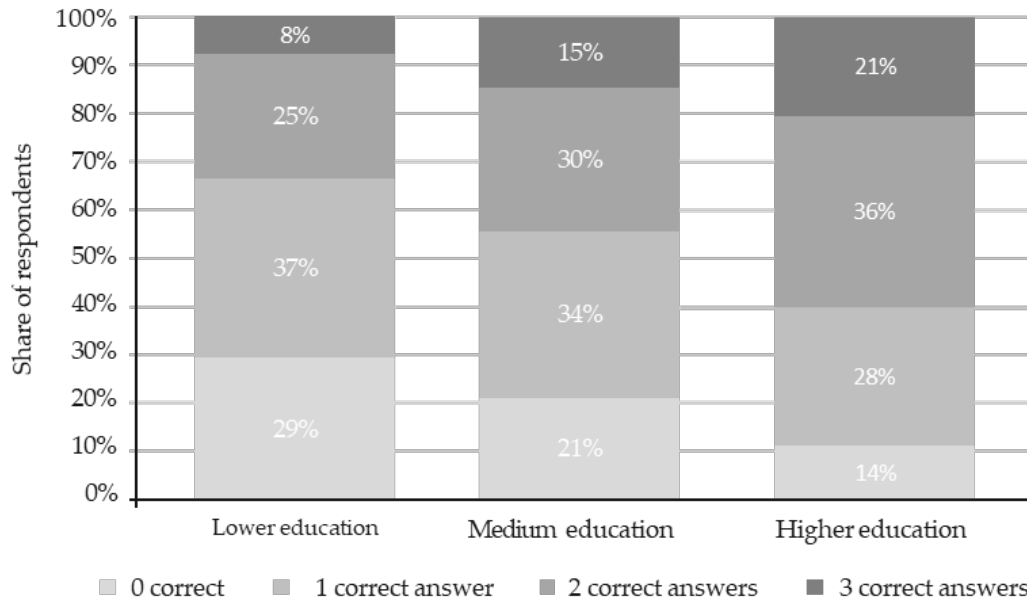
Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 13.

2.4.5.   Financial Literacy Differences in Europe

The Survey provides good evidence of the wide variation in understanding basic financial and risk-related concepts. Risk concepts specifically are the most difficult for people to understand. The survey results also vary considerably across Europe, particularly regarding differing educational levels. Analysing the relationship between theoretical knowledge and practical decision-making is vital to draw valid conclusions from the results. For this purpose, respondents who were able to answer all five questions correctly are considered to be "financially literate". Austria and Germany have the highest levels of financial literacy in the survey. The population in France, Portugal and Italy scores the lowest (Allianz/Lusardi, 2017).

Figure 12. Differences in Financial and Risk Literacy across Europe
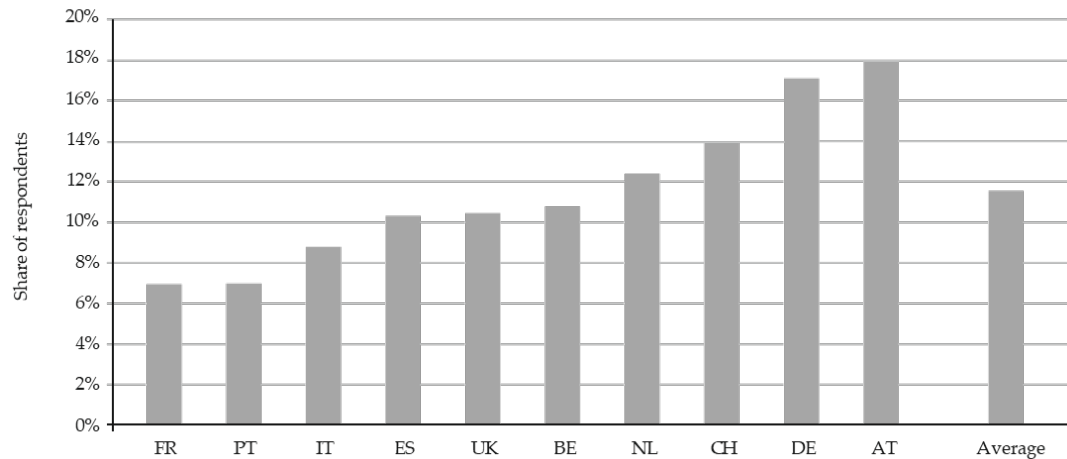
Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", p. 15.
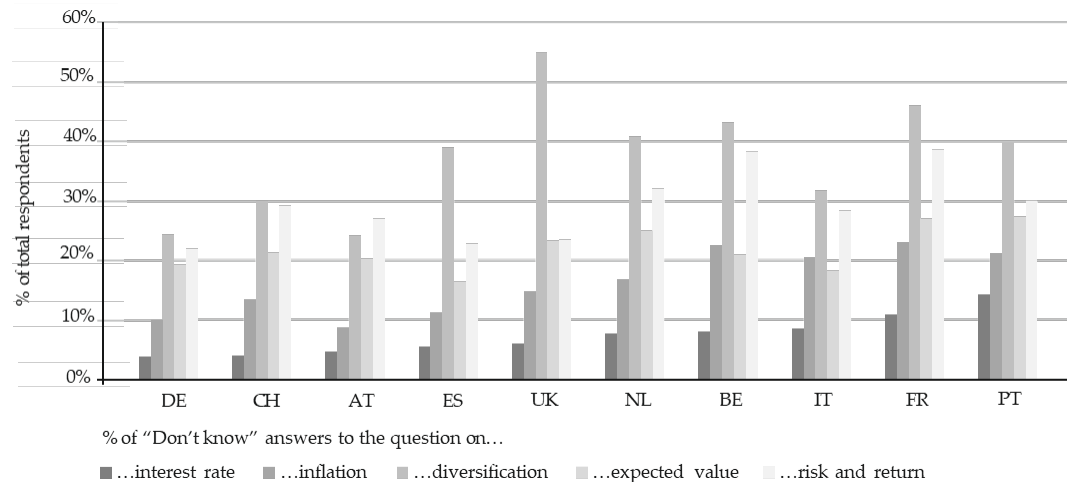
2.4.6. Correlation of Financial Literacy and Financial Decision-Making

Although the survey results on financial literacy provide a high level of evidence, it is necessary to assess whether people with good financial literacy also make better financial decisions. This is the only practical proof that financial literacy helps avoid savings and investment failures and thus positively impacts consumers' financial well-being and prosperity. In 2016, Allianz Group Economic Research found that between 2012 and 2016, German households lost 200 billion euros in investment income due to overcautious savings behaviour and thus suffered a correspondingly high loss of wealth (Allianz Economic Research, 2016). In addition to over-cautious investment behaviour, the academic literature has shown that many people find it challenging to control their credit card spending and often accumulate debt. People who tend to get into debt through credit card consumption, i.e., who have low debt competence, typically also tend to pay higher fees, make higher-cost transactions and take out loans at higher interest rates. Around a third of the costs and fees incurred by financially illiterate people are caused by this neglect and disregard. In addition, the under-diversification of portfolio investments, often found in studies, is another source of a lack of wealth creation and loss of household well-being. The research results thus clearly show

that it is the financial decisions that are taken that are important for wealth creation. In other words, knowing only the basic financial concepts is of limited use if people cannot translate their knowledge into decisions - i.e., apply it in the real world (Lusardi & Tufano, 2009).

Therefore, the study investigated people's ability to apply financial literacy in real-life situations. Participants faced real-life situations where they had to make financial decisions to achieve a clearly defined financial goal. The decision was to choose the appropriate product for the real-life scenario. The question was structured in such a way that there could only be one solution (product). The first question in the Allianz/Lusardi study on a real-life situation was about securing the standard of living in old age by means of a permanent payment or, alternatively one-time payment. The results indicate that only 59% of respondents were able to answer this simple question correctly. The findings show that Switzerland (71%) and the Netherlands (76%) performed best among the older respondents (over 50) who answered correctly. This is most likely due to the long tradition of occupational and private pension provision in both countries, and therefore an educational effect (in terms of pension provision and financial education) can also be assumed (Allianz/Lusardi, 2017).

The second day-to-day question was about liquidity planning and the appropriate financial instruments. Here the lack of knowledge is even more apparent, as only a third of respondents were able to answer the question correctly and select the appropriate product. Overall, 37% of respondents found the right financial solution for a real-life situation. A more detailed analysis by country shows that Germany (47%) achieved the highest rate of correct answers for the right product choice. Belgium achieved the worst result with 28% (Allianz/Lusardi, 2017).

The third question in the survey, which is based on a real-life situation, examines the distribution of assets for retirement provision and aims to check whether the respondents understand the diversification effect and can find the right product solution. Across all the countries surveyed, the results for correct answers to this question are the lowest, suggesting that many respondents do not understand the (risk) diversification effect and therefore do not have a suitable pension plan to help them achieve prosperity in old age. The survey tested two

investment failures. Firstly, not participating in the stock market, i.e., choosing the capital market product, and secondly, choosing the more optimal risk-return profile for given options. Long-term positive savings outcomes depend to a large extent on people's ability to make investment decisions involving risky investments. It is essential that respondents understand that this inherent risk will ultimately benefit them in the long run through higher returns. People's ability to understand the systematic nature of capital market investments and to avoid unsystematic risks is crucial for long-term planning and wealth accumulation. The results for both criteria were exceptionally low, with only 28% of respondents picking the right product. Many respondents had difficulty answering the question and replied, "I don't know". This could be partly due to how the question was phrased, using the financial terms risk, return, yield, investment (fund) and benchmark. This is all the more surprising as the terms used in the legally required product information brochures are standard and private investors are confronted with them almost daily in financial matters (Allianz/Lusardi, 2017).

Looking at the results of the fundamental questions together, it is clear that the results are as disappointing as those for the financial and risk literacy questions. Overall, however, it is striking that respondents with high levels of financial and risk literacy perform significantly better than those with low levels of financial literacy. The differences are significant when expressed in figures. For example, 63% of the financially literate could identify the optimal product in two out of three cases, compared to 22% of the financially illiterate. The knowledge gap between the financially literate and the financially illiterate is most pronounced in the diversification scenario. Overall, the question is whether financial and risk literacy is decisive (Allianz/Lusardi, 2017).

The fact that financially literate people have almost twice the survey score of financially illiterate people (regardless of their level of education) can be seen as the first evidence of a link between financial literacy and sound financial decisions. This would mean that a good understanding of financial and risk concepts demonstrably impacts the ability to make sound financial decisions, regardless of education level. As a result, a lack of risk literacy can significantly negatively impact today's savers' savings outcomes and financial well-being. Conservative and low-risk forms of saving will not be able to deliver the returns that savers need

to build wealth and provide for retirement. The survey shows that very often people are not educated to use advanced financial products that would be essential for their prosperity. In particular, women, the less educated and younger respondents have an apparent deficit in their understanding of risk (Allianz/Lusardi, 2017).

2.4.7. Financial Literacy in Germany by OECD/INFE

The OECD/INFE Adult Financial Literacy Survey includes results from more than 26 countries, including 12 OECD member countries, based on 125,787 adult respondents. The survey examines responses from individuals minimum age 18 and examines financial literacy and its components of knowledge, behaviour and attitudes, using the methodology and definition developed by OECD/INFE. The questions used are taken from the updated OECD/INFE Toolkit 2018 (OECD, 2020).

The survey results prove that overall financial literacy is low in the countries surveyed, confirming existing academic studies on individual financial literacy. The assessment of financial literacy is based on the OECD/INFE methodology and the OECD/INFE Toolkit 2018, which measures basic financial knowledge, behaviour and attitudes towards risk. A person with a score of 21 has a basic understanding of financial concepts and uses sound practices in his or her financial transactions. If a person scores the highest possible score, it means they have a high level of financial literacy (OECD, 2020).

Overall, respondents to the survey scored an average of 12.7 out of a possible 21 points for financial literacy, indicating a basic understanding of financial concepts and attitudes. The average of the participating OECD countries is 13.0 points. Compared to other countries, Germany ranks 4th with an overall score of 13.9 points, above the average of OECD member countries.

2.4.8. Risk Literacy Deficits in Germany

Financial literacy is an essential component of financial education to help individuals make informed financial decisions and compare financial products and services. Consumers who have a basic understanding of financial concepts

and can apply their numeracy skills in a financial context can better navigate financial matters and respond to news and events that may impact their finances. The OECD/INFE survey assessed the level of basic financial literacy using seven questions covering different aspects of knowledge that are useful to participants when making financial decisions. The maximum possible score for financial literacy is seven points, with one point awarded for each correct answer. Answering the questions correctly requires basic financial concepts such as inflation and interest calculations and understanding risk (OECD, 2020).

The evaluation shows that understanding interest payments on a loan was the most frequently answered question. Participants in Germany answered this question at an above-average rate of 91.5%. On the other hand, participants had problems understanding both simple and compound interest. Only 26.3% were able to answer both questions correctly. 78% of adults know what inflation is, but only 59.9% of them know how to calculate the value of money over time. It is particularly striking that participants in Germany were able to apply their knowledge of inflation to the question about the value of money over time. 77% of adults correctly answered the question on risk and return. The second question on risk and diversification was answered correctly by 58.9%. Respondents from Germany were above average in answering both questions correctly. The OECD defines a person as financially literate if they correctly answer at least five of the seven questions. 52.5% of respondents met this requirement. Germany ranks third with 67.9%, behind Hong Kong and Austria (OECD, 2020).

2.4.9. Short-Term View and Risk Aversion in Germany

The OECD/INFE methodology emphasises that consumers' actions and behaviours are crucial in shaping their financial situation and well-being. Certain behaviours, such as putting off paying bills and not planning for future expenses, can harm a person's financial situation and well-being. To capture these issues, the OECD conducted a survey that looked at participants' financial behaviour. By correctly answering questions about budgeting, shopping, saving, avoiding debt and controlling spending, a person can improve their financial behaviour and protect themselves from financial difficulties. Careful planning, saving,

monitoring cash flow and prioritising key expenses can help avoid debt (OECD, 2020).

The OECD/INFE methodology showed that, on average, adults in the whole sample in OECD countries achieved a maximum score of 9. The average score was 5.3 points. Germany was in the upper middle range with a behavioural score of 5.7. However, it was found that even if a person has sufficient knowledge and skills to be financially aware, attitudes towards money and planning for the future can influence whether they act. The OECD/INFE toolkit includes three statements designed to measure respondents' attitudes related to money and planning for the future. On average, participants in the sample of economies studied scored 3.0 out of a maximum of 5, but only 42.5% of adults scored above the minimum of 3. Participants from Germany scored around the average for financial attitudes, with a score of 3.1. This indicates that financial literacy in Germany is low in this respect (OECD, 2020).

2.4.10. Summary of Financial Literacy in Germany

In summary, the results of the reviewed studies provide the following findings on financial literacy and financial behaviour in Germany:

Table 3. Findings for Germany related to Financial and Risk Literacy

#	Findings for Germany with regard to Financial & Risk Literacy
1	Overall, financial literacy in Germany is above average in global and European comparison.
2	Only about 60% of the German population has basic financial literacy knowledge.
3	The German population demonstrates apparent knowledge gaps in assessing risk and return, leading to over-cautious investment in low-yielding investments and long-term losses in prosperity.
4	In Germany exists significant gender gaps in financial literacy. Women perform significantly worse than men.
5	Gender-specific differences increase over time and become much more pronounced from the age of 35 onwards to the disadvantage of women.

#	Findings for Germany with regard to Financial & Risk Literacy
6	The issue of old-age provision is only given below-average attention in Germany - many Germans do not provide for old age (37%).
7	The young population (under 35) has little provision for old age and often has no long-term savings products such as investment funds or life insurance (38%).
8	Only about half of the German population can be classified as active savers, which is on average by international comparison.
9	Germany's interest in and occupation with financial products is feeble (appr. 50%). Overall demand for financial advice is low.
10	The German population has tendencies for stronger short-term consumer spending and declining savings behaviour, which contradicts good financial literacy.
11	In Germany, debt borrowing to bridge income deficits is weak but has risen slightly recently.

Source: Illustration by the author.

2.5. FINANCIAL LITERACY OF ENTREPRENEURS/SELF-EMPLOYED AND SMES

Distinguishing Entrepreneurs/Self-employed from Employees

In this thesis, the comparison between employees and entrepreneurs/self-employed was deliberately chosen to address people in an employment relationship precisely and to conduct the study in a business-specific context. The term employee can therefore filter out pupils, students, pensioners or people without an employment relationship. According to German law, an employee is a person who, by entering into an employment contract, undertakes to perform a service in personal dependence and is therefore bound by instructions and to carry out work determined externally. An employment contract can be concluded with a natural person as well as a legal person (BGB §611a).

For entrepreneurs/self-employed, however, there is no single or legal definition. This is partly due to the term's origin in the French word "Entrepreneur" in English. Adopting a term from another language means that the definition of what it means to be an entrepreneur and what makes a person an entrepreneur is imprecise (Miller et al., 2009). The term "Entrepreneur" refers to a

person who starts a business and takes the risk of doing so to make a profit. This definition was initially formulated by the Irish-French economist Richard Cantillon, who is cited as the first person to define the term "Entrepreneur" in today's understanding of entrepreneurship/self-employment. According to Cantillon, the entrepreneur is the person who organises and takes the risk of the business (Filion, 2021).

Instead of an employee, an entrepreneur is responsible for leading and needs to be equipped to lead. In the early 20th century, the Austrian economist Joseph Alois Schumpeter (1911) emphasised the importance of the entrepreneur in his "Theory of Economic Development" and provided a precise and comprehensive account of entrepreneurship/self-employment by combining economic theory and psychological aspects of the entrepreneur. In doing so, Schumpeter provided a unique perspective on entrepreneurship/self-employment (Schaller, 2001).

Joseph Schumpeter expanded the meaning of entrepreneurship/self-employment in his economic development theory to include the dimensions of innovation and productivity. He defined an entrepreneur as someone who successfully implemented a new idea (Schumpeter, 1976) and not just someone who starts a business (Filion, 2021). According to Schumpeter, an entrepreneur is seen as someone who changes markets by implementing new configurations. This can be achieved by introducing new products or production methods, entering new markets and using unusual sources of materials, or reorganising a business (Schumpeter, 1934).

According to Professor Lois-Jacques Filion, entrepreneurship/self-employment can be defined by six components:

(1) Innovation,

(2) Opportunity recognition,

(3) Risk Management,

(4) Action,

(5) Use of Resources and

(6) Added Value

Entrepreneurs/self-employed must be able to identify opportunities and create value with innovative ideas and available resources. They must also be able to manage potential risks and act in the company's best interests (Filion, 2021). These components can also be seen in the definition of an entrepreneur published by the OECD. Here, entrepreneurs/self-employed seeks to create value by creating or expanding an economic activity by identifying and exploiting new products, processes or markets (OECD, 2015).

In summary, entrepreneurs/self-employed can be distinguished from employees because they do not usually have an employment contract. Although entrepreneurs/self-employed also could have an employment contract, the externally determined work of employees must be clearly distinguished from this. In this context, a managing director can also be considered analogous to an employee if he or she is employed in the enterprise without shares. The following definitions of entrepreneur and self-employed are used in this dissertation:

o   The German Civil Code (BGB) provides a legal definition. According to this definition, an entrepreneur is any natural or legal person or partnership with legal capacity who, when concluding a legal transaction, acts in the exercise of his commercial or independent professional activity. This includes freelancers, artisans, farmers and small traders (BGB §14(1)).

o   Self-employed persons run a company, business, or workplace as owners, co-owners, tenants, self-employed artisans, merchants, and freelancers. Self-employed persons do not include persons in a relationship under labour law who can only make independent arrangements within their work area (Destatis, 2023).

Financial Literacy of SMEs

In addition to the level of financial literacy in small and medium-sized enterprises (SMEs), the relationship between business success and financial literacy is of particular scientific relevance.

Based on a meta-study (Graña-Alvarez et al., 2022), a systematic review of 71 empirical studies on financial literacy in SMEs found that financial literacy is a

crucial factor influencing the performance of SMEs in an environment of high uncertainty and instability. The empirical work was mainly conducted in developing and emerging economies. It is based on Huston's (2010) conceptualisation of financial literacy, which has two dimensions: understanding basic financial concepts and using this knowledge in decision-making. Therefore, financial literacy in SMEs is seen as a combination of financial knowledge and the ability to apply it specifically to decision-making. The term financial literacy is thus intended to encompass not only the basics, which are already included in the definitions, but also the knowledge and application to manage the company's finances (Graña-Alvarez et al., 2022; Hammer & Siegfried, 2023).

A positive correlation is found between several characteristics of an entrepreneur, such as age, level of education, management experience and number of contacts, and his or her financial literacy. In addition, individuals with previous management experience are more likely to have more financial knowledge and skills to run businesses efficiently. Differences in financial literacy between entrepreneurs/self-employed and employees are also analysed according to gender, language and attitudes related to education. No significant effect is found for either objective or subjective financial literacy. However, men, English speakers, people with a positive attitude towards education or university education, and older people are more likely to have higher subjective financial literacy (Graña-Alvarez et al., 2022).

As a consequence of sound financial literacy within a company, there is a correlation with financial risk management, which increases financial risk tolerance. These findings are consistent with the finding that the higher the level of financial literacy, the more aware managers are of the risks involved in making risky financial decisions. This suggests that a high level of financial education in SMEs increases awareness of the potential risks a company faces. This awareness leads to a tendency to adopt risk management practices that can help reduce the burden of these risks. Acceptance of a particular loss level and increased risk awareness may lead to loss aversion (Graña-Alvarez et al., 2022). The study has been able to demonstrate scientifically that as financial literacy increases, so does the awareness of liquidity constraints and the use of cash flow management practices to avoid them. A positive relationship can also be established with the

use of various financial methods, costing and the use of financial reporting and record-keeping practices, which also have an increased positive impact and use among the company's stakeholders. This can persuade stakeholders to approve investments and funding, overcoming financial constraints that generally limit support for innovation. The level of financial literacy thus influences the financing decisions of SMEs. Managers with higher levels of financial literacy are less likely to use informal sources of finance such as family resources, internal finance or expensive, short-term sources. Ultimately, these individuals can convince lenders of the viability of their business and create a sustainable funding base. This overcomes traditional financing difficulties such as collateral requirements or high interest rates that lead to underfunding of businesses. These findings are in line with Lusardi and Mitchell's financial research, where financial literacy improves financial resources by enabling businesses to convince financial institutions (Lusardi & Mitchell, 2011a).

In the context of organisational capabilities, it is determined that financial literacy provides entrepreneurs/self-employed individuals with skills such as calculating, managing, and limiting the risks associated with starting and growing a business. It turns out that it is only by having these skills that loss-averse individuals become entrepreneurs/self-employed, as it provides an awareness of risk management that enables them to start and grow a business. This also has an impact on the eventual internationalisation of a business. Financial literacy increases the ability of entrepreneurs/self-employed to operate and expand in international markets by equipping individuals with the necessary skills to access finance, manage risk and make financial decisions. In addition, entrepreneurs/self-employed with a sound financial education are more likely to invest in innovation as they have a better understanding of the positive link between innovation and business success (Graña-Alvarez et al., 2022).

The chapter on SME performance compares various studies on the relationship between financial literacy and firm performance. Several studies show a positive relationship between financial literacy and SME growth. In other words, a lack of financial literacy is one of the main obstacles to SME growth. The ability of financially literate entrepreneurs/self-employed to quickly identify risks and opportunities positively impacts access to finance and business growth. It also

has an indirect effect on financial performance through the use of financial information in decision-making. Exploring financial opportunities in different markets can be another advantage of firms whose decision-makers are financially literate. As a result, companies can adapt to market changes with flexible resources. Identifying financial opportunities is facilitated by financial literacy when a firm is adaptable to contextual changes. Managers with a high level of financial literacy use financial information to evaluate past investments, predict market conditions and develop strategies to increase their investment returns (Graña-Alvarez et al., 2022; Hammer & Siegfried, 2023).

In the financial literacy, attitudes, behaviours and organisational capabilities section, a firm's performance is linked to its chosen strategy and depends on its implementation. Here, the two approaches to strategy are concretised: the industrial organisation (IO) and the resource-based view (RBV). The IO approach explains a firm's performance in the context of the structure-behaviour-performance paradigm. Here, a firm's performance depends on its strategy and the industry structure in which it competes. The RBV approach assumes that a company's performance depends on its combination of resources and capabilities available to implement its strategy and gain a competitive advantage. To achieve superior performance, decision-makers in the firm are expected to develop organisational capabilities that enable this combination to be dynamically adapted to the firm's environment. These organisational capabilities, therefore, directly impact SMEs performance (Graña-Alvarez et al., 2022).

For example, greater use of management accounting systems leads to better access to finance, facilitating other capabilities, such as the ability to innovate or internationalise. Thus, a high level of financial literacy leads to a positive attitude towards the use of management accounting systems, which makes it easier for the firm to use valuable knowledge to make better decisions (Graña-Alvarez et al., 2022; Hammer & Siegfried, 2023).

The remainder of the paper considers the behavioural economics perspective of how individual decisions and behaviours are influenced by people. Financial decisions in the company, based on the financial sophistication of the decision-makers, are influenced by psychological and social factors, as well as unconscious

processes and heuristics, rather than purely rational considerations and available information (Graña-Alvarez et al., 2022).

However, weaknesses in current research on financial education in SMEs are also highlighted. One of the most severe methodological shortcomings identified is the lack of consensus on the definition of financial literacy in SMEs. Few papers have used measures that include specific financial management skills. Most of the studies reviewed used self-reported measures of perceived financial literacy. There is also a lack of longitudinal studies and comparative studies in different settings. This means it is unclear how financial literacy develops over time and in different settings. Time is also relevant, as past decisions and performance likely influence the performance of today's financial decisions and behaviour. However, this temporal link is missing from the long-term studies in this area of research. However, some studies have shown that both financial decisions and managerial experience are related to financial literacy (Graña-Alvarez et al., 2022; Hammer & Siegfried, 2023).

Future work needs to examine the effects of financial education in different industries and countries to understand if there are differences in the effects. It is also suggested to examine the impact of financial literacy on the long-term performance of SMEs to understand how financial decisions and behaviour affect the long-term development of SMEs. Overall, there are still many unanswered questions about financial education in SMEs. Further research is needed better to understand financial literacy and its impact on SME performance. In addition, further research should clarify the role of financial education and management accounting and control systems (MACS) in financial decision-making and their impact on organisational capabilities. While it has already been established that the use of MACS affects innovation capabilities, it persists to be seen whether the level of MACS affects organisational capabilities. However, it remains to be seen whether the extent of this improvement depends on financial literacy. It is also worth noting that most studies have examined the impact of financial education on the financial performance of SMEs. However, there is a need to examine the impact of financial literacy on the non-financial performance of SMEs. This includes aspects such as employee satisfaction, customer satisfaction and environmental performance. There is also little empirical work on the relationship

with the gender of decision-makers in SMEs. Politicians are encouraged to promote financial literacy programs for entrepreneurs/self-employed, managers, and start-up teams in line with OECD recommendations. Financial literacy is directly related to all the identified outcomes, i.e., financial risk attitudes, behaviours, organisational capabilities and SME performance. In particular, financial literacy is an essential prerequisite for financial risk attitudes and behaviours and specific organisational capabilities that enhance SME performance (Graña-Alvarez et al., 2022).

2.6.   CONSEQUENCES OF FINANCIAL LITERACY ON ENTREPRENEURSHIP

Based on the existing scientific studies on the impact of financial education on entrepreneurship/self-employment, significant effects can be derived. The consequences of financial literacy on entrepreneurship/self-employment (in SMEs) can be divided into four groups:

- o   Financial Attitudes
- o   Financial Behaviour
- o   Organizational Capabilities
- o   SME performance.

2.6.1.   Financial Attitudes

Financial attitudes can scientifically represent a relationship and measure the extent to which an individual has favourable or unfavourable evaluations or judgments regarding financial decisions (Ajzen, 1991).

Figure 13. Interdependencies of Financial Literacy on Entrepreneurship
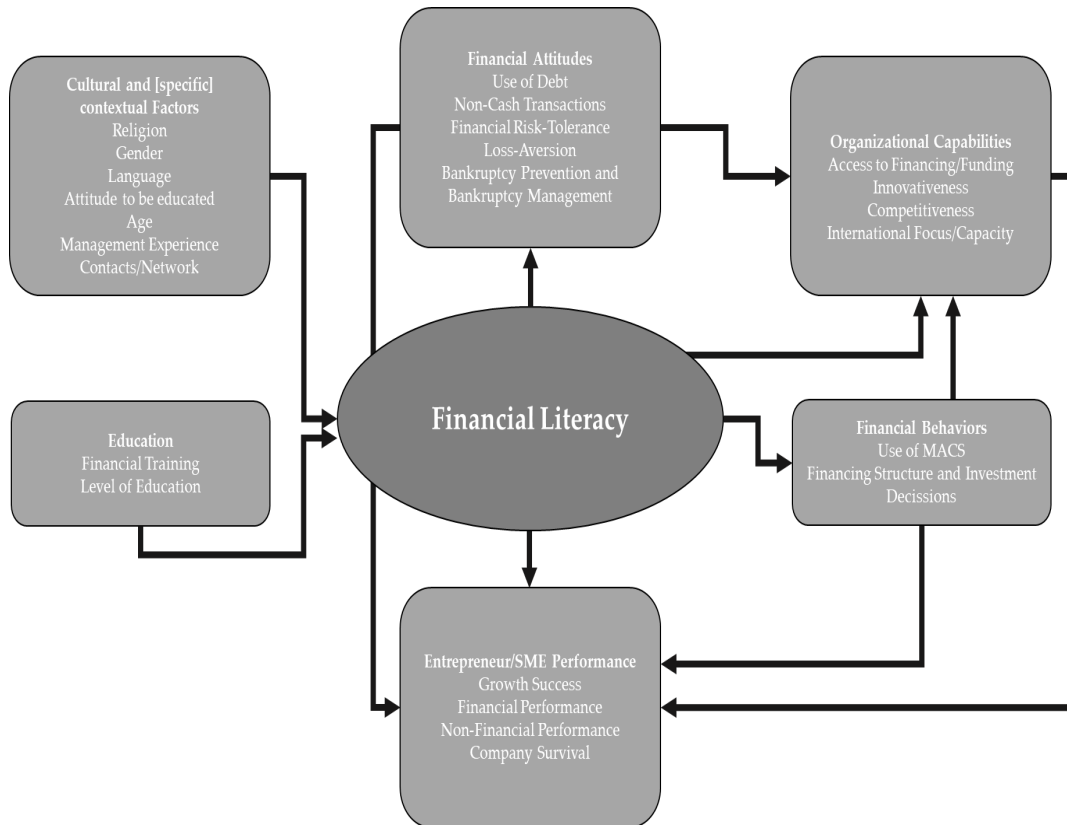
Source: Own presentation based on Graña-Alvarez et al. (2022), p. 16.

Existing research has shown that managers with lower financial literacy do not promptly recognise the consequences of bankruptcy and do not adopt appropriate management practices to counter them (Ekanem, 2015). In particular, studies in developing countries have demonstrated that cashless transactions are still perceived as risky by the self-employed and SMEs, and the benefits (such as the risk of losing cash or the transparent documentation of transactions) are not recognised. Based on these findings, it is clear that properly developed financial literacy could lead to an acceptance of the benefits and costs of cashless transactions and significantly increase the overall uptake of cashless payments in the entrepreneurial environment (Citradika et al., 2019). There is also scientific evidence on the use of external sources of finance, such as borrowing (e.g., from the bank; Koropp et al., 2013a). Overall, there is a positive correlation between the level of financial literacy and the willingness to use modern and contemporary

financial management tools in an SME. Scientific studies in personal finance indicate that financial literacy reduces risk aversion or increases risk-taking (Hallahan et al., 2004; Hsiao & Tsai, 2018). In particular, research in the context of SMEs suggests a positive relationship between financial literacy and good, conscious risk attitudes. Moreover, financial literacy significantly impacts the use of financial risk management, positively impacting risk-taking (Ye & Kulathunga, 2019). Overall, managers with high levels of financial literacy and a strong understanding of risk are more likely to use various risk management practices. This existing understanding of risk also positively impacts tolerance in financing innovation (Liu et al., 2020). Proper assessment and use of funding sources are critical to innovation and competitiveness, and thus to the success of the company or entrepreneur/self-employed (Riepe et al., 2022). It has been shown that entrepreneurs/self-employed have a better understanding and sensitivity to risky financial decisions as their financial literacy increases. It can be concluded that a high level of financial literacy among entrepreneurs and SMEs leads to an increased awareness of potential risks of a business, which in turn increases the willingness to use management tools such as risk management systems (Buchdadi et al., 2020).

Table 4. Effects of Financial Literacy on Financial Attitudes

Description	Scientific Source	Effect of Financial Literacy
Preferences for using cashless Transactions	Citradika et al., 2019	Direct positive effect
Preferences for the Use of Debt	Ekanem, 2015 Koropp et al., 2013a	Direct positive effect
Financial Risk Tolerance	Ye & Kulathunga, 2019 Buchdadi et al., 2020 Liu et al., 2020	Direct positive effect
Loss-Aversion	Riepe et al., 2022	Direct positive effect

Source: Own presentation based on Graña-Alvarez et al. (2022), p. 17.

2.6.2. Financial Behaviour

Financial literacy is an essential component of profitable entrepreneurship and successful self-employment. There is a broad consensus in academia that high levels of financial literacy are positively correlated with using management accounting and control systems (MACS). Using MACS conditioned by higher financial literacy also positively impacts firms' liquidity and cash flow management (Egbo et al., 2020; Sayinzoga et al., 2016). It has also been proven that financial literacy positively correlates with cost accounting, use of financial reports, consistent recording of business transactions, and management systems and processes (Ismanto et al., 2020; Tian et al., 2020). Therefore, scientifically, there is no doubt that entrepreneurs and self-employed people who have a high level of financial literacy are better able to assess opportunities and risks and map them in their risk assessment as well as risk management systems (Kulathunga et al., 2020; Mabula & Ping, 2018a; Nohong et al., 2019).

Also, it can be scientifically verified that enhanced financial literacy leads entrepreneurs to use a broader range of financial information when communicating with stakeholders or investors, providing a better picture of their business (Akhtar & Liu, 2018; Halabi et al., 2010). Moreover, it is scientifically established that financial literacy also positively affects the use of MACS for interpreting financial reports and making financing decisions. This is particularly evident in the fact that entrepreneurs with high financial literacy have lower use of family resources, internal financing, financial bootstrapping and do not use expensive short-term financing (Ekanem, 2015; Jayawarna et al., 2011; Nitani et al., 2020). Financially literate entrepreneurs and self-employed people are more persuasive to lenders and therefore have better access to credit (Campbell, 2006; Koropp et al., 2013b; Mottola, 2013). In terms of personal finance, financial literacy has also been shown to have a positive impact on entrepreneurs' income, savings and wealth accumulation, and retirement planning, as the financially literate are generally more knowledgeable about investment products (Abebe et al., 2018; Agabalinda & Isoh, 2020; Cherotich et al., 2019; Pahlevi et al., 2020; Sayinzoga et al., 2016).

Table 5. Effects of Financial Literacy on Financial Behaviors

Description	Scientific Source	Effect of Financial Literacy
Deployment MACS		
Cost calculation, Use of Financial Reports, and Recordkeeping Practices	Ismanto et al., 2020	Direct positive effect
Risk Management Practices	Kulathunga et al., 2020 Mabula & Ping, 2018a Tian et al., 2020	Direct positive effect
Risk Management Practices and related Capital Structure	Nohong et al., 2019	Indirect positive effect
Application of Financial Statements	Akhtar & Liu, 2018	Direct positive effect
Financing Decisions		
Capital Structure	Nohong et al., 2019	Direct positive effect
Financial Bootstrapping	Jayawarna et al., 2011	Direct negative effect
Use of expensive, short-term Funding Sources	Nitani et al., 2020	Direct negative effect
Use of Debt for Financing	Koropp et al., 2013b	Direct positive effect
Investment Decisions		
Entrepreneur's Readiness to plan for Retirement	Agabalinda & Isoh, 2020	Direct positive effect
Development of new Sources of Income	Sayinzoga et al., 2016	Direct positive effect
(Relation to) Savings	Cherotich et al., 2019 Pahlevi et al., 2020 Sayinzoga et al., 2016	Direct positive effect

Source: Own presentation based on Graña-Alvarez et al. (2022), p. 18.

2.6.3.   Organisational Capabilities

Organisational capability is the ability of a company to perform basic functional activities more efficiently than its competitors. It is further understood that companies, or the entrepreneurs in charge of them, use their monetary resources to guide their company through this critical phase in difficult market phases or a recessionary economic environment (Belas et al., 2018). In addition, financially literate entrepreneurs and self-employed are characterised by efficient management of human and business resources (Egbo et al., 2020). In academia, several studies established that financial literacy fundamentally strengthens the ability to become an entrepreneur or start a business, in particular because growth opportunities and potential risks (risk and return considerations) can be better assessed (Burchi et al., 2021; Ćumurović & Hill, 2019; Wongso et al., 2020). Furthermore, it has been found that risk-averse individuals only start a business when they have sufficient financial education, as this enables them to manage risks consciously. Finally, academic research has shown that financial education helps entrepreneurs manage liquidity and understand the impact of volatility (as a measure of risk; Illmeyer et al., 2017; Riepe et al., 2022). There is also evidence that financially literate entrepreneurs are more likely and more successful in persuading their stakeholders and funders to provide investment or financing. There is also evidence that these financially literate entrepreneurs are most probably invest in innovative (and thus future-rewarding) projects (Shah et al., 2021). In summary, the ability of an organisation or business to access credit, investment, and insurance due to its strong financial literacy is understood as these entrepreneurs are more persuasive to investors and financiers. In particular, they can convince creditors of the profitability of the business and the investment through sufficient preparation of financial company data (Bongomin et al., 2017; Buchdadi et al., 2020; Hussain et al., 2018). However, financially literate entrepreneurs are particularly capable of analysing the costs, opportunities, and risks of available funding sources and making optimal choices (Mabula & Ping, 2018b; Ye & Kulathunga, 2019). These scientific findings are consistent with those of individuals and households (Lusardi & Mitchell, 2011a). The organisational capability of the firm is also correlated with competitiveness, as the superiority of

financially literate entrepreneurs through the purposeful use of risk management practices gives them a distinct advantage over competitors (Ying et al., 2019).

Table 6. Effects of Financial Literacy on Organisational Capabilities

Description	Scientific Source	Effect of Financial Literacy
Abilities		
Financial Capacity of the Entrepreneur/Self-employed	Agyei et al., 2019	Direct positive effect
Entrepreneurship/Self-employment	Al Issa et al., 2019 Bilal et al., 2021 Burchi et al., 2021 Ćumurović & Hill, 2019 Wongso et al., 2020	Direct positive effect
Credit Risk Management Capability	Belas et al., 2018	Direct positive effect
Innovativeness		
Innovation Support	Illmeyer et al., 2017	Direct positive effect
Financial Risk Tolerance and Access to Finance	Liu et al., 2020 Tian et al., 2020	Indirect positive effect
Technological Innovation	García-Pérez-de-Lema et al., 2021	Indirect positive effect
Process, Product, Marketing and Organisational Innovations	Shah et al., 2021	Direct positive effect
Finance Accessibility		
Access to Credit	Fatoki, 2021	Direct positive effect
Access to the most important external Financing Channels	Tian et al., 2020	Direct positive effect
Funds from Financial Institutions	Mabula & Ping, 2018b	Direct positive effect
Financial Services by Banks	Bongomin et al., 2017 Ye & Kulathunga, 2019	Direct positive effect

Description	Scientific Source	Effect of Financial Literacy
Competitiveness		
Resource Acquisition	Ying et al., 2019	Direct positive effect
Competitiveness by Capital Structure	Nohong et al., 2019	Indirect positive effect

Source: Own presentation based on Graña-Alvarez et al. (2022), p. 21.

2.6.4. Effects of Financial Literacy on Company Performance

In order to correlate financial literacy's impact on entrepreneurship, financial literacy's impact on business success is of particular importance. In general, there is a consensus in the academic community that financial literacy is positively associated with long-term business growth, as entrepreneurs and self-employed individuals with high levels of financial literacy have the knowledge and skills necessary to make appropriate long-term decisions that promote business growth (Hossain et al., 2020). It has also been scientifically proven that managers with high financial literacy identify risks and opportunities for the firm at an early stage (Adomako et al., 2016; Bongomin et al., 2017; Fatoki, 2021). Another scientific proposition is that financial literacy also improves a company's financial performance and leads to a financially literate entrepreneur developing a better understanding of the importance and impact of compound interest, inflation, and risk diversification (Engström & McKelvie, 2017). Evidence suggests that entrepreneurs and self-employed individuals with high financial literacy make more rational decisions, leading to better returns (Hendrawaty et al., 2020). Entrepreneurs and self-employed with high financial literacy also use financial information much more extensively to evaluate investments, predict market conditions, and develop strategies that significantly improve their overall investment returns (Dahmen & Rodríguez, 2014). Financial literacy also positively impacts debt management, improving access to financial resources and thus financial performance (Adomako & Danso, 2014).

Table 7. Effects of Financial Literacy on Company Performance

Description	Scientific Source	Effect of Financial Literacy
Company Growth		
Increase in Profitability, Sales, and Market Share	Fatoki, 2021	Direct positive effect
Increases in Sales	Agyapong & Attram, 2019	Direct positive effect
Revenues and Earnings exceeded Expectations	Iramani et al., 2018	Direct positive effect
Growth in Sales, Assets, Profits, Capital, Employees, Market Share and satisfied Customers	Hossain, 2020	Direct positive effect
Productivity Growth	Mabula & Ping, 2018b	Direct positive effect
Financial Performance		
Cost Efficiency and Profit Margin (compared to Competitors)	Agyapong & Attram, 2019 Cherotich et al., 2019	Direct positive effect
Profitability compared to their Expectations and concerning Sales	Guliman & Uy, 2019 Rahim & Balan, 2020	Direct positive effect
Financial KPIs: ROA and ROI	Adomako & Danso, 2014 Engström & McKelvie, 2017	Direct positive effect
Correlating Financial Literacy and ROA using MACS	Ismanto et al., 2020	Indirect positive effect
Nonfinancial Performance of SMEs		
Customer and Employee Satisfaction, Market Size and Brand Loyalty	Tuffour et al., 2020	Direct positive effect
Market Share vs. Competitors	Agyapong & Attram, 2019 Guliman & Uy, 2019	Direct positive effect

Source: Own presentation based on Graña-Alvarez et al. (2022), p. 24.

2.7. STATUS OF ENTREPRENEURIAL ACTIVITIES IN GERMANY

A dynamic and growing start-up scene is desirable for the prosperity of a society, especially from an economic perspective. Start-ups create competition, ensure innovation, and force established companies to improve to secure their market share constantly. Consumers also benefit from start-up initiatives, as increased competition and price pressure from new entrants leads to goods and services being offered at lower prices or, on the supply side, being created only by start-ups entering the market.

New technologies from innovative start-ups accelerate the efficiency of markets or create entirely new markets and business models. Innovative and digital start-ups are thus drivers of modernising structural change. They are, therefore, particularly important for the sustainability of the economy.

Besides to data from the Global Entrepreneurship Monitor (GEM, 2021), data from the German Startup Monitor 2022 was used to analyse the German startup environment. The study has been conducted since 2013 as a joint project of the Bundesverband Deutsche Startups e.V. and the Chair of Digital Business and Digital Entrepreneurship at the University of Duisburg-Essen. To ensure the quality of the data, the surveyed founders and managing directors of start-ups in Germany were sent a survey link by email. The survey is always anonymous and was available online from 09/05/2022 to 26/06/2022, with an average survey duration of 17 minutes. A total of 1,976 complete data sets were included in the 2022 study. The start-ups surveyed by DSM 2022 are, on average, 2.8 years old and predominantly in the early stages of their business development (DSM, 2022).

In addition to the data providers DSM and GEM, further information on the startup ecosystem in Germany was obtained from the data provider startupdetector. All newly founded startups, all startup financing rounds and all startup investors are accessed on a weekly basis. To identify these, startupdetector uses the following criteria: Formation of a company registered in the commercial register. New company registrations between 01/07/2022 and 30/09/2022 were considered for the data used (startupdetector, 2022).

Development of Companies and the Self-Employed in Germany

Regarding the development of the German SME sector and the self-employed and companies as a total, it can be observed over the last 15 years that this sector has only increased by 12.8% in absolute terms, i.e., an annual growth of less than 1%. The trend has been almost stagnant since 2019, undoubtedly attributed to the pandemic. The Figure 14 below illustrates this stagnation.

Figure 14. German SME Sector from 2006 to 2021 (Number of Companies)
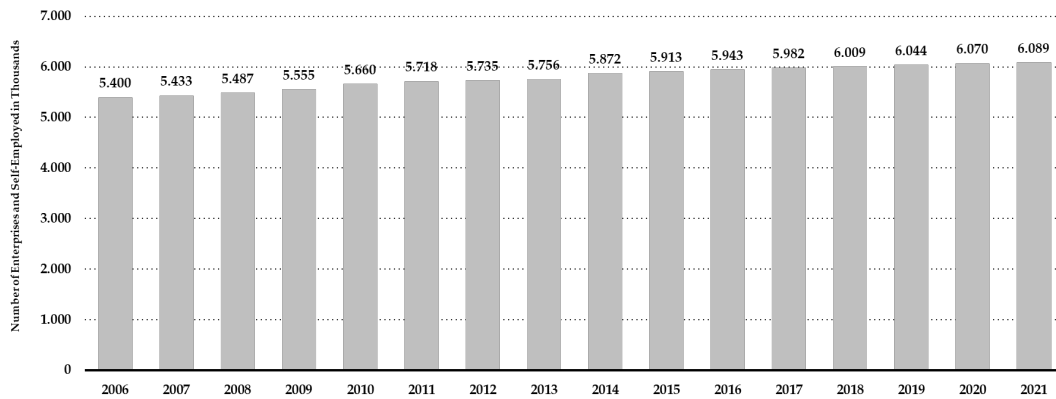
Source: Own presentation based on AG Mittelstand/Statista, 2022.

A more detailed analysis of the distribution of the revenues of self-employed persons and entrepreneurs in the SME segment reveals that micro-enterprises with revenues of up to EUR 1 million account for the largest share (85%). This is unsurprising as the number of enterprises with less than 10 employees in Germany is also the largest group within the German SME sector. Due to the large proportion of companies in the micro-enterprise segment, it has also been determined for this thesis that this group of entrepreneurs and self-employed persons has to be considered. Moreover, it can be assumed that this group of entrepreneurs and self-employed persons makes financial decisions and has not delegated them to a hired internal or external manager (startupdetector/Statista, 2022).

Figure 15. Distribution of SMEs in Germany by Annual Revenues in 2021
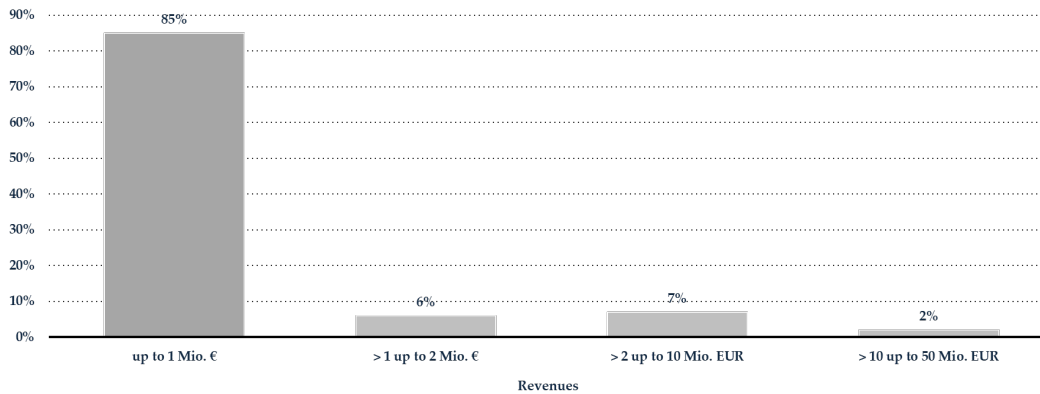
Source: Own presentation based on AG Mittelstand/Statista, 2022.

To assess the development in the German SME sector, it is appropriate to examine it in the context of the GEM countries and to draw conclusions as to whether Germany is following the international trend of declining start-up activity or whether it is falling even further behind, for example, the large industrialised nations. Following this trend analysis, the following chapter uses the GEM Monitor to examine German start-up activity in an international comparison closely.

Total Early-Stage Entrepreneurial Activity by GEM-Countries

Significant differences exist in the level of entrepreneurial activity among the 47 countries participating in the GEM. This is reflected in the Total Early-Stage Entrepreneurial Activity (TEA) rate for all countries participating in the GEM in 2021, which indicates the start-up frequency. The TEA rate measures the percentage of individuals out of all 18- to 64-year-olds in a given country who have started a business in the past three and a half years and are in the process of starting a business at the time of the survey. The TEA can therefore be used to provide a comprehensive overview of start-up activity in a country. The TEA includes young start-ups that have already taken place and those who intend to start a business but may not yet have done so by, for example, registering it in the commercial register. This group of persons is referred to as "prospective entrepreneurs". The differences in start-up frequency between countries are partly due to different economic and institutional conditions. For example, more businesses are often

founded by necessity in low-income countries. In high-income countries, this is a much less common scenario, e.g., because of the prevalence of job scarcity. Therefore, the GEM grouping of countries participating in the survey is analogous to the World Bank's classification of low-, middle-, and high-income countries. In the group of high-income countries, Germany ranks in the lower midfield with a TEA rate of 6.9%. The survey shows that many countries comparable to Germany have significantly higher start-up rates than Germany (United Kingdom, Netherlands, Switzerland, Sweden).

Germany ranks 23rd among the 31 high-income GEM countries in total early-stage entrepreneurial activity (TEA). Notably, employees' entrepreneurial activity within existing enterprises decreased in 2021. The rate of intrapreneurship in Germany is 5% in 2021; between 2015 and 2020 it was higher in each of the years surveyed, ranging from 6.6% to 9.2%. In an international comparison, very few people in Germany (3.2%) have sold, given up or closed down a business in the last twelve months. This figure is much higher in the US (6.4%) and Canada (11.5%) (GEM, 2021).

Looking at the start-up situation in Germany in 2022, the number of start-ups in the third quarter was significantly lower than in the second quarter of 2022, with 617 start-ups. There was also a significant decrease in the number of births compared to the same period of the previous year. Many start-ups had a Business-to-Business (B2B) model in both periods. Start-ups with a B2B approach increased slightly compared to the previous quarter, while start-ups with a B2C (Business-to-Consumer) approach remained almost unchanged and accounted for the largest share at 42%. The share of enterprises with an unknown business model decreased by two percentage points. A business model focused on corporate customers has the advantage that profitability is often achieved after only a few customers have been acquired. However, sales cycles are longer and more complex (startupdetector/Statista, 2022).

Figure 16. Number of Start-ups by Business Relationship in Q2 and Q3 2022

713
Start-ups in
Q2 2022

■ B2B   ■ B2C   ■ unknown

617
Start-ups in
Q3 2022

43%

38%

19%

42%

41%

17%

Source: Own presentation based on startupdetector/Statista, 2022.

As of 2021, the third quarter of 2022 registered an increase in start-ups, reaching its monthly peak for 2022 in September 2022 with 216 start-ups. However, compared to the previous year (2021), the number of new businesses was significantly lower. Overall, the number of new companies fell from 812 to 617 compared to last year's period (Q3 2021). The main reason for this is likely the associated fear of a (global) recession. In addition to the recent increase in the shortage of skilled workers, the onset of a recession is likely to exacerbate this trend by reducing the willingness to take risks and thus significantly impacting start-up behaviour. This development also shows that dealing with risks, which can be learned in financial literacy, seems essential for start-up behaviour. Successful companies that later became market leaders were often founded during recessions, which can be attributed to the predictive and realistic assessment of risks and potential returns among these company founders (startupdetector/Statista, 2022).

Figure 17. Number of Start-ups in Comparison of Q3 2021 to Q3 2022
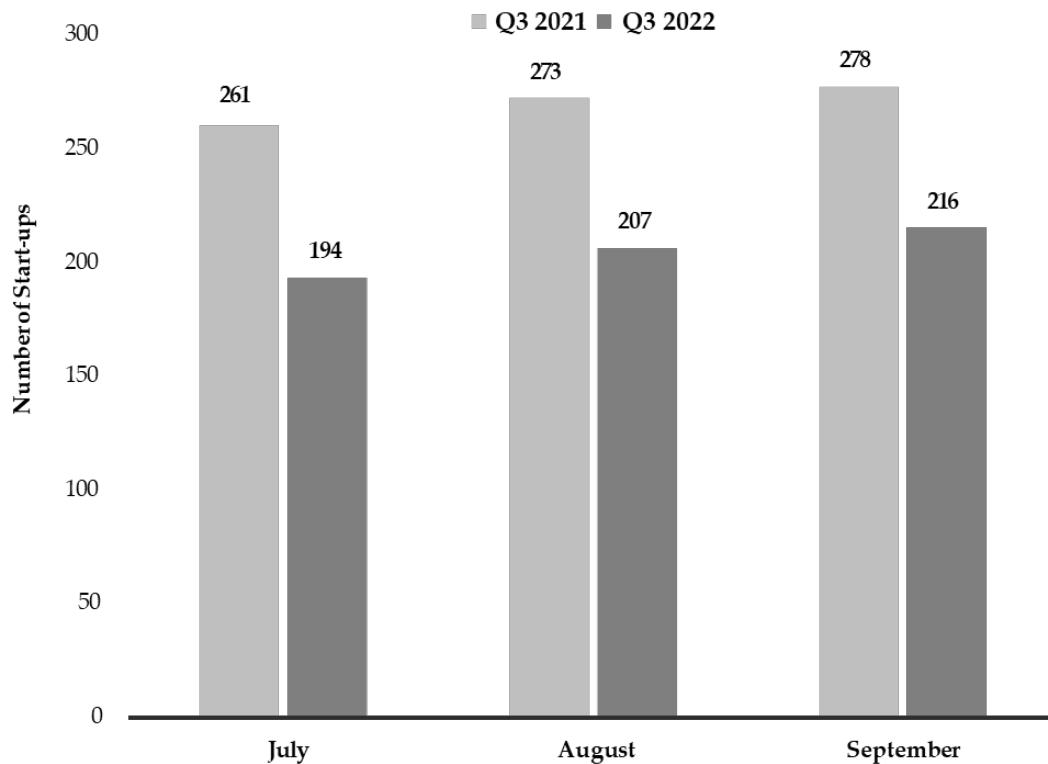
Source: Own presentation based on startupdetector/Statista, 2022.

2.8. DEMOGRAPHIC AND EDUCATIONAL BACKGROUND OF FOUNDERS

The influencing factor of education and demographics is, as already described for the socio-demographic factors in the previous chapter, essential for financial literacy and entrepreneurship and is therefore examined in more detail below.

Age-Distribution of Founders

In Germany, business startups have increasingly shifted to younger age groups over the past four years. In 2021, the two youngest age groups covered by the GEM had TEA rates of 8.3% (18-24 year olds) and 10% (25-34 year olds), well above the average for all 18-64 year olds. In contrast, the TEA rate for 55–64-year-

olds is only 3%. Thus, the fertility rate for the youngest age group is almost three times that of the oldest age group (GEM, 2021).

In terms of risk preferences, a key conclusion of the 2021 GEM report is that older respondents (in the 55-64 age group) have a significantly lower fear of failure, are most confident in their abilities and experience to start a business and are therefore less hesitant to start a business. On the other hand, in the age group with the highest TEA rate in Germany, the 25-34 age group, fear of failure is the most common barrier to starting one's own business (GEM, 2021).

The average age of the founders surveyed in the DSM is 36.4 years, well below the average age of the labour force, which is 43.3 years (Destatis, 2021). The largest group of respondents is in the age group between 25 and 34 years (corresponding to 42.2% of respondents) or in the age group between 35 and 44 years (corresponding to about 33.9% of respondents). Very few founders are younger than 25 (5.8% of respondents; DSM, 2022).

Gender-Distribution of Founders

In DSM 2022, the share of female founders was 20.3%, an increase of 2.6 percentage points compared to 2021. There has been a steady increase in female founders within the DSM survey series since 2014, but the increase remains low. About two-thirds of all newly born enterprises were founded by men (62.2%) in the DSM 2022. Looking at female founders in more detail shows that women under 30 (27.6 %) have a slightly higher prevalence than men (24.1%; DSM, 2022). In terms of start-up behaviour, similarities with financial literacy can be identified. The gender gap in financial literacy found in all scientific studies over the past 20 years is similar to that in entrepreneurship. Financial and risk literacy are less pronounced among women, which can also be derived from their willingness to start a business or become self-employed.

Figure 18. Proportion of Female Founders in the DSM Report 2022
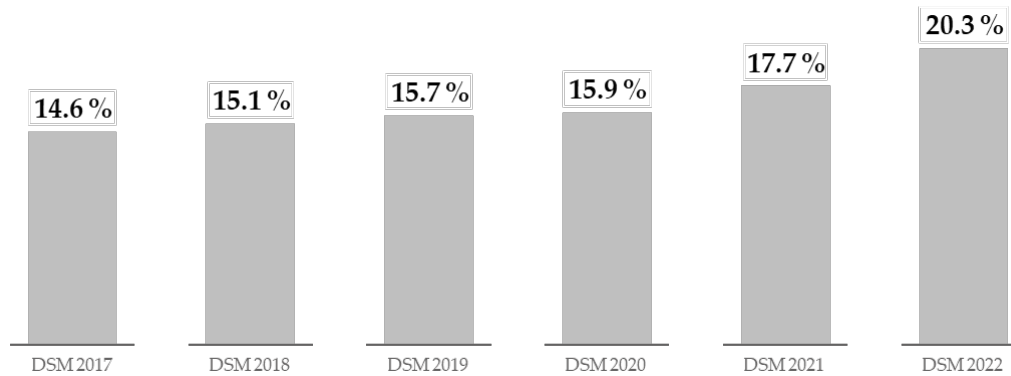
926 directors led the 617 start-ups created in the third quarter of 2022. 82 per cent of the start-ups were led by men. Women were involved in the management of 18%. This confirms the trend of the last few years that men dominate the start-up scene. Compared to the previous quarters, the third quarter showed a decline in the number of start-ups with female participation. During the Corona pandemic, the number of female-led start-ups rose steadily, as women are particularly likely to found e-commerce and health-care start-ups, which experienced a real boom during the pandemic.

These recent figures also confirm the existing gender gap in financial literacy. Overall, women perform significantly worse than men in financial literacy, which indicates that the gender gap in financial literacy may cause a significant gap in business start-ups. One key factor behind fewer start-ups by women could be that risk literacy is also less pronounced among women and that women act much more cautiously than men. However, this cautious approach does not necessarily mean a worse success ratio for existing companies. Scientific studies have also shown that an excessively risk-taking attitude leads to poorer business results. Therefore, although a gender gap in the number of start-ups can be observed, these few companies founded by women can be significantly more successful than companies founded by men, who have been scientifically demonstrated to have a greater risk propensity.

Figure 19. Demographic Characteristics of Founders in Q3 2022
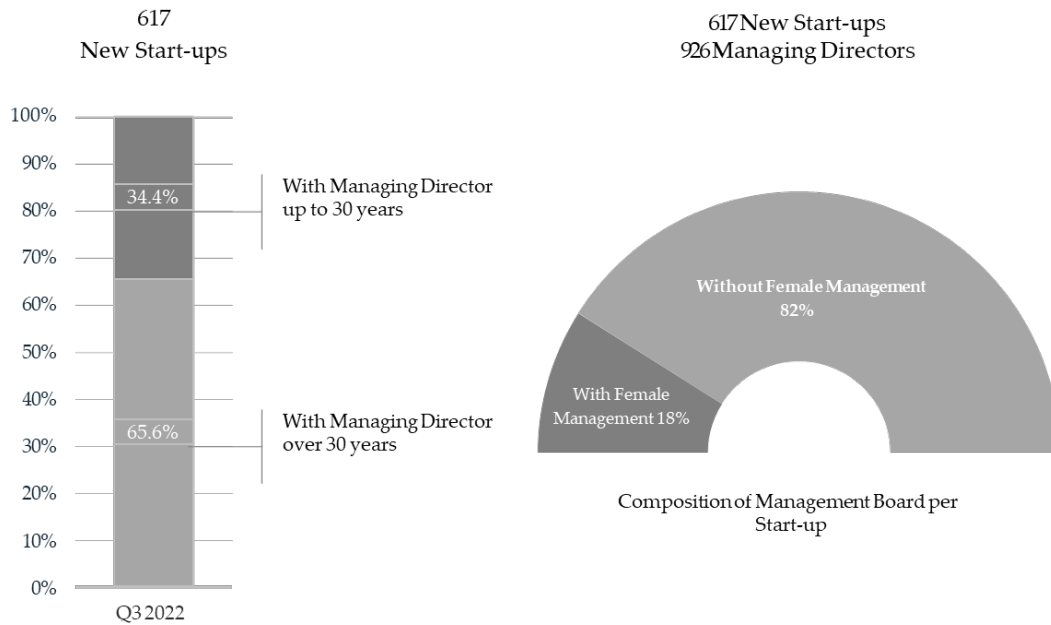
Source: Own presentation based on startupdetector/Statista, 2022.

Citizenship and Migration Background of Founders

A more precise examination of the data collected by the GEM for 2021 shows that the TEA rate of migrants, at just under 14%, is more than twice as high as the start-up rate of the native population (approx. 7%). Gender-specific differences could not be found among immigrant founders. The TEA rate was the same for men and women with a migrant background in 2021, at around 14%. An important finding of the GEM Report 2021 is also that 30% of founders with a migration background had significantly higher ambitions in terms of employment growth than founders without a migration background, which is significantly lower at 10% (GEM, 2021)

Most of the founders in the DSM study have only German citizenship (84.1 %), a further 4.2 % have German and foreign citizenship and 11.7 % have one or two foreign citizenships. Overall, 21.1 % of the surveyed founders have a migrant background compared to 25.9 % of the general labour force (Destatis, 2022). In terms of financial literacy, a migration background is also relevant. Overall, respondents with a migration background score lower on financial literacy. Remarkably, the start-up activities and the start-up frequency are three times

higher among people with a migrant background. Studies on the investment behaviour of investors with a migration background also suggest that risks are mispriced due to a lower level of financial literacy. This could also mean that this undifferentiated risk assessment resulting from lower financial literacy leads to this increased start-up activity among migrants (Krahnhof et al., 2020; Zureck & Jager, 2018).

Educational Background and Subjects studied by Founders

Notably, 87.2% of the founders have a university degree, of which every second has a master's degree (37.1%) or a diploma (17.1%). 17.8% have a bachelor's degree and 15.1% have a doctorate. 4.7% indicate that their highest educational qualification is a secondary school diploma and 4.1% have completed vocational training. In terms of degrees, STEM subjects (46.6%) and economics (38.0%) are the most relevant fields of study for founders (DSM, 2022).

Figure 20. Study Degrees of Founders in the DSM 2022 Report
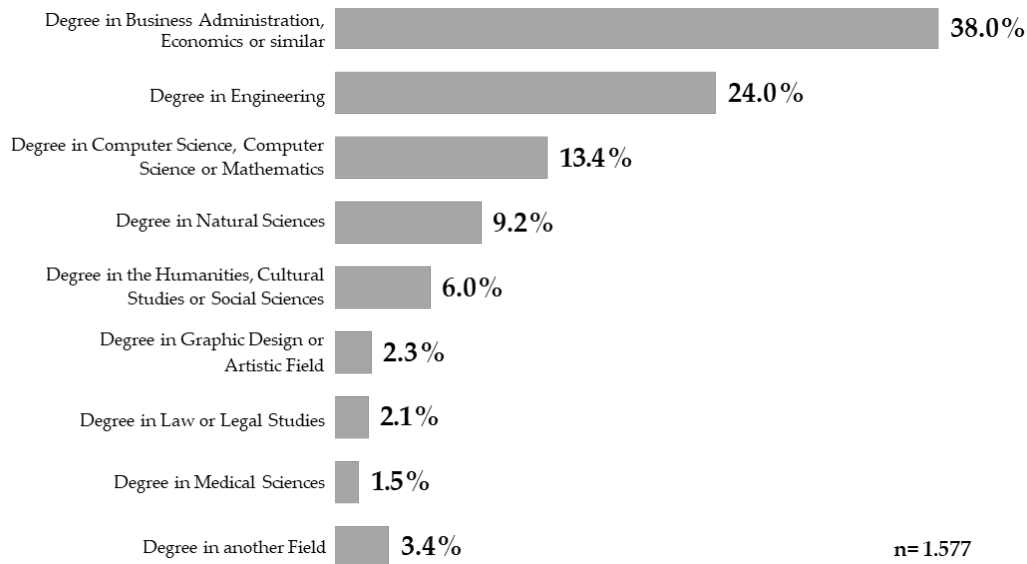
Source: Own presentation based on DSM 2022, p. 24.

A correlation can be found between education and entrepreneurship regarding educational level. Overall, the level of education also strengthens financial literacy. This significant correlation between education and

entrepreneurship and education level and financial literacy also strengthens the statistical evidence for education as a factor of influence.

Funding Sources of German Start-ups

In order to get a comprehensive picture of the German start-up scene, it is necessary to take a closer look at the financing side. In addition to the financing volume, the different capital sources must also be considered. It is imperative to distinguish between previously used and preferred forms of financing, as this also allows conclusions to be drawn about the availability of different sources of capital. In the DSM 2022 study, "personal savings" (74.9%) and, in second place, "family and friends" (23.3%) were the most frequently used sources of finance among the respondents. It is noticeable that although these sources are used more frequently than average, they are not among the founders' preferred finance sources. This suggests that other - much more preferred - sources of finance - such as strategic investors, venture capital or business angels - are not available. The reason for this could be a disadvantageous appearance - caused by less pronounced financial literacy (e.g., less professional presentation of facts and figures as well as one's risk management) vis-à-vis this investor and financing group. The high preference for these financing sources and the low share of realised investments support this assumption. Overall, the German ecosystem in the area of seed investment shows that there is still much catching up to do in terms of growth capital (DSM, 2022). Based on this data, it can be hypothesised that financial education significantly influences start-ups' financing. The financing structure of founders and self-employed persons with a higher level of financial education can be assumed to be more favourable and the need to resort to own capital would be reduced.

Figure 21. Funding Sources of Founders in the DSM 2022 Report

Source	Sources of Capital (to date)	Preferred Sources of Capital
Own Savings	**74.9%**	29.4%
Government Grants	**46.6%**	51.5%
Business Angel	**31.2%**	46.2%
Family and Friends	**23.3%**	8.6%
Venture Capital	**18.6%**	44.4%
Internal Financing (Cash Flow)	**18.4%**	34.5%
Strategic Investors (Companies, Family Offices)	**15.9%**	42.6%
Bank Loans	**13.1%**	15.3%
Incubator and/or Company Builder	**9.7%**	13.7%
Accelerator	**9.5%**	16.3%
Venture Debt	**2.2%**	5.4%

N= 1.594/1.550
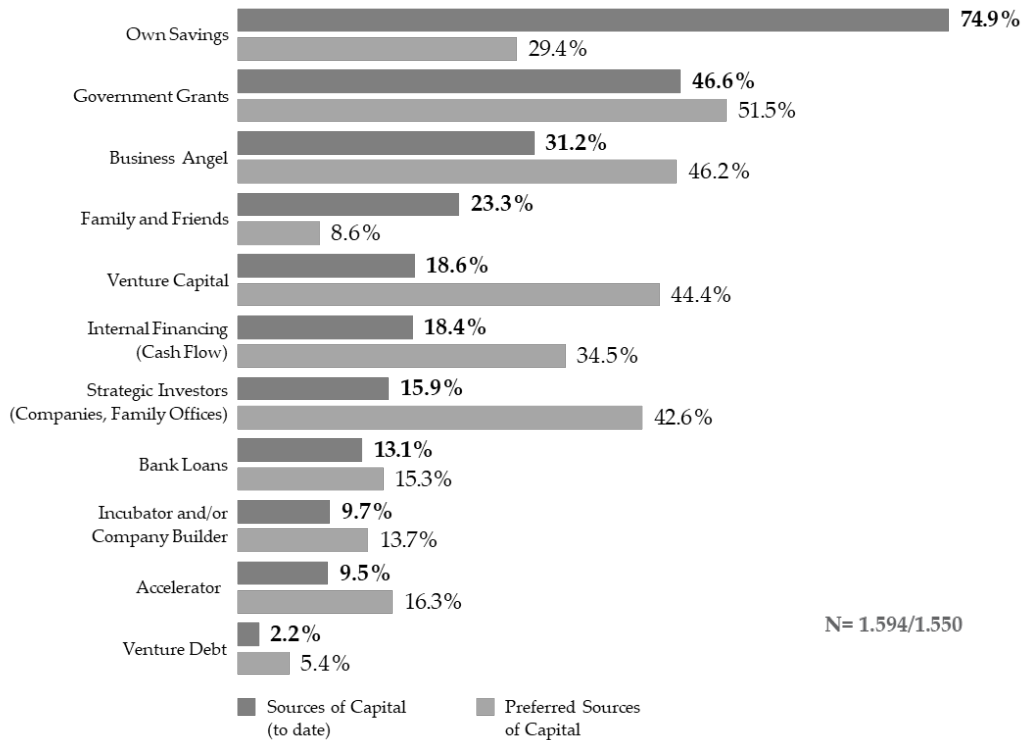
Source: Own presentation based on DSM 2022, p. 36.

Particularly in the start-up phase, the participation of the investor groups business angels, VCs and corporate investors is a form of financing preferred by founders. Due to limited financial resources and especially concerning the loss of founders and self-employed persons when starting their own businesses, access to external financing resources has a significant impact. Thereby, early-stage investors each have their characteristics to be evaluated when accessing these investors. The following Figure 22 provides an overview and a brief explanation.

Figure 22. Preferred Funding Sources of Founders

Business Angels	Venture Capitalists	Corporate Investors	Other
❑ Participation in Start-ups with Equity Capital as an Individual, in Investment Companies or together with other Business Angels ❑ In some cases, former or current Founders themselves with the necessary Capital	❑ Professional, Institutional Investors who invest other Investors' Money ❑ Also micro VCs, i.e. highly Professional Business Angels who have developed Team and Brand for this Purpose	❑ Companies that invest in Start-ups ❑ However, the Business Model is not focused exclusively on Equity Financing	❑ Family Offices, Accelerators, Crowd-Investing and other unknown Investors

Source: Own presentation based on startupdetector (2022).

Financing Mix as Key Element for Start-ups

For start-ups, the resource requirements and the financing mix depend very much on the motives of the founders and the respective business models. A long-term view of start-up activity shows that 60-70% of annual start-ups require financing. It is noticeable that in 2019 and 2020 more than half of the start-ups were financed exclusively by the founders themselves. By 2021, the share has dropped significantly and only own resources are used. The reason for the financing needs of start-ups lies in their constellation. An increasing number of start-ups with employees also means more start-ups with external financing. Conversely, more individuals starting up means more unfunded starting ups. The substantial increase in the share of births to solo entrepreneurs (particularly those with no employees) thus indicates a significant decrease in the demand for finance. Other reasons for the lower demand for financing are the increase in the number of young founders (who, due to their age, have little security for financing) and women (GEM, 2021)

Another reason for the preference for equity could be difficulties in obtaining finance. However, only 12% of founders reported difficulties in obtaining finance for their start-ups. Founders who relied on debt financing were much more likely to experience financing problems (21%). In Germany, relatively few founders had problems with start-up financing. This suggests that start-up financing is a major challenge for start-ups. It has to be taken into account that founders who have

successfully set up an enterprise and have overcome difficulties in obtaining finance, if any, are also visible on the market. It is therefore reasonable to conclude that start-up financing problems lead to the start-up project being abandoned before it has even started (GEM, 2021). These findings from the GEM also indicate implications of financial literacy. Research on financial literacy has demonstrated that individuals with lower levels of financial literacy have significantly worse financing conditions and are also more likely to lack good negotiating positions with lenders such as banks. Overall, founders with less financial literacy thus also have only limited sources of financing at their disposal. This limitation can harm the success of the business or self-employment.

2.9.   RATIONALES FOR ENTREPRENEURSHIP

Scholars have found robust evidence that intention reliably predicts human action in many contexts, including entrepreneurship (Brice, 2004). According to researchers Zhao, Seibert and Lumpkin (2010), entrepreneurial intention can be understood as an "expressed behavioural intention to become an entrepreneur" (pp. 383-384). Thompson (2009) describes entrepreneurial intention as "...a person's self-reported belief that he or she intends to start a new business and consciously plans to do so at some point in the future" (p. 676). Although not all entrepreneurial intentions lead to entrepreneurial activity, the understanding and study of entrepreneurial intentions have recently grown out of the recognition that entrepreneurship is a significant economic driver and plays a vital role in the prosperity of a society. As measured by the Global Entrepreneurship Monitor (GEM), the United States has significantly higher rates of entrepreneurship than other developed countries in North America, Europe and Asia (Ozaralli & Rivenburgh, 2016). In low-income countries, entrepreneurship is quite prominent in increasing economic activity. Countries such as Malaysia promote entrepreneurship through funding and business advisory services (Ismail et al., 2009), while other countries rely on research to support the development of entrepreneurs. In this regard, entrepreneurship research also looks at how macro-socio-economic factors stimulate entrepreneurial intentions; these include education, media support and policy frameworks (Alshammari & Al-Tarawneh, 2016). Another research focus in entrepreneurship is on the success of

entrepreneurship education programs and other types of curricula (Albornoz & Amorós, 2016; Bae et al., 2014; Fayolle & Gailly, 2015). However, there is also a particular focus on studying personality traits.

To study personality traits, numerous traits that can describe a personality are used. For this purpose, science has developed the Big Five personality traits (Goldberg, 1993): Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. Personality traits predict entrepreneurial intention because they are known to emerge as individual differences during human development and then remain relatively constant over time (McCrae & Costa Jr., 2008; Rauch & Frese, 2007).

Personality and entrepreneurial Activities

Entrepreneurial activity and innovation play a crucial role in economic growth in economies. However, start-up and self-employment rates are overall low in innovation-driven economies such as the U.S., Sweden and Germany (Acs & Audretsch, 2010; Kelly et al., 2011). Therefore, the scientific community has attempted to explore the extent to which reliable personality traits influence the propensity to become self-employed and to persist successfully in self-employment. From psychological analysis, there is scientific evidence that personality significantly influences career choice. Empirical evidence indicates that personality characteristics play a particularly significant role for self-employment and entrepreneurship. It has also been shown that entrepreneurs' personality structure is more distinctive than managers' (Borghans et al., 2008; Holland, 1997; Zhao & Seibert, 2006).

Scientifically, there are two approaches to analysing the effects of personality traits: one focuses on including general personality traits, particularly the "Big Five Model", and the other uses specific personality traits. In the Big Five personality analysis, a large number of distinct variables of personality are aggregated to create one succinct trait of personality and therefore offer higher validity in identifying relevant correlations of personality and entrepreneurial behaviour than merely traits of a more specific nature. However, there is also an academic consensus that the "Big Five Model" and its general trait approach are not sufficiently related to entrepreneurial tasks (Dudley et al., 2006; Zhao & Seibert,

2006). It is stressed that examining specific traits such as risk tolerance, achievement striving or control beliefs are more suitable for predicting entrepreneurial performance than the Big Five (Barrick & Mount, 2005; Zhao & Seibert, 2006).

In the scope of this research, the primary focus is on individuals who are already self-employed (founders, owners and managers with liability for the company). It is important to explore what influenced the decision to become self-employed. The decision to enter self-employment is driven by the individual's strategy and objectives, which are affected directly by personality characteristics and other factors such as mental abilities. Scientific studies on the theory of personality structure assume that the effects of perception and personality factors on entrepreneurial decisions are determined by the decision-making process and the strategies and goals of the person making the decision. Therefore, the study of self-employed individuals' tasks and how they manage them is relevant to the study of entrepreneurial decision-making. To be successful in entrepreneurship, every self-employed person must be able to identify and capitalise on opportunities (Baum & Locke, 2004).

An independent entrepreneur decides at each production, marketing and sales process of his goods or services whether he can compete or succeed. Entrepreneurs must possess a wide range of skills in the quality and quantity of production or services, investment strategies, an innovative marketing strategy and, in particular, sufficient market knowledge. Self-employed people must be almost "all-rounders" because of this variety of tasks (Lazear, 2004). In the daily competition process, self-employed people face various risks or uncertainties in their decisions. Consequently, not only technical knowledge and professional competencies are relevant for the self-employed, but especially personality traits such as risk tolerance, emotional stability or internal control mechanism (Baum & Locke, 2004; Tett et al., 2003).

The connection of personality traits with entrepreneurial tasks can be made scientifically through the Big Five taxonomy, which includes different personality traits in a concise personality construct. Through personality traits specifically defined for entrepreneurial management, the model is extended beyond the Big Five and receives a more valid definition (Rauch & Frese, 2007).

Understanding the Big Five and their spillover effects on entrepreneurship is essential. The individual factors of the Big Five, as well as a selected list of specific personality traits are described subsequently concerning entrepreneurial decisions.

Big-Five-Factor: Extraversion

Extraversion indicates the degree to which individuals are assertive, dominant, ambitious, and energetic in achieving a leadership function. Extraverted individuals are more sociable and have a more effortless ability to establish social networks or business partnerships (Judge et al., 1999). Assertiveness, leadership, and networking ability correlate with entrepreneurial progression about market entry decisions and entrepreneurial success. Therefore, the probability of becoming self-employed is significant when extraversion scores are high (Ciavarella et al., 2004; Costa et al.,1984).

Big-Five-Factor: Emotional Stability

The second factor in the Big Five model has an equally strong influence on entrepreneurs. It can be assumed that emotionally stable persons are generally considered self-confident, relaxed and able to endure stressful situations. These individuals are credited with handling the pressure to perform, remaining optimistic despite this stress and sustaining strong and sound relationships with others (Hurtz & Donovan, 2000; Judge et al., 1999). It is fundamental for an entrepreneur, whether in the early stages of entrepreneurship or already established, to be able to cope with stress as well as uncertainty and to be able to work in a still very agile and unstructured work environment with uncertain outcomes. An above-average level of stress resistance is required to endure the uncertainty in the different phases of self-employment. The degree of emotional stability can therefore be assumed to be decisive for the intention to become self-employed (Hurtz & Donovan, 2000).

Big-Five-Factor: Openness to Experience

A further decisive factor for entrepreneurship is openness to experience. This defines, in particular, a person's elementary ability to have new experiences and explore new ideas. The creative, innovative and curious adjectives also correspond to a high or above-average level of this necessary openness. The founding of a company is decisively influenced by these characteristics, such as exploring new ideas, being creative and exploring new paths. Therefore, scientific evidence shows that openness to experience significantly increases the probability of entering self-employment and being self-employed (Markman et al., 2005; McCrae, 1987; Sarasvathy, 2004).

Big-Five-Factor: Conscientiousness

Conscientiousness, besides the influencing factors already mentioned, is essential for entrepreneurs and has two components. Conscientious individuals are demonstrably performance-oriented on the one hand, and on the other hand, they are attributed the attributes of being hardworking, efficient and committed. The drive for performance reflects the individual's motivation to search for even better solutions continuously. As a result, the need for achievement inherent in conscientiousness is positively correlated with entrepreneurial success (McClelland, 1961; Zhao & Seibert, 2006). The personal traits of diligence and conscientiousness have not been extensively scientifically proven as determinants of entrepreneurship (Barrick & Mount, 1991; Rauch & Frese, 2007). All summed up, however, it can be supported that higher conscientiousness also leads to a higher probability of becoming an entrepreneur or self-employed (McClelland, 1961; Zhao & Seibert, 2006).

Big-Five-Factor: Agreeableness

The final, but not negligible, factor in the Big Five model is agreeableness. In research, people with a high agreeableness score are associated with being indulgent and trusting, altruistic and flexible. Also, a high agreeableness score indicates that these individuals behave cooperatively in business. If we correlate this with entrepreneurship, we can scientifically conclude that above-average agreeableness scores harm entrepreneurial survival, because for entrepreneurs, a

high level of agreeableness could negatively affect their ability to negotiate. Therefore, researchers assume that a lower score on agreeableness positively affects entrepreneurial success. Therefore, on aggregate, a low score on agreeableness leads to a higher probability of becoming an entrepreneur or starting one's own business (Chell et al., 1991; Schmitt-Rodermund, 2004; Zhao & Seibert, 2006).

Studies have shown that entrepreneurs differ significantly from employees and managers regarding the Big Five. Differences have been demonstrated in emotional stability, extraversion, agreeableness and openness, and conscientiousness (Brandstaetter,1997; Herrmann, 1989; Howard et al., 1996; Jackson, 1994; Zhao & Seibert, 2006). A survey based on a relatively small sample found that conscientiousness is the only factor that positively influences a company's success (Ciavarella et al., 2004). There is currently no scientific evidence that the Big Five approach significantly influences self-employment and entrepreneurship.

Specific Personality Traits related to Entrepreneurship

In addition to the Big Five, personality traits related explicitly to entrepreneurship are particularly relevant. Various research approaches provide a comprehensive list of personality traits relevant to entrepreneurship and self-employment (Bonnet & Furnham, 1991; Rauch & Frese, 2007). However, from past research, the main personality traits that could be crystallised about entrepreneurship are locus of control, need for achievement, and risk tolerance (Chell et al., 1991; Lawrence et al., 2008; McClelland, 1961; Rotter, 1966). In order to identify the specific personality traits relevant to entrepreneurial decision-making in addition to the well-known Big Five, it is decisive to focus on selected and established personality traits as well as those that have been studied more recently. Those are internal and external control mechanism, intolerance of risk, confidence, patience and impulsivity. Since entrepreneurs constantly have to make decisions related to their business results, it is assumed that locus of control is also a very relevant personality trait for entrepreneurial success, which has already been empirically proven. Thus, it is evident that when scores are high on the control mechanism, the probability of self-employment and entrepreneurship is

given (Begley & Boyd, 1987; Brockhaus, 1980; Evans & Leighton, 1989; Oosterbeek et al., 2010).

Based on the uncertainty associated with entrepreneurial investments, every entrepreneurial decision is based on a specific level of risk tolerance. However, it is important to note that there is no unilateral relationship between risk tolerance and entrepreneurial decisions. On the one hand, it can be stated that a pronounced degree of risk tolerance positively affects start-up behaviour. However, there is no scientific evidence that the entrepreneurial success of a company or its economic survival has a high positive correlation with risk tolerance. The opposite is more likely, as greater risk tolerance can lead to significant losses and even failure of the business or its bankruptcy as riskier ventures are made. Individuals with medium risk tolerance show the most tremendous entrepreneurial success (Caliendo et al., 2009; Chell et al., 1991; Cramer et al., 2002).

Besides risk tolerance, entrepreneurship and self-employment also require qualities such as the willingness to trust others and to rely on each other, as well as emotional traits such as being impatient and impulsive. Trust plays an essential role in relying on others, such as employees and business partners. The ability to trust other people is the fundamental prerequisite for exchange processes and plays a unique role in the foundation of the company, because it also includes the ability to delegate. Much scientific evidence suggests that people who do not trust other people or their network tend not to find their own company. Having too much trust, on the other hand, can also have a negative impact and, if trust is unrestricted, can lead to a significantly higher probability of losses or even the failure of the company (Caliendo et al., 2012; Logan, 2009). Studies have demonstrated that impulsiveness and impatience are particularly important for the propensity to start a business and the willingness to become self-employed when it entails entrepreneurial decisions and a focus on emotional aspects. In this context, impulsive entrepreneurs also tend to consider risky business opportunities - in contrast to less impulsive and more emotionless people. Consequently, impulsivity has a significant influence on entrepreneurial decisions and entrepreneurial success (Lawrence et al., 2008). It has also been scientifically proven that impatience significantly influences risk taking. Impatient and impulsive people are much more likely to engage in risk-taking and are therefore

more likely to become entrepreneurs and start their own businesses (Vereshchagina & Hopenhayn, 2009). Empirical research, based on the meta-analytic study by Rauch & Frese (2007), has identified that entrepreneurs have higher scores than (salaried) managers on the characteristics of innovativeness, stress tolerance, proactive personality, need for autonomy and significantly lower scores on the locus of control.

The following hypotheses can therefore be derived from existing scientific research (Costa & McCrae, 1992; DeNeve & Cooper, 1998; Levenson, 1973; Zhao Seibert, 2006):

➢ Individuals high in extraversion, emotional stability, and openness and with **above-average levels of risk tolerance**, internal locus of control, confidence, impulsivity, and impatience, and, in turn, low levels of external locus of control, are more likely to become entrepreneurs or become self-employed.

➢ The likelihood of leaving self-employment or entrepreneurial activity increases tolerability, the higher the level of extraversion, emotional stability and conscientiousness, and the lower the level of external locus of control. **A medium risk tolerance is the optimum level for entrepreneurship and self-employment**.

➢ The probability of becoming self-employed or an entrepreneur increases the degree of openness to experience, extraversion, emotional stability, and conscientiousness; conversely, **the lower they rate agreeableness, the lower their degree of external control, and the lower their risk aversion**.

In science, many theory proponents believe risk tolerance results from a specific combination of all five factors of the Big Five approach. Thus, individuals with high-risk tolerance also exhibit high scores on extraversion, openness to experience as well as emotional stability and low scores on agreeableness and conscientiousness (Nicholson et al., 2005).

A comprehensive study (based on data from the SOEP) for Germany proved that, in terms of the Big Five, the self-employed have higher average scores for openness and extraversion and lower scores for agreeableness and neuroticism. They also show a lower external locus of control, have less patience and are more impulsive than the rest of the German population. Self-employed people are more likely to have a university degree than the overall population. Further, the study provides evidence that the self-employed have higher real incomes and greater financial well-being (Caliendo et al., 2013). Generally, it can be concluded that correlations to financial literacy can be established from personality traits and characteristics. Openness to new concepts is an essential prerequisite for financial inclusion, as this increases the likelihood that different and, in particular, new financial instruments will be exploited. Risk tolerance, especially can be equated with financial literacy or risk literacy. For the empirical studies presented in later chapters, risk literacy is a decisive factor in whether individuals choose entrepreneurship or self-employment.

2.10. ENTREPRENEURSHIP AND RISK PREFERENCES

In academic research, a large body of literature has been developed that addresses the differences between employees and entrepreneurs and has produced robust results (Koudstaal et al., 2016). Key findings from the research papers were that attitudes toward risk, or risk preferences, are critical in determining whether individuals become entrepreneurs (Block et al., 2015).

Scientific research has confirmed that the risk preferences of an entrepreneur are very stable concerning and significantly associated with the respective entrepreneurial personality. However, it has also been explored that risk preferences can be improved based on entrepreneurial skills and abilities (Anderson et al., 2018). Overall, various models have been developed in scholarly studies that differentiate particular competency dimensions of individuals and successful entrepreneurs' associated skills and abilities (Bacigalupo et al., 2016).

In terms of risks in entrepreneurship, particular consideration should be given to the high volatility of cash flows and the associated uncertainty of income compared to employees, as well as the fact that it has been found that start-ups have a high failure rate (Åstebro et al., 2014; Hall & Woodward, 2010; Shane, 2009).

Because of this risk profile of self-employment or entrepreneurship, which differs significantly from salaried employees, scholars assume systematically divergent risk preferences among entrepreneurs compared to wage earners (Hvide & Panos, 2014). Studies in this context demonstrated that entrepreneurs preferentially behave in risk-neutral or risk-taking behaviour compared to salaried employees. This increased risk-taking is causative for entrepreneurship (Ahn, 2010; Cramer et al., 2002). This divergent risk preference compared to employees affects decisions and behaviours in dealing with risks. In terms of financing one's venture, it can be observed that risk-averse entrepreneurs often finance their startups with income from another second job (Elston & Audretsch, 2010). Overall, entrepreneurs' risk preferences have an ambivalent effect on a startup's survival, as scholars have shown that a median level of risk aversion seems optimal for business success (Caliendo et al., 2010).

It is important to note that the greater the propensity to take risks, the more willing people are to become entrepreneurs. However, this enhanced risk tolerance also means that these people achieve inferior results as entrepreneurs or are less successful (Hvide & Panos, 2014). However, when taking a comprehensive review of the existing scientific studies, it must also be acknowledged that significant and causal relationships between risk preferences and entrepreneurship have not been demonstrated by all of the studies conducted (Holm et al., 2013). It must also be taken into consideration that many studies have used only small samples and no incentive-oriented methods to survey risk preferences, so in science, we can only speak of a limited comprehensive understanding of how and under what circumstances risk preferences shape entrepreneurial probability. It also reveals that entrepreneurs' risk preferences are often very different and financial literacy moderates them in the process. As a result, it can be scientifically concluded that more risk-averse individuals, in particular, only become entrepreneurs if they also have more financial literacy (Åstebro et al., 2014).

2.11. SOCIO-ECONOMIC DIFFERENCES OF SELF-EMPLOYED AND FOUNDERS

In 2018, the OECD conducted a study that indicated that it would take six generations for a person from the lowest income bracket in Germany to reach the societal average income. This degree of intergenerational labour income mobility

between fathers and sons thus turned out to be extremely low and deviated significantly from previous estimates showing convergence within two to four generations (Corak, 2006; Schnitzlein, 2016). Researchers Hufe et al. (2018) and Stockhausen (2018) attributed the OECD's surprising result for Germany mainly to an unusual limitation of the study group to only dependent employees, which was implicitly confirmed by the OECD study (OECD, 2018). Due to the higher income dynamics of the self-employed compared to dependent employees, there is a comparatively large and positive effect on the labour income mobility of West German men in Germany. Moreover, the self-employed are more likely to have a higher level of education than employees, which was not the norm in the 1980s. In an international comparison, the average qualification level of German self-employed workers is comparatively high (Brenke, 2013). In contrast, the differences in qualification levels between self-employed with employees and without employees in Germany are low, even if the proportion with higher vocational qualifications tends to be higher among self-employed with employees than among solo self-employed, as is also evident from the study by Bonin et al. (2020). Combining these factors and their different trends probably accounts for part of the increased income differentials in the 2000s between employed and self-employed workers. At the same time, the income spread within the self-employed is much larger than among all employed persons (Bonin et al., 2020). It has been scientifically validated that self-employment has developed much more dynamically in recent decades and is a positive factor for social permeability in Germany. The result of a primarily previous society also fits better with the population's self-perception, which paints a predominantly positive picture of perceived income mobility between generations (Adriaans et al., 2019).

In order to answer the central question about the influence of the self-employed on the intergenerational labour income mobility of fathers and sons, differences in the structure of gross earned income were examined in addition to selected differences in the level of education, the extent of employment or the migration background. For the group of West German men of working age (35 to 55 years) that is the focus of the analysis, the SOEP analyses indicate that.

o   Compared with employees, the self-employed are more likely to possess a higher level of education today, although the difference between the two groups has increased from a similar level in the 1980s,

o   the proportion of persons with an immigrant background is higher in both groups than in the 1980s, but the differences between the groups have not increased significantly, and

o   full-time employment continues to dominate among employees and the self-employed, accounting for more than 90% of the total, but has declined since 1984.

III – OBJECTIVES

III -   OBJECTIVES

3.1. RESEARCH GAP

While the debate on a binding and accepted definition has been fierce in academia (Remund, 2010), financial literacy is mainly seen as the ability to process economic information to make sound financial decisions (Lusardi & Mitchell, 2014). It is considered "an essential tool for anyone who wants to be successful in today's society" (Lusardi, 2011a). Conceptually, financial literacy refers to an ability, i.e., the ability to manage financial affairs successfully and can therefore be considered a component of human capital (Lusardi et al., 2017).

The first known use of the term financial literacy is dated back to 1992, when a study commissioned by Australia's NatWest Bank for the National Foundation for Educational Research (NFER) described financial literacy. It defined financial literacy as "the ability to make informed judgements and effective decisions about the use and management of money" (Noctor et al., 1992). Later, financial literacy was further explored and outlined by Jump$tart Coalition for Personal Financial Literacy in its first study 1997. Jump$tart defined financial literacy as "the ability to use knowledge and skills to manage one's financial resources for lifelong financial stability effectively" (Jump$tart, 2023). The academic literature operationalises financial literacy with a variety of meanings. For example, it is applied to the review of knowledge about financial products (such as stocks, bonds or loans), financial concepts (inflation, accumulation, diversification), mathematical skills required for financial decision-making and financial planning (Hastings et al., 2013). The following Figure 23 provides an overview of the core competencies related to financial literacy.

Figure 23. Core Competencies of Financial Literacy
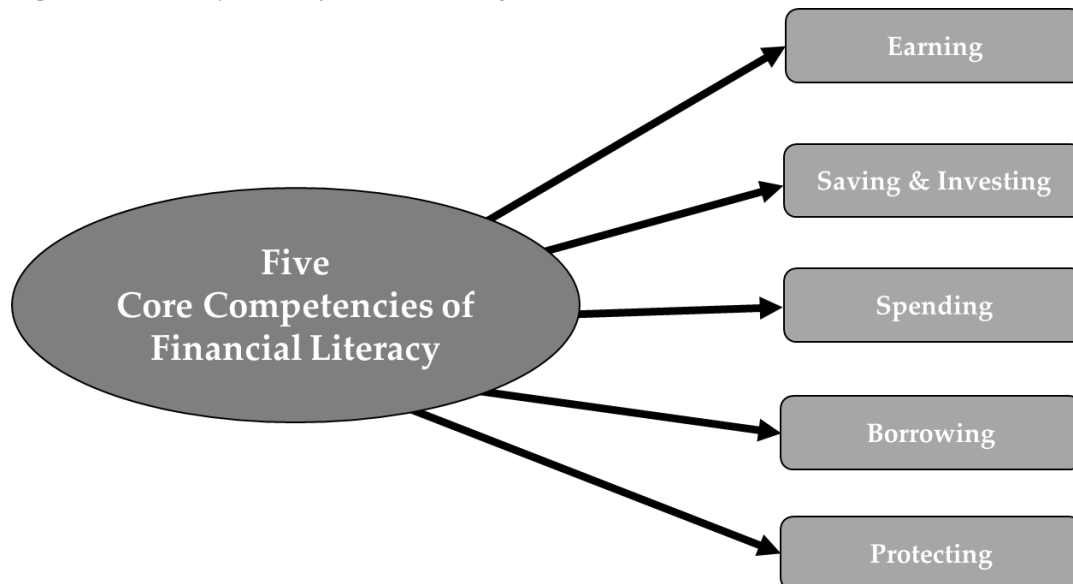
Source: Illustration by the author.

Existing theoretical and empirical research has focused almost exclusively on financial literacy as the ability of households to manage their finances in a proper economical manner (Lusardi & Mitchell, 2007). Other studies have targeted more specific population groups, such as students (Ansong & Gyensare, 2012), women (Lusardi & Mitchell, 2008), employees (Bayer et al., 2009) or investors (Müller & Weber, 2010).

Entrepreneurs' financial literacy level has important policy implications, as entrepreneurs play an essential role in promoting innovation and creating growth and jobs (Palacín-Sánchez et al., 2013; Puri & Zarutskie, 2012). Financial literacy is particularly important for entrepreneurs as they need to manage their personal finances effectively and in managing their company to make sound business decisions in financial terms.

In order to define a framework for entrepreneurs' financial literacy, knowledge blocks on decision-making in financial matters have been identified by the OECD. Particular focus was applied to the awareness, knowledge, skills, attitudes and behaviours an entrepreneur or self-employed person should have regarding effective financial decision-making. Combining these knowledge blocks leads to conclusions about the abilities and skills entrepreneurs and self-employed

persons should acquire or have access to when making appropriate financial decisions for their businesses. Financial decisions made by entrepreneurs and the self-employed are particularly important, which relate to the use of working capital, investment choices and access to finance (OECD, 2018).

Financing decisions, i.e., management of the funding and capital structure of business opportunities, are much better researched through the extensive academic literature on corporate finance. The cornerstones of these decisions are the severe information asymmetries, potential problems with agencies and significant transaction costs associated with entrepreneurial ventures (Binks et al., 1992; Lopez-Gracia & Sogorb-Mira, 2008; van Auken, 2005).

Due to market imperfections, entrepreneurs experience significant rejection rates and worse credit conditions than large companies when applying for the debt capital needed to cover investment expenditures (Cosh et al., 2009; Cowling et al., 2012). At the same time, the human capital of entrepreneurs, and especially their level of education, influence their access to external finance. Better-educated entrepreneurs are more likely to seek and receive external finance (Colombo et al., 2019; Cosh et al., 2009; Eckhardt et al., 2006; Mina et al., 2013). In their daily business operations, entrepreneurs and self-employed persons often need to implement financially relevant decisions in response to changing external conditions, on the one hand, and to improve the company's performance, on the other hand. For example, while the most common form of financing appears to be debt (Robb & Robinson, 2014), much of this is not necessarily related to the long-term need for capital expenditure, but to the short-term financing of operations (Cosh et al., 2009). Financial literacy could be a dynamic factor for (better) entrepreneurial results. This leads to the hypothesis that more people with financial literacy make better financing, investment and working capital decisions. Another hypothesis could also be that people with a high level of financial literacy are more willing to start a business because they have a good understanding of alternative sources of finance and can negotiate better with banks or other financial intermediaries.

In contrast to individuals and households, there is limited empirical evidence for the degree of financial literacy of the self-employed and small business owners. The connection between financial literacy and the probability of starting a business or business success has been scientifically researched only to a limited extent

(Ćumurović & Hyll, 2019; Dahmen & Rodriguez, 2014). Overall, academia does not yet have empirically robust research among potential and existing entrepreneurs on the degree of financial literacy and whether it is significant to the start-up or, over time, the success of the business (Lusardi et al., 2016; Trombetta, 2016). Notably, no data are available for the industrial country Germany as one of the strongest global economies.

3.2. RESEARCH QUESTIONS

After examining the essentials of research on financial literacy and entrepreneurship/self-employment in Chapter 2, this thesis addresses the following research questions illustrated in Table 8.

Table 8. Research Questions of Financial Literacy and Entrepreneurship

Research Questions (RQ)	
[Overall Topic: Impact of Financial Literacy Entrepreneurship in Germany]	
RQ1	*Can a scientifically valid measurement framework be developed to measure the financial literacy of entrepreneurs and the self-employed?*
	Scientific Justification
	In the academic world, there is still no binding measurement framework for the financial literacy of entrepreneurs and the self-employed. So far, only an OECD framework exists for relevant categories of entrepreneurs' and self-employed financial literacy. *(OECD, 2018; OECD, 2020).*
RQ2	*Are there significant differences in financial literacy between entrepreneurs/self-employed and private individuals (employees)?*
	Scientific Justification
	There are only a few academic studies for developed countries that have examined the financial literacy of entrepreneurs and the self-employed compared to individuals and employees (for Germany there is only one study that does not consider risk literacy).

	Research Questions (RQ) [Overall Topic: Impact of Financial Literacy Entrepreneurship in Germany]	
	(Ćumurović & Hyll, 2019; Dahmen & Rodriguez, 2014).
RQ3	*Is there a significantly positive correlation between financial literacy and entrepreneur-ship/self-employment?*
	Scientific Justification
	The research that exists so far shows that financial literacy correlates with entrepreneurship/self-employment. There is a lack of a broad data base for Germany. *(Al Issa et al., 2019; Bilal et al., 2021; Burchi et al., 2021; Ciavarella et al., 2004; Costa et al.,1984; Ćumurović & Hyll, 2019; Oosterbeck et al., 2010; Wongso et al., 2020).*
RQ4	*Is there a significantly positive correlation between financial literacy and business success of entrepreneurs/self-employed?*
	Scientific Justification
	A correlation between financial literacy and business success of entrepreneurs/self-employed is supported by current research (especially in emerging markets). There is no scientific empirical evidence for Germany to date. *(Adomako & Danso, 2014; Adomako et al., 2016; Anderson et al., 2018; Bongomin et al., 2017; Dahmen & Rodríguez, 2014; Fatoki, 2021; Hendrawaty et al., 2020; Hossain et al., 2020; Sucuahi, 2013; Suparno & Saptono, 2018).*

Source: Own presentation.

3.3. HYPOTHESES

Table 9 provides a holistic view of the research questions to be explored and the hypotheses deduced from them. Chapter 4 then explicitly addresses the methodology and empirical measurement procedures so that scientifically robust results can be obtained to answer the research questions and hypotheses.

Table 9. Overview of the Research Questions and Hypotheses

Research Questions (RQ) & Hypotheses (H) [Overall Topic: Impact of Financial Literacy Entrepreneurship in Germany]		
RQ1	*Can a scientifically valid measurement framework be developed to measure the financial literacy of entrepreneurs and the self-employed?*	
	Hypothesis 1	
	H_0	A scientifically valid measurement framework **cannot** be developed to measure the financial literacy of entrepreneurs and the self-employed.
	H_A	A scientifically valid measurement framework **can** be developed to measure the financial literacy of entrepreneurs and the self-employed.
RQ2	*Are there significant differences in financial literacy between entrepreneurs/self-employed and private individuals (employees)?*	
	Hypothesis 2	
	H_0	There are **no significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
	H_A	There **are significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
RQ3	*Is there a significantly positive correlation between financial literacy and entrepreneurship/self-employment?*	
	Hypothesis 3	
	H_0	There is **no significantly positive correlation** between financial literacy and entrepreneurship/self-employment.
	H_A	There is **a significantly positive correlation** between financial literacy and entrepreneurship/self-employment.

Research Questions (RQ) & Hypotheses (H)

[Overall Topic: Impact of Financial Literacy Entrepreneurship in Germany]

RQ4	*Is there a significantly positive correlation between financial literacy and business success of entrepreneurs/self-employed?*	
	Hypothesis 4	
	H_0	There is **no significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed?
	H_A	There is **a significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed?

Source: Own presentation.

IV – MATERIAL AND METHODS

IV -MATERIAL AND METHODS

4.1. METHODOLOGY

The research will focus on the scientific modelling of the survey design and the acquisition of survey participants. In addition to the quantitative empirical research, expert interviews were conducted bank decision-makers to provide a holistic view of the research complex. The following Figure 24 provides a general overview of the process.

Figure 24. Data Collection and Research Process
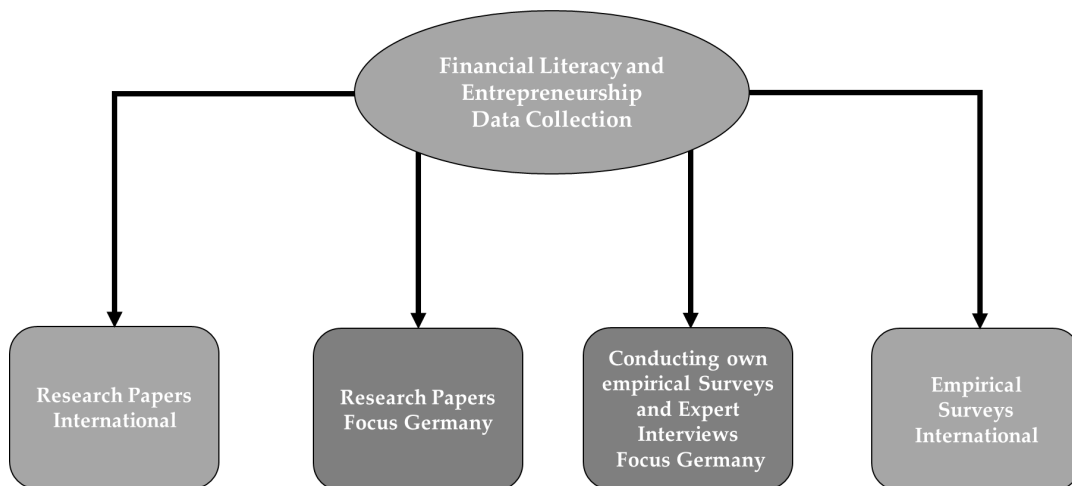
Source: Illustration by the author.

In designing the questionnaire, attention was paid to the interdependencies and correlations between fundamental cornerstones of both financial literacy and entrepreneurship. Specific focus has been put on the topic of "risk literacy", which is vital for both entrepreneurship and financial literacy.

The question of whether risk preferences and financial literacy are independent factors for entrepreneurial activity or whether their characteristics interact is scientifically relevant to the study. The academic question here is whether there is empirical evidence that high levels of financial literacy are associated with sound risk literacy. In the current disruptive economic environment, they play a crucial role (Erdem & Rojahn, 2022). Academic research

concludes that risk preferences are essential in determining who becomes an entrepreneur (Ahn, 2010; Hvide & Panos, 2014). Compared to a fixed income from employment, an entrepreneur has to cope with more significant variance and less income security (Åstebro et al., 2014). As a result, scholars have suggested that the risk preferences of entrepreneurs are systematically different from those of wage earners (Hvide & Panos, 2014).

Researchers Lusardi and Mitchell have developed three questions to measure financial literacy, which have become established as the "Big Three" (Lusardi & Mitchell, 2008; questionnaire in annex). These three questions represent the scientific standard for operationalising individuals' financial literacy and capability and have been used in various surveys worldwide, including the German PHF survey. However, in conjunction with the "Big Three", the question of risk assessment is still necessary for the optimal selection of financial products. Therefore, in addition to the fundamental questions on financial literacy, risk literacy was also asked and assessed.

The following Figure 25 gives a good overview of the correlations between risk and financial literacy and their measurability when the existing "Big Three" are supplemented by questions on risk and return as well as expected return.

Figure 25. Measuring Financial and Risk Literacy
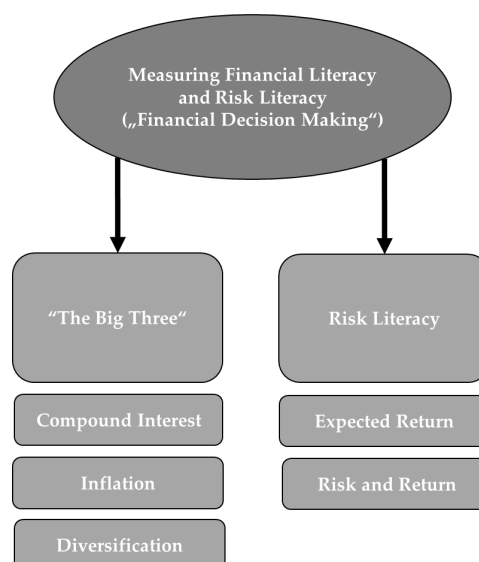
Source: Illustration by the author based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age".

Figure 26 below illustrates the key questions related to the "Big Three" of financial literacy, as well as those related to the risk literacy topics of "Expected Return" and "Risk and Return", which have been frequently applied in the existing academic literature. This thesis also primarily focuses on these established questions, but supplements them with additional questions, resulting in an ideal combination of questions for examining the correlation between financial literacy and entrepreneurship.

Figure 26. Measuring Financial and Risk Literacy – Questionnaire

Source: Illustration by the author based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age".

The national and international literature review on financial literacy for individuals and households is primarily based on the 20 most cited academic papers in the appendix. The empirical studies used in the paper are tabulated in Table 10.

Table 10. Household Surveys related to Financial Literacy

Name of Survey	Data of	Country	Focus	Sample Size	Initiator	Measure
Allianz/Lusardi Pension Paper 01/2017	2016	Europe	Adults	1.000	Allianz Group	Big Three + Risk Literacy
German Panel on Household Finances	2017	Germany	Adults	4.500	German Central Bank	Big Three
G20/OECD/INFE Report on Adult Financial Literacy in G20 Countries	2017	G20 Countries, Netherlands, Norway	Adults	100.000	OECD/G20	Knowledge, Behaviour and Attitude
SAVE - Sparen und Altersvorsorge in Deutschland	2013	Germany	Adults	1.430	Munich Center for the Economics of Aging (MEA)	Big Three (extended)
SHARE – Survey of Health, Ageing and Retirement in Europe	2016	Europe	Adults	123.000	European Commission	Numeracy and Interest
Socio-Economic Panel (SOEP)	2018	Germany	Adults	30.000	Deutsches Institut für Wirtschaftsforschung e.V. (DIW Berlin) (German Institute for Economic Research)	Interest and Risk
Standard & Poor´s Global Financial Literacy Survey	2014	Global	Adults	150.000	Standard & Poor´s	Interest, Inflation and Risk
U.S. Health and Retirement Study (HRS)	2018	US	Adults	20.000	University of Michigan National Institute on Aging and the Social Security Administration	Big Three + Risk Literacy

Source: Illustration by the author.

Overall, the number of studies measuring the financial literacy of entrepreneurs is limited. Two recent studies examine the subjective level of financial literacy of self-employed and entrepreneurs in the Netherlands (Utrecht Chamber of Commerce, 2017) and Canada (BDC, 2017). In both surveys, respondents were asked to assess their own knowledge in the field of financial management. The Canadian survey was supplemented by 10 questions to objectively measure financial literacy (e.g., concepts such as interest rates, credit cards, creditworthiness, house costs, bond prices and the pricing of goods or services). Test-based surveys were conducted only by Dahmen and Rodriguez

(2014) and Trombetta (2016). Trombetta (2016) proposes a questionnaire with eight questions on accounting and financial concepts, which he tested on a sample of 400 self-employed Spanish people. In addition to the three basic questions ("Big Three"), the other five questions dealt with

1. Perception of debt as a financing instrument

2. Evaluation of growth opportunities

3. Measurement of financial performance regarding revenue and accrual

4. Depreciation

5. Economic profitability concerning financial profitability

However, there is as yet no scientific consensus for this set of measures of financial literacy for entrepreneurs and the self-employed. In order to be representative of the degree of financial literacy between individuals and entrepreneurs, the "classic questions" on financial literacy from the established question sets ("Big Three", "Big Five" and various additions over the years; see appendix) are used initially. Priority is given to the questions established by Lusardi and Mitchell.

For the specific measurement of entrepreneurs' financial literacy, it is essential to include concrete questions related to entrepreneurship and financial literacy. The OECD (2018) has established a framework for entrepreneurs' required competencies and financial literacy. The framework is structured around four main areas of competencies, with the content of each area further split into distinct topics:

➢ **Choice and Use of Financial Services**

  o Basic Payment and Deposit Services

  o Financing the Business

➢ **Financial and Business Management and Planning**

  o Registration, Taxes and other legal Requirements

  o Keeping Records and Accounting

  o Short-term Financial Management

- o   Planning beyond the short term

- ➢ **Risk and Insurance**

  - o   Personal Risk and Insurance

  - o   Business Risk and Insurance

- ➢ **Financial Landscape**

  - o   External Influences

  - o   Financial Protection for MSMEs

  - o   Financial Information, Education and Advice

In order to have a comparability of individuals with entrepreneurs, the same survey basis must be used. This is based on the "Big Three" and "Big Five". When measuring risk capacity, an analogous survey should also be used for both professional groups - here, the questions developed by Lusardi in cooperation with Allianz (2017) will be applied. The framework for the specific measurement of entrepreneurs will be derived and developed from the OECD Framework (2018). This allows correlations and valid measurements to be made. The following Figure 27 gives a reasonable overview of the three sections of the questionnaire and the special fields of knowledge within the three sections.

Figure 27. Financial Literacy for Entrepreneurs - Competence Fields
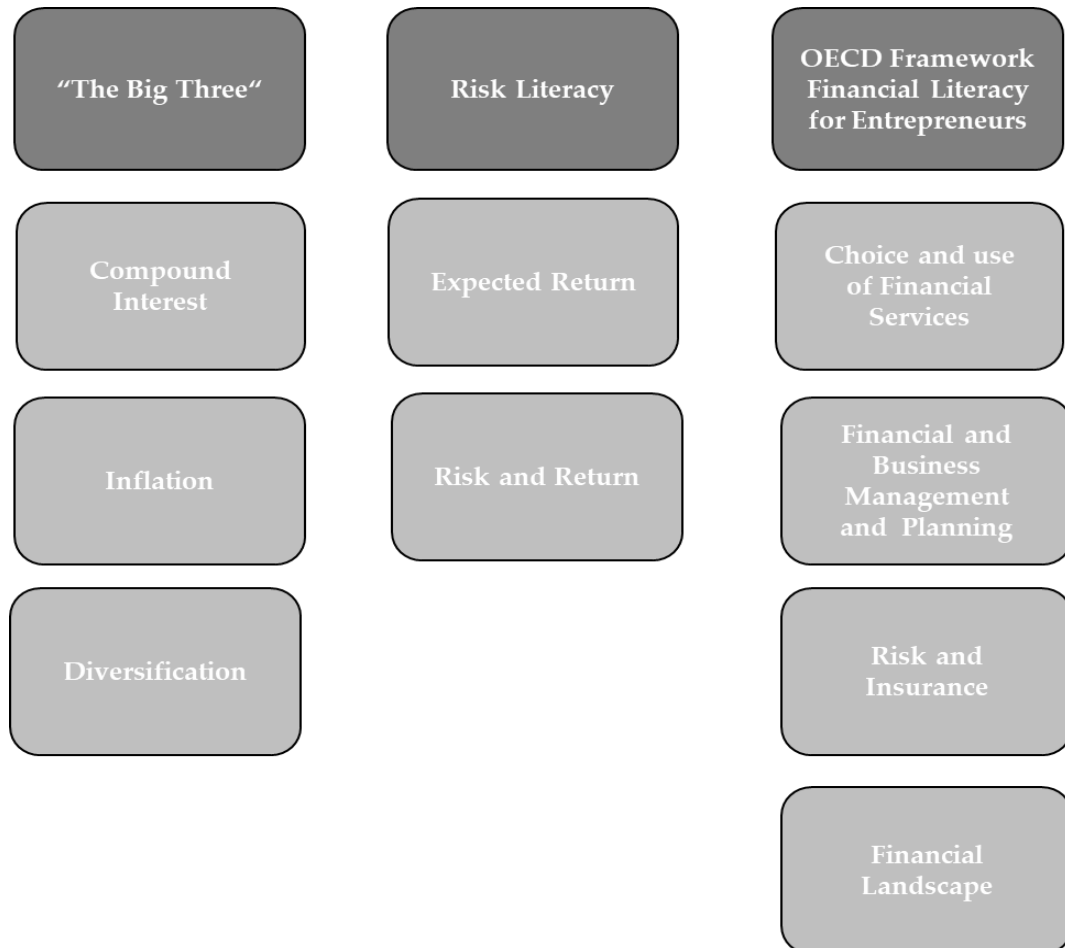
Source: Illustration by the author based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age" and OECD/INFE Core Competencies Framework on Financial Literacy for MSMEs (OECD, 2018).

Three quantitative empirical studies were conducted, and qualitative interviews then supplemented these. This procedure was crucial to find which survey and measurement method could deliver robust statistical results. In the first two surveys (1st and 2nd Survey), it was essential to check whether the already established measurement methods via the "Big Three" or "Big Five" are sufficient or have to be supplemented by further relevant questions for the correlation of financial literacy and entrepreneurship.

Applying a mixed methods approach, using both quantitative and qualitative research approaches, aimed to obtain a holistic view of the research

questions and hypotheses. Since there are no corresponding studies for Germany so far, or the only research available for Germany by Ćumurović and Hyll (2019) did not examine the relevant questions on risk literacy, new data and findings are obtained that can verify and establish a scientific causality between financial literacy and entrepreneurship. Of particular research, relevance is also the question of which statistical methods can be used to test this causality correctly. Applying the Doubly-Robust and Matching method, mainly used in medical research, raises this static significance test of causality to a new scientific level. The supplementary expert interviews with one of Germany's largest cooperative banks provide insights from the point of view of an SME and entrepreneurial bank on entrepreneurs and the self-employed that are not yet available in this form in scientific research.

4.2. DATA COLLECTION

To generate the required statistical data, a total of 3 waves of quantitative empirical research were conducted in the form of an online survey. Different statistical methods were used for evaluation, from logistic regression to a matching procedure. Further, different sources were used to find adequate and statistically valid survey participants. Among these are the personal and LinkedIn networks up to a personalised direct mailing to 2.675 recipients with entrepreneurial backgrounds. The methodologies used, as well as the sources for survey respondents, are presented in Table 11.

Table 11. Overview of Surveys, Measurement Methods and Respondents

#	Basis of the Financial Literacy Questions	Survey Timeframe	Statistical Method	Sources of the Survey Participants
1	o Big Three o Big Five o Allianz/Lusardi o OECD	November 13, 2022, until February 5, 2023	Descriptive Statistics & Logistic Regression	• Own LinkedIn Network (direct and via Posts) • WhatsApp Status • Empirio Network • Personal Network
2	o Big Five o Riepe o Falk et al.	December 16, 2022, until February 28, 2023	Matching & Doubly-Robust Method	• Own personal Network (Direct Approach)
3	o Big Three o Big Five o Allianz/Lusardi o OECD o Van Rooij et al. o Falk et al.	March 15, 2023, until May 31, 2023	Matching & Doubly-Robust Method	• Direct Mail to 2,675 Entrepreneurs and Self-employed (VGSD Members) via Email Outbound • Own LinkedIn Network (direct and via Posts) • WhatsApp Status and Broadcast • Empirio Network

Source: Illustration by the author.

An important aspect of the empirical studies was identifying and reaching a valid and comprehensive group of relevant survey participants. Since the group of entrepreneurs and self-employed persons is challenging to attract for surveys, the direct approach via mail outbound was most successful in the third study, since of the total of 2,675 addressed entrepreneurs and self-employed persons of the VGSD ("Verband der Gründer und Selbstständigen Deutschland e.V."; 5,852 Association Members), a total of around 150 responses were received, which corresponds to a response rate of 5.6%. The surveys are presented in Table 12 with

the respective numbers of participants according to entrepreneurs/self-employed persons and employees.

Table 12. Survey Participants of the Empirical Studies

Survey #	Total Number of relevant Participants (n)	Number of Participants (n) (Entrepreneurs/Self-Employed vs. Employees/Private Individuals)		Survey Timeframe
1	295	Entrepreneurs/Self-Employed	103	11/15/2022 to 02/05/2023
		Employees/Private Individuals	192	
2	127	Entrepreneurs/Self-Employed	48	12/16/2022 to 02/28/2023
		Employees/Private Individuals	79	
3	508	Entrepreneurs/Self-Employed	238	03/15/2023 to 05/31/2023
		Employees/Private Individuals	270	
Σ	930	Entrepreneurs/Self-Employed	389	
		Employees/Private Individuals	541	

Source: Illustration by the author.

4.3. QUANTITATIVE AND QUALITATIVE MIXED METHODS APPROACH

The dissertation uses a mixed methods approach to address financial literacy and entrepreneurship research areas. On the one hand, the explorative approach of qualitative research presents the current state of knowledge on financial education, entrepreneurship and financial literacy. A detailed literature review is used as the qualitative research approach. Expert interviews complement the qualitative approach. Empirical data will be collected through a quantitative research approach using several waves of surveys. The data will in the following

be analysed using logistic regression models and Matching methods to enable statistical testing of the formulated hypotheses.

Empirical social research is in a tense relationship between qualitative and quantitative research. However, it is irrelevant which research is applied as long as it is done correctly and thus the results of both methods contribute to the science of reality (Strübing, 2013). "Indeed, a closer look reveals that, for example, qualitative research designs sometimes also make use of quantitative data or that quantitative data is also (...) hypothesis-tested now and then" (Strübing, 2013, p. 2).

Using a quantitative (empirical surveys) and qualitative (expert interviews) research, an analysis and comparison of the financial literacy of employees and entrepreneurs will be conducted. Thereby, subjective and objective financial literacy assessments are achieved, then condensed and tested for significance in further research.

Since November 2022, a total of 3 empirical surveys have been conducted among private individuals and entrepreneurs, complemented by expert interviews with bank employees. This is intended to ensure that research also includes the perspective of the financing side via bank employees in the evaluation and underpins the quantitative study results. The mixed methods approach ensures more robust results and provides additional directions for future research.

4.3.1.   1st Quantitative Empirical Study

The online survey method was adopted for the first survey period from 13th of November 2022 to 5th of February 2023 as part of the quantitative research. The survey developed included 25 questions, starting with demographic characteristics followed by questions on measuring financial literacy and risk literacy to assess the financial literacy of different social groups. The questionnaire was distributed via the social media channels LinkedIn and WhatsApp and a survey link to entrepreneurs from the author's personal circle of acquaintances, as this group of people is more difficult to reach via social channels. The online survey was intended to refer exclusively to employed persons in order to receive responses only from entrepreneurs and employees. To ensure the fulfilment of this

criteria, the answer option "no employment status" was given for answering and respondents choosing this option were led directly to the end of the survey as they were not relevant for this first research. Participants labelled as entrepreneurs received six further questions about their entrepreneurial activities.

The questionnaire used for the first survey consisted of 25 questions (see table 11 in the appendix) providing information about the participant's socio-demographic characteristics, educational background and previous experience in the field of financial education, as well as the current situation of the company if the respondent was an entrepreneur. Also integrated were questions assessing the participant's financial literacy and risk competence. The "Big Three" and "Big Five" questions, survey items from Allianz/Lusardi and the OECD/INFE framework on entrepreneurial financial literacy were used. These questions are designed to determine how the financial knowledge of entrepreneurs and employees differs and whether a link to entrepreneurship can be identified among individuals with higher financial literacy. In the following Table 13, the questions related to financial and to risk literacy are presented - the entire questionnaire can be found in the appendix.

Table 13. Questions related to FL and Self-Assessment on Risk (1st Study)

No.	Question in Questionnaire	Scientific Foundation
1	Suppose you had 100€ in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?	**"Big Three"** Lusardi & Mitchell, 2011b
2	For the same amount of money, you can enter either one of two lotteries: Lottery A pays a prize of €200 and the chance of winning is 5%. Lottery B: pays a prize of €90,000 and the chance of winning is 0.01%. If you do not win, you do not receive any money. Which	**"Expected Return"** **[Risk Literacy]** Allianz/Lusardi, 2017

No.	Question in Questionnaire	Scientific Foundation
	lottery pays the higher average amount?	
3	You can invest in two projects. Project A will either deliver a return of 10% or 6% with either outcome equally likely. Project B will either deliver a return of 12% or 4% with either outcome equally likely. Which of the following is true? Compared to Project B, Project A has...	**"Risk & Return"** **[Risk Literacy]** Allianz/Lusardi, 2017
4	Please tell me if this statement is true or false. "A company pays dividends to a bank to pay off a loan.	**"Financial Landscape"** OECD, 2018
5	Imagine you receive 200€ as a gift, but you have to wait a year before you can spend the money. If inflation stays at 2%, how much will you be able to buy with the 200€ in one year?	**"Big Three"** Lusardi & Mitchell, 2011b [adjusted to Inflation question]
6	A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.	**"Big Five"** Lusardi & Mitchell, 2014
7	Please tell me if this Statement is true or false. "If a financial investment offers the chance to make a lot of money, it is likely that there is also the risk of losing a lot of money".	**"Risk & Return"** **[Risk Literacy]** Allianz/Lusardi, 2017 [adjusted question]

No.	Question in Questionnaire	Scientific Foundation
8	Please tell me if this Statement is true or false. "High inflation means that the cost of living is rising rapidly".	**"Big Three"** Lusardi & Mitchell, 2011b [adjusted to Inflation question]

Source: Own elaboration based on Allianz/Lusardi (2017), Lusardi & Mitchell (2011b/2014) and OECD (2018).

Logistic regression was used to analyse the collected data and was performed using SPSS. In order to investigate the data, a financial literacy index is created by summarising the correct answers to financial literacy questions. Correct answers to the financial questions were coded as "1" and incorrect answers as "0". This allows the difference in financial literacy between entrepreneurs and employees to be examined statistically.

This index is the used as a variable to predict whether a person is an entrepreneur or an employee. The regression equation with (i) for the respective study participant is shown in Equation 1.

Equation 1. Formula of Logistic Regression (1st Study)

$$P\ (Entrepreneur) = \beta 0 + \beta 1 * FinancialLiteracy_i + \varepsilon_i$$

Source: Own presentation.

4.3.2.   2nd Quantitative Empirical Study

Methodology and Operationalisation

The second quantitative study aims to expand the examination of the correlation between financial literacy and entrepreneurship in Germany. This research approach uses Logistic Regression and Matching methods. Based on the results of the literature review, a second questionnaire was created to generate a valid study group. In this context, the socio-demographic factors of the study participants relevant to financial literacy were also queried. Individuals' financial literacy level was assessed using the "Big Five" model of Lusardi and Mitchell (2014), which has been established as a standard in academia. The model includes

questions on inflation, compound interest, mortgages, bond prices and diversification, and compares results with previous studies. The questions included three multiple-choice questions to test skills in simple interest calculation and understanding the relationship between interest rates and bond prices, as well as two true/false questions to test knowledge of mortgages and the concept of risk diversification (Lusardi & Mitchell, 2014).

In addition to the questions from the "Big Five" model, two additional questions on the topic area of risk attitude, which was found particularly relevant in the literature review, were integrated. The first question on entrepreneurs' risk aversion was taken from Riepe et al. (2022). In addition, another question in the form of a self-assessment of one's risk attitude was taken from a paper on risk measurement by Falk et al. (2018). A self-assessment of the level of financial literacy by the study participants was omitted due to the problems mentioned in the previous chapters regarding subjective self-assessment in previous surveys. However, a combination of test questions on financial literacy and a self-assessment seems appropriate given the linear positive correlations between these two forms of research mentioned above. Table 14 presents the knowledge questions included in the questionnaire and the self-assessment question on risk attitudes. Appendix 11 contains the entire questionnaire with all questions.

Table 14. Questions related to FL and Self-Assessment on Risk (2nd Study)

No.	Question in Questionnaire	Scientific Foundation
1	Suppose you had 100€ in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?	**"Big Three"** Lusardi & Mitchell, 2011b
2	Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?	**"Big Three"** Lusardi & Mitchell, 2011b

No.	Question in Questionnaire	Scientific Foundation
3	If interest rates rise, what will typically happen to bond prices?	**"Big Five"** Lusardi & Mitchell, 2014
4	A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.	**"Big Five"** Lusardi & Mitchell, 2014
5	Buying a single company's stock usually provides a safer return than a stock mutual fund.	**"Big Five"** Lusardi & Mitchell, 2014
6	Suppose you owe 3.000€ on your credit card. You pay a minimum payment of 30€ each month. At an annual percentage rate of 12% (or 1% per month), how many years would it take to eliminate your credit card debt if you made no additional new charges?	Riepe et al., 2022
7	How would you rate yourself personally? Are you generally a risk taker or do you try to avoid risks? Please check a box on the scale where 0 means "not at all willing to take risks" and 10 means "very willing to take risks".	Self-evaluation of Respondents on their own Risk Aversion (adopted from Falk et al., 2018)

Source: Own elaboration based on Lusardi & Mitchell (2011b/2014), Riepe et al. (2022), and Falk et al. (2018).

The questions on socio-demographic variables identified as particularly relevant in the literature review, such as age, gender, income, and education, are oriented here to various studies on financial literacy (e.g., Ćumurović and Hyll,

2019; Lusardi & Mitchell, 2014). These questions were formulated based on the literature and the questions on the demographic standards of the Federal Statistical Office (Beckmann et al., 2016). In order to distinguish between entrepreneurs and private individuals, a conditional question on employment status was used. Individuals classified as entrepreneurs also received four additional questions on the variables year of establishing their own business, industry, number of employees, and turnover in the previous calendar year.

All financial literacy questions, except the self-assessment question, have only one correct answer. In addition, the options "don't know" and "don't specify" are provided. The "don't know" option reduces the risk of random guessing and avoids a random response. However, even with the "Don't know" option, the risk of randomly selecting the correct answer despite ignorance remains. However, not using this option significantly increases the risk of biased scoring of this answer as knowledge. In addition, the "Don't know" option is always available to avoid blank responses and the risk of dropout if respondents refuse to answer a question. For the socio-demographic questions, it is also possible for respondents to skip the question. These measures serve as preventative measures to avoid a high dropout rate.

A logistic regression analysis is first performed on the survey data to help examine the relationship between financial literacy and entrepreneurship in Germany. As is common in scientific studies of this kind, the further processing of the raw data from the survey requires some preprocessing steps in order to be able to analyse it further using statistical methods in Python. All preprocessing steps were implemented in Python functions and stored in a separate file. Common problems in the data set were missing values, NaN values, and information stored in inaccessible formats, which could be handled using the scikit-learnSimpleImputer. To rid the data of outliers and hard-to-process values, metric variables such as age, income, parental knowledge, and personal risk attitudes were z-standardized using the scikit-learn StandardScaler. Before applying the statistical evaluation methods, the data is checked for outliers and multicollinearity so that the application requirements are given. Outliers are examined visually by plotting the data as histograms with the matplotlib-API and checked for using the z-score test with the numpy-API. After applying the z-score

test with the common threshold of a z-score of 3 the preprocessed data file is returned and used for the further examination.

The present dataset was further divided into groups of entrepreneurs and non-entrepreneurs and listed according to the response ID. All processed data from the preparation process were linked to a dataset using a function. This enabled the results of the questions to be mapped to the corresponding demographic variables based on the response ID. In addition, an index of financial literacy was created based on the correctly answered questions.

For the analysis, the construct of financial literacy was defined following Riepe et al. (2022) as the variable "high financial literacy", which takes the value 1 if the financial literacy of the study participant is equal to or above the median and 0 for "low financial literacy" if it is below the median.

Following van Rooij et al. (2012), answers were categorised the education groups into no vocational education, intermediate vocational education (ISCED-level 3), higher vocational education (level 5), and higher education (level 6/7) based on the ISCED framework. In addition, the information on personal risk attitude was classified into low (0-2), medium (3-7), and high (8-10) groups based on the reported value (Caliendo et al., 2009; Ćumurović & Hyll, 2019. In this study, the level of financial education represents the independent variable predicting the dependent variable entrepreneur/non-entrepreneur. Following similar studies (Ćumurović & Hyll, 2019; Nicolini & Haupt, 2019), the socio-demographic data of the study participants (age, gender, educational level, income, knowledge transfer, as well as employment status) are considered as control variables in the regression equation (1), where i represents each study participant). The variables gender and education are classified as dummy variables with the reference categories Gender_m and Education_ISCED-3. The data for the variables age and income was elevated in a numerical form. For a better overview of the data these variables will be shown in categories in chapter 5. Both variables are transformed using the scikitlearn simpleimputer-API to fit them into the regression model.

Equation 2. Formula of Logistic Regression (2nd Study)

$$P\ (Entrepreneur) = \beta 0 + \beta 1 * FinancialLiteracy_i + \beta 2 * Age_i$$
$$+\ \beta 3 * KnowledgeDissemination_i + \beta 4 * Income_i + \beta 5 * Gender\_w_i$$
$$+\ \beta 6 * Education\_ISCED\text{-}5_i + \beta 7 * Education\_ISCED\text{-}7_i$$
$$+\ \beta 8 * Education\_noPT_i\ +\ \beta 9 * SA_i\ +\ \varepsilon_i$$

Source: Own presentation.

The implementation of logistic regression in Python is based on the statsmodel API. This is done using the sm.logit function and the lbfgs-method to specify the optimisation algorithm for fitting the model to the data. However, when studying the effect of financial literacy on the probability of being an entrepreneur, there are some confounding factors to consider. For example, in many studies, the values of the independent variable also depend on the values of other predictive variables. The consequences of this problem, known as endogeneity, are spurious regression coefficients resulting from possible correlations between the variables examined (Avery et al., 2005). In this context, entrepreneurship may also affect an individual's financial literacy and lead to systematic errors due to reverse causality.

To address these problems, so-called matching techniques can be applied, provided that the confounding variables are measured, can help solve endogeneity problems (Caliendo & Kopeinig, 2005). This causal analysis aims to measure the direct way one variable affects another. In order to investigate this effect, the so-called backdoor criterion must be satisfied (Glymour et al., 2016). To ensure the fulfilment of these criteria, blocking all non-causal paths between a variable X and a variable Y has to be guaranteed. If this is the case, the causal effect of the variable X on Y can be represented by Equation 3.

Equation 3. Formula Backdoor-Criterion

$$P\ (Y\,|\,do\ (X)) = \sum P\ (Y\,|\,X,\ Z)\ P\ (Z)$$

Source: Own presentation based on Pearl (2009).

In order to provide a better overview and classification of the variables under investigation into backdoor variables, causal diagrams (Pearl, 2009) are suitable to represent the data generation process graphically. This representation includes all

the data included in the study and the causal relationships between them, represented by arrows. Figure 28 shows the causal diagram for the variables in this study.

Figure 28. Causal Diagram for Backdoor Variable Identification (2nd Study)
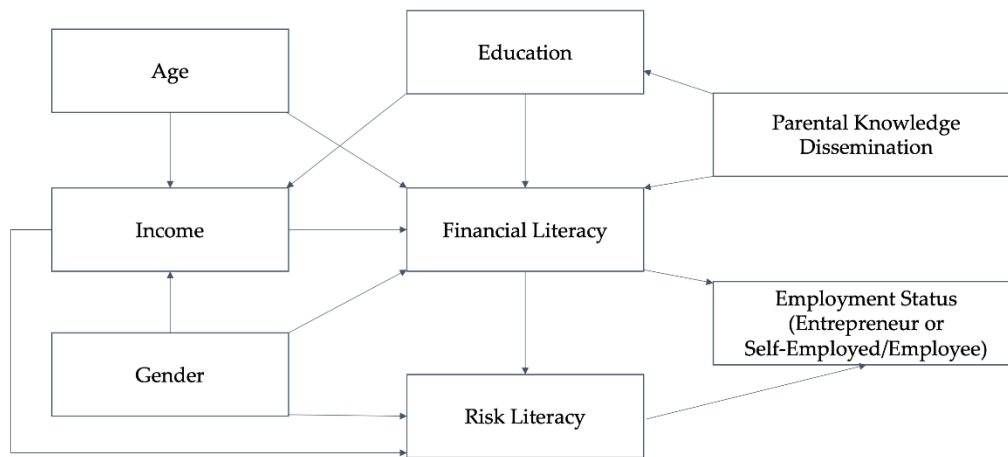
Source: Own presentation based on Huntington-Klein (2021).

From the literature, the identification of the backdoor variables is based on the study of the respective relationships of the variables with each other. The impact of financial literacy on entrepreneurship has been demonstrated in the existing literature (Ćumurović & Hyll, 2019). Moreover, Christelis et al. (2010), Lusardi (2012), and Lusardi and Mitchell (2011a) were able to demonstrate the influence of a person's personal education level on financial literacy, which classifies this variable as a backdoor variable. In addition, the influence of income (Lusardi & Mitchell, 2011a), gender (Lusardi & Mitchell, 2014) and age (Grable & Roszkowski, 2008) on financial literacy can be demonstrated using existing literature, which is why these variables also meet the backdoor criterion. Ćumurović & Hyll (2019) demonstrated an impact of parental knowledge transmission on financial literacy and individuals' general education level.

Hsiao and Tsai (2018) suggest that financial education reduces risk aversion or, in other words, increases the acceptable risk threshold. Accordingly, based on the literature, the variables of parental knowledge transmission, education, age, income, gender, and risk attitude can be identified as backdoor variables for

investigating the relationship between financial education and entrepreneurship and, accordingly, were a part of the matching procedure to be conducted.

The literature presents numerous Matching methods for estimating treatment effects (Imbens, 2004). Among the most well-known methods are Mahalanobis Distance Matching (MDM) and Propensity Score Matching (PSM; King & Nielsen, 2019). While King and Nielsen (2019) discourage the use of PSM due to uncertain and unreliable estimates that can vary widely depending on the outcome model used, there are many proponents of PSM in the literature. In several studies, good covariate balance was achieved based on PSM, and in contrast, some worse balance was achieved using MDM than without a Matching method (e.g., Ripollone et al., 2018). PSM can also counteract the inadequate distribution of covariates between two groups (Li & Green, 2013).

In this study, the PSM method is also appropriate because the resulting propensity scores can be used for further investigation using the Doubly-Robust method. The estimator for the propensity score is estimated following Hirano et al. (2003) based on logistic regression and maximum likelihood. For the analysis, the respondents were divided into a treatment group and a control group on the basis of the status "high financial literacy" (treatment group) and "low financial literacy" (control group) based on similarities in the control variables. As described above, the classification is based on the mean in the respective groups, as in Riepe et al. (2022). By controlling for confounding effects, differences between entrepreneurs and non-entrepreneurs can be attributed solely to financial education. An unbiased estimate of the effect of financial education on entrepreneur/non-entrepreneur status can be obtained.

King and Nielsen (2019) propose using inverse probability weighting (IPW) to remove the limitations. IPW is often used when the treatment and control groups in a dataset are unbalanced, that is, when the proportion of individuals in each group is unequal, as in the case of this study. The propensity score is used as an inverse weight (Shiba & Kawahara, 2021). Using IPWs also reduces bias in estimating the treatment effect of matching.

For implementation in Python, the causal inference API of Wong (2020) is used here. Based on the processed data, the Matching Model is constructed by adding the backdoor variables. The M.est_propensity function produces

propensity scores based on logistic regression. Observations that are poorly matched between the treatment and control groups to their covariates are omitted by trimming the propensity scores, as these may lead to biased estimates of the treatment effect. For this purpose, the method trim_s in the Causal Model class, an improved algorithm, is used to balance the treatment and control groups. This phenomenon, referred to as Common Support, is further explored through visual analysis of the PSM distributions in the treatment and comparison groups. By removing such observations, the method helps to improve the accuracy of the causal effect estimate (Lee et al., 2011). In addition, a balance test is performed to assess the PSM. Furthermore, to ensure the robustness of the results, the investigation ran the MDM on the underlying data.

In order to avoid potential misspecification problems of the two previously used methods, the data are then examined using the Doubly-Robust method (Bang & Robins, 2005), which combines the strengths of the Matching and Regression methods. This method has been described more extensively in the statistical literature (Bang & Robins, 2005; Lunceford & Davidian, 2004) but is still considered unknown to the broader research community. Imbens (2004) notes that propensity scores can also be used as weights to obtain a balanced sample of treated and untreated individuals.

Existing research confirms that the Doubly-Robust method is able to provide an unbiased estimate when the confounding factor is omitted from one of the previously used models (Funk et al., 2011). During implementation, the previously calculated propensity scores of each variable are included as an additional control variable in the Doubly-Robust regression model. This results in an unbiased estimate of the treatment effect, even if one of the previously applied methods is not correctly specified. However, caution should be exercised as the Doubly-Robust method is relatively new. For example, the Doubly-Robust estimator is less efficient than the maximum likelihood estimator of a correctly specified model, so the significance of the results is limited (Funk et al., 2011) and should only be considered in the context of the overall study.

The questionnaire was programmed in the software Lime Survey, which is often used for scientific surveys, and the link to the online survey was sent to individuals who correspond to the status of an entrepreneur as defined by the

OECD (2018). For this purpose, persons from various companies in the personal network were contacted. In order to establish a comparison group of private individuals, the questionnaire was also distributed to people from the author's circle of acquaintances and network. The questionnaire was open to participants from 12/16/2022 to 02/28/2023.

4.3.3.   3rd Quantitative Empirical Study

Based on the findings of the previously completed research, the next step was to conduct a study based on Lusardi Mitchell's (2011b, 2014) "Big Three" and "Big Five" questions, the Allianz/Lusardi survey (2017) questions on risk literacy as well as the OECD (2018) framework for financial literacy of entrepreneurs. The purpose of this study included the continued investigation of the impact of financial literacy on entrepreneurship, as well as a detailed analysis of the impact of financial literacy on entrepreneurial success. Technically, unless otherwise explained, this study is based on the procedure of study 2 presented in 4.3.2.

A more extensive questionnaire was used to address the limited significance of the level of financial literacy of the "Big Five" model that arose in study 2. For this purpose, in addition to the questions from study 2, the socio-demographic variables identified in the literature as particularly relevant were asked about migration background and economic schooling. Analogous to study 2, the query of these variables was oriented here to various studies on financial literacy (e.g., Ćumurović & Hyll, 2019; Lusardi & Mitchell, 2014). The formulation of these questions was based on the literature and the questions on the demographic standards of the Federal Statistical Office (Beckmann et al., 2016).

The level of financial literacy was queried in Study 3 using the "Big-Three" model by Lusardi and Mitchell (2011a) to include a model classified as a scientific standard and to allow comparison with other studies. The questions on inflation, compound interest, and mortgages cover basic financial concepts.

Only one question of the "Big Five" model (regarding mortgages) was selected due to the limitations mentioned in chapter 4.2 and to avoid an excessive number of questions. The focus here was on risk literacy as a significant factor in the literature and the previously conducted study. For this purpose, questions

from a study by Allianz and Lusardi (2017) on longevity risk, liquidity risk, and underdiversification risk were used. Further Questions from this study on expected value and lottery choice were added. A question on financial inclusion by Van Rooij et al. (2011a) was also integrated into the questionnaire. Similar to study 2, another question in the form of a self-assessment of one's attitude toward risk was adopted from a paper on risk measurement published by Falk et al. (2018).

Table 15 presents the knowledge questions included in the questionnaire and the self-assessment of personal risk attitude. Appendix 12 contains the entire questionnaire, including all questions.

Table 15. Questions related to FL and Self-Assessment on Risk (3rd Study)

No.	Question in Questionnaire	Scientific Foundation
1	Suppose you had 100€ in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?	**"Big Three"** Lusardi & Mitchell, 2011b
2	Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?	**"Big Three"** Lusardi & Mitchell, 2011b
3	Buying a single company's stock usually provides a safer return than a stock mutual fund. True or false?	**"Big Three"** Lusardi & Mitchell, 2011b
4	A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest	**"Big Five"** Lusardi & Mitchell, 2014

No.	Question in Questionnaire	Scientific Foundation
	paid over the life of the loan will be less.	
5	Which of the following statements is correct? If somebody buys the stock of firm B in the stock market:	**"Financial Inclusion"** Van Rooij et al., 2011a
6	For the same amount of money, you can enter either one of two lotteries: Lottery A pays a prize of €200 and the chance of winning is 5%. Lottery B: pays a prize of €90,000 and the chance of winning is 0.01%. If you do not win, you do not receive any money. Which lottery pays the higher average amount?	**"Expected Return"** **[Risk Literacy]** Allianz/Lusardi, 2017
7	You can invest in two projects. Project A will either deliver a return of 10% or 6% with either outcome equally likely. Project B will either deliver a return of 12% or 4% with either outcome equally likely. Which of the following is true? Compared to Project B, Project A has...	**"Risk & Return"** **[Risk Literacy]** Allianz/Lusardi, 2017
8	Over a long period of time (e.g., 10 or 20 years), which investment typically provides the highest return?	**"Expected Return"** **[Risk Literacy]** Allianz/Lusardi, 2017 [adjusted question]

No.	Question in Questionnaire	Scientific Foundation
9	Normally, which asset displays the highest fluctuations over time?	**"Risk & Return"** **[Risk Literacy]** Allianz/Lusardi, 2017 [adjusted question]
10	How do you assess yourself personally? Are you generally a risk-taker or do you try to avoid taking risks? Please tick a box on the scale, where the value 1 means "not at all willing to take risks" and the value 5 means "very willing to take risks".	Self-evaluation of Respondents on their own Risk Aversion (adopted from Falk et al., 2018)

Source: Own elaboration based on Allianz/Lusardi (2017), Falk et al. (2018), Lusardi & Mitchell (2011b), OECD (2018) and Van Rooij et al. (2011a).

The structure is based on the questionnaire used in study 2. In order to distinguish between entrepreneurs and private individuals, a conditional question on the employment relationship was added. Persons classified as entrepreneurs were also asked four additional questions on the variables year in which their company was founded, industry, number of employees and turnover in the previous calendar year. Other specifications were also adopted from the previously conducted study. For example, all questions on financial literacy, except self-assessment, have only one correct answer. In addition, the options "Don't know" and "Don't specify" are given. The option "Don't know" serves to try to reduce the risk of a coincidental guess and to avoid an answer based on the random principle.

The empirical investigation is based on the same procedure used in study 2, using an adapted version of the previously created Python data processing files. Missing values and NaN-values were again handled using the scikit-learnSimpleImputer and z-standardized using the scikit-learn StandardScaler (Pedregosa et al., 2011).

To perform the statistical analysis, as previously, the construct financial literacy was classified following Riepe et al. (2022) as the variable "High financial literacy", which has the value 1 if the financial literacy of the study participant is equal to or above the median and 0 for "Low financial literacy" if it is below the median. In addition, the classification based on the ISCED framework (van Rooij et al., 2012) was also used and classified into the educational groups of no vocational education, intermediate vocational education (ISCED level 3), higher vocational education (level 5) and higher education (level 6/7).

As in study 2, the independent variable financial literacy first predicts the dependent variable entrepreneur or self-employed/employee. Following comparable studies (Ćumurović & Hyll, 2019; Nicolini & Haupt, 2019), the socio-demographic data of the study participants are again considered as control variables in the regression equation (1), with i for the respective individual study participant. In this case, the variables gender, education, migration background, economic schooling, employment situation, and income are classified as dummy variables.

Equation 4. Formula of Logistic Regression (3ʳᵈ Study)

$$P\ (Entrepreneur) = \beta 0 + \beta 1 * FinancialLiteracy_i + \beta 2 * Age_i$$
$$+\ \beta 3 * Gender\_w_i + \beta 4 * MigrationBackground\_no_i + \beta 5 * KnowledgeDissemination_i$$
$$+\ \beta 6 * EconomicSchoolEducation\_no_i +\ \beta 7 * EmploymentSituation_i + \beta 8 * Income_i$$
$$+\ \beta 6 * Education\_ISCED\text{-}5_i + \beta 7 * Education\_ISCED\text{-}7_i\ + \beta 8 * Education\_noPT_i$$
$$+\ \beta 9 * SA_i\ + \varepsilon\,i$$

Source: Own presentation.

As before, the logistic regression was performed in Python based on the statsmodel API (Seabold et al., 2010). In order to avoid potential endogeneity problems in this study as well, the propensity score matching procedure presented in section 4.3.2 was subsequently performed using the causal inference API by Wong (2019). The identification of the backdoor variables followed the same principle here and is shown in Figure 29. The additional variables of *Migration Background* and *Economic School Education* influence the level of financial literacy, as shown by Hammer and Zureck (2022). The variable *Employment Situation* is

excluded from the propensity score matching as it does not fulfil the backdoor criterium.

Figure 29. Causal Diagram for Backdoor Variable Identification (3ʳᵈ Study)
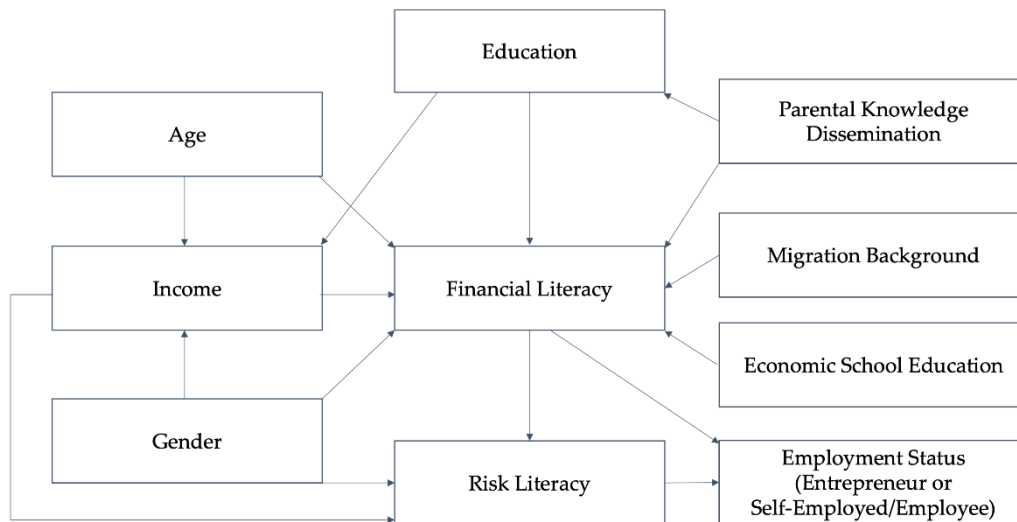
The calculated propensity scores are also applied to study 3 in order to subsequently examine the data using the Doubly-Robust method (Bang & Robins, 2005). This also provides a check on the robustness of the statistical results. In addition, as in study 2, balancing tests based on a two-tailed t-test is performed to examine the results in more detail (Girma & Görg, 2007; Brixiová et al., 2020).

To further examine the relationship between financial literacy and entrepreneurship, a detailed examination of the entrepreneur data is made to determine the influence of financial literacy on entrepreneurial success. The collected data about the foundation year of the participant's companies, industry, number of employees and turnover of the past calendar year are used to classify the entrepreneurs. The total monthly net income is used as a measurement for success and is compared to the individual participants financial literacy score to enable a detailed statement about the direct effect of financial literacy on entrepreneurial success. The spearman rank-order correlation coefficient is calculated to investigate this hypothesis (hypothesis 4). The participants classified as entrepreneurs are compared based on their financial literacy and monthly net

income. In this case, a positive correlation would imply that entrepreneurs with higher financial literacy have higher entrepreneurial success.

Following the difficulties encountered with the Lime Survey program in study 2, the empirio Survey program was used again in this study. As described above, this time, the survey was addressed via a direct mailing to 2.675 entrepreneurs or self-employed persons all over Germany. The questionnaire was open to participants from 03/15/2023 to 05/31/2023.

4.3.4.   Qualitative Research: Expert Interviews

The qualitative research is based on the Grounded Theory by Barney Glaser and Anselm Strauss (1998). The research style of Grounded Theory has an analysis of interviews as its objective. By using observations and complementary empirical data, a theory is established. For implementation, this means alternating data collection and analysis until there is no more new knowledge in the analysis (Flandorfer, 2018). For this purpose, all conducted interviews were recorded using a voice dictation app and subsequently transcribed. Two interviews were conducted with experts from the banking industry who had already worked in corporate and retail client advisory positions. Through literature research, a guideline was developed based on the research questions using the theoretical framework. This includes the structure and the questions collected, sequenced to build on each other and classified according to the topics, resulting in a structured interview. In the preparation, the possibility of formulating the questions as openly as possible was used so that follow-up questions were possible. This also allows for extensive and comprehensive answers from the interviewee. When selecting the experts, it was essential to consider the following criteria: The experts should be qualified professionals who have at least completed vocational training as a bank clerk and or studies in finance. The experts must have already looked after both private and corporate clients and have many years of experience in this field. In addition, they should have a basic knowledge of the topic of financial literacy in order to be able to classify the interview questions accordingly and answer them sufficiently. Consequently, a corporate client advisor and a bank branch manager of the Frankfurter Volksbank Rhein/Main eG were selected. The interviews were carried out on the branch office premises. In addition, the

questions always referred to the Corporate and Private Clients (CCs and PCs) general and were not personalised at either interview stage. The expert interviews are intended to provide a further, objective perspective on the following research questions and hypotheses. Since the financing of a business, often represented by bank financing, constitutes an important component for entrepreneurs and the self-employed, an assessment by these experts provided further insights beyond the quantitative empirical studies that have already been conducted. The following research questions and hypotheses were tested through expert interviews.

Table 16. Research Questions and Hypotheses related to the Expert Interviews

Research Questions (RQs) & Hypotheses (Hs) in Relation to Expert Interviews		
RQ1	*Can a scientifically valid measurement framework be developed to measure the financial literacy of entrepreneurs and the self-employed?*	
	Hypothesis 1	
	H_0	A scientifically valid measurement framework **cannot** be developed to measure the financial literacy of entrepreneurs and the self-employed.
	H_A	A scientifically valid measurement framework **can** be developed to measure the financial literacy of entrepreneurs and the self-employed.
RQ2	*Are there significant differences in financial literacy between entrepreneurs/self-employed and private individuals (employees)?*	
	Hypothesis 2	
	H_0	There are **no significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
	H_A	There **are significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).

Source: Own presentation.

Introduction of the Interview Experts

Financial literacy is a fundamental issue in the financial sector, especially in medium-sized banks such as cooperative banks. The core business in this banking segment consists primarily of advising retail customers. Therefore, it highly depends on the customer's financial literacy and the customer advisor's assessment. For this reason, experts from the customer advisory service of a cooperative bank were specifically consulted for the expert interviews. In customer business, a distinction is made between advisory services for corporate customers and advisory services for private customers. It is crucial to examine both sides to analyse the financial literacy between employees and entrepreneurs. For this reason, (banking) experts with experience in both areas were interviewed. Frankfurter Volksbank Rhein/Main eG was selected for the interviews. On the one hand, Frankfurter Volksbank Rhein/Main eG is the Volksbank with the most members in Germany and has the fourth-highest balance sheet total of all cooperative banks (BVR, 2022). On the other hand, Frankfurter Volksbank shows an increased commitment to financial literacy with its sustainability mission statement and its education portals, especially for young people (Frankfurter Volksbank Rhein/Main eG, 2023; additional information in the appendix).

Due to the official engagement and review of the interview guideline by the regional market management in cooperation with the Frankfurter Volksbank Rhein/Main eG, the interviews may be evaluated officially (but anonymously). The two expert interviews have been referred to as "Interview 1" and "Interview 2" to distinguish them. After consultation with the company, two experts were assigned as interview partners. In "Interview 1", Expert 1 (interview transcribed in the appendix) is a branch manager who has worked in the branch bank for 24 years. Although in the past she has dealt more with private clients (PC) than corporate clients (CC), as a branch manager, she is still responsible for both groups and has many years of experience. "Interview 2" is about Expert 2 (interview transcribed in the appendix), who has a banking diploma in corporate banking. Expert 2 has been working with private and corporate clients for many years.

Interview Procedure

For the interviews, a guideline with the targeted questions was first prepared and submitted to the Frankfurter Volksbank Rhein/Main eG supervisors for review prior to the interviews. After approval by Frankfurter Volksbank Rhein/Main eG, appointments were made with the experts to conduct the interviews. The bank permitted the interviews to be recorded and analysed for scientific purposes. The interviews were conducted on-site in the respective branches. The interview guide was sent to the participants in advance and the interviews were then conducted in a conference room at the bank. Before the interview and the recording, the participants were informed about the interview procedure. The questions from the guide included introductory questions on financial literacy and then built on specific topics such as customer risk management. In order to be able to analyse the interviews later on, the interviews were divided into categories. For this purpose, the interviews were categorised into seven thematic areas (analogous to the OECD financial literacy framework for entrepreneurs and self-employed persons), presented in Table 17 with an example.

Table 17. Results of Expert-Interviews related to FL and OECD-Framework

Category	Text Sample
Financial Literacy / Development	"We can also distinguish, for example, are there customers who deal with the topics and finances or do you not deal with it?"
Distinction CC and PC	"Where the corporate client also considers all the tax aspects, as it were, which is quite different with private clients."
Customer Preparation – „Using MACS"	"And most self-employed clients do manage to provide all the documents we need. This speeds up the whole process."
Financial Instruments	"So the more I know about the market, the exponentially more opportunities you have, of course."

Category	Text Sample
Financing Structures	"Yes, and when it comes to lending, he can also assess that much better."
Risk Management	"The customer is well aware that he has to cover different risks and he is prepared to do so."
Digital Affinity	"Definitely yes. And this showed us not only during the pandemic period, but this was already the case before, that these customers were more willing to make cashless payments at times, or to use credit cards to make their payments before."

Source: Own presentation.

Interview Evaluation

The interviews aim to corroborate the results of the quantitative surveys with qualitative statements from a bank's customer advisory service. The research relates to whether entrepreneurs and the self-employed already enter into investment discussions with a higher financial literacy than employees/private individuals. The comparison of the two groups of people is scientifically relevant to the research questions and hypotheses posed. After the interviews were previously assigned to the knowledge categories of the OECD framework, the evaluation was carried out for each of these categories of the OECD framework.

V – RESULTS

V - RESULTS

Over the course of the research in this doctoral thesis, the empirical procedures were steadily improved and several waves of research were conducted. In particular, the quantitative empirical research was tested for static significance with a total of 3 surveys in relation to factors influencing financial literacy already established in existing research. Further, statistical significances proving a relation between financial literacy and entrepreneurship were tested. To complement the quantitative empirical research, expert interviews were held with the so-called financing side of entrepreneurship – with bank decision-makers. After each of the research studies is conducted, a comparison is made for significance to the existing research findings. In a scientifically correct approach, the limitations of the respective research and its results are discussed and possible biases are highlighted.

5.1. RESULTS OF THE 1ST QUANTITATIVE RESEARCH STUDY

5.1.1. Descriptive Statistics

A total of 350 people participated in the first survey. 55 of these were excluded due to not having an employment relationship and were therefore irrelevant for further empirical analysis. The number of participants was cleaned up for these respondents. A broad distribution can be observed starting with the question about the participants' age. The distributions among the four age categories, from Table 18, are very close, with the lowest proportion of 22.4% (18-25 years) to the highest proportion of 28.8% (36-50 years).

Table 18. Distribution of Ages (1st Study)

Age	n	%	Cumulative %
> 50 years	75	25.4	25.4
18 - 25 years	66	22.4	47.8
26 - 35 years	68	23.1	70.8
36 - 50 years	85	28.8	99.7
No answer	1	.3	100.0
Σ	**295**	**100.0**	

Source: Own illustration with SPSS.

Regarding the demographic gender question, the proportion of male respondents (202) significantly exceeds the proportion of female respondents (93). This disparate distribution can be explained by the fact that the survey was shared via LinkedIn, where 61.9% of users are male (Statista, 2020). Additionally, the survey was shared within the primarily male network community, but the disparate distribution is still very significant and therefore limits the scientific validity of the survey.

Table 19. Gender Distribution (1st Study)

Gender	n	%	Cumulative %
Male	202	68.5	68.5
Female	93	31.5	100.0
Σ	**295**	**100.0**	

Source: Own illustration with SPSS.

Regarding the highest level of education, 65.8% of participants had a bachelor's degree or higher. It is also notable in this survey that none of the participants has no degree and only five have a secondary education certificate. This may also be attributed to one's circle of contacts since this is characterised by

family, university and profession and consequently involves participants with higher educational degrees. It can also be deduced from this that the members on LinkedIn also have higher educational levels.

Table 20. Distribution by Educational Level (1st Study)

Educational Level	n	%	Cumulative %
High School Diploma or equivalent (Entrance Qualification for Studies at Universities of Applied Sciences)	58	19.7	19.7
Bachelor Degree	74	25.1	44.7
Certificate of Secondary Education	5	1.7	46.4
Master´s Degree earlier equivalent Degree (Diploma, Magister)	86	29.2	75.6
Doctorate/Ph.D.	34	11.5	87.1
Secondary School Diploma	38	12.9	100.0
Σ	295	100.0	

Source: Own illustration with SPSS.

The analysis below provides information on the respondents' self-assessment of how they perceived financial education by their parents. Mean values were calculated to represent the average for the respective category. The standard deviation shows the extent to which the participants differ in their assessment – a high degree of dispersion in the assessment results in a higher standard deviation.

The self-assessment of how well one's parents educated one is shown in connection with age (scale of 1 - 10) in Table 21. The result shows that people between 18 and 25 feel best financially enlightened by their parents. This mean value continues to decrease as age increases. Among people over 50, the value is then only 5.07. In addition, the standard deviation in comparing these two age groups is significantly different, at 2.24 and 2.77. The younger people's assessments are thus significantly lower than those of their parents. Thus, the assessments of the younger persons are closer together and are more meaningful. In contrast, the assessments of the persons over 50 years are more dispersed and

have more significant differences. Fundamentally, however, it can be assumed based on this evaluation that dealing with finances is becoming an increasingly important topic within the family over time, and it can be seen that younger people today are being financially educated at an earlier age.

Table 21. Financial Education by the Parents (1st Study)

Age	n	Mean	Standard Deviation
18 - 25 years	66	6.24	2.24
26 - 35 years	68	5.34	2.56
36 - 50 years	85	5.48	2.98
> 50 years	75	5.07	2.77
no answer	1	.	.
Σ	295	5.52	2.69

Source: Own illustration with SPSS.

In the following figure, the mean values from the question of how well the participants had been personally informed about finances by their parents are combined with the respective income levels. The respondents' income distribution shows that most participants earn between 2,001€ and 5,000€ per month with a frequency of 141 (295). The increased number of people earning more than 10,000€ per month is related to research focused on entrepreneurs, as 46 of the 51 participants in this highest income group are entrepreneurs. One surprising fact is that the 37 people who earn less than 2,001€ assume better financial education from their parents than the 141 people who earn between 2,001 and 5,000€. If we include here the age of the participants who earn less than 2,001, it turns out that the proportion of young people between 18 and 25 years is very high at 59.5%. Thus, the result can also be explained by Table 21, as young people feel better informed by their parents on the subject of financial literacy than older people. Notably, the standard deviation is increased for the highest and lowest incomes. This means a wide gap exists between assessing people with low and exceptionally high incomes.

Table 22. Financial Education by Parents vs. Income Level (1ˢᵗ Study)

Monthly Net Income	Mean	n	Standard Deviation
No Income	7.00	2	,000
450 – 1.000€	5.75	8	3.240
1.001 - 2.000€	5.69	29	2.002
2.001 - 5.000€	5.16	141	2.578
5.001 - 10.000€	5.70	64	2.747
> 10.000€	6.12	51	3.154
Σ	5.52	295	2.694

Source: Own illustration with SPSS.

The total of 295 participants is split into 103 entrepreneurs and 192 employees. The high number of entrepreneurs about the number of participants can be explained by the targeted search for participants from this group to obtain the most significant analysis possible. In Table 23, these groups of persons are shown together with the assessment of the education by parents about finances. Here, employees obtained a mean score of 5.41, compared to 5.73 in the entrepreneurs' group. It can thus be stated that entrepreneurs generally consider themselves to be slightly better informed by their parents than employees.

Table 23. Financial Education by the Parents vs. Employment Status (1ˢᵗ Study)

Employment Status	Mean	n	Standard Deviation
Employees	5.41	192	2.577
Entrepreneur/Self-employed	5.73	103	2.901
Σ	5.52	295	2.694

Source: Own illustration with SPSS.

Two questions were asked regarding the participants' school years. First, whether the person had already worked or completed internships during their school years. Second, whether the participants had a business subject in school. For analysis purposes, the questions were coded in such a way that "Yes" was represented as "1" and "No" as "0". This shows that most people had both an

economics class at school and had already worked during their time at school. The number of persons to whom this applies is 133, with additional analysis indicating that 57.6% of persons between 18 and 25 answered both questions with yes. An equally high correlation, with 102 persons, exists between the statements that the person had no economic subject but already worked. To this group belong 30.4% of the persons in the age of over 50 years. A relationship exists rarely with persons who had economics in school but did not work. In this case, the analysis shows only 18 cases. Due to the lack of correlation and the small number of participants, who neither had an economics class at school nor had worked during their school years, it is not scientifically valid to extrapolate from this.

The survey then focused exclusively on entrepreneurs in their industry, asking them about their key business figures to determine how much a well-diversified cross-section can be represented. Overall, 29% of the entrepreneurs surveyed came from an entrepreneurial family and had already experienced entrepreneurship in their parental home. Table 24 shows that people from various industries participated in the survey. However, a large number of respondents are from management consulting, while just 2 people are in the restaurant industry. Overall, the analysis shows that a widely diversified range of large and small companies from diverse industries were represented in the survey. This ensures that the data collected represents people working as self-employed or entrepreneurs in Germany and that a comparison can be made with employees.

Table 24. Sector Distribution of Entrepreneurs and Self-employed (1ˢᵗ Study)

Sector	Annual Revenue in Mio. €	Number of Employees	Background of an entrepreneurial Family	n
Management Consulting	4.0	16.7	29%	21
Trade and Commerce	10.1	23.8	31%	16
IT (Information Technology)	4.7	56.0	30%	10
Banking and Financial Services	7.2	37.0	20%	10
Real Estate Industry	16.9	61.7	50%	6
Automotive and Engineering Industry	12.8	25.8	33%	6
Healthcare/Social Services	2.4	17.5	75%	4
Electronics Industry	21.2	111.7	0%	3
Gastronomy	30.0	150.0	0%	2
other Industry	9.2	28.6	24%	25
Σ				**103**

Source: Own illustration with SPSS.

The final part of the survey comprises the questions designed to capture the participant's financial literacy. For this purpose, questions from previous scientific studies were chosen to make the results comparable. The nine questions cover interest rates, diversification, inflation, risk assessment, and risk and return. The answers have been coded "True=1" and "False=0" in the evaluation. This makes it possible to calculate mean values and to analyse the questions more precisely. Consequently, the average values formed in the following are the same as the percentage of how many people answered the respective questions correctly. In the evaluation, the participants summed up the correct answers to the financial questions to determine how many questions the participants answered properly. This resulted in a mean value of 7.57/9 for all 295 participants. In other words, 84.1% of the participants answered the finance questions accurately.

First, the results of the finance questions were related to whether the participant had economics or a similar class in school. Individuals with an economics subject in school answered an average of 7.76 of the nine questions accurately. At the same time, individuals who did not have an economics subject answered 7.36 questions properly on average. Figure 36 lists the individual means of correctly answered questions in a bar chart grouped by the subject question. A more detailed evaluation demonstrates that knowledge of inflation does not depend on whether one had an economics class at school. This is because 92% of those to whom this applies answered the questions on inflation correctly, while 94% of those to whom it does not apply answered correctly. Thus, there are no significant differences in the question of inflation. This can be attributed to the fact that the inflation issue is currently present in all media (due to high inflation rates). On the other hand, the result of the questions on the interest rate and diversification is significant. Here the persons with an economics class achieved a result of 93% in each case and the persons without this school education only 85% and 83%. For the questions on risk and return as well as expected return, respondents with an economics class in school achieved 71.5% correct answers overall compared to only 63% correct answers without an economics subject in school. It should be noted, at this point, that these questions are financial questions, but require a higher level of basic mathematical understanding. There is a correlation between the result and higher school education. People who stated "Hauptschule" as their highest level of education only answered the two questions correctly 40% on average. At the same time, participants with a high school diploma as the highest educational qualification achieved a result of 61%.

Figure 30. FL Questions and School Subject "Economics" (1ˢᵗ Study)
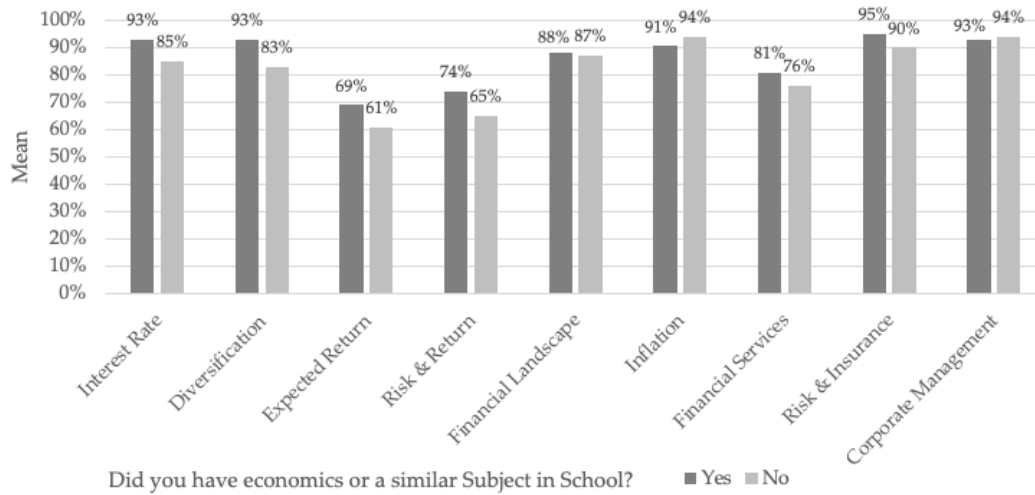
Source: Own illustration by author.

Table 25 illustrates the number of questions on financial literacy answered correctly concerning the participant's income. There is a correlation between financial literacy and income, as the average number of correct answers increases with monthly income. For example, people with an income of €1,001 to €2,000 answered 6.79 of nine questions correctly on average, which equates to 75.4%. In comparison, people with an income of between €5,001 and €10,000 answered 7.86 or 87.3% of the questions correctly. Thus, there is a difference of 11.9% between the two groups of people in the income classes. The standard deviation, which indicates the average distance of all participants from the calculated mean, shows a greater spread of correct answers among the groups of people with very high and low incomes. The number of correct answers, on the other hand, is closer together for people with incomes between €2,001 and €10,000. Nevertheless, the differences in the standard deviation are within a moderate range. Due to the steady increase in the mean paired with rising income, it is possible to derive from Table 25 a significant correlation.

Table 25. Relationship between Financial Literacy and Income (1ˢᵗ Study)

Monthly Net Income	Mean of correct answered FL Questions	n	Standard Deviation
No Income	6.00	2	1.414
450 – 1.000€	6.50	8	1.773
1.001 - 2.000€	6.79	29	1.878
2.001 - 5.000€	7.50	141	1.620
5.001 - 10.000€	7.86	64	1.531
> 10.000€	8.04	51	1.843
Σ	7.57	295	1.707

Source: Own illustration with SPSS.

Finally, for presenting the survey results to answer the research questions, the correct response rates are grouped by employment in Table 26 and by the financial questions in Figure 31. Since answers from people without employment are filtered out at the beginning, the results of entrepreneurs and employees are consequently compared. Generally, both groups performed well, with over 80% correct answers. Table 26 shows that employees achieved a worse result at 81.8% compared to entrepreneurs with 88.2%.

In Figure 31, the percentage of correct answers are specified in order to identify differences in the topic areas and to investigate the overall difference from Table 26. Both groups of participants are highly certain about the inflation and risk assessment questions, with over 90% correct answers in both cases. Deviations can be identified in the interest rate and risk/return questions. 88% of employees and 93% of entrepreneurs understand the compound interest effect. The most significant difference is in the question, "You can invest in two projects. Project A will yield either a 10% or 6% return, with both outcomes equally likely. Project B will yield either a 12% or 4% return, with both outcomes equally likely. Which of the following statements is correct?". In this case, entrepreneurs scored the question 83% correct, while the employee group only scored 63%. The statement from the financial landscape area, "A company pays dividends to a bank to settle

a loan" was declared false by 94% of the entrepreneurs. In comparison, employees answered it in the negative by 84%. Regarding the question about loan terms and the resulting compound interest effect, there are also recognisable differences among respondents in the different employment groups. For example, 83% of entrepreneurs know that a shorter borrowing term results in higher monthly instalments, but less total interest has to be paid. In contrast to entrepreneurs, only 76% of employees can answer these questions correctly or understand this fact correctly.

Noticeable and scientifically relevant for both groups, employees and entrepreneurs, is that the correct answers to the risk questions and the risk/return questions were significantly worse overall compared to the standard financial literacy questions ("Big Three").

Table 26. Financial Literacy by Employment Relationship (1ˢᵗ Study)

Employment Relationship	%	n
Employees	81.8	192
Entrepreneur/Self-employed	88.2	103
Σ	**84.1**	**295**

Source: Own illustration with SPSS.

The following figure provides details on the individual questions on financial and risk literacy and compares the results of entrepreneurs/self-employed persons with those of employees/private persons. The financial literacy of the entrepreneurs and self-employed persons surveyed in the first study is higher than that of employees/private persons.

Figure 31. FL Comparison Entrepreneurs vs. Employees (1ˢᵗ Study)
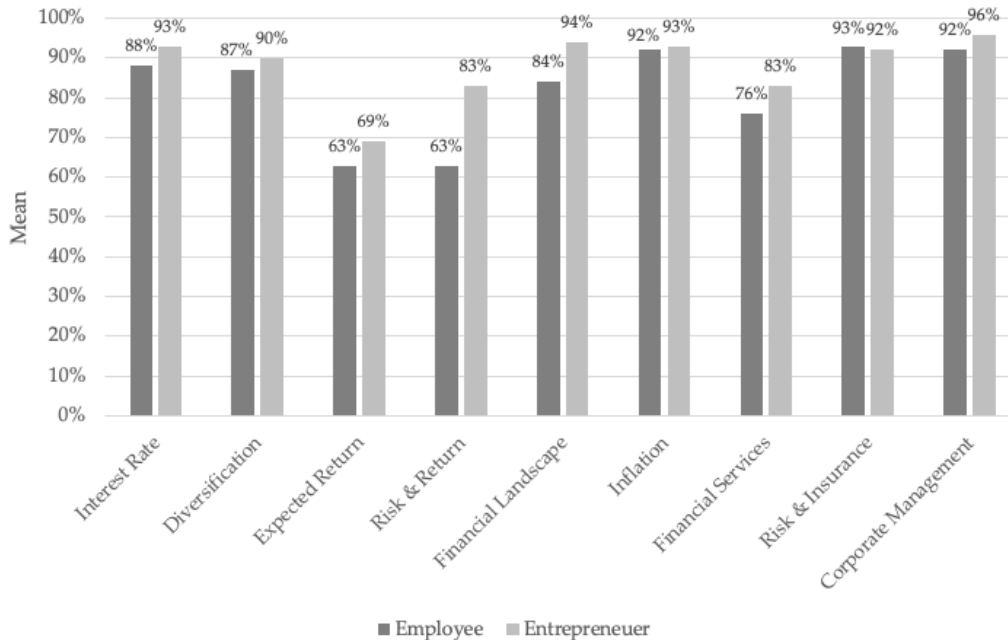
Comparison of Study Results with OECD and Allianz/Lusardi Surveys

In order to classify the survey concerning the current state of research on financial literacy in Germany, the survey results will be compared with the results of the Allianz/Lusardi and OECD surveys, which have already been discussed in the theory section. A comparison is significant since the surveys cover the same areas and contain the same questions.

Table 27 maps the questions of the "Big Three" and risk literacy. Comparing the correct answers in percentages for the two surveys, it is evident that participants in the survey conducted for this thesis performed significantly better. The interest rate question had a difference of less than 10%. For the question regarding inflation, the difference is the largest at over 30%. The same trend continues for all questions, with our survey having a spread of correct answers of about 27%. On the other hand, the Allianz/Lusardi survey has a spread of almost 40% due to the particularly weak performance in the area of "Expected Return" and very good performance in the area of "Interest Rate". Overall, the survey

participants of the Allianz/Lusardi survey performed worse in all areas compared to this (own) 1st Study.

Table 27. Comparison of 1st Study Results with Allianz/Lusardi Survey

Survey	Interest Rate	Diversification	Inflation	Risk & Return	Expected Return
1st Thesis Study	**89.5%**	**88.1%**	**92.2%**	**69.8%**	**65.1%**
Allianz/Lusardi (2017)	81.6%	73.4%	59.9%	58.0%	42.0%

Source: Own presentation based on 1st Study Results and Allianz/Lusardi (2017).

In comparison with the results of the OECD/INFE survey, the difference in financial and risk literacy is much less significant than in comparison with the Allianz/Lusardi survey. Overall, however, respondents to our 1st Study tend to perform better than those surveyed by OECD/INFE. The question on "Corporate Management" was answered correctly by 92.2% of respondents in our 1st Study, compared with only 85.9% in the OECD/INFE survey. The "Risk and Insurance" and "Financial Landscape" questions follow the same trend. Financial Services is the only question on which the OECD/INFE respondents outperformed the participants of this thesis study.

Table 28. Comparison of 1st Study Results with OECD/INFE Survey

Survey	Financial Services	Corporate Management	Risk and Insurance	Financial Landscape
1st Thesis Study	**87.5%**	**92.2%**	**92.6%**	**93.6%**
OECD/INFE (2020)	91.5%	85.9%	80.2%	85.2%

Source: Own presentation based on 1st Study Results and OECD/INFE (2020).

In summary, the respondents of the self-administered 1st study performed better than the Allianz/Lusardi and the OECD/INFE survey respondents. The differences are particularly pronounced compared to the Allianz/Lusardi survey, while the OECD/INFE comparative scores are much closer. One reason could be that the Allianz/Lusardi survey was conducted in 2017. This would indicate that the level of financial literacy has been on the rise in recent years. However, it can be concluded that the participants in our survey have a higher level of financial

literacy. This could be due to the social environment and the circle of respondents (own personal network).

The generally above-average level of education of the respondents also is in line with a significantly positive correlation between education level and financial literacy, which has already been demonstrated in several academic studies (Bachmann, 2021; Lusardi & Mitchell, 2014; Stolper & Walter, 2017). Overall, the results of the first survey also show a higher level of risk literacy among entrepreneurs. The survey is also in line with the assumption that a high level of financial literacy among entrepreneurs also leads to better results in the categories of the OECD Framework for entrepreneurs and the self-employed.

5.1.2.   Statistical Analysis

Financial literacy, as shown in Table 29, presents the results of the logistic regression based on the presented regression equation in 4.3.1. The significance level is set at 5%. The positive coefficient for financial literacy in row 1 has a significant p-value of 0.05, which suggests a positive influence of a higher level of financial literacy on the probability of being an entrepreneur. The pseudo R2 value for the regression performed is 2.6%.

Table 29. Logistic Regression Results (1ˢᵗ Study)

Logistic Regression Results Study 1				
Variable	**Coefficient**	**Std. Error**	**z**	**p > |z|**
Financial Literacy	0.045	0.016	0.161	0.005

Note: The significance level used is 5%. Source: Own calculations by the author based on SPSS.

The sample size of study 1 is comparably large, but effects of socio-demographic variables are not considered which will be further discussed in the limitations section. Figure 32 shows the confusion matrix for the logistic regression of study 2. As it can be seen, 70 instances were correctly classified as the Negative class (True Negative), 81 instances were correctly classified as the Positive class (True Positive), 113 instances were mistakenly classified as the Positive class (False Positive) and 22 instances were mistakenly classified as the Negative class (False Negative). To evaluate the model's performance, the AUC (Area Under the Curve)

is determined. Its comparably low value of 0.6170 indicates that the model has a moderate discriminative ability. The ratio of correctly grouped cases is also comparably low with 54.20%.

Figure 32. Confusion Matrix logistic Regression (1st Study)

Confusion Matrix		Actual Values	
		Positive	**Negative**
Predicted Values	**Positive**	*True Positve 81*	*False Positive 113*
	Negative	*False Negative 22*	*True Negative 70*

Source: Own calculations by the author based on SPSS.

5.1.3.   Hypotheses Testing

Finally, the research questions and hypotheses must be placed to the empirical results. The answers to the research questions and hypothesis are presented in Table 30.

Table 30. Overview Hypotheses Testing – 1st Study

Research Questions (RQ) & Hypotheses (H) – 1st Study		
RQ1	*Can a scientifically valid measurement framework be developed to measure the financial literacy of entrepreneurs and the self-employed?*	
	Hypothesis 1	
	H_A	A scientifically valid measurement framework **can** be developed to measure the financial literacy of entrepreneurs and the self-employed.
Result	The empirical results of the 1st study and the questions used in the survey, which referred to questions frequently used in academia (in empirical studies), provide valid results for measuring financial literacy of entrepreneurs and the self-employed.	
RQ2	*Are there significant differences in financial literacy between entrepreneurs/self-employed and private individuals (employees)?*	
	Hypothesis 2	
	H_A	There **are significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
Result	The 1st study measured the level of financial literacy of entrepreneurs and the self-employed and compared this to private individuals/employees. Overall, the entrepreneurs surveyed in the 1st study had a (significant) higher financial and risk literacy level than private individuals/employees.	
RQ3	*Is there a significantly positive correlation between financial literacy and entrepreneur-ship/self-employment?*	
	Hypothesis 3	
	H_A	There is **a significantly positive correlation** between financial literacy and entrepreneurship/self-employment.
Result	In the 1st study, logistic regression was used to examine the correlation of financial literacy and entrepreneurship/self-employment. The results are	

Research Questions (RQ) & Hypotheses (H) – 1st Study		
	statistically significant for the 1st study. However, the restriction must be made that only one variable was used in the logistic regression and the socio-demographic factors were not included as variables here. Under this restriction, the hypothesis is in line for the 1st study.	
RQ4	*Is there a significantly positive correlation between financial literacy and business success of entrepreneurs/self-employed?*	
	Hypothesis 4	
	H0	There is **no significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.
	HA	There is **a significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.
Result	**H4 out of Scope for the 1st study.**	

Source: Own presentation.

5.2. RESULTS OF THE 2ND QUANTITATIVE RESEARCH STUDY

5.2.1. Descriptive Statistics

At the end of the questionnaire period, the total number of participants was 174. A total of 127 people completed the questionnaire. Among the 127 complete results are 48 entrepreneurs (37.80%) and 79 employees (62.20%). Among the participants there are also 48 women and 79 men. It should be noted that within the group of entrepreneurs, there are only 11 women, corresponding to a rate of 24.45%. In the group of employees, the proportion of women is 45.84%. The following Table 31 shows the characteristics of the respondents in detail.

Table 31. Sample Characteristics (2ⁿᵈ Study)

Sample characteristics					
Variable	N	Mean	Std. Dev.	Min.	Max.
Financial Literacy	127	0.81	0.19	0.2	1
Gender_ Female	127			0	1
Age	121	38.19	13.52	16	70
Knowledge Dissemination	127	4.76	2.24	1	10
Income	94	3815.05	4454.72	0	40.0000
Risk	127	5.57	2.44	0	10
Entrepreneur	127	0.38	0.49	0	1

Note: This table shows the sample characteristics. The variable female takes the value 1 if the study participant is female, otherwise it is equal to 0. The procedure is analogous for the variable entrepreneur. If the value is 1, it is an entrepreneur; if it is an employee, the variable takes the value 0. Due to missing values, the sample size varies for the different socio-demographic variables. Source: Illustration by the author based on own Python analysis.

Overall, the self-assessment responses on the topic of risk were classified as low (0-2), medium (3-7) and high (8-10), following Ćumurović and Hyll (2019) and studies on risk attitude and entrepreneurship (Caliendo et al., 2009). However, in this study, risk attitudes are used as a numerical variable and the classification is only used for robustness checks. In addition, consistent with existing research (e.g., van Rooij et al., 2012), the recorded values for education were classified into four groups according to the International Standard Classification of Education (ISCED) framework: Intermediate vocational education (ISCED level 3), higher vocational

education (level 5), tertiary education (level 6/7), and a fourth group that includes no vocational education and other vocational education. The following Table 32 shows the distribution of responses for all socio-demographic variables. Furthermore, as previously mentioned, the data for age and income is presented in different classes to get a better overview of the data distribution.

Table 32. Demographics, Risk and Knowledge Dissemination (2nd Study)

	Employees	Entrepreneurs	Total
Number of Survey Participants	*79*	*48*	*127*
Number of female Survey Participants	*37*	*11*	*48*
Number of male Survey Participants	*42*	*37*	*79*
Age			
16-34 years	*42*	*14*	*56*
35-44 years	*11*	*12*	*23*
45-54 years	*10*	*10*	*20*
55-64 years	*9*	*8*	*17*
>64 years	*1*	*2*	*3*
Education			
No Vocational Education	*8*	*0*	*8*
ISCED 3 – Intermediate Vocational Education	*16*	*5*	*21*
ISCED 5 – Higher Vocational Education	*7*	*4*	*11*
ISCED 7 – Tertiary Education	*48*	*39*	*87*
Income			
0 – 1.000 €	*13*	*1*	*14*
> 1.000 – 2.500 €	*21*	*3*	*24*
> 2.500 – 5.000 €	*23*	*16*	*39*

	Employees	Entrepreneurs	Total
> 5.000 – 7.500 €	2	4	6
> 7.500 – 10.000 €	0	8	8
>10.000€	0	1	1
Self-Assessment Risk			
Low (0-2)	13	3	16
Medium (3-7)	53	25	78
High (8-10)	12	19	31
Knowledge Dissemination			
Low (0-2)	20	4	24
Medium (3-7)	52	36	88
High (8-10)	7	8	15

Source: Illustration by the author based on Python analysis.

Before the Regression and Matching analysis is conducted, the survey results are evaluated using descriptive statistics. The financial literacy questions differ in complexity, which is reflected in the proportion of correct answers. All statistical and graphical analyses described below were produced using Python and Excel. In line with other studies (e.g., Bucher-Koenen and Lusardi, 2011), the proportion of correct answers decreases continuously with the complexity of the questions.

The study participants always answered at least one of the "Big Five" knowledge questions correctly. **Questions 1 and 2** on interest rates and inflation were answered correctly by almost all participants (96.85% and 93.70%). The analysis shows no significant differences between the groups of employees and entrepreneurs. It should be emphasised that question 2 on inflation, with 93% correct answers, was answered significantly better than other studies based on the "Big Three" and "Big Five" questions for Germany and in an international comparison. One possible reason is the sharp rise in inflation in Germany since mid-2022.

Question 3 on bond prices was answered correctly by only 54.33% of respondents, although it is remarkable that only 45.65% of female respondents answered this question correctly, compared to 58.1% of male respondents. It is also notable that entrepreneurs achieved a correct rate of 71.73%. Gender differences can also be found within the group of entrepreneurs. For example, 74.29% of male entrepreneurs achieved the correct answer, while only 63.64% of female entrepreneurs could do so. For this question, the number of participants who chose the "don't know" option was extraordinarily high (18.11%) compared to the other questions, where the average rate of "don't know" answers was between 0 and 10%.

Question 4 on the mortgage duration again shows a difference between female (63.04%) and male (75.67%) participants, with a correct rate of 70.87%. The entrepreneur's group achieved a comparable rate of 71.74%, with almost no gender difference. **Question 5** on the return on equity funds was answered correctly by almost all participants (88.19%). As with the other questions, however, male respondents performed better here. In this case, there are no significant differences between the survey groups of entrepreneurs and employees.

The results show no significant differences when comparing the two groups of respondents, entrepreneurs and employees. Looking at the overall assessment, there are notable differences between the two groups regarding gender. Figure 33 shows the percentage of correct answers by gender and employment status (entrepreneur/employee) for all five financial literacy questions.

Figure 33. "Big Five" Results by Employment Status and Gender (2ⁿᵈ Study)
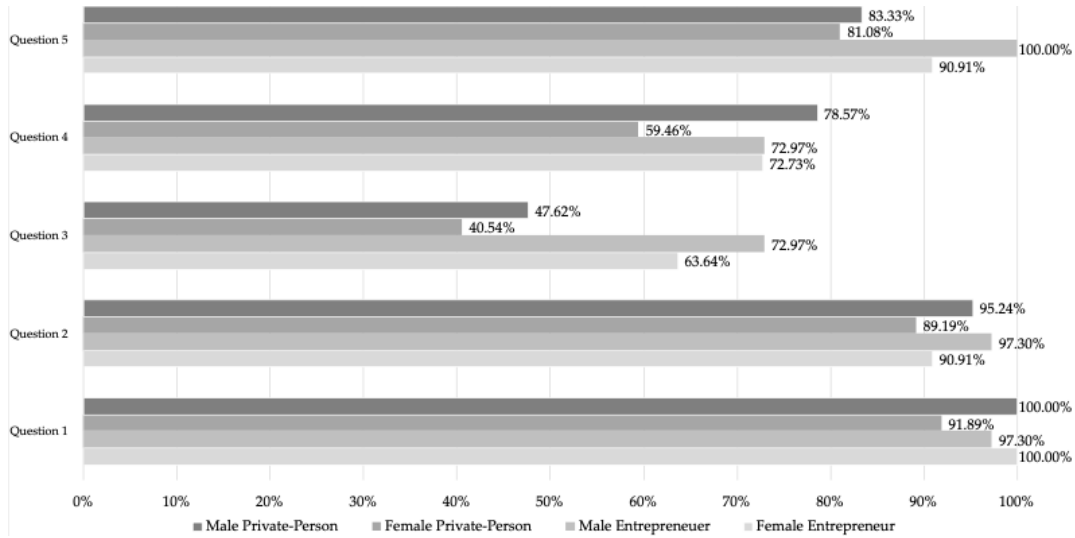
On a scale of 0 to 1 for correct answers to the financial literacy questions, female respondents score an average of 0.75, while male respondents score an average of 0.84. Female entrepreneurs score an average of 0.84, while male entrepreneurs score 0.88. This is slightly higher than female non-entrepreneurs (0.72) and male non-entrepreneurs (0.81). Figure 34 illustrates this distribution for the study groups.

Figure 34. Average Financial Literacy of the Survey Participants (2ⁿᵈ Study)
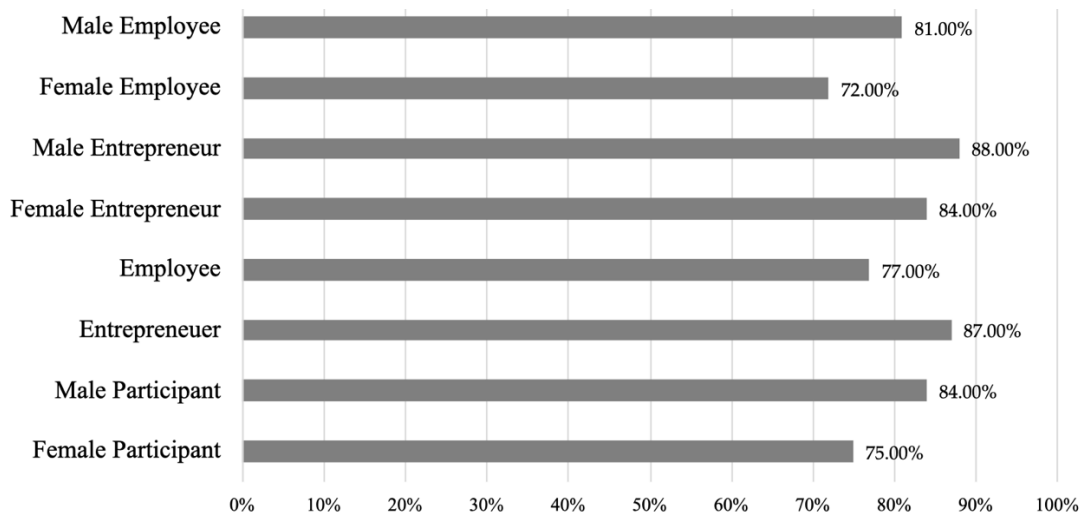
Based on dividing the groups into financially highly literate and financially less literate participants based on the mean threshold (following Riepe et al., 2022), **43.04% of all male participants** are considered financially literate, but **only 27.08% of all female participants**. However, this relatively low proportion is due to the comparatively good results of the study participants and the resulting high mean threshold as a basis for evaluation.

In Germany, more than 50% of respondents in financial literacy studies scored correctly on the questions of the Lusardi Mitchell model of the "Big Three" (Bucher-Koenen & Lusardi, 2011). Consistent with Lusardi and Mitchell (2014) and Klapper et al. (2015), there is a clear gender gap in financial literacy. On average, men score 16% higher than women on this paper's two financial literacy questions, similar to the study conducted by Lusardi in collaboration with Allianz (2017). It should be noted, however, that the findings of these studies are primarily based on Lusardi and Mitchell's "Big Three" model and therefore cannot be directly applied to the findings of this survey/assessment (which is based on the "Big Five" model). In contrast to the findings from research on individuals, there is no evidence from existing research of differences between entrepreneurs and entrepreneurship. Figure 35 shows the distribution of mean scores by entrepreneur/non-entrepreneur status and gender.

Figure 35. Study Participants with high Financial Literacy (2ⁿᵈ Study)
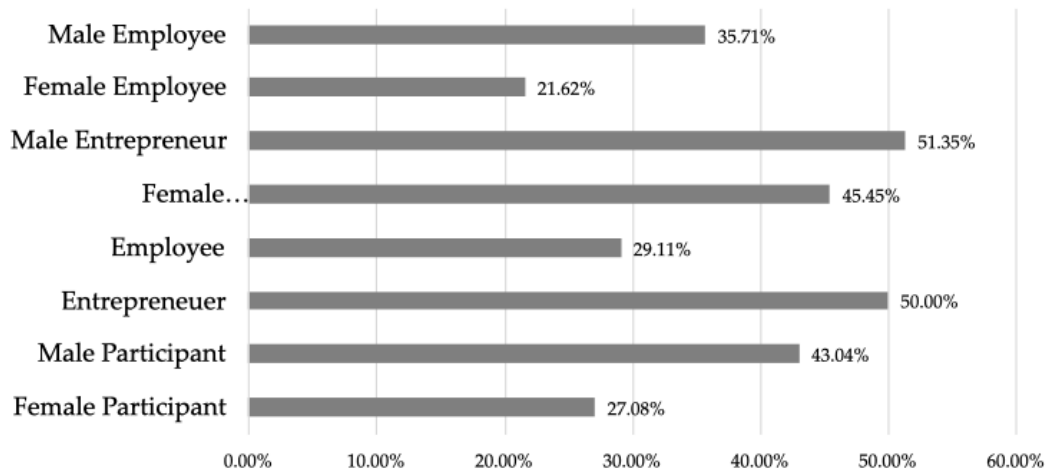
Note: Using the mean value, the chart shows the percentages of participants classified as financially literate according to Riepe et al. (2022). Source: Illustration by the author based on Python analysis.

The study participants' self-assessment of their attitude to risk reveals that female participants scored lower on average (4.85) than male participants (6.32). On average, entrepreneurs gave only a slightly higher, scientifically insignificant score to their willingness to take risks (6.04) than non-entrepreneurs (5.14). The analysis of the survey results also indicates a correlation known from research. Individuals with the highest level of financial literacy have the highest risk attitude scores. Hallahan et al. (2004) and Hsiao and Tsai (2018) found that financial literacy reduces risk aversion or increases the acceptable risk threshold in their scientific results.

This difference is shown to be much more pronounced for entrepreneurs, which is in line with Liu et al. (2020), who showed that managers with higher financial literacy have a good understanding of the impact of risk, so they have a greater financial risk tolerance in terms of financing innovative activities. The results are also in line with the strong relationship between risk attitude and financial literacy found by Riepe et al. (2022). Overall, entrepreneurs are found to be more risk-averse than employees. In the research, it was noticeable that high scores in the area of low financial literacy were shown for employees and female participants. Figure 36 shows the self-assessment scores on risk and the scores achieved on the financial literacy knowledge questions by the study group.

Figure 36. Risk Attitude Self-Assessment vs. "Big Five" FL Score (2ⁿᵈ Study)
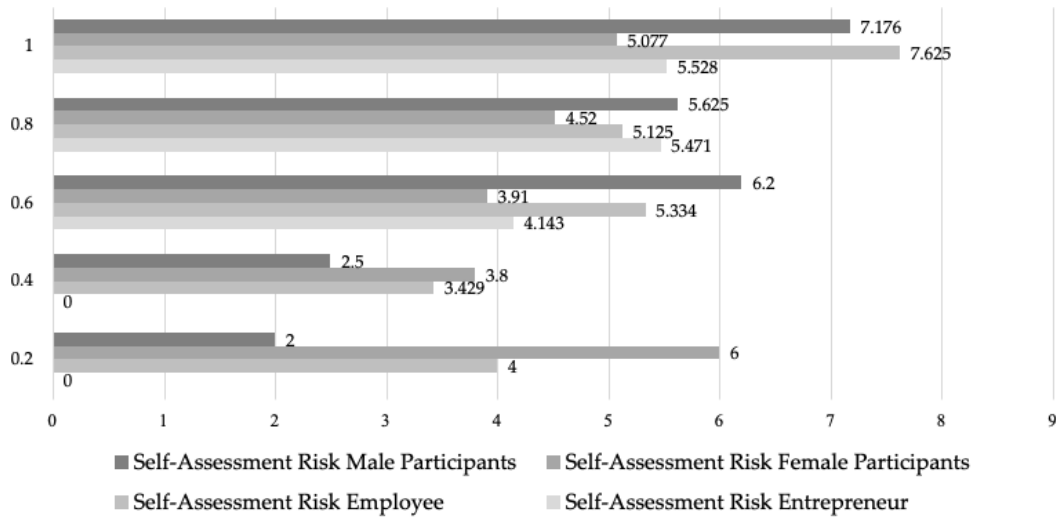
Note: The values 0.2 to 1 represent the respective number of correct answers achieved, with 0.2 for one correct answer and 1 for 5 correct answers. For the study group entrepreneurs, no data are available in the group financial education score 0.2 and 0.4, as no results were obtained in this group. Source: Illustration by the author based on Python analysis.

The analysis of the socio-demographic variables provides further scientifically relevant findings. The educational level of the participants in the study is a significant factor in this context. 70.73% of the participants have an academic education, whereby the value for male respondents with an academic education (69.62%) is slightly lower than the comparable value for female respondents (72.73%). It is also noticeable that almost all entrepreneurs have a high education level. **For example, 81.25% of the entrepreneurs have at least a bachelor's degree and only 10.42% have an apprenticeship or comparable job training**. Overall, it has to be mentioned that all participants in the study have a comparably high level of education. Figure 37 shows the breakdown of participants by gender and education.

Figure 37. Educational Level by Gender and Employment Status (2nd Study)
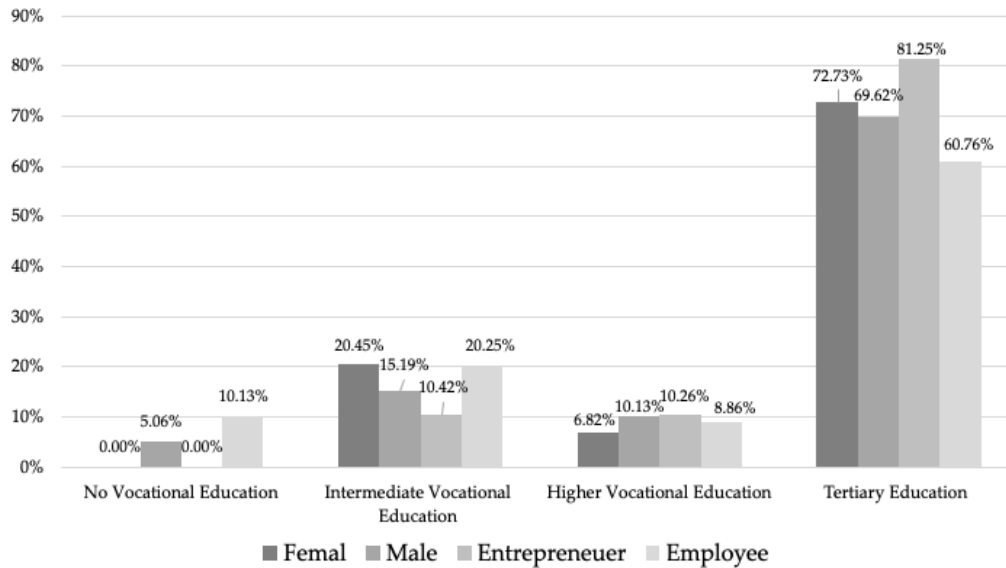
Source: Illustration by the author based on Python analysis.

The data also revealed significantly higher values for the monthly net income of the entrepreneur's study group, with an average of €6,563.66, compared to €2,419.14 for private individuals. In addition, people with a higher level of education receive a higher average monthly net income, as shown in Figure 37. There is a clear difference between male respondents with an average monthly net income of €5,033.67 and female respondents with only €2,792.31. Female participants earn significantly less than male participants: €2,383.09 per month compared to €5,443.09 per month. However, these data are not representative of the whole sample, as only 72.44% of respondents reported monthly net income. Figure 38 shows the monthly net income of the study participants by gender and study group.

Figure 38. Net Income by Gender and Employment Status (2ⁿᵈ Study)
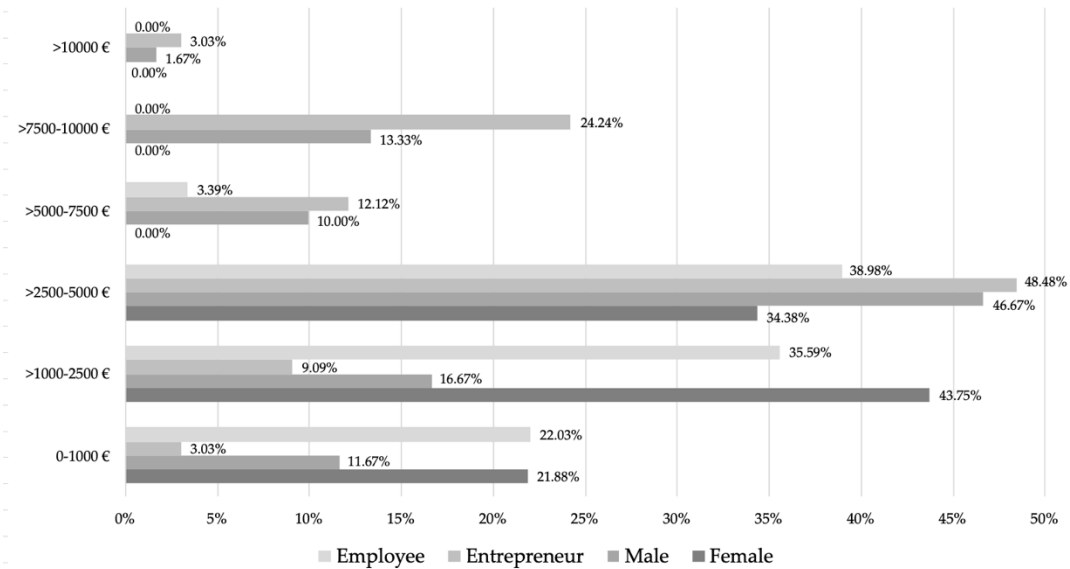
Source: Illustration by the author based on Python analysis.

Further notable differences can be found in the age of the respondents. The average age of female respondents (37.88 years) is the same as that of male respondents (38.64 years). The average age of the respondents is 38.198 years. The age range is between 16 and 70 years. It is noticeable that the group of private individuals, with an average age of 34.84 years, has a significantly lower value than the entrepreneurs, with an average age of 43.78 years.

Noticeably, only a small proportion of people are aged 64 and over. Figure 39 shows the distribution of the group by age group and the number of correct answers. The older age groups have a better financial education. It should be noted, however, that there are significantly fewer respondents in these age groups. In line with existing studies (e.g., Allianz/Lusardi, 2017), people under 35 have a slightly lower level of financial literacy and people over 50 achieve slightly better results in financial literacy.

Figure 39. Age Distribution by correct Answers for the "Big Five" (2nd Study)
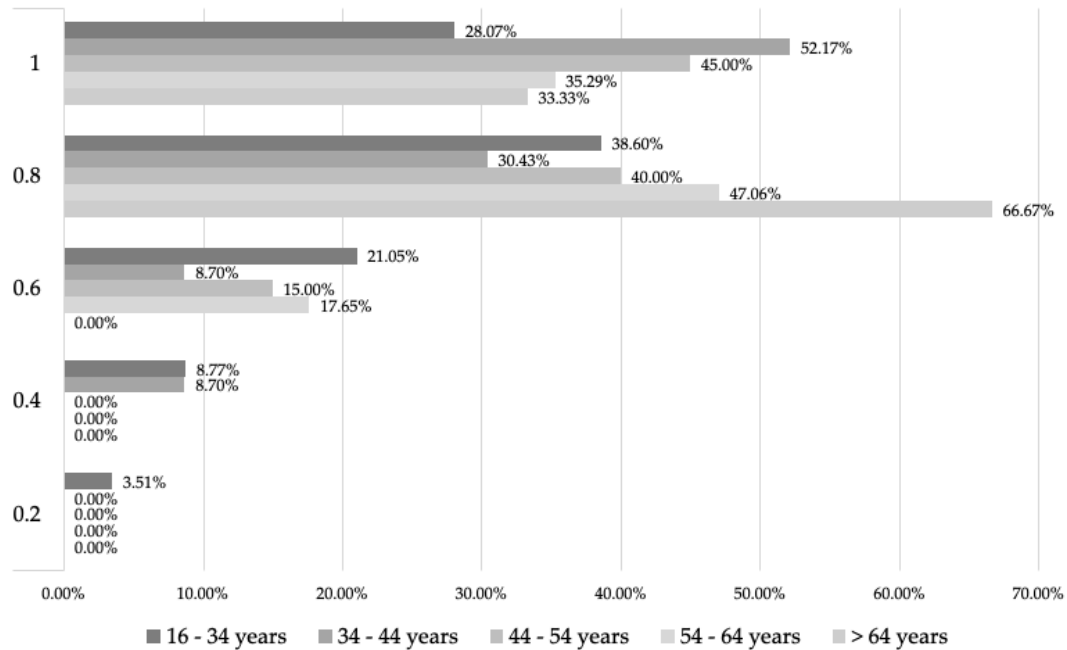
Differences are also evident in the employment situation of the participants. 62.99% of participants indicated full-time employment and 19.69% reported part-time employment. Among the 5.51% of survey participants who indicated "Other" are pensioners and working students and trainees, so that this group can be assigned to the groups "In training" and "Not_employed". Figure 40 illustrates the distribution of the analysis of this question.

Figure 40. Employment Status of the Study Participants (2ⁿᵈ Study)
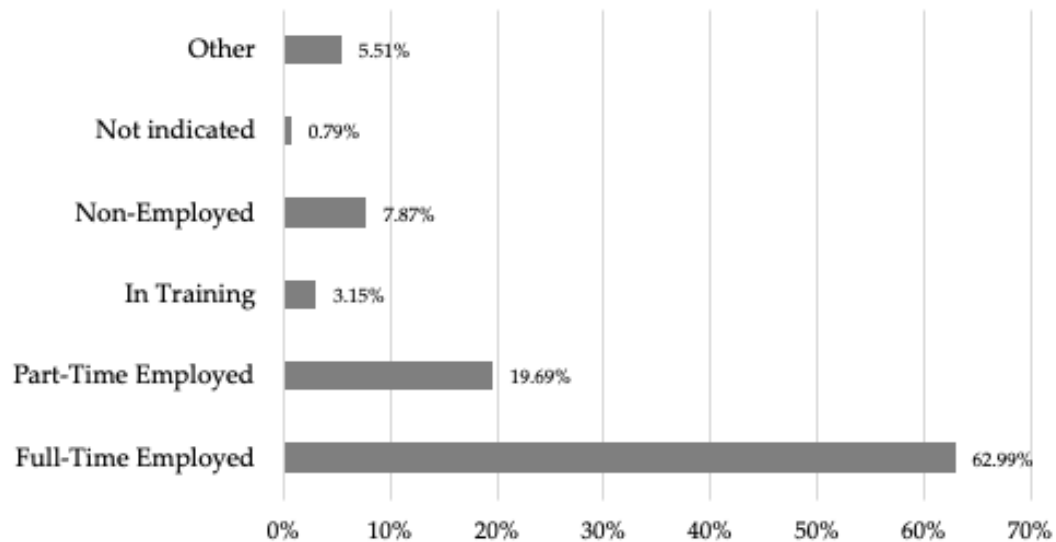
The analyses also show that entrepreneurs stated that they received better education/knowledge transfer on finance from their parents (5.71) than the group of private individuals (4.22). The survey participants were asked to assess a scale of 1-10, with 1 as the lowest and 10 as the highest possible indication. In this context, the male participants (5.1) achieved higher values than the female participants (4.29). The highest average value is achieved by male entrepreneurs with 6.05. Figure 41 shows the risk attitude of the respective study groups based on the scores achieved for the knowledge questions on financial literacy.

Figure 41. Knowledge Transfer by Parents vs. Risk Assessment (2ⁿᵈ Study)
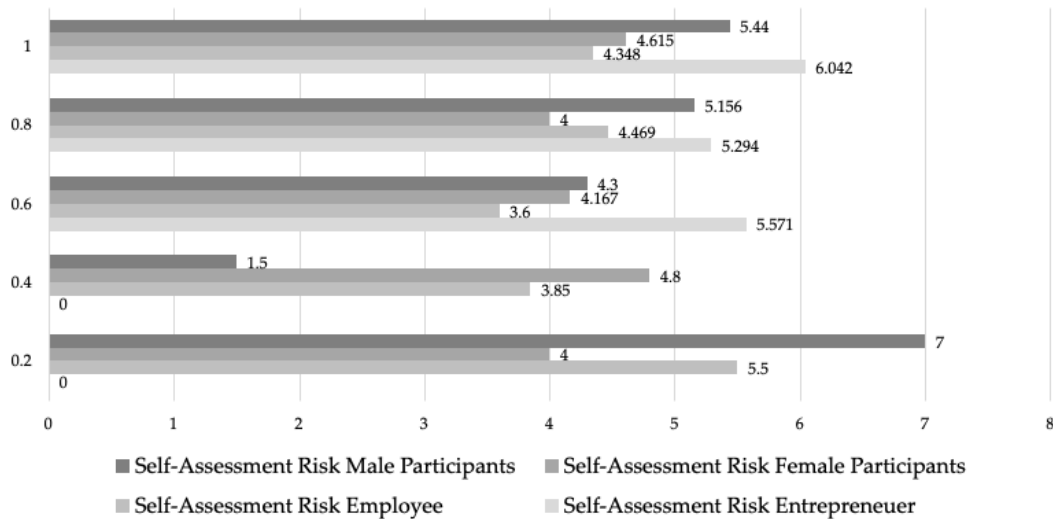
Note: The values 0.2 to 1 represent the respective number of correct answers achieved, with 0.2 for one correct answer and 1 for 5 correct answers. For the study group entrepreneurs, no data are available in the group financial education score 0.2 and 0.4, as no results were obtained in this group. Source: Illustration by the author based on Python analysis.

The analysis of the company-specific questions is carried out using Lime Survey and Python. The majority of the companies were founded in the period between 2000-2022. The average number of employees is 28, with companies having between 0 and 540 employees. The average turnover of the last calendar year is 5.057.607€. At this point, however, it should be noted that only a limited number of research participants reported the turnover of their company and the average value was strongly influenced by outliers. The industry distribution varies, but most surveyed entrepreneurs are from the management consulting and IT industries, as shown in Figure 42. Further specification based on the criteria recorded, such as revenue and number of employees, was not carried out by the survey participants due to the values they often failed to provide.

Figure 42. Business Sectors of Study Participants (2ⁿᵈ study)
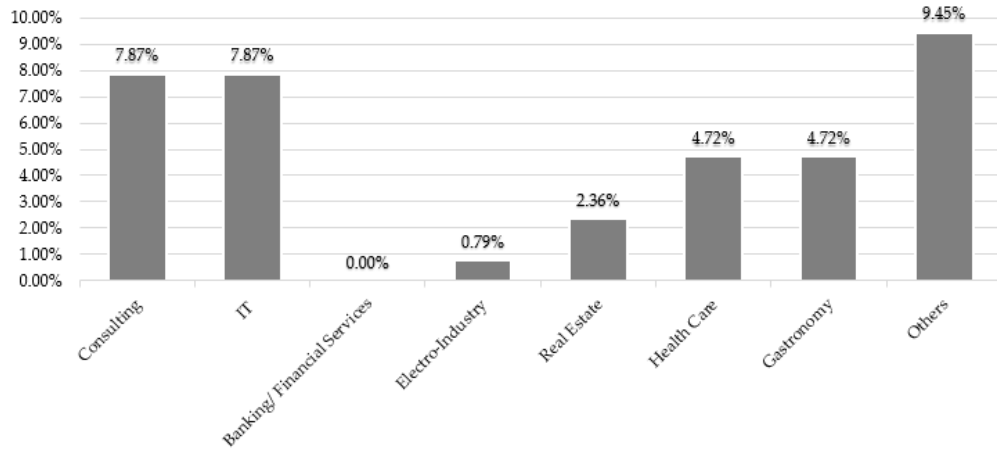
Source: Illustration by the author based on Python analysis.

5.2.2.   Statistical Analysis

The overall sample size for study 2 after the data preparation is 127, which is indicates a limited validity of the results due to the comparably small sample size. The application requirements have been checked in chapter 4. The Box-Tidwell-Test (Box & Tidwell, 1962) is conducted to assess the extent of linearity among the continuous variables. Table 33 shows significant p-values for all continuous variables of the model which indicates that there is no linearity among the variables.

Table 33. p-Values for continuous variables - Box-Tidwell Test (2ⁿᵈ Study)

Variable	p-Value
Financial Literacy	*0.0001*
Age	*0.0278*
Income	*0.0378*
Knowledge Dissemination	*0.0580*
Self-Assessment Risk	*0.0524*

Source: Illustration by the author based on Python.

The calculation of the variance inflation factors (VIFs) with the statsmodel-API enables a check for multicollinearity between the variables of the regression model. A high value larger than 10 indicates significant multicollinearity of a parameter with variables of the model. As Table 34 shows, no significant multicollinearity between the variables of study 2 can be found.

Table 34. Variance Inflation Factors (2ⁿᵈ Study)

Variable	Variance Inflation Factor
Financial Literacy	6.84
Age	1.22
Knowlegde Dissemination	1.13
Income	1.23
Gender_w	1.83
ISCED 5 – Higher Vocational Education	1.54
ISCED 7 – Tertiary Education	5.64
No Vocational Education	1.41
Self-Assessment Risk	1.24

Source: Illustration by the author based on Python.

Table 35 presents the results of the logistic regression based on the presented regression equation. The significance level is set at 5%. Dummy variables represent the nominally scaled variables gender and education. The negative coefficient for financial literacy in row 1 has a non-significant p-value of 0.41, so there seems to be no influence on the probability of being an entrepreneur. For the variables knowledge transfer (0.0315) and income (0.0098), statistically significant coefficients with a p-value smaller than 0.05 are available. The results show that the variables income, knowledge transfer and no education (education no BA) have the strongest effect. The variable no education has a strong negative effect but cannot be considered significant due to the extremely high p-value. The regression results show no relationship between financial education and the probability of being an entrepreneur. The variable income, however, is particularly relevant for predicting

entrepreneur status with the highest positive coefficient and a significant p-value. No statistically relevant influence was found for any of the other variables examined. The pseudo R^2-value for the regression performed is 31.8%.

Table 35. Logistic Regression Results (2nd Study)

Logistic Regression Results Study 2				
Variable	**Coefficient**	**Std. Error**	**z**	**p > |z|**
Financial Literacy	*-0.6093*	*0.7378*	*-0.8258*	*0.4089*
Age	*0.2624*	*0.2556*	*1.0267*	*0.3046*
Knowledge Dissemination	*0.5295*	*0.2541*	*2.0838*	*0.0372*
Income	*2.5988*	*0.7779*	*3.3407*	*0.008*
Gender	*-0.1655*	*0.5129*	*-0.3227*	*0.7469*
Education Isced-5	*0.1597*	*0.9415*	*0.1697*	*0.8653*
Education Isced-7	*0.2588*	*0.6685*	*0.3871*	*0.6987*
No Vocational Education	*-23.9796*	*140476.689*	*-0.0002*	*0.9999*
Self-Assessment Risk	*0.3595*	*0.2522*	*1.4252*	*0.1541*

Note: The significance level used is 5%. For a better overview all dummy variables are shown with their full name (e.g., Knowledge Dissemination for SA). Source: Own calculations by the author based on Python.

Figure 43 shows the confusion matrix for the logistic regression of study 2. As it can be seen, 70 instances were correctly classified as the Negative class (True Negative), 31 instances were correctly classified as the Positive class (True Positive), 9 instances were mistakenly classified as the Positive class (False Positive) and 17 instances were mistakenly classified as the Negative class (False Negative). The confusion matrix helps in assessing the performance of the model across different classes and understanding the types of errors it makes. To evaluate the model's performance, the AUC (Area Under the Curve) is determined. Its value of 0.7660 indicates that the model has moderate discriminative ability. The ratio of correctly grouped cases is comparably accurate with 79.50%.

Figure 43. Confusion Matrix logistic Regression (2ⁿᵈ Study)

Confusion Matrix		Actual Values	
		Positive	**Negative**
Predicted Values	**Positive**	*True Positve 31*	*False Positive 9*
	Negative	*False Negative 17*	*True Negative 70*

Source: Own calculations by the author based on Python.

It is important to emphasise that the regression analysis results must be interpreted as correlations and do not represent causalities. It can be assumed that not only financial literacy promotes entrepreneurship, but entrepreneurs also have a higher level of financial literacy due to their activities. Therefore, the regression analysis is followed by implementing the PSM to investigate the relationship further. Here, the control variables from the logistic regression model identified as backdoor variables were used to calculate the propensity scores for the treatment variable "Financial Literacy" and then match the individuals from the treatment group and the control group on this basis. The average treatment effect (ATE) is then derived from the average difference in the variables between the treatment group and the control group. The PSM reduces the control group from 80 to 69 observations and results in 69 observations in the control group and 47 in the treatment group after matching.

The results reveal that the mean values for the treated and control groups can be approximated using the PSM. However, for the target variable Y (status entrepreneur/non-entrepreneur), an approximation of the mean values is relatively low. Table 36 displays the ATE, which allows an assessment of the meaningfulness of the PSM. The ATE has a value of -0.011, showing a slightly negative effect of financial literacy on entrepreneurship. The negative ATE implies an adverse effect of the treatment. However, the result is not significant due to the high p-value. This is in line with the results of the logistic regression analysis. Table 37 shows the results of the PSM in the before/after comparison for all backdoor variables, as well as the target variable status entrepreneur/non-entrepreneur (Entrepreneur).

Table 36. Average Treatment Effect for PSM (2nd Study)

	Estimation	Std. Error	z	P > |z|
ATE	-0.011	0.081	-0.141	0.888

Source: Own calculations by the author based on Python.

Table 37. Control and Treatment Group before/after PSM (2nd Study)

Before PSM	Controls (N_c = 80)		Treated (N_t = 47)		
Variable	Mean	Std. Deviation	Mean	Std. Deviation	Raw-Diff.
Entrepreneur	0.3	0.461	0.511	0.505	0.211
Financial Literacy	-0.112	1.056	0.190	0.886	0.309
Age	-0.110	0.999	0.187	0.996	0.297
Knowledge Dissemination	-0.113	1.171	0.193	0.588	0.330
Gender	-0.438	0.499	0.277	0.452	-0.338
Education Isced-5	0.087	0.284	0.021	0.146	-0.293
Education Isced-7	0.100	0.302	0.064	0.247	-0.131
No Vocational Education	0.588	0.495	0.851	0.360	0.609
Self-Assessment Risk	-0.247	0.948	0.421	0.964	0.699

After PSM	Controls (N_c = 69)		Treated (N_t = 47)		
Variable	Mean	Std. Deviation	Mean	Std. Deviation	Raw-Diff.
Entrepreneur	0.333	0.475	0.511	0.505	0.177
Financial Literacy	-0.096	1.072	0.190	0.886	0.291
Age	-0.051	1.002	0.187	0.996	0.238
Knowledge Dissemination	-0.069	1.252	0.193	0.588	0.268
Gender	0.406	0.495	0.277	0.452	-0.273

After PSM	Controls (N_c = 69)		Treated (N_t = 47)		
Variable	Mean	Std. Deviation	Mean	Std. Deviation	Raw-Diff.
No Vocational Education	0.072	0.261	0.021	0.146	-0.242
Education Isced-5	0.116	0.323	0.064	0.247	-0.181
Education Isced-7	0.681	0.469	0.851	0.360	0.406
Self-Assessment Risk	-0.112	0.925	0.421	0.964	0.564

Source: Own calculations by the author based on Python.

The assumption of standard support assumes a substantial overlap of the distributions of the matching variables in the control and treated groups (Huntington-Klein, 2021). As described previously, common support was ensured using the trimming function while running the PSM.

For further evaluation of the PSM, a balance test in the form of a 2-sample t-test is also performed between the treatment and control groups (Brixiová et al., 2019; Girma & Görg, 2007). Table 38 below displays the normalised average differences between the treatment group and the control group, the differences before and after the implementation of the PSM, as well as the results of the 2-sample t-test performed for each study variable.

Table 38. Balancing-Test for PSM (2nd Study)

Covariate	Sample	Mean Treated	Mean Control	Diff	Reduction in Diff	t-test	P > |t|
Entrepreneur	Unmatched	0.3	0.511	0.211		2.39	0.019
	Matched	0.333	0.511	0.177	0.034	-1.924	0.057
Age	Unmatched	-0.112	0.19	0.309		1.64	0.103
	Matched	-0.096	0.19	0.291	0.018	-1.511	0.134
Knowledge Dissemination	Unmatched	-0.11	0.187	0.297		1.67	0.108
	Matched	-0.051	0.187	0.238	0.059	-1.258	0.211
Income	Unmatched	-0.113	0.193	0.33		1.67	0.097
	Matched	-0.069	0.193	0.268	0.062	-1.336	0.184

Covariate	Sample	Mean Treated	Mean Control	Diff	Reduction in Diff	t-test	P > |t|
Gender	Unmatched	0.438	0.277	-0.338		-1.81	0.072
	Matched	0.406	0.277	-0.273	0.065	1.429	0.156
No Vocational Education	Unmatched	0.087	0.021	-0.293		-1.48	0.14
	Matched	0.072	0.021	-0.242	0.051	1.22	0.225
Education Isced-5	Unmatched	0.1	0.064	-0.131		0.7	0.488
	Matched	0.116	0.064	-0.181	-0.05	0.936	0.351
Education Isced-7	Unmatched	0.588	0.851	0.609		3.185	0.002
	Matched	0.681	0.851	0.406	0.203	-2.096	0.038
Self-Assessment Risk	Unmatched	-0.247	0.421	0.699		3.81	0.001
	Matched	-0.112	0.421	0.564	0.135	-2.99	0.003

Source: Own calculations by the author based on Python.

Further, as indicated by the non-significant t-tests, most variables are not significantly different after matching, which is why the null hypothesis of the 2-sample t-test is rejected and the balancing tests are met for these variables. However, for the variables entrepreneur/non-entrepreneur, income, ISCED 7 education, and attitudes toward risk (SA), significant t-test results are obtained, so the balancing conditions are not met here. Nevertheless, this does not indicate a failure of the matching procedure since it is in the natural sampling distribution that there are non-comparable parts of the sample and there are nevertheless approximations of the mean values with minor mean differences for the variables in question (Huntington-Klein, 2021).

In addition, balance testing is subject to some limitations (Zhang et al., 2019). Due to the reduced sample size after conducting the PSM, the statistical significance decreases and there is an increase in the probability of detecting false statistical evidence (Zhang et al., 2019). Accordingly, the result does not necessarily mean that the treatment by the PPP is ineffective or negative, because other factors may be decisive beyond the lack of statistical significance. In this case, the significant t-tests of some variables may be due to the nature of the sample since a too low proportion of comparable observations can lead to biased matching results,

which can also be seen in the graphs, i.e., for the variable income (Huntington-Klein, 2021).

Overall, no significant indicators for a positive influence of financial literacy on entrepreneurship could be found using the PSM. Only a non-significant, slightly negative influence was found, which is in line with the regression analysis results. In addition, the graphical analyses and balance testing revealed an insufficient number of comparable observations for the PSM in some places, which limits the significance of the result.

For further investigation, the Doubly-Robust method is performed with the previously calculated propensity scores for the individual variables as an additional control variable. The implementation in Python is analogous to logistic regression based on the utilities package and the Python library statsmodel. Table 39 presents the results of the Doubly-Robust method.

Table 39. Doubly-Robust-Method Results (2nd Study)

Doubly-Robust-Method Results Study 2				
Variable	Coefficient	Srd. Error	z	p > |z|
Financial Literacy	-0.5227	1.0761	-0.4857	0.6272
Age	0.2961	0.3996	0.7411	0.4586
Income	2.5894	0.7808	3.3162	0.0009
Knowledge Dissemination	0.5356	0.2604	2.0571	0.0397
Gender	-0.1805	0.5307	-0.3401	0.7338
No Vocational Education	-23.3488	104130.1497	-0.0002	0.9998
Education Isced-5	0.2426	1.2103	0.2005	0.8411
Education Isced-7	0.4359	1.7497	0.2492	0.8032
Self-Assessment Risk	0.4360	0.7427	0.5871	0.5572
Propensity Score	-0.5473	4.9766	-0.1100	0.9124

Note: The significance level used is 5%. For a better overview all dummy variables are shown with their full name (e.g., Knowledge Dissemination for SA). Source: Own calculations by the author based on Python.

Analogous to the logistic regression results, there is a negative coefficient of -0.5227 for the variable "Financial Literacy", which is also insignificant in this case, with a p-value of 0.6272. The results of the Doubly-Robust method are in line with the significant results for income and knowledge transfer variables. The variable income has the highest positive coefficient. The Doubly-Robust method also shows that financial literacy does not favour the probability of being an entrepreneur. No statistically relevant influence was found for any of the other variables examined.

Overall, the logistic regression results using the Doubly-Robust method could be confirmed. According to the results, the research hypothesis is rejected. Comparing the results of both research approaches, no significant impact of the level of financial literacy on the probability of being an entrepreneur can be demonstrated. However, it is found that entrepreneurs have higher income and financial knowledge and risk-taking than individuals.

Matching methods were used to adjust the results for confounding factors, and the Doubly-Robust method was used to examine the causal effect in more detail. However, some factors were significant for predicting the status entrepreneur. The knowledge transfer by the parents and the personal attitude towards risk play a decisive role in predicting the probability of being an entrepreneur. Thus, it can be stated that the probability of being an entrepreneur increases with increasing positive attitudes towards risk and is influenced by parents' knowledge transfer on finance.

These findings are consistent with other research, such as Rostamkalaei et al. (2022), who found no significant differences between individuals and entrepreneurs regarding financial literacy. The results of the Lusardi et al. (2016) study are highly relevant to the analysis of this paper, as it also demonstrated the significant impact of some socio-demographic variables positively associated with financial literacy on entrepreneurship. As described in the literature review, the study by Ćumurović and Hyll (2019) is considered the only known study investigating the objective context from Germany. The study found a positive impact of financial education on the probability of being self-employed. The data used was significantly larger than in this 2nd empirical study, with over 1000 study participants, but the overall proportion of entrepreneurs in the total sample was small, at only 104. Considering the educational level of the study participants (from

Ćumurović and Hyll), it can be observed that only slightly more than 10% have a university degree, which is significantly lower compared to this 2nd empirical dissertation study (more than 70% have a university degree), so that in the study of Ćumurović and Hyll targeted significantly broader population group with distinctly heterogeneous educational level. Since the level of education is found to have a high impact on financial literacy according to existing literature, this is a significant limitation to the significance of the results of this 2nd empirical thesis study. Also, the number of control variables used in this case was significantly higher than those used in the work presented, providing more information about the study participants and thus a more detailed result.

Nevertheless, applying the Doubly-Robust method is also subject to some limitations. The same applies to the Matching methods used. For example, due to the novelty of the method, many aspects such as the selection of control variables and the diagnostics of the methods to detect the treatment effect have not yet been adequately studied (Funk et al., 2011). Therefore, considering these limitations, the Doubly-Robust method should be viewed as a complement to, rather than a substitute for, the other methods used. Since the only study by Ćumurović and Hyll (2019) on Germany that measures the financial literacy of entrepreneurs and the self-employed only uses logistic regression, this dissertation provides a statistically more valid result to test the causality between financial literacy and entrepreneurship.

5.2.3.   Robustness Check Statistical Analysis

To ensure the robustness of the results, several tests of robustness and sensitivity analyses were performed based on the control variables. First, statistical evaluation methods examined the numerical variables classified in their non-standardised form. In the course of this, no significant deviations were found. In addition, only completely filled-in data sets were used in a further regression, reducing the sample size to 92 participants. In this case, there were also no changes in the results.

Furthermore, the standardisation of the numerical variables was replaced with MinMax scaling as an alternative to z-standardisation. This showed a slight change in the results. Using the MinMax scaling for the variables, a slightly

negative, significant influence of financial education on entrepreneurship is found using logistic regression. However, this relationship is not statistically significant when additional variables are added.

To further check the robustness of the results, an alternative regression analysis was conducted to introduce the self-assessment of risk attitude into the risk groups low (0-2), medium (3-7), and high (8-10), following Ćumurović and Hyll (2019). Again, no changes in the overall result were detected. To check the robustness of the logistic regression results, the number of variables was varied by selectively omitting control variables from the presented regression equation, a wide variety of combinations were tested. Similarly, no changes in the results could be detected.

Table 40. Logistic Regression 95%-Quantile Robustness (2ⁿᵈ Study)

Robustness Check Logistic Regression Results Study 2			
Variable	**Coefficient**	**Srd. Error**	**z**	**p > |z|**
Financial Literacy	-0.4723	0.9041	-0.5225	0.6013
Age	0.1617	0.3285	0.4923	0.6225
Knowledge Dissemination	0.5675	0.3150	1.8018	0.0716
Income	3.46834	1.0913	3.1782	0.0015
Gender	0.0157	0.5536	0.0283	0.9774
Education Isced-5	0.2615	1.0727	0.2438	0.8074
Education Isced-7	0.2332	0.8197	0.2846	0.7760
No Vocational Education	-13.7724	1311.3665	-0.0105	0.9916
Self-Assessment Risk	0.2234	0.3198	0.6986	0.4848

Note: The significance level used is 5%. For a better overview all dummy variables are shown with their full name (e.g., Knowledge Dissemination for SA). Source: Own calculations by the author based on Python.

In addition to the graphical evaluations and the balance testing in the course of the PSM already presented, the MDM was also performed with the underlying data to validate the results of the PSM. Here, analogous to the PSM, a negative ATE

of -0.048 results and thus a slightly negative effect of the treatment, which, however, is also not significant due to the high p-value. The results are shown in the following Table 41.

Table 41. Average Treatment Effect for MDM (2nd Study)

	Estimation	Std. Deviation	z	P > |z|
ATE	*-0.048*	*0.141*	*-0.339*	*0.734*

Source: Own calculations by the author based on Python.

Overall, using the robustness checks performed, deviations could only be found when using an alternative standardisation of the numerical variables. Beyond that, no significant deviations could be found. Using the applied statistical evaluation methods, no significant influence of financial literacy on the probability of becoming an entrepreneur was found, so the research hypothesis must be rejected. However, this research found significant influences of income and knowledge transfer by parents on the probability of becoming an entrepreneur.

5.2.4.   Hypotheses Testing

Finally, the research questions and hypotheses about the empirical results must be placed. The answers to the research questions and hypothesis are presented in the Table 42 below.

Table 42. Overview Hypotheses Testing – 2nd Study

Research Questions (RQ) & Hypotheses (H) – 2nd Study		
RQ1	*Can a scientifically valid measurement framework be developed to measure the financial literacy of entrepreneurs and the self-employed?*	
	Hypothesis 1	
	H0	A scientifically valid measurement framework **cannot** be developed to measure the financial literacy of entrepreneurs and the self-employed.

Research Questions (RQ) & Hypotheses (H) – 2nd Study	
Result	In the 2nd study, the focus was on the "Big Five" questions. This focus proved to be insufficient. However, a statistical measurement method could be established with the Matching method that, in contrast to a logistic regression, also includes backdoor variables (such as socio-demographic variables). Thus, a statistically significantly more robust result can be achieved.
RQ2	*Are there significant differences in financial literacy between entrepreneurs/self-employed and private individuals (employees)?*
	Hypothesis 2
	H0 · There are **no significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
Result	The results of the 2nd study indicate a higher level of financial and risk literacy among the entrepreneurs and self-employed people surveyed than individuals/employees. Overall, however, the differences are not statistically significant.
RQ3	*Is there a significantly positive correlation between financial literacy and entrepreneur-ship/self-employment?*
	Hypothesis 3
	H0 · There is **no significantly positive correlation** between financial literacy and entrepreneurship/self-employment.
Result	The 2nd study does not provide a statistical correlation between financial literacy and entrepreneurship due to the backdoor variables included in the Matching method (such as the socio-demographic factors). However, the socio-demographic factors, including age, gender, educational level and risk assessment, have statistical significance.
RQ4	*Is there a significantly positive correlation between financial literacy and business success of entrepreneurs/self-employed?*

Research Questions (RQ) & Hypotheses (H) – 2nd Study		
	Hypothesis 4	
	H0	There is **no significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.
	HA	There is **a significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.
Result	**H4 out of Scope for the 2nd study.**	

Source: Own presentation.

5.3.   RESULTS OF THE 3RD QUANTITATIVE RESEARCH STUDY

5.3.1.   Descriptive Statistics

At the end of the study period, the total number of participants amounts to 508, significantly higher than in the two previous studies. A total of 147 persons had to be excluded from the sample due to missing data as they did not answer all questions resulting in a total of 357 for the statistical analysis. The participants comprise 35.57% (T127) female participants and 64.43% (230) male participants. A total of 158 participants (44.25%) have specified that they are entrepreneurs, of which 67.08% are male and 32.92% are female. Among the 249 private individuals, the rate of female participants is 30.12%. 11 persons who did not provide any information regarding this categorisation were assigned to the group of private persons. The following Table 43 shows the sample characteristics of the third quantitative study.

Table 43. Sample Characteristics (3rd Study)

Sample characteristics					
Variable	N	Mean	Std. Dev.	Min.	Max.
Financial Literacy	357	0.7712	0.2029	0.1111	1
Age	357	41.72	14.98	17	83
Gender_Female	357			0	1
Migration Background	357			0	1
Knowledge Dissemination	357	3.35	2.56	1	5
Economic School Education	357			0	1
Entrepreneur	357	0.4425	0.4973	0	1

Note: This table shows the sample characteristics. The variable female takes the value 1 if the study participant is female, otherwise it is equal to 0. The procedure is analogous for the variable entrepreneur. If the value is 1, it is an entrepreneur; if it is a private person, the variable takes the value 0. Due to missing values, the sample size varies for the different socio-demographic variables. Source: Illustration by the author based on own Python analysis.

In line with the approach taken in study 2, the variable education was divided into four groups according to the International Standard Classification of Education (ISCED) framework: Intermediate vocational education (ISCED level 3), higher vocational education (level 5), tertiary education (level 6/7), and a fourth group that includes no vocational education and other vocational education research (e.g., van Rooij et al., 2012). For better clarity, the analyses of the variables are presented in table 40. Similar to study 2, the variable age is shown in categories in Table 44.

Table 44. Demographics, Risk and Knowledge Dissemination (3rd Study)

	Employees	Entrepreneurs	Total
Number of Survey Participants	199	158	357
Number of female Survey Participants	75	52	127
Number of male Survey Participants	124	106	230
Age			

	Employees	Entrepreneurs	Total
16-34 years	116	17	133
35-44 years	29	33	62
45-54 years	31	48	79
55-64 years	16	48	64
> 64 years	3	7	10
Migration Background			
Yes	23	8	31
No	176	150	326
Education			
No Vocational Education	22	5	27
ISCED 3 – Intermediate Vocational Education	33	28	61
ISCED 5 – Higher Vocational Education	25	15	40
ISCED 7 – Tertiary Education	119	110	229
Income			
No Income	11	2	13
Income < 1000€	33	16	49
Income 1000€ - 2000€	55	28	83
Income > 2000€ - 3000€	29	33	62
Income > 3000€ - 4000€	17	24	41
Income > 4000€ - 5000€	24	52	76
Income > 5000€	30	3	33
Self-Assessment Risk			
1 = not at all willing to take risks	13	4	17
2 = slightly willing to take risks	50	27	77

	Employees	Entrepreneurs	Total
3 = average risk tolerance	75	70	145
4 = willing to take risks	53	46	99
5 = very willing to take risks	8	11	19
Knowledge Dissemination			
1 – No Knowledge Dissemination	17	18	35
2 – Little Knowledge Dissemination	57	56	113
3 – Medium Knowledge Dissemination	65	42	107
4 – Good Knowledge Dissemination	43	32	75
5 – Very Good Knowledge Dissemination	17	10	27
Economic School Education			
Yes	112	72	184
No	87	86	173
Employment Situation			
Job Training/Apprenticeship	3	0	3
Employment Status No Employment	28	0	28
Employment Status Part-Time (20 hours)	15	7	22
Employment Status Part-Time (21-29 hours)	11	10	21
Employment Status Part-Time (< 20 hours)	15	5	20
Employment Status Full-Time (30-34 hours)	12	12	24
Employment Status Full-Time (35-39 hours)	31	18	49
Employment Status Full-Time (40 hours)	29	22	51
Employment Status Full-Time (41-48 hours)	31	32	63
Employment Status Full-Time (> 48 hours)	24	52	76

Source: Illustration by the author based on Python analysis.

The descriptive statistics and the subsequent analysis by Logistic Regression and Matching Method are based on the approach in study 2. Again, all statistical and graphical analyses described below were produced using Python and Excel.

Similar to the second study, the participants always answered at least one of the knowledge questions correctly. Questions 1, 2 and 4, also used in study 2, had lower rates of correct answers in this case. **Questions 1 and 2** on interest rates and inflation were answered correctly by 87.10% and 92.06%, respectively. Similar to the second study, the analysis shows no significant differences between the groups of individuals and entrepreneurs, as well as male and female participants.

Concerning **question 3** on shares of a company, 86.51% of the participants achieved the correct answer. Here the male participants, with 90.86%, have a better rate than the female participants. Within the group of entrepreneurs, there are no significant gender-specific differences. The comparison between the two groups of entrepreneurs and private individuals also shows no significant differences.

Question 4 (loans) was answered correctly by only 63.49% of respondents, where only 64.56% of female respondents answered this question correctly, compared to 70.43% of male respondents. Entrepreneurs achieved a correct rate of 70.89%. 70.75% of male entrepreneurs achieved the correct answer, while 71.15% of female entrepreneurs could do so, which is significantly higher than the female employees (60.00%). For this question, the number of participants who chose the 'don't know' option was comparably high (9.13%). Question 5 on shares in a company was answered correctly by 82.36% (75.59% women, 89.13% men). The entrepreneurs achieved a rate of 84.81% of correct answers; among them, 75.00% of female entrepreneurs and 89.63% of male entrepreneurs were able to answer correctly.

Questions 6 and 7 regarding lottery and investment have exceptionally high rates for the "I don't know" answer option with 16.67% and 15.08% respectively. The rate for the correct answer is comparatively low for these questions at 58.13% and 58.33%. Differences can again be seen for gender. Male participants show a rate of 67.39% and female of 60.62% for choosing the correct answer. Male entrepreneurs (67.92%) perform worse than their female counterparts (69.23%).

For **questions 8 and 9** on investment and asset value, 72.28% and 57.29% of participants score the correct answer, again showing gender differences. For

question 9, female participants (41.73%) scored significantly worse than males (72.17%). This is also evident in question 8 with 58.26% correct answers for the female and 82.17% for the male participants. Within the group of entrepreneurs, it can be seen that males perform better (84.90% and 68.86) than females (71.15% and 48.07%).

As in the 2ⁿᵈ study, the comparison of the two study groups of entrepreneurs and non-entrepreneurs reveals no significant differences concerning the level of financial literacy. Remarkable differences are again found in the gender category; female participants score significantly lower on the financial literacy knowledge questions. Figure 44 shows the percentage of correct answers by gender and employment status (entrepreneur/employee) for all five financial literacy questions.

Figure 44. FL Questions by Employment Status and Gender (3rd Study)
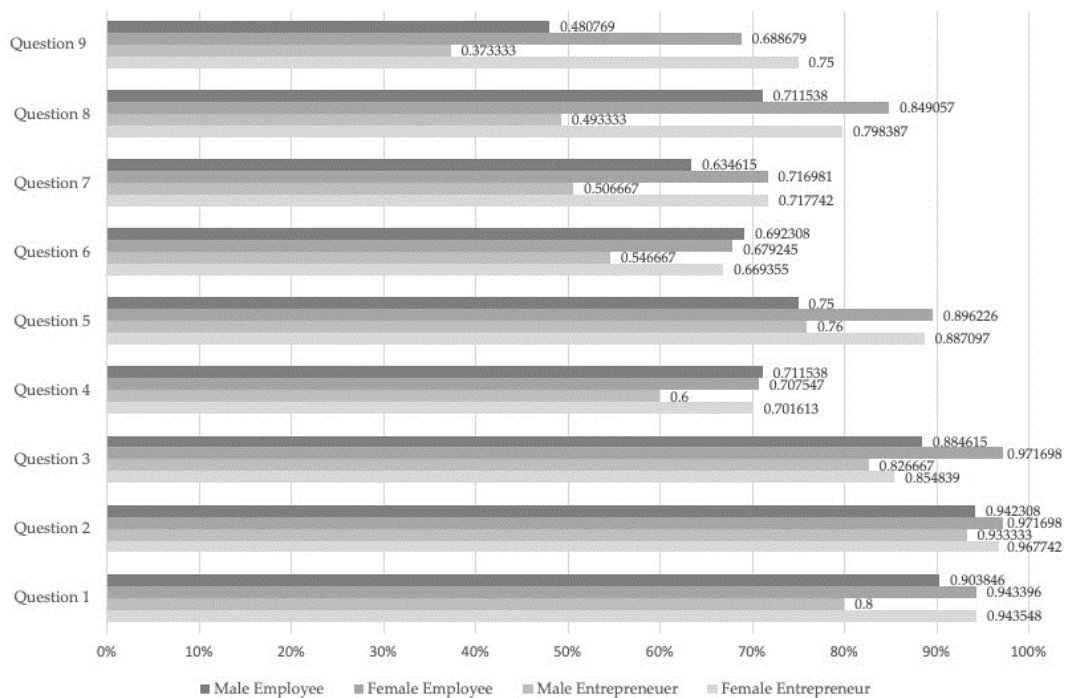
Source: Illustration by the author based on Python analysis.

A classification on a scale of 0 to 1 for correct answers to the financial literacy questions (analogous to the 2ⁿᵈ study) finds that female respondents score an

average of 0.65. In contrast, male respondents score an average of 0.81. Here, female entrepreneurs score an average of 0.75, while male entrepreneurs score 0.82. Again, the results are slightly better compared to female non-entrepreneurs (0.65) and male non-entrepreneurs (0.81). Figure 45 illustrates this distribution for the study groups.

Figure 45. Average Financial Literacy of the Survey Participants (3ʳᵈ Study)
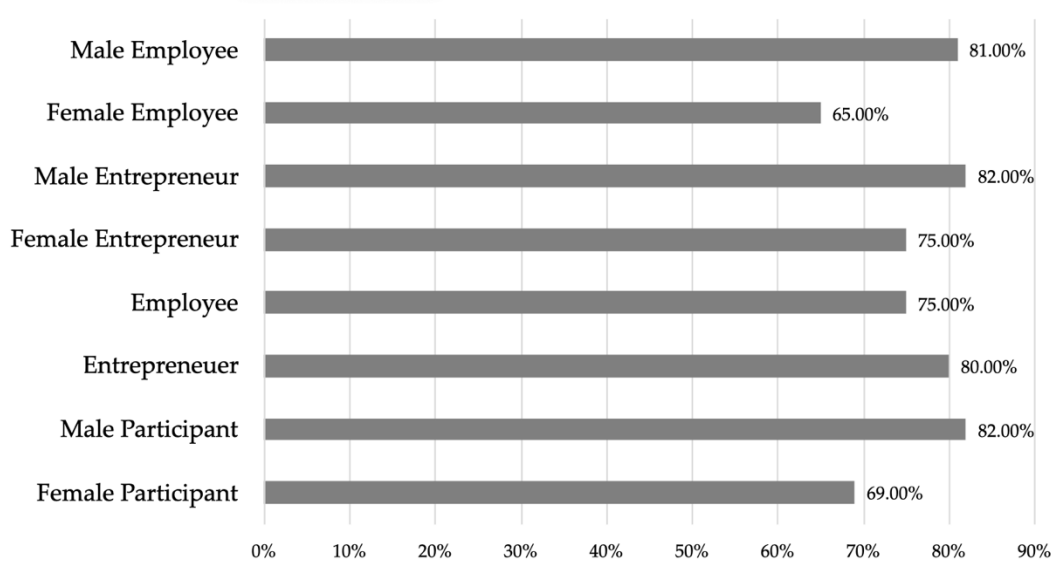
Source: Illustration by the author based on Python analysis.

Using again the classification according to Riepe et al. (2022) based on the division of the groups into financially highly literate and financially fewer literate participants based on the mean threshold, it appears that 74.78% of all male participants are considered financially literate, but only 46.46% of all female participants. These results show that more participants are financially literate than in study 2. Both studies also align with Lusardi and Mitchell (2014) and Klapper et al. (2015), who also showed a clear gender gap in financial literacy.

Nevertheless, it should be noted that the findings of these studies are primarily based on Lusardi and Mitchell's "Big Three" model and therefore cannot be directly applied to the findings of this survey, where the number of questions is significantly higher. Figure 46 shows the distribution of mean scores by entrepreneur/non-entrepreneur status and gender.

Figure 46. Study Participants with high Financial Literacy (3ʳᵈ Study)
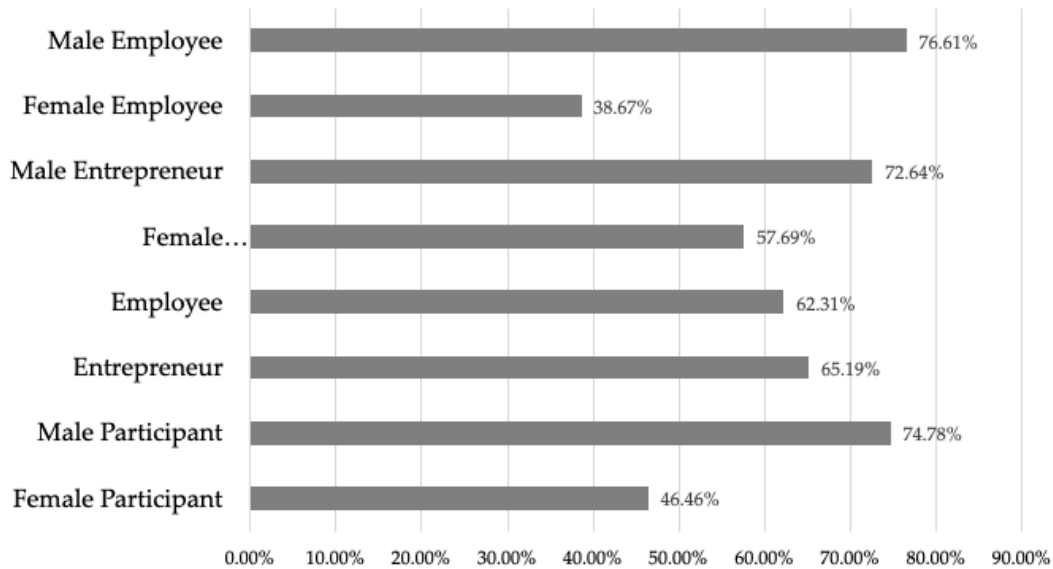
Source: Illustration by the author based on Python analysis.

The view on the participants' self-assessment of their attitude to risk provides further insights. The results are similar to those of study 2: Female participants scored lower on average than male participants. On average, entrepreneurs gave only a slightly higher, scientifically insignificant score to their willingness to take risks than non-entrepreneurs. These results are also consistent with findings in the literature (Hallahan et al., 2004; Hsiao & Tsai, 2018). In addition, the results from the 3ʳᵈ study are in line with the assumption that entrepreneurs are more risk-averse than individuals, which aligns with various research approaches (Liu et al., 2020; Riepe et al., 2022).

Additional findings are derived from evaluating the socio-demographic variables, which followed the procedure from study 2. The variable education is particularly significant in this case as well. As in study 2, there is a high level of participants with academic education. 64.14% of the participants have an academic education, whereby the value for male respondents with an academic education (63.04%) is slightly lower than the comparable value for female respondents (66.14%). Study 3 also shows that almost all entrepreneurs have a high level of education. Thus, 69.62% of the entrepreneurs have at least a bachelor's degree and only 17.72% have an apprenticeship or comparable training. Overall, there is again

a high level of education. Figure 47 shows the breakdown of participants by gender and education.

Figure 47. Educational Level by Gender and Employment Status (3rd Study)
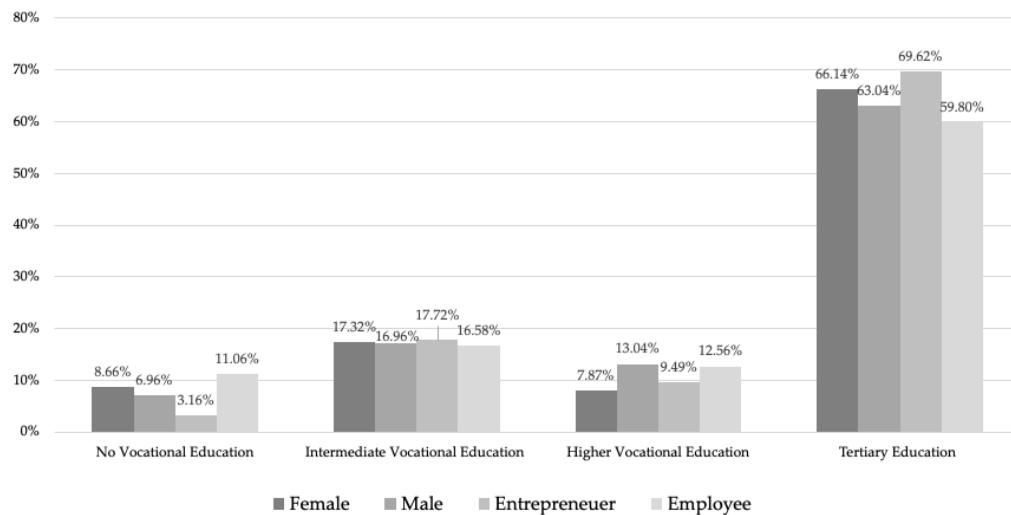
Source: Illustration by the author based on Python analysis.

In line with the results of the second study, significantly higher values are found for the monthly net income of the entrepreneurs compared to the private individuals. Unlike in study 2, the results were directly collected in income groups. Male participants achieve a higher average monthly net income than female participants. Figure 48 shows the monthly net income of the study participants by gender and study group.

Figure 48. Monthly Net Income by Gender and Employment Status (3rd Study)
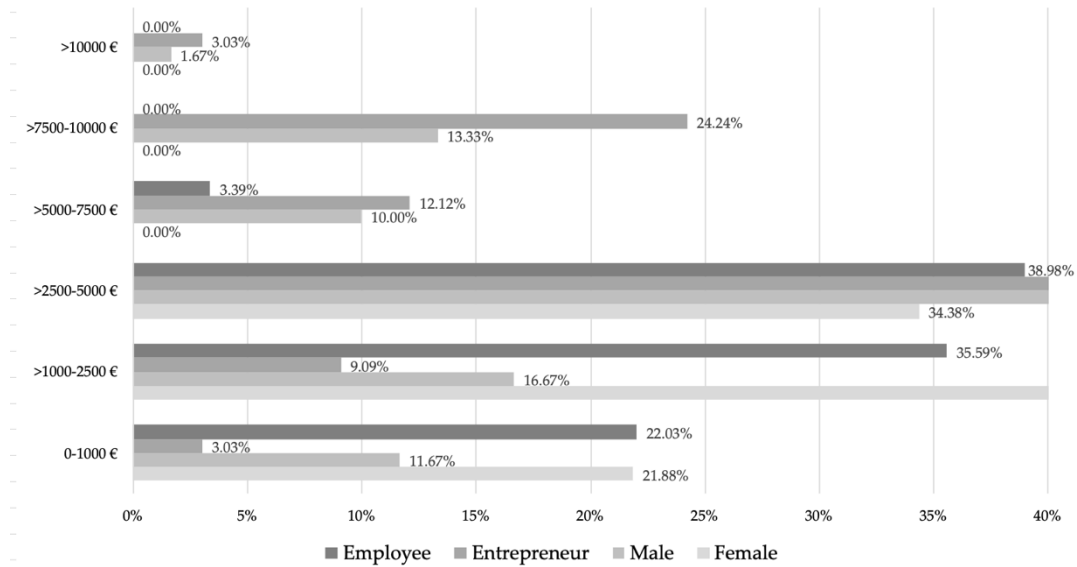
Significant differences also emerge in the evaluation of the age of the study participants. The average age of the participants is 41.72 years and thus significantly higher than in study 2. The average age of female participants (37.82 years) is lower than male participants (44.87 years). Mainly apparent differences are evident when comparing the age of entrepreneurs (49.74 years) with that of private individuals (35.35 years). Differences are also evident in the employment situation of the participants. 73.67% of participants indicated full-time employment and 17.65% reported part-time employment. Figure 49 illustrates the distribution of the analysis of this question.

Figure 49. Employment Status of Study Participants (3rd Study)
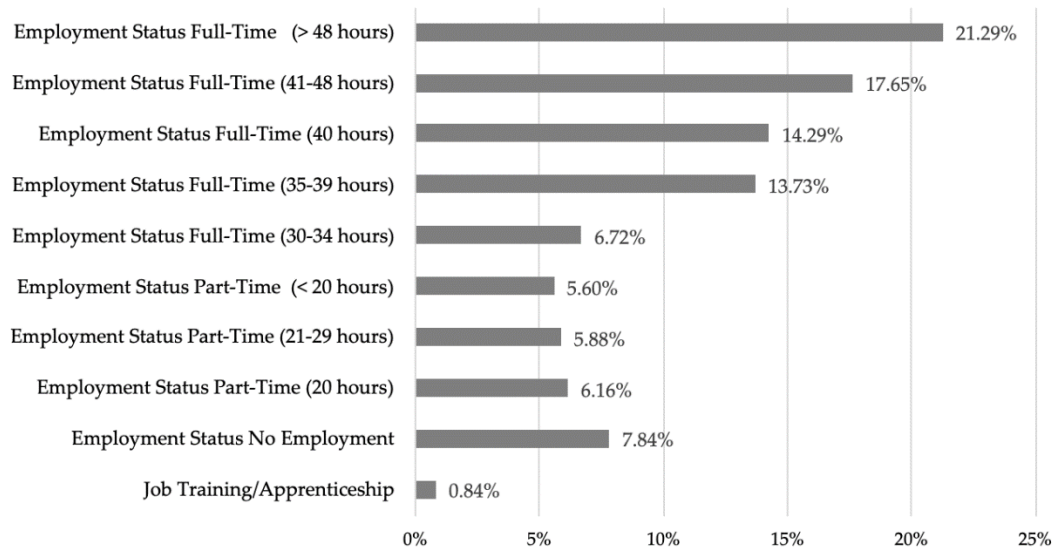
Their parents' variable education/knowledge transfer on finance gives further insights. Unlike in study 2, survey participants were asked to give an assessment only on a scale of 1-5, with 1 as the lowest and 5 as the highest possible indication that entrepreneurs stated that they had received better education on finance from their parents than non-entrepreneurs. The male participants achieved higher values than the female participants.

The analysis of the company-specific questions finds that most companies were founded between 2000-2022, have less than 10 employees and had a revenue in 2022 of less than 2.000.000€. The industry distribution varies, like in study 2, but most of the surveyed entrepreneurs are from the consulting and IT industries, as shown in Figure 50.

Figure 50. Business Sectors of Study Participants (3rd Study)
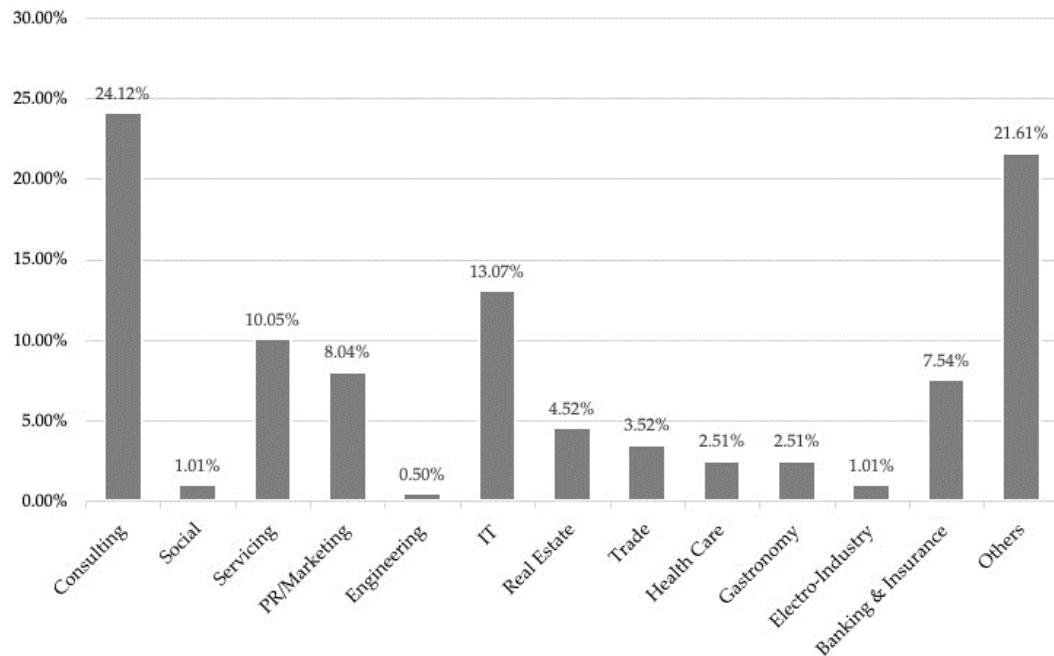
Source: Illustration by the author based on Python analysis.

5.3.2.   Statistical Analysis

With an overall number of 357, the preprocessed sample size for study 3 is significantly larger than in study 2, which improves the validity of the results. In line with the previous studies, the Box-Tidwell-Test (Box & Tidwell, 1962) is conducted to assess the extent of linearity among the continuous variables. Table 45 shows significant p-values for all continuous variables of the model which indicates that there is no linearity among the variables.

Table 45. p-Values for continuous variables - Box-Tidwell Test (3rd Study)

Variable	p-Value
Financial Literacy	*0.0002*
Age	*0.0002*
Knowledge Dissemination	*0.0415*
Self-Assessment Risk	*0.0304*

Source: Illustration by the author based on Python analysis.

The calculation of the VIFs for study 3 (Table 46) shows no multicollinearity between the variables of the regression model as the threshold of 10 is not surpassed.

Table 46. Variance Inflation Factors (3ʳᵈ Study)

Variable	Variance Inflation Factor
Financial Literacy	*7.84*
Age	*1.67*
Knowlegde Dissemination	*1.08*
Gender_w	*2.29*
ISCED 5 – Higher Vocational Education	*1.69*
ISCED 7 – Tertiary Education	*5.45*
No Vocational Education	*2.09*
No Migration Background	*8.87*
No Economic School Education	*2.22*
Employment Status No Employment	*3.66*
Employment Status Part-Time (20 hours)	*2.87*
Employment Status Part-Time (21-29 hours)	*2.97*
Employment Status Part-Time (< 20 hours)	*2.90*
Employment Status Full-Time (30-34 hours)	*3.52*
Employment Status Full-Time (35-39 hours)	*5.60*
Employment Status Full-Time (40 hours)	*6.07*
Employment Status Full-Time (41-48 hours)	*6.81*
Employment Status Full-Time (> 48 hours)	*7.89*
Income > 2.000€-3.000€	*3.44*
Income > 3.000€-4.000€	*3.08*

Income > 4.000€-5.000€	*2.59*
Income > 5000€	*4.47*
Income < 1000€	*1.90*
No Income	*1.70*
Self-Assessment Risk	*1.30*

Analogous to the procedure in study 2, the logistic regression is first performed based on the regression equation presented in chapter 4.3.3 to investigate the probability of being an entrepreneur. The significance level is again set at 5%. In addition to the dummy variables gender_w, education_no BA, education ISCED 3 (Intermediate BA), education ISCED 5 (Higher BA), education ISCED 7 (Higher Education), the nominal scaled variables migration background, economic school education and employment situation are added as dummy variables in study 3. Like in study 2, the negative coefficient for financial literacy in row 1 has a non-significant p-value of -0.27, so there seems to be no influence on the probability of being an entrepreneur. Statistically significant coefficients with a p-value smaller than 0.05 are shown for the variables age (x) and self-assessment risk (x). A strong negative effect is found for the variable Employment situation_not employed, but it cannot be considered significant due to the extremely high p-value. Consistent with study 2, no relationship can be derived between financial education and the probability of being an entrepreneur from the regression results. The variable income, however, is particularly relevant for predicting entrepreneur status with the highest positive coefficient and a significant p-value. No statistically relevant influence was found for any of the other variables examined. The pseudo R^2-value for the regression performed is 32.6%.

Table 47. Logistic Regression Results (3rd Study)

Logistic Regression Results Study 3			
Variable	**Coefficient**	**Std. Error**	**z**	**p > |z|**
Financial Literacy	-0.2693	0.8126	-0.3315	0.7403
Age	1.4197	0.2046	6.9399	0.0001
Knowledge Dissemination	0.0506	0.1439	0.3514	0.7523
Gender	0.9008	0.3687	2.4429	0.0146
Education Isced-5	-0.9282	0.5434	-1.7082	0.0876
Education Isced-7	-0.0523	0.3898	-0.1342	0.8933
No Vocational Education	1.0247	0.9016	1.1365	0.2557
No Migration Background	0.9493	0.5223	1.8172	0.0692
No Economic School Education	0.1534	0.2922	0.5251	0.5995
Employment Status No Employment	-12.9342	39.9295	-0.3239	0.7460
Employment Status Part-Time (20 hours)	-1.4963	0.9836	-1.5212	0.1282
Employment Status Part-Time (21-29 hours)	-1.2107	0.9677	-1.2511	0.2109
Employment Status Part-Time (< 20 hours)	-1.0954	1.0639	-1.0296	0.3032
Employment Status Full-Time (30-34 hours)	-1.7154	0.9933	-1.7269	0.0842

Logistic Regression Results Study 3				
Variable	**Coefficient**	**Std. Error**	**z**	**p > |z|**
Employment Status Full-Time (35-39 hours)	*-1.5037*	*0.9176*	*-1.6387*	*0.1013*
Employment Status Full-Time (40 hours)	*-1.3663*	*0.9294*	*-1.4700*	*0.1416*
Employment Status Full-Time (41-48 hours)	*-1.3013*	*0.8726*	*-1.4913*	*0.1359*
Employment Status Full-Time (> 48 hours)	*-0.7501*	*0.8470*	*-0.8856*	*0.3758*
Income > 2.000€-3.000€	*-0.0653*	*0.5156*	*-0.1269*	*0.8990*
Income > 3.000€-4.000€	*0.5484*	*0.5580*	*0.9829*	*0.3257*
Income > 4.000€-5.000€	*0.2853*	*0.6291*	*0.4535*	*0.6502*
Income > 5000€	*0.2193*	*0.6020*	*0.3643*	*0.7156*
Income < 1000€	*-1.4612*	*0.8754*	*-1.6692*	*0.0951*
No Income	*0.1157*	*1.4570*	*0.0794*	*0.9367*
Self-Assessment Risk	*0.4776*	*0.1599*	*2.9869*	*0.0028*

Note: The significance level used is 5%. For a better overview all dummy variables are shown with their full name (e.g., Knowledge Dissemination for SA). Source: Own calculations by the author based on Python.

Figure 51 shows the confusion matrix for the logistic regression of study 3. As is can be seen, 153 instances were correctly classified as the Negative class (True Negative), 120 instances were correctly classified as the Positive class (True

Positive), 46 instances were mistakenly classified as the Positive class (False Positive) and 38 instances were mistakenly classified as the Negative class (False Negative). The AUC (Area Under the Curve) value of 0.8545 indicates that the model has a comparably good discriminative ability. It suggests that there's an 85.45% chance that the model will correctly distinguish between a randomly chosen positive instance and a randomly chosen negative instance. The ratio of correctly grouped cases is comparably accurate with 76.47%.

Figure 51. Confusion Matrix logistic Regression (3rd Study)

Confusion Matrix		Actual Values	
		Positive	**Negative**
Predicted Values	**Positive**	*True Positve 120*	*False Positive 46*
	Negative	*False Negative 38*	*True Negative 153*

Source: Own calculations by the author based on Python.

The implementation of the PSM in the 3rd study is based on the same procedure as in the 2nd study. The backdoor variables were used to calculate the propensity scores for the treatment variable Financial Education. The PSM reduces the control group from 126 to 118 observations, resulting in 118 observations in the control group and 185 in the treatment group after matching.

In line with the results from the 2nd study, it is revealed that an approximation of the mean values for the treated and control groups can be achieved by applying the PSM. In contrast, the target variable Y (status entrepreneur/non-entrepreneur) results show a relatively low approximation of the mean values. The resulting positive ATE (Table 48) implies a positive effect of the treatment. However, the result is insignificant due to the high p-value, which is in line with the results of the 2nd study and the previously performed logistic regression. The overall results of the PSM in the before/after comparison for all backdoor variables, as well as the target variable status entrepreneur/employee, can be seen in Table 49.

Table 48. Average Treatment Effect for PSM (3rd Study)

	Estimation	Std. Error	z	P > |z|
ATE	*0.029*	*0.048*	*0.603*	*0.546*

Source: Own calculations by the author based on Python.

Table 49. Control and Treatment Group before/after PSM (3rd Study)

Before PSM	Controls (N_c = 126)		Treated (N_t = 231)		
Variable	Mean	Std. Deviation	Mean	Std. Deviation	Raw-Diff.
Entrepreneur	*-0.103*	*1.088*	*0.056*	*0.948*	*0.156*
Financial Literacy	*-0.065*	*1.039*	*0.035*	*0.981*	*0.099*
Age	*0.540*	*0.500*	*0.255*	*0.437*	*-0.605*
Knowledge Dissemination	*0.143*	*0.351*	*0.095*	*0.294*	*-0.147*
Gender	*0.508*	*0.502*	*0.714*	*0.453*	*0.432*
Education Isced-5	*0.119*	*0.325*	*0.052*	*0.222*	*-0.241*
Education Isced-7	*0.841*	*0.367*	*0.952*	*0.213*	*0.370*
No Vocational Education	*0.524*	*0.501*	*0.463*	*0.500*	*-0.121*
No Migration Background	*0.095*	*0.295*	*0.043*	*0.204*	*-0.205*
No Economic School Education	*0.056*	*0.230*	*0.061*	*0.239*	*0.022*
Income >2.000€-3.000€	*0.238*	*0.428*	*0.229*	*0.421*	*-0.020*
Income >3.000€-4.000€	*0.143*	*0.351*	*0.190*	*0.394*	*0.128*
Income >4.000€-5.000€	*0.087*	*0.283*	*0.130*	*0.337*	*0.137*
Income >5000€	*0.111*	*0.316*	*0.268*	*0.444*	*0.408*
Income < 1000€	*0.167*	*0.374*	*0.052*	*0.222*	*-0.373*
No Income	*0.048*	*0.214*	*0.030*	*0.172*	*-0.089*
Self-Assessment Risk	*-0.413*	*1.017*	*0.226*	*0.919*	*0.659*

Source: Own calculations by the author based on Python.

After PSM	Controls (N_c = 118)		Treated (N_t = 185)		
Variable	Mean	Std. Deviation	Mean	Std. Deviation	Raw-Diff.
Entrepreneur	0.415	0.495	0.465	0.500	0.050
Financial Literacy	-0.080	1.101	-0.007	0.919	0.072
Age	-0.094	1.056	-0.005	0.991	0.087
Knowledge Dissemination	0.542	0.500	0.308	0.463	-0.486
Gender	0.144	0.353	0.119	0.325	-0.074
Education Isced-5	0.500	0.502	0.649	0.479	0.303
Education Isced-7	0.127	0.335	0.065	0.247	-0.212
No Vocational Education	0.847	0.361	0.941	0.237	0.305
No Migration Background	0.517	0.502	0.470	0.500	-0.093
No Economic School Education	0.093	0.292	0.054	0.227	-0.150
Income >2.000€-3.000€	0.119	0.325	0.162	0.370	0.125
Income >3.000€-4.000€	0.127	0.335	0.130	0.337	0.008
Income >4.000€-5.000€	0.178	0.384	0.168	0.374	-0.027
Income > 5000€	0.195	0.398	0.232	0.424	0.091
Income < 1000€	0.254	0.437	0.243	0.430	-0.025
No Income	0.144	0.353	0.211	0.409	0.175
Self-Assessment Risk	0.093	0.292	0.124	0.331	0.100

Source: Own calculations by the author based on Python.

Standard Support is again assured by the use of the trimming function in the course of running the PSM.

The balance test in the form of a 2-sample t-test is performed as in the 2nd study and serves the further evaluation of the PSM. Table 50 shows the normalised average differences between the treatment group and the control group, the differences before and after the implementation of the PSM, as well as the results of the 2-sample t-test performed for each study variable.

Table 50. Balancing-Test for PSM (3rd Study)

Covariate	Sample	Mean Treated	Mean Control	Diff	Reduction in Diff	t-test	P > |t|
Entrepreneur	Unmatched	0.405	0.463	0.058		2.39	0.019
	Matched	0.415	0.465	0.050	-0.008	-1.924	0.057
Financial Literacy	Unmatched	-0.103	0.056	0.156		1.34	0.124
	Matched	-0.080	-0.007	0.072	-0.084	-0.079	0.234
Age	Unmatched	-0.065	0.035	0.099		1.64	0.103
	Matched	-0.094	-0.005	0.087	-0.012	-1.511	0.134
Knowledge Dissemination	Unmatched	0.540	0.255	-0.605		1.67	0.108
	Matched	0.542	0.308	-0.486	0.119	-1.258	0.211
Gender	Unmatched	0.143	0.095	-0.147		1.67	0.097
	Matched	0.144	0.119	-0.074	0.073	-1.336	0.184
Education Isced-5	Unmatched	0.508	0.714	0.432		-1.81	0.072
	Matched	0.500	0.649	0.303	-0.129	1.429	0.156
Education Isced-7	Unmatched	0.119	0.052	-0.241		-1.48	0.14
	Matched	0.127	0.065	-0.212	0.029	1.22	0.225
No Vocational Education	Unmatched	0.841	0.952	0.370		0.7	0.488
	Matched	0.847	0.941	0.305	-0.065	0.936	0.351
No Migration Background	Unmatched	0.524	0.463	-0.121		3.185	0.002
	Matched	0.517	0.470	-0.093	0.027	-2.096	0.038
No Economic School Education	Unmatched	0.095	0.043	-0.205		3.81	0.001
	Matched	0.093	0.054	-0.150	0.052	-2.99	0.003

Covariate	Sample	Mean Treated	Mean Control	Diff	Reduction in Diff	t-test	P > |t|
Income >2.000€-3.000€	Unmatched	0.056	0.061	0.022		-0.184	0.853
	Matched	0.059	0.059	0.001	-0.021	0.215	0.829
Income >3.000€-4.000€	Unmatched	0.087	0.039	-0.199		1.133	0.257
	Matched	0.076	0.049	-0.114	0.085	-1.459	0.145
Income >4.000€-5.000€	Unmatched	0.071	0.065	-0.006		1.204	0.229
	Matched	0.062	0.052	-0.010	0.004	-0.834	0.404
Income > 5000€	Unmatched	0.127	0.143	0.046		3.519	0.004
	Matched	0.119	0.162	0.125	-0.071	-2.386	0.017
Income < 1000€	Unmatched	0.119	0.156	0.107		-3.631	0.001
	Matched	0.127	0.130	0.008	-0.099	2.916	0.003
No Income	Unmatched	0.167	0.182	0.040		-0.833	0.405
	Matched	0.178	0.168	-0.027	-0.067	0.543	0.587
Self-Assessment Risk	Unmatched	0.190	0.225	0.085		3.04	0.002
	Matched	0.195	0.232	0.091	-0.006	-4.821	0.002

Source: Own calculations by the author based on Python.

The results are similar to study 2, as the non-significant t-tests for most variables are not significantly different after matching, which is why the null hypothesis of the 2-sample t-test is rejected and the balancing tests are met for these variables. However, the balancing conditions are not met for the variables entrepreneur/non-entrepreneur, Background, No_Economic School, Income > 5000€, Income < 1000€, and attitudes toward risk (SA), as they have significant t-test results. Nevertheless, as mentioned before, a failure of the matching procedure can be due to the characteristics of the sample (Huntington-Klein, 2021) and the use of balance testing is subject to some limitations (Zhang et al., 2019).

The Doubly-Robust method is performed as in study 2 with the implementation in Python based on the utilities package and the Python library statsmodel. Table 51 presents the results of the Doubly-Robust method.

Table 51. Doubly-Robust-Method Results (3rd Study)

Doubly-Robust-Method Results Study 3			
Variable	**Coefficient**	**Std. Error**	**z**	**p > |z|**
Financial Literacy	-1.0430	0.6367	-1.6382	0.1014
Age	1.1377	0.1691	6.7289	0.001
Knowledge Dissemination	-0.0039	0.1315	-0.0294	0.9766
Gender	0.7185	0.3004	2.3915	0.0168
Education Isced-5	-0.9026	0.4876	-1.8509	0.0642
Education Isced-7	-0.1317	0.3407	-0.3865	0.6991
No Vocational Education	0.1487	0.7497	0.1983	0.8428
No Migration Background	0.4564	0.4126	1.1062	0.2687
No Economic School Education	0.0170	0.2657	0.0640	0.9490
Income > 2.000€-3.000€	-0.2807	0.4109	-0.6832	0.4945
Income > 3.000€-4.000€	0.3839	0.4430	0.8667	0.3861
Income > 4.000€-5.000€	0.1932	0.5074	0.3807	0.7034
Income > 5000€	0.5661	0.4639	1.2202	0.2224
Income < 1000€	-1.6776	0.7524	-2.2297	0.0258
No Income	-0.8901	0.9683	-0.9192	0.3580
Self-Assessment Risk	-0.8901	0.9683	-0.9192	0.005
Propensity Score	-0.3244	0.4217	-0.7693	0.4417

Note: The significance level used is 5%. For a better overview all dummy variables are shown with their full name. Source: Own calculations by the author based on Python.

The results of the Doubly-Robust method provide further insights and differ from those of the previous logistic regression. There is a slightly negative coefficient of -1.0430 for the financial literacy variable, which is, however, not statistically significant due to a high p-value. Furthermore, there is a statistically significant positive effect of the variable *Age* with a coefficient of 1.1393, which leads to the conclusion that age positively impacts the probability of being an entrepreneur. In addition, a statistically significant coefficient is found for the variable *Risk*. Thus, when a person's self-assessed risk tendency is higher, the probability of becoming an entrepreneur increase. No statistically relevant influence was found for any of the other variables examined.

The results of the PSM are in line with the findings of the logistic regression concerning the target variable Financial Literacy but revealed different findings for the socio-demographic variables. Here, the variables *Age and Risk-Assessment* were statistically significant for the probability of becoming an entrepreneur. According to the results, the research hypothesis is rejected and no significant impact of the level of financial literacy on the probability of being an entrepreneur can be demonstrated in study 3.

Overall, the results of study 3 are consistent with the findings of the previously conducted second study and the research approaches presented in chapter 5.2 by, for example, Rostamkalaei et al. (2022) and Lusardi et al. (2016). Compared to the study by Ćumurović and Hyll (2019), the problems of the high level of education are again apparent, making it difficult to compare the studies.

In addition, the limitations of the Doubly-Robust and Matching methods already presented in chapter 5.2 must be considered. The methods have to be seen as a supplement to the investigation based on logistic regression. Study 3 found no statistically significant financial literacy influences the probability of becoming an entrepreneur. However, as already shown in study 2, the influence of some socio-demographic variables could be detected.

For the investigation of hypothesis 4, the spearman rank-order correlation coefficient is calculated, as described in chapter 4 of this thesis. The coefficient of 0.2208 implies a moderate correlation, meaning that as the level of financial literacy of an entrepreneur increase, the ranks of the other variable, income, tend to increase as well.

5.3.3. Robustness Check Statistical Analysis

The robustness tests used in study 2 are performed to check the robustness of the results. Again, the variables classified as numerical variables are examined in their non-standardized form. No significant deviations were found. Again, no significant changes were found.

Using the MinMax-scaling as an alternative to the z-standardization for the numerical variables shows a slight change in the results. In line with study 2, an alternative regression analysis was conducted to introduce the self-assessment of risk attitude into the risk groups low (0-2), medium (3-7), and high (8-10), following Ćumurović and Hyll (2019). No changes in the overall result were detected. The number of variables was varied to check the robustness of the logistic regression results; a wide variety of combinations were tested by selectively omitting control variables from the presented regression equation. Similarly, no changes in the results could be detected.

Subsequently, as already described in chapter 5.2, in addition to the balance testing, the MDM was also performed with the underlying data to validate the results of the PSM. Here, analogous to the PSM, a negative ATE of -0.048 results and thus a slightly negative effect of the treatment, which, however, is also not significant due to the high p-value. The results are shown in Table 52.

Table 52. Average Treatment Effect for MDM (3rd Study)

	Estimation	Std. Deviation	z	P > |z|
ATE	-0.048	0.141	-0.339	0.734

Source: Own calculations by the author based on Python.

In summary, using the robustness checks, deviations could only be found when using the alternative standardisation, which is in line with study 2.

5.3.4.   Hypotheses Testing

Finally, the research questions and hypotheses concerning the empirical results must be placed. The answers to the research questions and hypothesis are presented in Table 53 below.

Table 53. Overview Hypotheses Testing (3rd Study)

Research Questions (RQ) & Hypotheses (H) – 3rd Study		
RQ1	*Can a scientifically valid measurement framework be developed to measure the financial literacy of entrepreneurs and the self-employed?*	
	Hypothesis 1	
	H$_A$	A scientifically valid measurement framework **can** be developed to measure the financial literacy of entrepreneurs and the self-employed.
Result	The Results of the 3rd study demonstrate that the combination of objective questions on financial literacy and risk literacy already used in science and supplementary questions on subjective risk assessment achieve sound scientific measurability, in line with the statistical verification procedures using the different Matching methods.	
RQ2	*Are there significant differences in financial literacy between entrepreneurs/self-employed and private individuals (employees)?*	
	Hypothesis 2	
	H$_0$	There are **no significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
Result	The statistical results of the 3rd study show no statistical significance for a higher financial literacy of entrepreneurs and self-employed persons compared to employees/private persons. The statistical results of the third study show no statistical significance for higher financial literacy among entrepreneurs and self-employed compared to employees/private	

Research Questions (RQ) & Hypotheses (H) – 3rd Study	
	individuals. However, this is limited by the fact that the general level of education was above average for both entrepreneurs/self-employed and employees/private individuals and almost the same for both occupational groups.
RQ3	*Is there a significantly positive correlation between financial literacy and entrepreneur-ship/self-employment?*
	Hypothesis 3
	H$_0$ — There is **no significantly positive correlation** between financial literacy and entrepreneurship/self-employment.
Result	The 3rd study could not prove the statistical significance that financial literacy influences becoming an entrepreneur. However, there was significance for the socio-demographic factors of age and risk assessment.
RQ4	*Is there a significantly positive correlation between financial literacy and business success of entrepreneurs/self-employed?*
	Hypothesis 4
	H$_A$ — There is **a significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.
Result	To test H4 and the correlation of financial literacy to business success, income was used as a measure of success. Overall, the 3rd study identified a moderate correlation (Spearman correlation coefficient of 0.2209) between financial education and business success (higher income) among entrepreneurs. More financially educated entrepreneurs thus achieve a higher business success/income than less financially literate entrepreneurs.

Source: Own presentation.

5.4. RESULTS OF QUALITATIVE RESEARCH – EXPERT INTERVIEWS

The interviews were conducted to underpin the results of the quantitative empirical survey with qualitative statements from a bank's customer advisory service. In particular, it should be investigated and verified whether entrepreneurs or self-employed persons already have a better basic knowledge of finance and investment than employees. It makes sense to compare the two groups of people about the hypotheses set out at the beginning of the thesis and in relation to the financial literacy of entrepreneurs presented by the OECD. Once the interviews had been categorised, they were evaluated and analysed. Before assessing the categories, the introductory questions will first be analysed.

Both interviews began with an introduction of the experts, in which they briefly explained their professional backgrounds. It turned out that Expert 1 from interview 1 works as a branch manager mainly with PCs, but also looks after CCs in the sense of "smaller retailers, smaller limited companies". Expert 2, on the other hand, now works in corporate banking and therefore deals exclusively with CCs. When asked if the experts and their colleagues were familiar with the term financial literacy, both answered in the emphatic affirmative. Expert 2 continued: "Financial literacy is very important, but in my view, it is often neglected" (see interview in the appendix). This is in line with the findings in the literature that financial literacy is important in both perspectives – for retirement planning and access zu finance (Liu et al., 2020; OECD, 2018; Tian et al., 2020).

As the research topic includes comparing employees and entrepreneurs, it was asked whether a correlation could be established concerning the differences between PC and CC. The following answer was given "Correct, you can say that. And since 95% of the corporate clients who come to us are also the founders or owners, you can say that. But you should not generalise so much" (see the interview in the appendix). This answer is very important in order to be able to relate the statements of the interviews to the comparison made in the thesis between employees (private clients, PCs) and entrepreneurs/self-employed (corporate clients, CCs).

In the following, the results of the expert interviews are placed concerning the OECD framework for entrepreneurs and the self-employed and evaluated

accordingly. At the end of the chapter, the research questions and hypotheses are compared to draw valid scientific conclusions.

5.4.1. Financial Literacy and Company Development

When asked how the respondents would describe a financially literate client, Expert 1 responds: "A financially literate client has the ability to see through to their net worth and liquidity statement". Expert 2 also refers to the "financial world" (see interviews in the appendix) and includes economic and socio-political issues. Asked about a possible trend in whether customers are more familiar with finance today than in the past, Expert 1 replies, "Yes, customers are more financially literate than they were 20 years ago". Expert 2 attributes this to the power of the internet, which enables many people to make their own decisions.

5.4.2. Differences between CCs and PCs

This category aims to show how much a CC's support differs from a PC is regarding the bank's subject areas and products. It is clear that corporate banking is more individualised and retail banking more standardised. Both experts point out that payment transactions are an important topic for CCs. In addition, financing options play a greater role at CCs. "PCs can be divided into two groups. Once the customer who has money and that on the other hand the customer who needs money from the bank" (see interviews in the appendix). According to Expert 1, in pension provision, the initiative usually comes from the CC, whereas the private client increasingly needs the initiative of the advisor. Expert 2 elaborates on the distinction between PC and CC: "For many people, going to the bank is like going to the accountant or the tax office. People don't enjoy that. It's more like a duty for them. The CC, however, sees us more as a game partner with whom he can get ahead. And for the PC, we're more like a company where you're just a customer" (see interviews in the appendix). Expert 1 also confirms that the PC tends to avoid certain financial topics.

5.4.3.   Use of MACS

This refers to the preparation made by a CC and PC before visiting a bank using management accounting and control systems in the form of financial statements and financial reports. For CCs, these may be balancing sheets and liquidity statements. But the prior knowledge of the client is also addressed. Expert 1 comments on comparing PCs and CCs: "Yes, with CCs it is of course different. But definitely, a corporate client is better prepared. When it comes to filing, they know what to do, especially if it's ongoing disclosure. In any case, these are CCs issues. When he comes here, which he will certainly do at some point, what he has to file with the PC is very different. There are clients who bring a statement of assets and liabilities and can, so to speak, prepare their own liquidity statement. On the other hand, there are also very, very many PCs who have an enormous problem with this" (see interviews in the appendix). Expert 2 explains how the client's preparation or the correct financial statements or asset statements influence the bank's decision on a possible loan: "You could say that, like in a restaurant, the eye eats with you. So for us as a bank, the numbers are a very decisive factor. And the tax consultant is definitely the point of contact for us. If there are any queries, the customer comes with proper documentation, the figures are well prepared, everything is complete. Then we as people - we are only people in the bank - naturally have more fun approaching things than if we first have to run after the customer for the documents" (see interviews in the appendix).

Asked whether the preparation and understanding of financial reports and liquidity calculations have changed due to the crises and the current inflation, Expert 1 is sure there has been a clear improvement. However, she sees this more on the part of the CCs. Expert 2 also speaks of a positive development, but sees this mainly as a temporary effect.

Table 54. Findings to OECD Area of Competency – Use of MACS

OECD Areas of Competency	Results
Use of MACS	➢ CCs are better equipped for bank meetings and often have well-prepared financial documents. ➢ CCs are familiar with the submission process of documents due to the permanent disclosure of their financial situation (which is also required by §18 KWG). ➢ CCs with well-organized documents and liquidity statements are more likely to be provided with financing. ➢ The "crises" of recent years (Financial Crisis, Euro Crisis, Corona Pandemic) have once again improved the management systems of corporate clients.

Source: Own presentation.

5.4.4.   Financing Structures

When analysing the statements of both experts, it can generally be concluded that financially literate clients also have better financial structures. Financially educated clients "make better decisions, and their finances are better structured and better organised" (see interviews in the appendix). According to Expert 1, financially educated clients can also better assess their financial structures when taking out a loan. When asked if there are differences between PCs and CCs, Expert 1 said that in both the corporate and retail sectors, some clients are better organised

and others worse. However, she adds that the structures in the private client sector are more disorganised, although it is generally much easier for private clients to compile documents. One conclusion could be that a PC is not as reliant on good structures as a CC (who is particularly aware of them in his day-to-day business), so it does not seem as critical for PCs to neglect them.

Table 55. Findings to OECD Area of Competency – Financing Structures

OECD Areas of Competency	Results
Financing Structures	➢ Financially literate customers have better financial structures, make better financial decisions and their finances tend to be better structured and organised. ➢ Financially educated customers can better assess their financial structures when taking out loans. ➢ CCs tend to be better organised than PCs because CCs organise their finances daily.

Source: Own presentation.

5.4.5. Risk Management

When asked about the importance of risk management, Expert 2 said it was essential for both CCs and PCs. Expert 2 assesses the extent to which a financially literate corporate client differs from a retail client: "…risk is always part of a business. A financially literate entrepreneur takes risks in the same way, but calculates them differently and understands the consequences of the risks more" (see interviews in the appendix). According to Expert 2, financially literate PCs prioritise risk protection and provision for themselves and their families. Expert 1 speaks of a significantly higher customer affinity in the corporate customer segment when covering existential risks. The CC is aware that certain risks need to be insured and is willing to do so. Expert 2 attributes the higher affinity to the fact that an entrepreneur is obliged to act proactively. In contrast, a PC does not feel so responsible because he knows "he can fall back on the social safety net in Germany" (see interviews in the appendix).

When asked whether a company's risk management plays a role in granting credit, both experts state that risk management is a fundamental criterion in the decision-making process. The experts consider that there are both "hard facts" and "soft facts" that influence the decision (see interviews in the appendix).

According to the experts, risk management changed, particularly during the Corona pandemic. In principle, the pandemic period was "that was a new situation for us as a bank. And of course we reviewed the loans again in that respect and looked at different risks" (see interviews in the appendix).

Table 56. Findings to OECD Area of Competency – Risk Management

OECD Areas of Competency	Results
Risk Management	➢ For CCs, the risk assessment is always a part of the daily (operational) business. ➢ Financially literate entrepreneurs take the same risks (as a PC), but calculate those risks

OECD Areas of Competency	Results
	differently and understand their consequences better.
	➢ Entrepreneurs take more responsibility for themselves in the first place and rely less on the (German) Welfare State.
	➢ Risk protection and provision for oneself and the family have a higher status for entrepreneurs.
	➢ Protecting against existential risks is a much higher priority for CCs than PCs.
	➢ CCs act proactively concerning protection and provision, while PCs do not consider themselves to be so responsible (since they can fall back on the social safety net in Germany).
	➢ Risk management is a fundamental criterion in the decision-making process when granting loans.
	➢ Risk management changed during the Corona pandemic and became a much higher priority from both the Bank's and the CC's perspective.

Source: Own presentation.

5.4.6.   Financial Instruments

The expert interviews were used to determine the extent to which financially literate clients have a more comprehensive range of financial instruments available to them. The interviews revealed that the more financial literacy an entrepreneur has, the more options they have and the more they know how to deal with them. Expert 1 relates this to the company's size, as small- to medium-sized companies' asset structure is more manageable. In her view, the larger the company, the greater the interest in financial instruments. For a financially literate PC, she says, it is part of the process "at least a custody account, that they have an orderly asset structure. And yes, that's already a difference to our, let's say, average customer who is more concerned with classical investments". This client also has "different demands on the bank" (see interviews in the appendix).

Table 57. Findings to OECD Area of Competency – Financial Instruments

OECD Areas of Competency	Results
Financial Instruments	➢ High financial literacy among entrepreneurs leads to increased use of financial instruments. ➢ The larger the company, the greater the interest in financial instruments. ➢ Financially literate CCs have significantly higher expectations regarding the use of financial instruments and the advice provided by the bank.

Source: Own presentation.

5.4.7.   Digital Affinity

The interview asked about the correlation between financial literacy and digital affinity. Expert 1 believes there is a clear correlation here: "Definitely yes. And this showed us not only during the pandemic period, but this was already the case before, that these customers were more willing to make cashless payments at times, or to use credit cards to make their payments before" (see interviews in the appendix). Expert 2, on the other hand, sees a specific connection between people with a higher level of wealth, who are becoming less and less sensitive to digital payment transactions. However, he would not generalise: "Of course, there are also very smart entrepreneurs or PCs who are totally smart and still prefer to pay with cash. I think that always has a bit to do with personal attitude" (see interviews in the appendix).

At the end of the interviews, both experts were asked how they would assess whether an entrepreneur comes to financial and investment discussions with a more solid basic knowledge. Expert 1 replied that it depends on the individual, but CCs are generally more informed overall. Expert 2 would not generalise and notes that the entrepreneur has a greater obligation. "An entrepreneur simply has to act differently than an employee (…). So he has to deal with more things than a private person" (see interviews in the appendix).

Table 58. Findings to OECD Area of Competency – Digital Affinity

OECD Areas of Competency	Results
Digital Affinity	➢ Financially literate customers are more likely to pay cashless or by credit card. ➢ CCs are overall better informed in financial (and digital) matters since a business owner per se has to cope with more issues than a private person.

Source: Own presentation.

5.4.8.   Hypotheses Testing from the Expert Interviews

The two experts' statements are in line with the assumption that entrepreneurs have a higher level of financial literacy. Entrepreneurs who act as CCs with the bank are obliged to know more and be better prepared (especially about the creditor, the bank) simply because of their entrepreneurial activity. As a result, CCs enter meetings with the bank advisor better informed. "An entrepreneur simply has to act differently than an employee. And there is no statutory pension, no statutory health insurance, no statutory unemployment insurance. So he has to deal with more things than a private person". According to the experts, however, generalisations should not be made: "…the self-employed person has an obligation, but not everyone fulfills that obligation to themselves" (see interviews in the appendix). Overall it is significant that entrepreneurs are generally more financially literate because of their obligations.

Finally, the research questions and hypotheses must be placed to the qualitative results through expert interviews. The answers to the research questions and hypothesis are presented in Table 59 below.

Table 59. Overview Hypotheses Testing (Expert Interviews)

Research Questions (RQ) & Hypotheses (H) – Expert Interviews		
RQ1	*Can a scientifically valid measurement framework be developed to measure the financial literacy of entrepreneurs and the self-employed?*	
	Hypothesis 1	
	H_A	A scientifically valid measurement framework **can** be developed to measure the financial literacy of entrepreneurs and the self-employed.
Result	The designed questionnaire based on the OECD questions for entrepreneurs and self-employed provides good results/information for the expert interviews. It gives an objective view of the financial capability of entrepreneurs and the self-employed from the perspective of the funder - in this case the banks.	
RQ2	*Are there significant differences in financial literacy between entrepreneurs/self-employed and private individuals (employees)?*	
	Hypothesis 2	
	H_A	There **are significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
Result	Overall, experts on the financing side rate the financial literacy of entrepreneurs and the self-employed higher than that of private individuals.	
RQ3	*Is there a significantly positive correlation between financial literacy and entrepreneur-ship/self-employment?*	
	Hypothesis 3	
	H_0	There is **no significantly positive correlation** between financial literacy and entrepreneurship/self-employment.
	H_A	There is **a significantly positive correlation** between financial literacy and entrepreneurship/self-employment.
Result	**H3 out of Scope for the Expert Interviews.**	

Research Questions (RQ) & Hypotheses (H) – Expert Interviews		
RQ4	*Is there a significantly positive correlation between financial literacy and business success of entrepreneurs/self-employed?*	
	Hypothesis 4	
	H_0	There is **no significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.
	H_A	There is **a significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.
Result	**H4 out of Scope for the Expert Interviews.**	

Source: Own presentation.

VI – DISCUSSION

VI -DISCUSSION

Although it is difficult to compare the results with other studies due to the lack of comparable research approaches and significant methodological limitations of the studies conducted to date, the study by Lusardi et al. (2016) is based on the U.S. Health and Retirement Study (HRS), mentioned earlier, is relevant in this context. Here, a significantly higher level of variables associated with financial literacy, such as income, wealth, and education, was found among entrepreneurs compared to individuals, which can be related to the findings of this paper. The only comparable study on this topic in Germany is the one conducted by Ćumurović and Hyll (2019) on the relationship between financial literacy and self-employment in Germany, which found a higher level of financial literacy among entrepreneurs than among individuals. Furthermore, Oosterbeck et al. (2010) have shown that higher financial literacy translates into a lower willingness to become an entrepreneur, as individuals are more aware of the potential risks of starting a business, which is in line with the findings of this paper. Pooling the findings from previous research approaches can be seen as a cornerstone for future research, but at the same time also highlights some significant challenges.

When interpreting the results, the extent of the decisions associated with financial literacy in entrepreneurship must be considered. A simplified conclusion of the impact of financial literacy on entrepreneurship based on a few knowledge questions on selected areas of financial knowledge should be avoided. Moreover, comparing the financial literacy construct against the background of private individuals and entrepreneurs is difficult. While entrepreneurs as private individuals are comparable to non-entrepreneurs, where financial knowledge gained in business may have a positive impact, their entrepreneurial financial decisions are often influenced by experts, such as external advisors, or delegated to third parties. The goals and outcomes also differ significantly when comparing these two groups. Entrepreneurs are primarily interested in securing long-term sources of financing or managing working capital in the short term. In contrast, private individuals are interested in taking out loans and providing for their retirement, which is also evident from the research findings.

The timeliness of the issue and the need for further investigation of this relationship is also derived from the immense importance of entrepreneurship (e.g., OECD, 2016; Palacín-Sánchez et al., 2013). As a country strongly characterised by entrepreneurship, this mainly applies to Germany. From previous literature, the significant impact of entrepreneurship on innovation creation, growth, apprenticeships and employment, private income and tax revenues for public spending can be demonstrated, indicating the safeguarding of the international competitiveness of the German economy. Promoting entrepreneurship in Germany is essential to ensure the criteria above in the long term. Research on the factors influencing entrepreneurship, such as financial literacy, is fundamental.

In investigating this relationship, it is important to note that existing research approaches are all subject to (significant) limitations, such as the lack of a uniform method of measuring financial literacy against the background of entrepreneurship. In addition, limitations are evident in the definition of entrepreneurship, which needs to be established in future research approaches. Moreover, another limitation is the broad classification used in this paper, which aggregates a wide range of entrepreneurs into a single group. In the course of the analysis, survey participants were classified as entrepreneurs who were either freelance or self-employed. Thus, the various entrepreneurs differ in terms of their areas of responsibility. Freelance entrepreneurs or micro-enterprise owners differ in some ways from high-tech entrepreneurs and managers of larger companies.

However, as mentioned earlier, these problems can largely be attributed to the lack of a uniform measurement method. Furthermore, with such a small number of financial literacy questions, it is not possible to make a significant statement about an individual's level of financial literacy. In addition, the findings of this survey suggest that the "Big Five" model is insufficient for differentiating between a medium and a high level of financial literacy (Nicolini & Haupt, 2019). Significant differences emerge in the rate of correct answers only for the questions with elevated complexity. In addition, due to the single-choice format of the questions, there is a possibility that participants may answer the question correctly by chance. The understanding of the concepts cannot be checked - in the absence of the possibility to justify the chosen answer option. Regardless of the numerous limitations of the "Big Three" and "Big Five" models, the small number of

questions of this methods enables a higher acceptance and can therefore lead to a higher number of participants with a simultaneous reduction of the dropout rate. The survey question on risk self-assessment should also be interpreted with specific precautions. Research results have shown an enormous gap between subjective perception and actual objective results (Bucher-Koenen et al., 2017), which is why the self-assessment results on risk attitude are also subject to limitations.

To provide a scientifically robust conclusion on research question one, the measurability of financial literacy of entrepreneurs, three quantitative empirical survey waves with different survey contents from the already scientifically established questionnaires "Big Three", "Big Five", OECD and the Allianz/Lusardi study (Allianz/Lusardi, 2017; Lusardi & Mitchell 2011b/2014; OECD; 2018; Van Rooij et al., 2011a) were deliberately used in this thesis. Studies one and two were used to test which questions appear to be the most appropriate for a scientific test procedure of the financial literacy of entrepreneurs and self-employed persons.

In study three, the findings of the first two studies were implemented in the questionnaire and the survey was also consistently sent to an entrepreneurial target group (members of the VGSD) by direct e-mailing. This made it possible to reach entrepreneurs, in particular, who primarily make their own financial decisions in their companies. In addition, the survey was distributed via LinkedIn posts in an extensive network of around 7,500 followers. This resulted in an almost balanced ratio of entrepreneurs/self-employed persons and employees/private persons surveyed. Finally, the expert interviews conducted at one of the largest cooperative banks in Germany, Frankfurter Volksbank Rhein/Main eG, provided further scientifically relevant insights from the perspective of the financing side (bank).

A significant finding from the statistical analysis was that a logistic regression procedure is insufficient for statistically significant results. The Matching method was therefore applied in particular, including other influencing variables such as socio-demographic factors. While the advantage of including several variables (backdoor variables) in the Matching method provides statistically more robust results, it also leads to the fact that the backdoor variables can eliminate the influence of financial literacy. The third study also showed that the of entrepreneurs and self-employed persons is higher in the logistic regression. However, when the other variables, such as gender (Fonseca et al., 2012) and

education (Bachmann, 2021; Lusardi & Mitchell, 2014; Stolper & Walter, 2017), are included, no statistical significance emerges. To obtain more significant statistical results, it is necessary to have a larger number of participants overall and also a heterogeneous group of participants with regard to educational levels. All three studies were limited by the fact that most participants were highly educated. Given the importance of educational attainment for financial literacy, the statistical significance of having a majority of highly educated respondents is relatively low for both entrepreneurs/self-employed and employees/private individuals.

Proposed as a framework by the OECD (2018), the knowledge categories for entrepreneurs and the self-employed were reviewed based on expert interviews. They provided excellent insights from the perspective of the financing side (bank). Overall, the research questions and hypotheses are in line. Therefore, it can be assumed that the research results obtained from this thesis could only be achieved through a mixed methods approach of quantitative and qualitative research. The mixed methods should, therefore, also be used for future research - in particular, interviewing experts provides a much more holistic picture of the actual realities of life for entrepreneurs and the self-employed compared to employees and private individuals.

Since no data on financial literacy of entrepreneurs and self-employed are available for Germany, except for the study by Ćumurović and Hyll (2019), this dissertation creates a dataset that provides statistically relevant significance. By testing the causality of financial literacy on entrepreneurship using the Doubly-Robust and Matching method, it is possible to statistically prove for the first time that the influence of financial literacy on entrepreneurship is weak. The effect of financial literacy on entrepreneurial success, which was also shown to be weak in this dissertation, can be statistically validated using these two methods.

Furthermore, the questionnaire developed over the survey waves has created a framework for scientific research that can also be used for future research. This dissertation has explored an area of financial literacy in Germany that has not previously been explored to this extent and thus provides new scientific insights.

VII – CONCLUSIONS

VII - CONCLUSIONS

The literature review and the subsequent empirical research were implemented to investigate the measurability of financial literacy among entrepreneurs and to compare entrepreneurs/self-employed and private individuals (employees). The results of the quantitative and qualitative research conducted, as well as the existing studies, were presented and described in detail. The studies' results concerning the hypotheses and research questions are now discussed.

Table 60. Hypotheses Overview

Impact of Financial Literacy Entrepreneurship in Germany: Hypotheses (H)	
H1	A scientifically valid measurement framework **can** be developed to measure the financial literacy of entrepreneurs and the self-employed.
H2	There **are significant** differences in financial literacy between entrepreneurs/self-employed and private individuals (employees).
H3	There is **a significantly positive correlation** between financial literacy and entrepreneurship/self-employment.
H4	There is **a significantly positive correlation** between financial literacy and business success of entrepreneurs/self-employed.

Source: Own presentation.

According to hypothesis **H1**, a scientific framework to measure the financial literacy of entrepreneurs and self-employed can be developed. This hypothesis mainly relates to the underlying theory of this thesis. Using the measurability framework from the Allianz/Lusardi survey (2017) theory and with the help of the "Big Three" and "Big Five" questions (2011b/2014) and the OECD/INFE Framework (2020), quantitative research could be developed that measures financial literacy and groups it by the employment relationship. General financial literacy questions could be derived from existing surveys and questions related to knowledge from which a company benefits. The framework developed by the

OECD/INFE includes four primary areas of competence, each subdivided into specific topics. It describes the financial knowledge and skills entrepreneurs should possess to run their businesses effectively. The OECD has extensive experience developing financial literacy frameworks and measuring financial literacy in the general population. The "Big Three" and the risk questions used in the Allianz/Lusardi survey contain basic concepts for understanding interest rates, inflation and risk diversification. They are used worldwide to measure financial literacy. Comparing the survey results with those of Allianz/Lusardi and the OECD shows that those surveyed had a higher level of financial literacy. In this study and those of the OECD and Allianz/Lusardi, the same trends can be observed in the results in the individual areas. For example, the thesis and the Allianz/Lusardi survey participants performed worst in the "Expected Return" and "Risk and Return" areas. The only outlier here is the inflation question: the surveys differ significantly. This may be a consequence of the current inflation. The quantitative studies and the expert interviews provide scientifically valid results so that the mixed methods approach to measurement can be interpreted as appropriate. Hypothesis **H1** can thus be verified and the level of financial literacy of entrepreneurs and the self-employed can be measured using the developed scientific framework.

Hypothesis **H2** states that the financial literacy levels of employees and entrepreneurs can be measured and compared. No direct company-specific comparison between entrepreneurs and employees exists in the literature yet. A comparison between the two groups of participants is possible by conducting the survey with the financial questions used, which asks for general financial literacy and financial knowledge that is important in the company. The subjective self-assessment and the financial questions are supported by the objective assessment of experts from a bank's corporate customer advisory service. The 1st empirical study concluded a significant difference between the groups regarding financial knowledge. From the analysis of the 1st study, it can be seen that entrepreneurs answered the financial questions better. Entrepreneurs answered 88.2% of the financial questions correctly, while employees answered 81.8% correctly. Although employees' answers from the survey also testified to a good level of education, entrepreneurs performed visibly better, particularly in risk and return questions, with 76% (employees 63%). Logistic regression also provides statistical significance

in 1st study that entrepreneurs and self-employed have better financial literacy than employees/private individuals. The hypothesis is supported by the conducted expert interviews that a CC can be related to an entrepreneur and a PC to an employee. The described differences between PC and CC allow for comparability. Entrepreneurs who are CCs have an obligation to be more knowledgeable and prepared. The bank experts also confirmed in the interviews that CCs are better informed than PCs. They attributed this finding to the fact that CCs need significantly more information due to their entrepreneurial activities and have to deal more intensively with financial issues as part of their retirement planning since they cannot rely on state support compared to a PC.

In the 2nd and 3rd studies, no statistical significance was found due to the inclusion of backdoor variables (age, gender, income, etc.). The confounding variables suggest that being an entrepreneur is not dependent on having higher financial literacy, but rather that factors such as education, gender or income are statistically relevant. In this case, the Matching and Doubly-Robust method is more statistically accurate than logistic regression. Overall, for hypothesis H2 within this thesis, it can be stated that the **1st study** (based on logistic regression with a single variable) **is in line with H2**. The qualitative **expert interviews are also in line with H2**. In contrast, **H2 is rejected by** the **2nd and 3rd study**.

Hypothesis **H3** examines the influence of financial literacy on the intention to become an entrepreneur or self-employed. This hypothesis was tested in quantitative studies 1 to 3. The expert interviews did not include H3 in the scope. The **1st study is in line with** - due to its statistical limitations by logistic regression – **H3**. In the 2nd and 3rd study, no statistical significance of financial literacy on entrepreneurship was found by including the backdoor variables of Matching and Doubly-Robust method. However, the variables "Age" and "Risk Propensity" were found to be significant on entrepreneurship. It is particularly relevant for this thesis that the personal self-assessment of risk is a crucial variable for the intention to become an entrepreneur or self-employed person. The questions on risk and return as well as expected return integrated from the Allianz/Lusardi (2017) questionnaire provide an initial indication in the context of the risk assessment inquiry. However, the questions on these two categories are answered significantly worse by all participants (entrepreneurs/self-employed and employees/private

persons) than questions in the context of, i.e., the "Big Three". As a result, risk literacy does not significantly influence entrepreneurship or the willingness to become an entrepreneur. In this context, the personal (subjective) assessment of willingness or aversion to take risks is significant. The literature indicates that a moderate to slightly above-average risk tolerance is decisive for the willingness to become an entrepreneur or to be self-employed (Baum & Locke, 2004; Tett et al., 2003). In particular, a moderate risk tolerance can be crucial for successful entrepreneurship (Caliendo et al., 2009; Cramer et al., 2002; Chell et al., 1991). **The 2nd and 3rd study rejects H3**.

H4 suggests that a higher level of financial literacy also leads to greater business success. Overall, entrepreneurs and the self-employed have higher incomes than employees and private individuals in all quantitative studies conducted. However, it was necessary to answer the hypothesis (H4) that income and financial literacy are compared among each other exclusively for the group of entrepreneurs and self-employed. This comparison was carried out in the 3rd quantitative study since it had the largest number of participating entrepreneurs. The questionnaire used there processed and refined all the findings of the 1st and 2nd study. The **1st and 2nd** study, as well as the conducted **expert interviews, did not have the review of H4 in the scope**.

The statistical results of the 3rd quantitative study could prove that among the entrepreneurs and self-employed persons surveyed, those with a higher financial literacy also achieve a higher net income. It was also observed that entrepreneurs and self-employed persons with an average to slightly above-average risk affinity - measured by subjective self-assessment - achieve higher incomes than those who are risk-averse or have indicated a below-average willingness to take risks. If we equate the net income of entrepreneurs for this study with business or self-employment success, **the results are in line with H4.**

In summary, it can be concluded from this thesis that the mixed methods using quantitative (Matching and Doubly-Robust method) and qualitative (Expert Interviews) studies proved appropriate. Another finding is that a pure logistic regression is insufficient for statistical measurement since the so-called backdoor variables do not find an expression. Based on H1, it can be concluded that the questionnaire used in the 3rd study, which contains elements from the "Big Three",

the "Big Five", the Allianz/Lusardi Survey, and parts of the OECD (Allianz/Lusardi, 2017; Lusardi & Mitchell 2011b/2014; OECD; 2018; Van Rooij et al., 2011a) framework as well as a subjective self-assessment of the risk affinity of entrepreneurs and self-employed persons, has proven to be suitable. As a statistical method, due to the significant influence of socio-demographic factors on financial literacy, the Matching and Doubly-Robust method proves to be the most suitable - even though this measurement method leads to the weakening of financial literacy as a variable. Correlations can be measured most accurately using this method.

When testing the financial literacy of entrepreneurs and self-employed persons compared to employees/private persons (H2), the logistic regression of the 1st study leads to that the hypothesis is in line. The statements of the experts in the interviews conducted are also in line with this assumption. H2, however, as mentioned above, is rejected when backdoor variables are added in the Matching and Doubly-Robust method of the 2nd and 3rd study. **Overall, the result for H2 is ambiguous, as the statistical procedures reject the hypothesis in the majority, but the qualitative expert interviews are in line with the assumption**.

H3 tests the (significantly positive) correlation of financial literacy to entrepreneurship. Quantitative studies 1 to 3 test this correlation. Again, **H3 is only in line with the logistic regression results of the 1st study**, but rejected in the Matching and Doubly-Robust method of the 2nd and 3rd studies. Overall, no statistically significant correlation can be found between financial literacy and the probability of being or becoming an entrepreneur or self-employed person. **The hypothesis is therefore rejected**.

H4 assumes that entrepreneurs and the self-employed have higher business success due to higher financial literacy. The examination of business success was based on net income. **Exclusively the 3rd study had the H4 review in scope**. Using the Matching and Doubly-Robust method, a moderate correlation between higher financial literacy and business success (net income) was found for entrepreneurs and the self-employed. The third study identified a moderate correlation (Spearman correlation coefficient of 0.2209) between financial education and business success (higher income) among entrepreneurs. More financially educated entrepreneurs thus achieve a higher business success/income than less financially literate entrepreneurs.

In summary, the financial literacy of entrepreneurs and the self-employed can be measured through a scientific framework based on existing financial and risk literacy questions. A combination of quantitative and qualitative methods, a mixed methods approach, has proven to be scientifically effective. The questionnaire used in the 3rd study (based on Allianz/Lusardi, 2017; Lusardi & Mitchell, 2011b/2014; Van Rooij et al., 2011a) as well as the questions used in the interviews (focusing on the OECD framework of 2018) proved to be appropriate. Overall, a tendency towards higher financial literacy among entrepreneurs and the self-employed compared to employees and private individuals, as well as the intention to become an entrepreneur or self-employed (due to higher financial literacy), can only be found in logistic regression. These hypotheses were rejected in the statistically more exact Matching and Doubly-Robust method. In this case, a broader survey group (including a lower level of education overall) might provide different results. This aspect should be considered in future research.

A scientifically important finding is that entrepreneurs and the self-employed with a higher level of financial education also have greater business success (measured in net income). It is consistent with scientific research for private individuals (Bachmann et al., 2021).

In addition to testing the established hypotheses, socio-demographic factors were also a component of the statistical measurement procedures. Here, the gender gap already proven in numerous studies was also shown for this thesis. The gender gap can thus also be proven for entrepreneurs and the self-employed and has statistical significance. Suppose we relate the relatively low start-up rates among women to this. In that case, we can conclude that a higher level of financial education among women would probably also lead to a higher start-up rate.

Table 61. Overview of the Hypotheses Tests of Studies and Expert Interviews

Hypothesis	1st Study	2nd Study	3rd Study	Expert Interviews
H1	H_A	H_0	H_A	H_A
H2	H_A	H_0	H_0	H_A
H3	H_A	H_0	H_0	*Out of Scope*
H4	*Out of Scope*	*Out of Scope*	H_A	*Out of Scope*

Source: Own presentation.

VIII – LIMITATIONS AND FUTURE WORK

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The present limitations and the literature provide insights into future research approaches. Most studies use the "Big Three" or "Big Five" model. However, these models are also subject to substantial limitations and limited informative value due to the small number of questions. Other questions have not been adopted uniformly to date but have been set up individually by the respective authors during the studies. The previous research implies that future studies should use questionnaires specifically adapted to entrepreneurship to gain more profound insights into the study context. The biggest problem is the lack of a uniform measurement method and the crucial differences between financial literacy construct in the context of private individuals and entrepreneurs/self-employed. First steps have been taken in this regard by the OECD (2018), which has published an initial definitional framework as a reference for developing a unified methodology for measuring the financial literacy of entrepreneurship. In addition, clear interpretive rules need to be established for comparing the financial literacy of individuals and entrepreneurs since entrepreneurs always have to make financial decisions as individuals simultaneously. Thus, suitable results may be obtained if only entrepreneurs' financial literacy is measured using a method specified for entrepreneurship.

Once a uniform method of measurement has been defined and uniform rules of interpretation have been established, future research approaches should go beyond comparisons with private individuals and look in detail at the relationship between financial literacy and entrepreneurial performance and the decisions made by entrepreneurs, as well as their impact on entrepreneurial success. This will ultimately allow conclusions to be drawn about the effect of financial literacy on factors such as growth and business survival in difficult situations such as the current geopolitical situation. Previous studies have focused heavily on research methods on private individuals' financial literacy, which is why other variables should be examined in addition to the usual measurement methods.

However, asking for additional variables involves the difficulties already mentioned of a potentially high dropout rate due to the time required, especially

when surveying the target group of entrepreneurs, who only have limited time available for surveys. This does, on the other hand, improve the validity of the statistical research methods. However, one of the most significant challenges for future research will be the need to control the increasing number of confounding factors associated with this. In addition to socio-demographic variables, personality traits have also been identified in the literature (e.g., Shinnar et al., 2012) as important factors influencing entrepreneurship. They should be further investigated in future research approaches.

For investigation, as evidenced in existing literature, qualitative approaches to analysing the relationship between financial literacy and entrepreneurship are suitable in addition to the primarily used quantitative approaches. Here, among other things, the research form of the experiments is vital in order to further test for causal relationships. This paper shows that Matching methods can be the first step in investigating causality. However, it is important to note that the design of qualitative studies in this area also faces significant challenges. In the literature, mixed methods as a combination of quantitative and qualitative investigation are particularly effective, so future research approaches should use a mixed methods to combine the advantages.

Limitations have emerged while writing this thesis, some of which have already been addressed in the research critique of the empirics. On the one hand, due to the still young foundational literature and the different approaches, financial literacy theory is highly mutable, making it difficult to define and generally address the topic. On the other hand, the quantitative study resulted in limitations in the number of participants on the part of the entrepreneurs. It is recommended to build on this and to expand the survey with a higher number of participants in order to obtain representative results. It should also be noted that using PSM, MDM and Doubly-Robust method is limited to controlling for endogeneity due to observable variables. In future research, the control of endogeneity due to unobserved influences through methods such as instrumental variables (IV) regression is highly recommended for future research.

In addition, it makes sense for further analysis to subject the size dependency of the companies to a more detailed examination concerning financial literacy. In the expert interview, it became clear that financing structures and risk management

also increase with the company's size. Thus, an entrepreneur of a larger company would have to have broader financial knowledge than an entrepreneur of a smaller company.

In the course of this research project, the problem also arose that, in addition to a broader scope in terms of the number of participants and the size of the companies surveyed, it would be particularly appropriate to have a more comprehensive sample of respondents in terms of their level of education. In all three quantitative studies conducted, the level of education was above average and lower levels of education were under-represented. Since the level of education is crucial for financial literacy and (as evidenced by the quantitative empirical research in this thesis) for entrepreneurship/self-employment, lower levels of education must be more strongly included in surveys.

Furthermore, this research has shown that entrepreneurs and the self-employed are challenging to persuade to participate in a survey. The relevant (entrepreneurial) lobbying associations have also demonstrated limited cooperation, so a long-term study - supported by entrepreneurial associations - could be significant for the research.

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X – APPENDIXES

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APPENDIX 1. Financial Literacy Definitions in Germany

Term	Definition and conceptual Classification
Finanzielle Allgemeinbildung *Financial Literacy* (Reifner, 2003)	„Finanzielle Allgemeinbildung im Sinne dieser Untersuchung betrifft die kritische und an den Bedürfnissen der Nutzer orientierte Vermittlung von Wissen, Verständnis und sozialer Handlungs-kompetenz im Umgang mit auf Kreditmöglichkeiten aufgebauten Finanzdienstleistungen, die die Menschen außerhalb ihrer beruflichen Sphäre für sich selber benutzen, um Einkommen und Ausgaben, Arbeit und Konsum während ihrer Lebenszeit sinnvoll miteinander in Beziehung setzen zu können." *"Financial literacy in the sense of this study concerns the critical and user-oriented transfer of knowledge, understanding and social competence in dealing with financial services based on credit facilities, which people use for themselves outside their professional sphere in order to be able to relate income and expenses, work and consumption to each other meaningfully during their lifetime."*
Finanzielle Allgemeinbildung/ Finanzkompetenz *Financial Literacy/Competence* (Kaminski and Friebel, 2012)	„Finanzielle Allgemeinbildung bezeichnet den Prozess zur Entwicklung von Finanzkompetenz. Diese wird als die Summe von Einstellungen, Motivationen, Wertvorstellungen, Kenntnissen, Fähigkeiten und Fertigkeiten verstanden, die es einem Individuum ermöglichen, sich kompetent und mündig auf dem Finanzdienst-leistungsmarkt zu orientieren, es befähigen, seine privaten Finanzen zu organisieren, entsprechend zu handeln und sich an der Analyse und Gestaltung der institutionellen Rahmenbedingungen des Finanzdienst-leistungsbereichs zu beteiligen. Finanzielle Allgemeinbildung umfasst neben der Verbraucher-perspektive auch die Unternehmensperspektive und die ordnungs-politische Dimension, um eine multiperspektivische Auseinander-setzung mit dem Finanzwesen, den Finanzprodukten und den darauf bezogenen institutionellen Rahmen-bedingungen zu ermöglichen." *"Financial literacy refers to the process of developing financial competence. This is understood as the sum of attitudes, motivations, values, knowledge, abilities and skills that enable an individual to orientate himself or herself competently and maturely in the financial services market, to organise his or her private finances, to act accordingly and to participate in the analysis and configuration of the institutional framework of the financial services sector. General financial education includes not only the consumer perspective but also the corporate perspective and the regulatory dimension, in order to enable a multi-perspective examination of the financial system, financial products and the related institutional framework."*

Term	Definition and conceptual Classification
Finanzwissen *Financial Education (Literacy)* (European Commission, 2007)	„Die Vermittlung von Finanzwissen soll dem Einzelnen Finanzprodukte und -konzepte näherbringen und ihm das nötige Rüstzeug an die Hand geben, um sich in diesem Bereich zurechtzufinden und bei Finanzdienstleistungen in Kenntnis der Risiken und Chancen die richtige Entscheidung zu treffen. Finanzwissen sollte ein Leben lang erworben werden. Die Vermittlung von Finanzwissen stellt eine Ergänzung zu den legislativen Bemühungen dar, angemessene Verbraucherinformationen, einen angemessenen Verbraucherschutz und eine angemessene Verbraucher-beratung sicherzustellen. Zusammengenommen helfen diese Maßnahmen den Verbrauchern, die für ihre persönliche Finanzlage besten Entscheidungen zu treffen." *„Financial education is intended to give individuals an understanding of financial products and concepts and to provide them with the necessary tools to find their way around in this area and to make the right decisions in financial services in full knowledge of the risks and opportunities. Financial education should be acquired throughout life. Financial education complements legislative efforts to ensure adequate consumer information, protection and advice. Taken together, these measures help consumers to make the best decisions for their personal financial situation."*

Source: Illustration by the author based on European Commission, 2007; Kaminski & Friebel, 2012; Reifner, 2003.

APPENDIX 2. The "Big Three" Financial Literacy Questionnaire

The "Big Three" financial literacy questions (listed below), created by Professor Annamaria Lusardi and Professor Olivia S. Mitchell, have now been used in more than 20 countries to measure financial knowledge. Comparisons of results across countries have demonstrated that financial illiteracy is a global problem, that financial literacy peaks in middle age, and that women consistently score lower than men. (Note: Correct Answers in **bold**).

1. **Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?**

    - **More than $102**
    - Exactly $102
    - Less than $102
    - Do not know
    - Refuse to answer

2. **Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?**

    - More than today
    - Exactly the same
    - **Less than today**
    - Do not know
    - Refuse to answer

3. **Please tell me whether this statement is true or false. "Buying a single company's stock usually provides a safer return than a stock mutual fund."**

- o   True
- o   **False**
- o   Do not know
- o   Refuse to answer

Source: GFLEC, Three Questions to Measure Financial Literacy, accessed 1ˢᵗ of November 2022 at: http://gflec.org/wp-content/uploads/2015/04/3-Questions-Article2.pdf.

APPENDIX 3. The "Big Five" Financial Literacy Questionnaire

1. **Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?**

    A) More than $102

    B) Exactly $102

    C) Less than $102

    D) Don't know

    E) Prefer not to say

2. **Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?**

    A) More than today

    B) Exactly the same

    C) Less than today

    D) Don't know

    E) Prefer not to say

3. **If interest rates rise, what will typically happen to bond prices?**

    A) They will rise

    B) They will fall

    C) They will stay the same

    D) There is no relationship between bond prices and the interest rate

    E) Don't know

    F) Prefer not to say

4. **A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.**

    A) True

    B) False

    C) Don't know

    D) Prefer not to say

5. **Buying a single company's stock usually provides a safer return than a stock mutual fund.**

    A) True

    B) False

    C) Don't know

    D) Prefer not to say

Source: GFLEC, "Big Five" Test your financial literacy knowledge with the "Big Five" questions, accessed 1ˢᵗ of November 2022 at: https://gflec.org/education/questions-that-indicate-financial-literacy#5.

APPENDIX 4. The "Big Five" by Anderson, Baker and Robinson

(Note: Correct Answers in **bold**)

Compounding. Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? Please select one.

- o **More than $102**
- o Exactly $102
- o Less than $102
- o Don't know
- o Prefer not to say

Inflation. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? Please select one.

- o More than today
- o Exactly the same as today
- o **Less than today**
- o Don't know
- o Prefer not to say

Diversification. Buying a single company's stock usually provides a safer return than a stock mutual fund. Please select one.

- o True
- o **False**

- o   Don't know

- o   Prefer not to say

Mortgage. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. Please select one.

- o   **True**
- o   False
- o   Don't know
- o   Prefer not to say

Bond Pricing. If interest rates fall, what should happen to bond prices? Please select one.

- o   They will rise
- o   **They will fall**
- o   They will stay the same
- o   There is no relationship between bond prices and the interest rate
- o   Don't know
- o   Prefer not to say

Source: Anderson et al., 2016. Precautionary Savings, Retirement Planning and Misperceptions of Financial Literacy. Swedish House of Finance Research, No.15-01, Duke I&E Research Paper No. 15-5, p. 27.

APPENDIX 5. DHS Supplements by van Rooij, Lusardi & Alessi

(Note: Correct Answers in **bold**)

Module 1: Basic Literacy Questions

1.) Numeracy

Suppose you had 100 € in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

- o **More than 102 €**
- o Exactly 102 €
- o Less than 102 €
- o Do not know
- o Refusal

2.) Interest Compounding

Suppose you had 100 € in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total?

- o **More than 200 €**
- o Exactly 200 €
- o Less than 200 €
- o Do not know
- o Refusal

3.) Inflation

Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

- o   More than today
- o   Exactly the same
- o   **Less than today**
- o   Do not know
- o   Refusal

4.) Time Value of Money

Assume a friend inherits 10,000 € today and his sibling inherits 10,000 € 3 years from now. Who is richer because of the inheritance?

- o   **My friend**
- o   His sibling
- o   They are equally rich
- o   Do not know
- o   Refusal

5.) Money Illusion

Suppose that in the year 2010, your income has doubled, and prices of all goods have doubled too. In 2010, how much will you be able to buy with your income?

- o   More than today
- o   **The same**
- o   Less than today

- o   Do not know

- o   Refusal

Module 2: Advanced Literacy Questions

6.) Which of the following Statements describes the Main Function of the Stock Market?

- o   The stock market helps to predict stock earnings

- o   The stock market results in an increase in the price of stocks

- o   **The stock market brings people who want to buy stocks together with those who want to sell stocks**

- o   None of the above

- o   Do not know

- o   Refusal

7.) Which of the following Statements is correct?

If somebody buys the Stock of Firm B in the Stock Market:

- o   **He owns a part of Firm B**

- o   He has lent money to Firm B

- o   He is liable for Firm B's debts

- o   None of the above

- o   Do not know

- o   Refusal

8.) Which of the following Statements is correct?

- o   Once one invests in a mutual fund, one cannot withdraw the money in the first year
- o   **Mutual funds can invest in several assets, for example, invest in both stocks and bonds**
- o   Mutual funds pay a guaranteed rate of return which depends on their past performance
- o   None of the above
- o   Do not know
- o   Refusal

9.) Which of the following Statements is correct?
If somebody buys a bond of firm B:

- o   He owns a part of firm B
- o   **He has lent money to firm B**
- o   He is liable for firm B's debts
- o   None of the above
- o   Do not know
- o   Refusal

10.) Considering a long Time Period (e.g., 10 or 20 Years), which Asset normally gives the highest Return?

- o   Savings accounts
- o   Bonds
- o   **Stocks**

o   Do not know

o   Refusal

11.) Normally, which Asset displays the highest Fluctuations over time?

o   Savings accounts

o   Bonds

o   **Stocks**

o   Do not know

o   Refusal

12.) When an Investor spreads his Money among different Assets, does the Risk of losing Money:

o   Increase

o   **Decrease**

o   Stay the same

o   Do not know

o   Refusal

13.) If you buy a 10-year Bond, it means you cannot sell it after 5 Years without incurring a Major Penalty. True or false?

o   True

o   **False**

o   Do not know

o   Refusal.

14.) Stocks are normally riskier than Bonds. True or false?

- o **True**
- o False
- o Do not know
- o Refusal

15.) Buying a Company Stock usually provides a safer Return than a Stock Mutual Fund. True or false?

- o True
- o **False**
- o Do not know
- o Refusal

16.) If the Interest Rate falls, what should happen to Bond Prices?

- o **Rise**
- o Fall
- o Stay the same
- o None of the above
- o Do not know
- o Refusal

Source: van Rooij et al. (2012). Financial literacy, retirement planning and household wealth. The Economic Journal, 122(560), pp. 449 – 478.

APPENDIX 6. S&P Global Financial Literacy Survey Questionnaire

In the "S&P Global Financial Literacy Survey", the literacy questions that measure the four fundamental concepts for financial decision-making are basic numeracy, interest compounding, inflation, and risk diversification (correct answers in **bold**) are posed as follows.

Risk Diversification:

Suppose you have some money. Is it safer to put your money into one business or investment, or to put your money into multiple businesses or investments?

- o one business or investment
- o **multiple businesses or investments**
- o don't know
- o refused to answer

Inflation:

Suppose over the next 10 years the prices of the things you buy double. If your income also doubles, will you be able to buy less than you can buy today, the same as you can buy today, or more than you can buy today?

- o less
- o **the same**
- o more
- o don't know
- o refused to answer

Numeracy (Interest)

Suppose you need to borrow 100 US dollars. Which is the lower amount to pay back: 105 US dollars or 100 US dollars plus three percent?

- o   105 US dollars

- o   **100 US dollars plus three percent**

- o   don't know

- o   refused to answer

Compound Interest

Suppose you put money in the bank for two years and the bank agrees to add 15 percent per year to your account. Will the bank add more money to your account the second year than it did the first year, or will it add the same amount of money both years?

- o   **more**

- o   the same

- o   don't know

- o   refused to answer

Suppose you had 100 US dollars in a savings account and the bank adds 10 percent per year to the account. How much money would you have in the account after five years if you did not remove any money from the account?

- o   **more than 150 dollars**

- o   exactly 150 dollars

- o   less than 150 dollars

- o   don't know

- o   refused to answer

Source: **Standard & Poor's Ratings Services**, Global Financial Literacy Survey 2014, p. 6.

APPENDIX 7. Financial Decision Questions (Allianz/Lusardi Survey)

(Note: Correct Answers in **bold**)

Scenario 1: Longevity Risk

Alexa is 66 years old and about to retire. She is still in good health and is looking forward to enjoying her retirement. She owned a small restaurant and was self-employed for her entire working life. Recently, she sold the restaurant and put the proceeds into a bank account, which she considers sufficient to cover unforeseen expenses. She does not have a partner or close relatives. In addition, she paid into a retirement savings product which is about to come due. The product provider offers her two options to access her savings:

1. Alexa can receive 250,000 € as a lump sum payment right now (in other words, a single 250,000 payment), or

2. Alexa can receive 1,700 € as a stream of monthly fixed payments over her entire lifetime until death

Alexa wants to be sure she has enough money until she dies. Which payout method would you recommend?

☐ Take the lump sum

☐ **Take the stream of fixed payments**

☐ Does not make any difference

☐ Don't know

Scenario 2: Liquidity Risk

Your friend Bob is excited. His daughter will be marrying in two years and he promised to pay for the wedding festivities. He wants to set aside the money today and does not want to keep the money in his bank account. Bob considered the current investment offers from his bank on the Internet and came up with three interesting products:

1. A commodity fund which invests in gold and which, despite large fluctuations in the last two years, achieved an annual return after costs of 7%.

2. **A two years fixed-term deposit with a fixed interest of 1.5% per annum.**

3. An insurance product with a guaranteed interest rate of 2.5% per year and entails an entry cost of 5% of the invested capital.

Which option would you recommend?

☐ Commodity fund

☐ **Fixed-term deposit**

☐ Insurance product

☐ Don't know

Scenario 3: Underdiversification Risk

Helen is 40 years old. She is an employee at a large German company. She has a regular and secure income. She owns her own apartment and has no outstanding debt. She is already well prepared with a retirement savings plan and has set aside a little bit of money for a rainy-day fund. She unexpectedly received an inheritance

of 10,000 €. As she does not need the money immediately, she plans to invest the money long-term and is willing to take some risk to achieve a higher return. Her advisor presented her two investment options (see the following illustration). She is unsure and asks you for advice of what to do.

<table>
<tr><td>

☐ Product name "**Global Multi Asset**"
Investment objective:
The fund invests 75% of its portfolio in international stocks and 25% in the market for European bonds with an investment-grade rating.

– Expected return (p.a.): 6.40%
– Expected volatility (p.a.): (Price fluctuation) 7.50%
– Expected years with negative returns: One year in five years
– Benchmark stocks: MSCI World Index
– Benchmark bonds: Barclays Euro Aggregate Index
– Total expense ratio (costs): 0.75%

</td><td>

☐ Product name "**German Multi Asset**"
Investment objective:
The fund invests 75% of its portfolio in *German* stocks and 25% in the market for *German* bonds with an investment-grade rating.

– Expected return (p.a.): 5.00%
– Expected volatility (p.a.): (Price fluctuation) 7.50%
– Expected years with negative returns: One year in four years
– Benchmark stocks: *DAX Index*
– Benchmark bonds: *REX Index*
– Total expense ratio (costs): 0.75%

</td></tr>
</table>

☐ Neither option 1, nor option 2. Rather keep the money in bank account

☐ Don't know

Source: Own presentation based on Allianz/Lusardi (2017), "When will the penny drop? Money, Financial Literacy and Risk in the Digital Age", pp. 18 – 20.

APPENDIX 8. OECD Framework on Financial Literacy for MSMEs
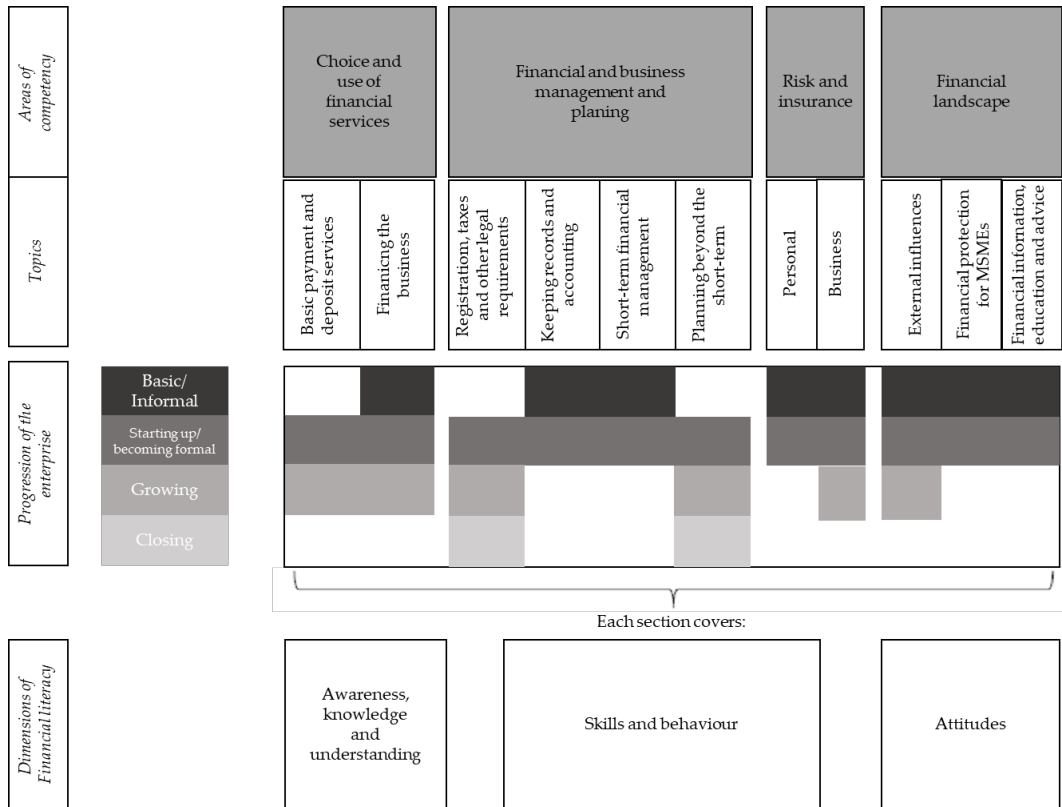
Source: Own presentation based on OECD/INFE Core Competencies Framework on Financial Literacy for MSMEs (OECD, 2018).

APPENDIX 9. Top 20 Most cited Financial Literacy Papers

Rank	Authors	Published	Journal	Title
1	Lusardi, A. & Mitchell, O.S.	2007	Journal of Monetary Economics	"Baby boomer retirement security: the roles of planning, financial literacy, and housing wealth".
2	van Rooij, M.C.J., Lusardi, A. & Alessie, R.J.M.	2011	Journal of Finance and Economics	"Financial literacy and stock market participation".
3	Lusardi, A. & Mitchell, O.S.	2008	The American Economic Review	"Planning and financial literacy: How do women fare?".
4	Lusardi, A., Mitchell, O.S. & Curto, V.	2010	Journal of Consumer Affairs	"Financial literacy among the young".
5	Lusardi, A. & Mitchell, O.S.	2011	Journal of Pensions Economics and Finance	"Financial literacy around the world: an overview".
6	Huston, S.J.	2010	Journal of Consumer Affairs	"Measuring Financial Literacy".
7	Lusardi, A. & Mitchell, O.S.	2014	Journal of Economic Literature	"The economic importance of financial literacy: theory and evidence".
8	Howlett E, Kees, J. & Kemp, E.	2008	Journal of Consumer Affairs	"The role of self-regulation, future orientation, and financial knowledge in long-term financial decisions".
9	McDaniel, L., Martin, R.D. & Maines, L.A.	2002	The Accounting Review	"Evaluating financial reporting quality: the effects of financial expertise versus financial literacy".

Rank	Authors	Published	Journal	Title
10	van Rooij, M.C.J., Lusardi, A. & Alessie, R.J.M.	2011	Journal of Economic Psychology	"Financial literacy and retirement planning in the Netherlands".
11	Lusardi, A. & Mitchell, O.S.	2011	Journal of Pensions Economics and Finance	"Financial literacy and retirement planning in the United States"
12	Remund, D.L.	2010	Journal of Consumer Affairs	"Financial literacy explicated: the case for a clearer definition in an increasingly complex economy".
13	Kozup, J. & Hogarth, J.M.	2008	Journal of Consumer Affairs	"Financial literacy, public policy, and consumers' self-protection - more questions, fewer answers".
14	van Rooij, M.C.J., Lusardi, A. & Alessie, R.J.M.	2012	The Economic Journal	"Financial literacy, retirement planning and household wealth".
15	Fernandes, D., Lynch, J.G. & Netemeyer, R.G.	2014	Management Science	"Financial literacy, financial education, and downstream financial behaviours".
16	Gathergood, J.	2012	Journal of Economic Psychology	"Self-control, financial literacy and consumer overindebtedness".
17	Bucher-Koenen, T. & Lusardi, A.	2011	Journal of Pensions Economics and Finance	"Financial literacy and retirement planning in Germany".
18	Servon, L.J. & Kaestner, R.	2008	Journal of Consumer Affairs	"Consumer financial literacy and the impact of online banking on

Rank	Authors	Published	Journal	Title
				the financial behavior of lower-income bank customers".
19	Bruine de Bruin et al.	2010	Journal of Consumer Affairs	"Expectations of inflation: the role of demographic variables, expectation formation, and financial literacy".
20	Walstad, W.B., Rebeck, K. & MacDonald, R.A.	2010	Journal of Consumer Affairs	"The effects of financial education on the financial knowledge of high school students".

Source: Own presentation based on Stolper & Walter, 2017, pp. 582 – 587.

APPENDIX 10. Questionnaire 1ˢᵗ Quantitative Study

1. How old are you?

    o   18 - 25 years

    o   26 - 35 years

    o   36 - 50 years

    o   > 50 years

    o   I refuse to answer

2. What is your biological Gender?

    o   Male

    o   Female

    o   Diverse

    o   I refuse to answer

3. What is your highest Educational Qualification?

    o   Secondary School

    o   High School

    o   High School Diploma or equivalent (entrance Qualification for Studies at Universities of Applied Sciences)

    o   Bachelor's degree

    o   Master's Degree or earlier equivalent (Diploma, Magister)

    o   Doctorate Degree

    o   No Degree

4. What is your Parents' highest Level of Education?

    o   Secondary school

    o   High School

    o   High School Diploma or equivalent (entrance qualification for studies at
        universities of applied sciences)

    o   Bachelor's degree

    o   Master's Degree or earlier equivalent (Diplom, Magister)

    o   Doctorate degree

5. What is your own average monthly Net Income?

    o   No Income

    o   450 - 1.000€

    o   1.001 - 2.000€

    o   2.001€ - 5.000€

    o   5.001 - 10.000€

    o   > 10.000€

6. How many years of professional Experience do you have?

    o   0 - 5 years

    o   6 - 10 years

o   11 - 20 years

o   20+

7. According to your personal Assessment (Scale: 1 = not at all and 10 = comprehensively), how well did your Parents educate you about dealing with Finances?

    [Scale from 1 - 10 as a response]

8. Did you have Economics or a similar Subject in School?

    o   Yes

    o   No

9. Have you previously worked or completed Internships while in School?

    o   Yes

    o   No

10. What is your current Employment Status?

    o   Employee

    o   Self-employed/Entrepreneur

    o   No Employment Relationship (School Pupil/Full-time Student)

11. Do you come from a Family of Business Owners?

o Yes

o No

12. How long has your Company existed?

o < 5 years

o 5 - 9 years

o 10 - 14 years

o 15 - 20 years

o > 20 years

13. How long have you been a Business Owner, even if you have run a Business before?

o < 1 year

o 1 - 2 years

o 2 - 5 years

o 6 - 10 years

o > 10 years

14. In which Industry does your Company operate?

   o   Management Consulting

   o   IT (Information Technology, Artificial Intelligence)

   o   Banking / Financial Services

   o   Electronics Industry

   o   Trade and Commerce

   o   Real Estate Industry

   o   Healthcare / Social Services

   o   Automotive / Engineering Industry

   o   Gastronomy

   o   other Industry

15. How many Employees work in your Company?

   o   < 10

   o   10 - 49

   o   50 - 249

   o   > 249

16. What is the annual Turnover of your Company?

   o   < 1 M€

- o   1 - 5 M€

- o   5 - 10 M€

- o   10 - 50 M€

- o   > 50 M€

17. Suppose you had 100 € in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

- o   **More than 102 €**
- o   Exactly 102 €
- o   Less than 102 €
- o   Don't know
- o   I refuse to answer

18. For the same amount of money, you can enter either one of two lotteries: Lottery A pays a prize of €200 and the chance of winning is 5%. Lottery B: pays a prize of €90,000 and the chance of winning is 0.01%. If you do not win, you do not receive any money. Which lottery pays the higher average amount?

- o   **Lottery A**
- o   Lottery B
- o   These two lotteries pay the same average amount
- o   Don't know
- o   I refuse to answer

19. You can invest in two projects. Project A will either deliver a return of 10% or 6% with either outcome equally likely. Project B will either deliver a return of 12% or 4% with either outcome equally likely. Which of the following is true? Compared to Project B, Project A has...

   o   Higher return and lower risk
   o   **Same average return and lower risk**
   o   Lower return and higher risk
   o   Don't not know
   o   I refuse to answer

20. Please tell me if this statement is true or false. "A company pays dividends to a bank to pay off a loan."

   o   True
   o   **False**
   o   Don't not know
   o   I refuse to answer

21. Imagine you receive 200€ as a gift, but you have to wait a year before you can spend the money. If inflation stays at 2%, how much will you be able to buy with the 200€ in one year?

   o   **Less than today**
   o   Exactly the same
   o   More than today
   o   I do not know
   o   I refuse to answer

22. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. Please select one.

   o **True**

   o False

   o Don't know

   o I refuse to answer

23. Please tell me if this Statement is true or false. "If a financial investment offers the chance to make a lot of money, it is likely that there is also the risk of losing a lot of money."

   o **True**

   o False

   o Don't know

   o I refuse to answer

24. Please tell me if this Statement is true or false. "High inflation means that the cost of living is rising rapidly."

   o **True**

   o False

   o Don't know

   o I refuse to answer

25. Thank you for participating in the survey. I would be happy to send you the results of the survey if you are interested. Please enter your e-mail address.

   [Field for entering the email address]

Source: Own elaboration based on Allianz/Lusardi (2017), Lusardi & Mitchell (2011b/2014) and OECD (2018).

APPENDIX 11. Questionnaire 2ⁿᵈ Quantitative Study

1. Suppose you had 100 € in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

    o   **More than 102 €**

    o   Exactly 102 €

    o   Less than 102 €

    o   Don't know

    o   I refuse to answer

2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? Please select one.

    o   More than today

    o   Exactly the same as today

    o   **Less than today**

    o   Don't know

    o   I refuse to answer

3. If interest rates rise, what will typically happen to bond prices? Please select one.

    o   They will rise

    o   **They will fall**

    o   They will stay the same

    o   There is no relationship between bond prices and the interest rate

o Don't know

o I refuse to answer

4. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. Please select one.

o **True**

o False

o Don't know

o I refuse to answer

5. Buying a single company's stock usually provides a safer return than a stock mutual fund. True or false?

o True

o **False**

o Don't know

o I refuse to answer

6. Suppose you owe 3.000€ on your credit card. You pay a minimum payment of 30€ each month. At an annual percentage rate of 12% (or 1% per month), how many years would it take to eliminate your credit card debt if you made no additional new charges?

o Less than 5 years

o Between 5 to 10 years

o   Between 10 to 15 years

o   **Never**

o   I don´t know

o   I refuse to answer

7. How would you rate yourself personally? Are you generally a risk taker or do you try to avoid risks? Please check a box on the scale where 0 means "not at all willing to take risks" and 10 means "very willing to take risks".

    [Scale from 1 - 10 as a possible response]

8. What is your biological Gender?

o   Male

o   Female

o   Diverse

o   I refuse to answer

9. How old are you? (If you do not want to answer this question, you can simply skip and work on the next question)

    [Entering a Number]

10. What is your highest educational qualification?

   o Completion of vocational-occupational Training (Apprenticeship)

   o Completion of vocational school Training (vocational or commercial School)

   o Completion of a technical School, Master Craftsman School or technical School

   o Bachelor's Degree

   o Master's Degree or earlier equivalent (Diplom, Magister)

   o Doctorate Degree (Ph.D.)

   o No educational Qualification (yet)

   o Not stated

   o Other

11. On a scale of 1-10: How would you rate your parents' education/knowledge transfer on the subject of finance? (Where the value 1 represents a low level of knowledge transfer and the value 10 represents an extremely high level of knowledge transfer).

   [Scale from 1 - 10 as a possible response]

12. What is your own average monthly net income? (Please enter in €; if you do not want to answer this question, you can simply skip and work on the next question).

    [Entering a Number]

13. Which employment situation suits you? What in this list applies to you? Please note that employment means any paid activity or activity associated with an income.

    o   Full-Time

    o   Part-time

    o   In vocational training/apprenticeship

    o   Not employed (including Pupils or Students not working for pay, Unemployed, Early Retirees, Pensioners without additional income)

    o   Not specified

    o   Other

14. Are you self-employed or a freelancer?

    o   Yes

    o   No

    o   Not specified

15. In which year was your company founded? (If you do not want to answer this question, you can simply skip and work on the next question).

   [Entering a Number]

16. In which industry does your company operate?

   o   Management Consulting

   o   IT

   o   Banking and Insurance [Financial Services]

   o   Electrical Industry

   o   Real Estate Industry

   o   Healthcare Industry

   o   Gastronomy

   o   Other

17. How many employees does your company have? (If you do not want to answer this question, you can simply skip and work on the next question).

   [Entering a Number]

18. How much turnover did your company achieve in the past calendar year? (Please enter in €; if you do not want to answer this question, you can simply skip and work on the next question).

   [Entering a Number]

Source: Own elaboration based on Lusardi & Mitchell (2011b/2014) and Riepe et al. (2022).

APPENDIX 12. Questionnaire 3rd Quantitative Study

1. How old are you?

    [Entering a Number]

2. What is your biological Gender?

    o   Male

    o   Female

    o   Diverse

    o   I refuse to answer

3. What is your highest Educational Qualification?

    o   Completion of vocational-occupational Training (Apprenticeship)

    o   Completion of vocational school Training (vocational or commercial School)

    o   Completion of a technical School, Master Craftsman School or technical School

    o   Bachelor's Degree

    o   Master's Degree or earlier equivalent (Diplom, Magister)

    o   Doctorate Degree (Ph.D.)

    o   No educational Qualification (yet)

    o   Not stated

4. Do you have a Migration Background (i.e., you were not born in Germany)?

   o   Yes

   o   No

   o   Not specified

5. **On a Scale of 1 - 5**: How would you rate your Parents' Education/Knowledge

   Transfer on the topic of Finance? (Where the value 1 represents no Knowledge

   Transfer and the value 5 represents an exceedingly high Knowledge Transfer).

   o   1 = no Knowledge Transfer

   o   2 = low Knowledge Transfer

   o   3 = average Knowledge Transfer

   o   4 = good Knowledge Transfer

   o   5 = exceptionally good Knowledge Transfer

   o   Not specified

6. Did you have Economics or a similar Subject in School?

   o   Yes

   o   No

   o   Not specified

7. Which Employment Situation applies to you? Please note that paid Employment is understood to mean any paid Activity or Activity associated with an Income.

   o Full-time (more than 48 hours)

   o Full-time (41 - 48 hours)

   o Full-time (40 hours)

   o Full-time (35 - 39 hours)

   o Full-time (30 - 34 hours)

   o Part-time (21 - 29 hours)

   o Part-time (20 hours)

   o Part-time (less than 20 hours)

   o In vocational training/apprenticeship

   o Not employed (including Pupils or Students not working for pay, Unemployed, Early Retirees, Pensioners without additional income)

   o Not specified

8. What is your monthly Net Income?

   o No Income

   o up to 1.000 €

   o > 1.000 - 2.000 €

   o > 2.000 - 3.000 €

- o   > 3.000 - 4.000 €

- o   > 4.000 - 5.000 €

- o   > 5.000 €

- o   Not specified

9. Are you self-employed (Entrepreneur/Freelancer)?

- o   Yes

- o   No

- o   Not specified

10. In which year did you start your own business?

[Entering a Number]

11. How much Revenue did your Company generate in the past Calendar Year?

- o   ≤ € 2 million

- o   > € 2 - 10 million

- o   > 10 - 50 m €

- o   > € 50 million

- o   Not specified

12. In which industry does your company operate?

- o   Automotive Industry

- o   Banking and Insurance [Financial Services]

- o   Electrical Industry

- o   Gastronomy

- o   Healthcare Industry

- o   Trade and Commerce

- o   Real Estate Industry

- o   IT (Information Technology, Artificial Intelligence, Digital Solutions, Software)

- o   Mechanical Engineering

- o   PR/Marketing

- o   Service Industry

- o   Social Services

- o   Management Consulting

- o   Other Industry (none of the above)

- o   Not specified

13. How many employees work in your company?

    o   < 10

    o   10 - 49

    o   50 - 249

    o   > 249

    o   Not specified

14. Suppose you had 100 € in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

    o   **More than 102 €**
    o   Exactly 102 €
    o   Less than 102 €
    o   Don't know
    o   I refuse to answer

15. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? Please select one.

    o   More than today
    o   Exactly the same as today
    o   **Less than today**
    o   Don't know
    o   I refuse to answer

16. Buying a single company's stock usually provides a safer return than a stock mutual fund. True or false?

   o   True

   o   **False**

   o   Don't know

   o   I refuse to answer

17. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. Please select one.

   o   **True**

   o   False

   o   Don't know

   o   I refuse to answer

18. Which of the following statements is correct? If somebody buys the stock of Firm B in the stock market:

   o   **He owns a part of Firm B**

   o   He has lent money to Firm B

   o   He is liable for Firm B's debts

   o   None of the above

   o   Don't know

   o   I refuse to answer

19. For the same amount of money, you can enter either one of two lotteries: Lottery A pays a prize of €200 and the chance of winning is 5%. Lottery B: pays a prize of €90,000 and the chance of winning is 0.01%. If you do not win, you do not receive any money. Which lottery pays the higher average amount?

   o **Lottery A**

   o Lottery B

   o These two lotteries pay the same average amount

   o Don't know

   o I refuse to answer

20. You can invest in two projects. Project A will either deliver a return of 10% or 6% with either outcome equally likely. Project B will either deliver a return of 12% or 4% with either outcome equally likely. Which of the following is true? Compared to Project B, Project A has...

   o Higher return and lower risk

   o **Same average return and lower risk**

   o Lower return and higher risk

   o Don't not know

   o I refuse to answer

21. Over a long period of time (e.g., 10 or 20 years), which investment typically provides the highest return?

   o Overnight Deposits

   o Time Deposits

   o Savings Accounts

o Bonds/Fixed Income Funds

o **Stocks/Equity Funds**

o Commodities (e.g., Gold)

o Cryptocurrencies (e.g., Bitcoin)

o Don't not know

o I refuse to answer

22. Which asset typically fluctuates the most over time?

o Overnight Deposits

o Time Deposits

o Savings Accounts

o Bonds/Fixed Income Funds

o Stocks/Equity Funds

o Commodities (e.g., Gold)

o **Cryptocurrencies (e.g., Bitcoin)**

o Don't not know

o I refuse to answer

23. How do you assess yourself personally? Are you generally a risk-taker or do you try to avoid taking risks? Please tick a box on the scale, where the value 1 means "not at all willing to take risks" and the value 5 means "very willing to take risks".

o 1 = Not at all willing to take risks

o 2 = Somewhat/slightly willing to take risks

o 3 = Average willingness to take risks

o 4 = Willing to take risks

- o   5 = Extremely willing to take risks

- o   I refuse to answer

24. Thank you for participating in the survey. I would be happy to send you the results of the survey if you are interested. Please enter your e-mail address.

[Field for entering the email address]

Source: Own elaboration based on Allianz/Lusardi (2017), Lusardi & Mitchell (2011b/2014), Van Rooij et al. (2011a) and OECD (2018).

APPENDIX 13. Interview Guideline for the Expert Interviews

Interview Partner: Expert 1 / Expert 2

Interviewer: Thomas Hammer

Language: German

Date: 7th of February 2023 **[Expert 1]** / 9th of February 2023 **[Expert 2]**

1. Introduction

a.   Introduction

b.   Background

c.   Financial Literacy - Concept

d.   Distinction between Private and Corporate Clients

e.   Aim of the Expert Interviews

2. Questionnaire

1. Are you and your colleagues familiar with the term financial education?

2. How would you describe a financially literate customer?

3. You have been working in a retail bank for a long time and have thus advised customers for many years. Do you have the impression that customers in today's world are more concerned with the topic of finances than they used to be?

4. What are the most common topics/products you discuss with corporate customers as an advisor? Do you notice any differences between corporate clients and private clients?

5. Do you think that many people hide from the topics of investment, retirement planning and general finances? If so, do you see this problem more at the CC or PC level?

6. How would you rate the competence of CCs in using financial reports and financial statements for lending compared to private customers with their own household accounts?

7. Based on the last two questions, do you identify a recent development since the last crises and current inflation?

8. Is the willingness to grant a loan higher if the customer has orderly records and support from an external tax advisor?

9. Looking at your overall customer base, do you think customers who appear more financially educated also have better financing structures? (Thus, less short-term/expensive loans, but long-term/favourable loans). And can differences between CC and PC be derived in this regard?

10. Do you have the impression that financially educated entrepreneurs hedge more risks for their company and themselves as a liable person? (if they are personally liable) and how do you determine this? (e.g., via insurance, pension plan, liability, professional liability).

11. Do you think financially educated private clients cover more risks for themselves and their family through insurance? Are there any differences?

12. Have you noticed whether the risk management of your corporate clients has changed concerning past/current crises and, if so, whether it has improved?

13. Is the risk management of a company, in addition to personal suitability, a significant decision criterion when granting a loan?

14. What is your impression when looking at their clientele, do financially literate entrepreneurs have a wider range of financial tools? (Crowdfunding, venture capital, private equity).

15. On the flip side, when you look at private clients, do financially educated PCs have a wider range of financial tools for investing?

16. How does financial literacy affect the use of credit cards, cashless payments, as well as online banking? Are these individuals thus fundamentally more digitally savvy?

17. Can you assess whether entrepreneurs who act as CCs have a different view of finance than these individuals as PCs?

18. What is your personal assessment? Does a corporate customer (entrepreneur) already appear with a sounder basic knowledge than a private customer (employee) in financial/investment discussions?

Source: Own elaboration; Questions based on Graña-Alvarez et al., 2022.

APPENDIX 14. Profile of Frankfurter Volksbank Rhein/Main eG

Frankfurter Volksbank Rhein-Main eG is a cooperative bank (2nd largest in Germany) and has its registered office in Frankfurt am Main. The bank's business area includes the city of Frankfurt and large parts of the Rhine-Main region.
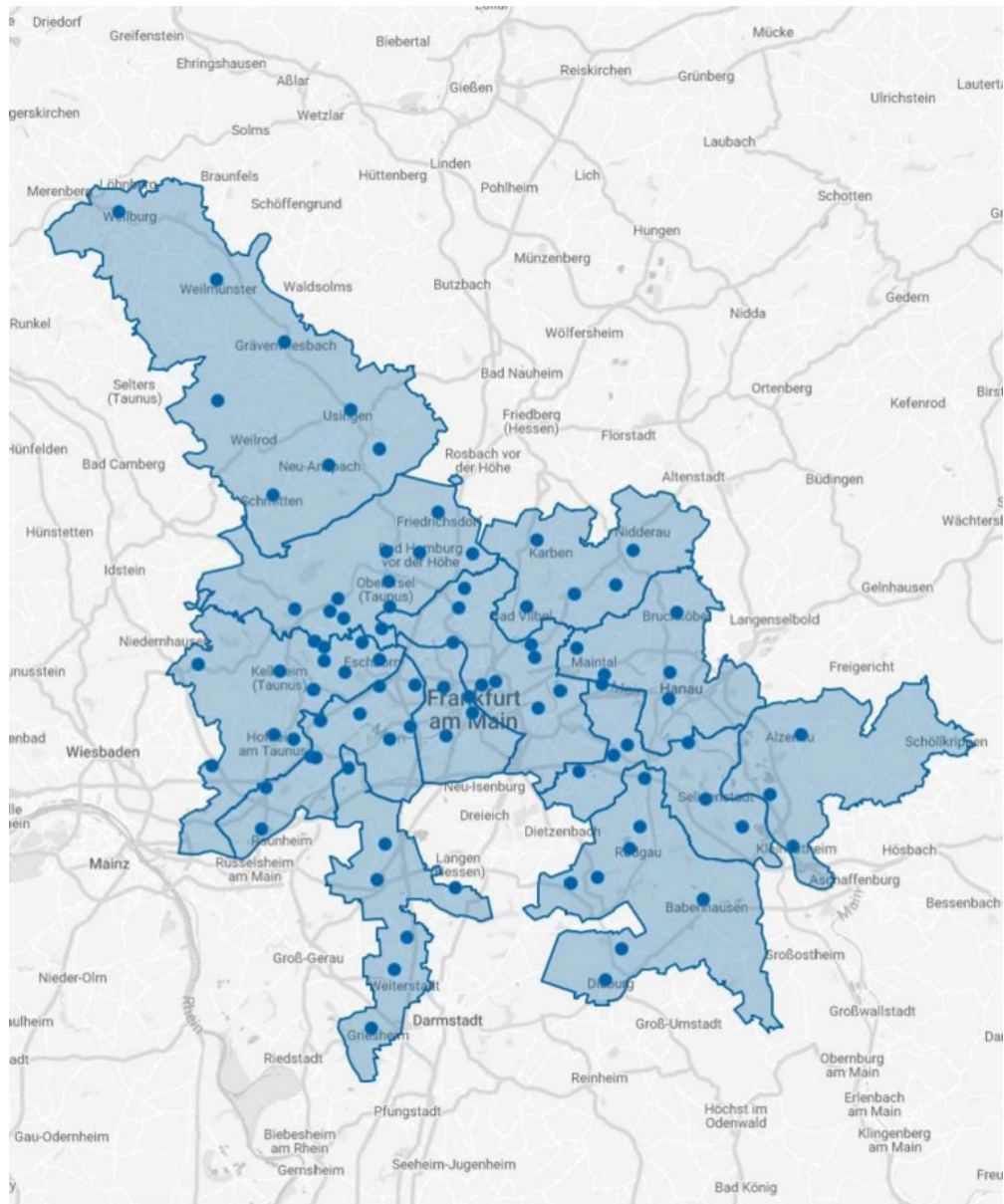
Source: Frankfurter Volksbank Rhein/Main eG. Accessed at 4th of June 2023 via Ihre FVB | Frankfurter Volksbank (frankfurter-volksbank.de).

APPENDIX 15. Transcription of Expert Interview 1

00:00:03

Hammer: Is the term financial literacy familiar to you and your colleagues?

00:00:12

Expert 1: Yes, of course.

00:00:15

Hammer: How would you describe a financially literate client?

00:00:20

Expert 1: A financially literate client has the ability to see through to their net worth and liquidity statement.

00:00:29

Hammer: Okay. Have you been working in the branch bank for a long time, so you've been advising clients for many years? Do you feel that customers today are more concerned about finances than before?

00:00:43

Expert 1: Yes, I have been working in the branch bank for 24 years. Mostly in the retail sector, of course. But also corporate customers. Small traders, smaller limited companies. And yes, I would say it has changed a lot. Yes, customers are more financially literate than they were 20 years ago.

00:01:09

Hammer: Okay, very good. What are the most common issues or products that you, as an advisor discuss with corporate clients? Are there any differences between corporate clients and private clients?

00:01:20

Expert 1: Yes, of course. Especially when it comes to retirement, it's a very, very big topic where the corporate client knows that he has to do something for his retirement, where the corporate client also considers all the tax aspects, as it were, which is quite different with private clients.

00:01:44

Hammer: Okay, and what kind of topics or products do you often talk about? With corporate clients.

00:01:51

Expert 1: With corporate clients, of course, there are several topics that we talk about, as far as the topic of pensions is concerned, that is clearly the Rürup ["Rürup Pension"]. Regarding payment methods, there are issues such as cash terminals so that customers can also do cashless payments. Of course we also discuss these issues. Is the customer represented on the Internet? Can we be helpful there? For private customers, of course, the classic Riester pension, but also Rürup. Depending on the income situation and how to provide for old age and deal with existential risks.

00:02:38

Hammer: Okay. Do you think many people tend to hide from the topic of investment, retirement and general finances? If so, is this a problem for CCs or PCs?

00:02:52

Expert 1: It's a bit of a mix, but I think it's more of a problem at the PC level, that people are hiding behind different issues, which is more part of it for the self-employed. The private client prefers to wait and see, knowing that I have made provisions for various risks.

00:03:16

Hammer: How do you rate the competence of CCs in using financial reports and annual accounts for lending? Compared to PCs with their own household accounts?

00:03:27

Expert 1: Yes, with CCs it is of course different. But definitely, a corporate client is better prepared. When it comes to filing, they know what to do, especially if it's ongoing disclosure. In any case, these are CCs issues. When he comes here, which he will certainly do at some point, what he has to file with the PC is very different. There are clients who bring a statement of assets and liabilities and can, so to speak,

prepare their own liquidity statement. On the other hand, there are also very, very many PCs who have an enormous problem with this.

00:04:11

Hammer: Okay. Based on the last two questions, can you see a current development since the last crises and the current inflation?

00:04:19

Expert 1: Yes, I would rather say that it has improved significantly in the corporate sector and in the retail sector, as I said, depending on the customer, but even there not as good an improvement as in the CCs. Okay.

00:04:34

Hammer: Is the willingness to lend higher if the client has proper records and support from an external tax advisor.

00:04:45

Expert 1: Yes, of course. But actually only because these figures are a basic requirement. And most self-employed clients do manage to provide all the documents we need. This speeds up the whole process.

00:05:02

Hammer: Okay, looking at your overall client base, do you think clients who appear more financially literate also have better funding structures?

00:05:12

Expert 1: Of course, definitely. A client who has a very good financial education has the whole picture. Yes, and also when it comes to credit, they can assess it much better. Like someone who is now a beginner in this field.

00:05:33

Hammer: And can you then also derive differences between CCs and PCs?

00:05:39

Expert 1: There are both, of course. In both the corporate and retail sectors there are clients who are better organised and clients who are not so well organised. As I

said, in the retail sector it tends to be the latter. However, it is much easier to get the documents together for private clients than for corporate clients.

00:06:05

Hammer: Do you have the impression that financially literate entrepreneurs hedge more risks for their company and themselves as a liable person when they are personally liable? And on what do you base that? Insurance or pension plans, for example?

00:06:21

Expert 1: Yes, definitely. But not only that, but there are also existential risks that need to be covered. So there is a much higher customer affinity in corporate banking. The customer is well aware that he has to cover different risks and he is prepared to do so.

00:06:45

Hammer: Do you think financially educated PCs are hedging more risks for themselves and their families through insurance? Are there differences?

00:06:55

Expert 1: Yes, there are differences. But when it comes to lending. A CC is more willing to insure against all these risks than a PC. But if you advise them properly, even a PC will come to the conclusion that it makes sense to cover various risks, sometimes even with insurance.

00:07:24

Hammer: Have you noticed whether the risk management of your CCs has changed and perhaps even improved in light of the past or current crises?

00:07:34

Expert 1: Yes, of course, it has changed, especially in the Corona period, that was a new situation for us as a bank. And, of course we reviewed the loans again in that respect and looked at different risks.

00:07:55

Hammer: Besides personal suitability, a company's risk management is an important decision criterion when granting a loan. Can you elaborate on that?

00:08:07

Expert 1: Yes, of course. So the risk management. If you are. As a CC, you don't know at all what your risks are, but you haven't taken precautions against your risks or you don't want to take precautions against your risks. Yes, of course it is a very, very big issue. And the more you know about it, the better it is for the company. For the person anyway. And then, of course, it plays a very, very big role from our side as well.

00:08:40

Hammer: What is your impression when you look at your clientele? Do financially educated entrepreneurs have a wider range of financial instruments, for example crowdfunding, venture capital or private equity?

00:08:54

Expert 1: Again, very different depending. So small to medium enterprises? Rather no. Yes, so the asset structure there is, I would say, quite manageable. The bigger the company, the more interest there is. And the client is also willing to invest more broadly.

00:09:16

Hammer: On the other hand, financially literate PCs have a broader range of financial instruments in terms of investments?

00:09:28

Expert 1: So have you definitely heard that with a financially literate client, in addition to having at least a custody account, that they have an orderly asset

structure. And yes, that's already a difference to our, let's say, average customer who is more concerned with classical investments.

00:09:53

Hammer: How does financial literacy affect using credit cards, cashless payments and online banking? Are these people fundamentally more digital?

00:10:04

Expert 1: Definitely yes. And this showed us not only during the pandemic period, but this was already the case before, that these customers were more willing to make cashless payments at times, or to use credit cards to make their payments before.

00:10:28

Hammer: Can you assess whether entrepreneurs who act as CCs have a different view on finance than, for example, people who act as PCs?

00:10:41

Expert 1: Again, different. Certainly there are also, let's say, individuals who are PCs who are on a par. But as I said, the bigger the company gets, the more structure is brought into it; yes, there is also something in that respect.

00:10:59

Hammer: Okay. What is your personal assessment? Does a CC present himself as an entrepreneur in financial and investment discussions with a more well-founded basic knowledge than a PC?

00:11:14

Expert 1: It depends on the client, of course. We have both. But yes, it is more the case in the corporate sector that clients come to us more informed. They have already looked at various things on the Internet, so they come to the interview and are prepared accordingly.

APPENDIX 16. Transcription of Expert Interview 2

00:00:00

Hammer: Why don't you introduce yourself first for a moment?

00:00:05

Expert 2: Yes, with pleasure. I'm Stefan N., 37 years old. After graduating from high school, I trained as a bank clerk at a Volks- und Raiffeisenbank (cooperative bank). It was a very classic banking apprenticeship, with vocational school and on-the-job training. The training lasted two and a half years. After that, I was taken on at the bank, was then assigned by the bank to the private customer business, then took on various consulting activities in the PC business and then developed further over the years, so that at some point I also became a branch manager. I combined all of this with a degree. It's called a banking diploma, banking and business administration. I also like to deal with financial topics in my private life because I'm very interested in them. And two years ago, I switched from private banking to corporate banking at Volksbank. I first started with smaller business and commercial customers. You can imagine that as the small master painter or the small "one-man show". And now I'm in the CC business. That's the higher level. And this is where I've been working for over a year now.

00:01:27

Hammer: Okay, so you've been serving PCs and CCs both now for some time?

00:01:35

Expert 2: Exactly. And it was then mainly about financing business. But yeah, right. I'm familiar with both sides.

00:01:44

Hammer: Are you and your colleagues familiar with the term financial literacy?

00:01:49

Expert 2: Definitely yes. Financial literacy is very important, but from my point of view, it is often neglected. We can also distinguish, for example, are there customers who deal with the topics and finances or do you not deal with it? I see financial literacy on three levels, namely in the form of school education or at

universities. That the relevant institutions teach young people about finance. In my view, as I've just said, there's far too little of it, and if there is, it's only taught in the higher years or, for example, at the commercial high school, where it's not taught until the tenth or eleventh grade. And yes, there is financial education, as I have subdivided it on the part of the training company or the employer. Then there are advanced training courses or web-based training courses, so-called WebBTs, or that you get brochures or information on new tax topics or on new investment opportunities. Yes, there are already possibilities with the employer. Or it's also important to keep yourself busy in your private life, for example, by reading the business section of the (German Newspaper) Handelsblatt or various newspapers via YouTube, Instagram, Zickzack, the adult education center or various seminars on your own initiative.

00:03:24

Hammer: I had the analysis or comparison in my doctoral thesis between entrepreneurs and employees. Would you agree there that you can relate PCs and CCs there, that you say the employees are predominantly PCs and the entrepreneurs are CCs?

00:03:47

Expert 2: Correct, you can say that. Definitely the same. And since 95% of the CCs who come to us are also the founders or owners, you can say that. But you shouldn't generalise it so much. So financial literacy does not depend on whether someone is a private individual or a CC. So there are also very well-educated private individuals who are very well-versed in financial topics. But as a rule, the entrepreneur is already a bit more on his own. The entrepreneur should be more familiar with or know more about tax issues. The entrepreneur has to make his own calculations and therefore, we as bankers, when it comes to finance, often talk on a different level than with the private person. As I said, there are private individuals who are very knowledgeable, they know how to calculate interest, they know all the conditions, they know all the terms and conditions of shares, they have full understanding, they are sometimes even fitter than we are in the bank. But as a rule, it's just that the entrepreneur who should be more concerned with the issues.

00:00:00 [Author's note: new recording due to technical problems]

Hammer: How would you describe a financially literate customer?

00:00:03

Expert 2: So a financially literate client is someone who has been exposed to economic, political, and social issues since they were in school and is familiar with the financial world.

00:00:21

Hammer: You've been working in a branch bank for a long time, so, as you mentioned, you've been advising customers for many years. Do you think customers are more concerned with finances nowadays than they were?

00:00:33

Expert 2: Yes, the internet creates transparency and comparability. So the Internet is the megatrend that has come over all of us. There are comparison portals, there are various forums where people can get information. This has turned many people into independent decision-makers. Yes, so there are already significantly more people who are dealing with it.

00:00:55

Hammer: And what are they? What are the most common topics or products you discuss with CCs as a consultant? And would you make a distinction there between CCs and PCs?

00:01:05

Expert 2: Yes, CCs are more concerned with the topic of payment transactions. It's important to them that all income and expenses are booked sensibly via the account using a wide variety of payment methods, such as card payment devices, etc. The whole issue of payment transactions is important to CCs. The whole topic of payment transactions is important for CCs at a bank and mostly CCs are interested in financing possibilities for new vehicles, machines, but also for real estate, for leasing and for insurance services. PCs can be divided into two groups. Once the customer who has money and that on the other hand, the customer who needs money from the bank. Corporate banking is more individualised and retail banking is more standardised.

00:01:50

Hammer: Do you think many people are hiding from the issue of investing, retirement planning and general finances? And if so, do you see that problem more at the corporate or retail levels?

00:02:04

Expert 2: For many people, going to the bank is like going to the accountant or the tax office. People don't enjoy that. It's more like a duty for them. The CC, however, sees us more as a game partner with whom he can get ahead. And for the PC, we're more like a company where you're just a customer.

00:02:27

Hammer: How do you rate the competence of CCs in using financial reports and financial statements for lending purposes? Compared to PCs with their household financial statements?

00:02:37

Expert 2: Yes, fifty-fifty. There are CCs, they deal with the issues. They know their figures, and CCs, they don't know their figures at all and let everything go through the tax advisor. They may be great at painting the wall or operating great machines, but then they know relatively little about their finances and the company. Or then, if only passively via the tax advisor. With PCs, it depends on the willingness to deal with the issues. There are PCs who can completely understand an offer, take it apart, know where the appropriate places are. But the PC is rather yes, he rather does not know the topics completely.

00:03:24

Hammer: Based on the last two questions, note a recent trend since the last crises and the current inflation.

00:03:31

Expert 2: Yes, on average, people are just forced or just motivated to deal more with the issues and finances, because whether that is now savings potential. In the most diverse areas of life, interest becomes more expensive and prices also more expensive. In my view, however, this is only ever a temporary effect. In the short term, it has moved people to save more or even to go into shares in part. You can

also see this quite clearly in young people, who then became customers of all the neo-brokers and with financial investments. But whenever the crisis or inflation goes down again, these issues also go down again, that people deal with it.

00:04:13

Hammer: Is the willingness higher in a loan if the customer has orderly records and support from an external tax advisor?

00:04:24

Expert 2: You could say that, like in a restaurant, the eye eats with you. So for us as a bank, the numbers are a very decisive factor. And the tax consultant is definitely the point of contact for us. If there are any queries, the customer comes with proper documentation, the figures are well prepared, everything is complete. Then we as people - we are only people in the bank - naturally have more fun approaching things than if we first have to run after the customer for the documents. Or having to ask the customer about every other question, every other figure.

00:04:57

Hammer: Looking at your overall customer base, do you feel that customers who appear more financially literate also have better financing structures?

00:05:06

Expert 2: Yes, the answer I give, that's true for PCs and for CCs. I find financially educated people make better decisions, and generally speaking, their finances are better structured and better organised.

00:05:18

Hammer: Do you think financially literate entrepreneurs hedge risks more strongly for your company and yourself as liable persons? And what do you base that on? So, for example, through insurance, liability, professional liability, retirement plans and so on?

00:05:34

Expert 2: So definitely yes. This means that an entrepreneur who does not take a risk will also go under in the end, because a risk is always part of a business. A financially literate entrepreneur takes risks in the same way, but calculates them

differently and understands the consequences of the risks more. And an entrepreneur is someone who takes more responsibility for himself from the ground up and relies less on the welfare state. He knows he has to take care of his insurance privately, he has to take care of his pension privately, he has to take care of or protect against his risks privately in a different way. Then an employee who knows he can fall back on the social safety net in Germany.

00:06:21

Hammer: Do you think financially educated PCs cover more risks through insurance for themselves and their families? So are there differences there?

00:06:31

Expert 2: Again, a definite yes. PCs with a financial education usually have a certain foresight. It's important to them to hedge risks and make provisions for the future, and also to protect their families. And when it comes to corresponding offers, literate people check and compare the offer more in terms of price and performance. They don't let it be foisted on them like that, they just take it as it is and compare it.

00:06:55

Hammer: Besides personal suitability, is a company's risk management also a significant decision-making criterion in your case, i.e. when granting loans?

00:07:09

Expert 2: Yes. There are many factors that go into deciding whether to grant a loan. Once there are these hard facts that you look at, okay, like the numbers and there are soft facts or qualitative factors. This is where the characteristics of the actions, the management are evaluated and then those are the factors that go into the decision accordingly.

00:07:36

Hammer: So risk management would also come into it?

00:07:40

Expert 2: Definitely yes, 100 percent. So that's very, very important.

00:07:43

Hammer: Okay. What's your impression? When you look at your clientele, do financially literate entrepreneurs also have a wider range of financial tools, so crowdfunding, venture capital, diversified equity and so?

00:07:55

Expert 2: So the more I know about the market, the exponentially more opportunities you have, of course. I say, like golf, there are different clubs. And if you, if you know how to play with the corresponding clubs, then you know that with a heavy club you tend to hit the balls far and with a light club you tend to hit the balls precisely. And this can be transferred to the entrepreneur. The more he knows about all the things, the more precisely he knows again has to play.

00:08:24

Hammer: On the flip side, if you look at PCs now, do financially literate PCs have a wider range of financial instruments in investing?

00:08:34

Expert 2: Definitely yes. So a PC who follows the market and who knows the financial instruments also knows exactly. Just as he also knows how to invest his money. And of course, he has different demands on the bank.

00:08:50

Hammer: How does financial literacy affect using credit cards, cashless payments, and online banking? So are these people more digitally affine in those areas as well?

00:09:03

Expert 2: It always depends a little bit. Of course, there are also very smart entrepreneurs or PCs who are totally smart and still prefer to pay with cash. I think that always has a bit to do with personal attitude. There will also be people who are not smart and don't have a penny in their pocket, but know how to pay with an iPhone. I wouldn't make that quite so dependent on that. But I read a study the other day. There it was about the fact that people who have more money, so belong to the participation and class, are more likely to be insensitive and then also more likely to pay with the card.

00:09:44

Hammer: Can you judge whether entrepreneurs who are CCs have a different view on finance than these people have as PCs? So can an entrepreneur perform better as a CC and at the same time perform worse as a PC, if he also goes to the bank?

00:10:07

Expert 2: Yes, so the entrepreneur is yes always two things at the same time in the person, he is yes CC and he is yes PC at the same time. And I believe that even as a PC, one cannot completely discard one's characteristics as an entrepreneur. I believe that entrepreneurs and PCs are less different. But entrepreneurs are used to acting on their own responsibility more than employees, for example. From my personal experience, employees and entrepreneurs are not as price-sensitive when they know that good performance has its price.

00:10:45

Hammer: And now, finally, your assessment. Would you say that CCs come to financial and investment discussions already with a more well-founded basic knowledge than a PC? Generally speaking, if you look at the distribution now there are always exceptions, of course, but basically speaking.

00:11:07

Expert 2: I wouldn't say fundamentally and I wouldn't say in a particularly recognisably higher way. I think it would be rather less of an educational thing. So I think it's more of a basic attitude story. An entrepreneur simply has to act differently than an employee. And there is no statutory pension, no statutory health insurance, no statutory unemployment insurance. So he has to deal with more things than a private person.

00:11:33

Hammer: So, in a way, he must know more or prepare himself better.

00:11:39

Expert 2: Yes, definitely. But also the bank is in obligation to advise their customers fully. And it's just that the self-employed person has an obligation, but not everyone fulfills that obligation to themselves. And there is, for example, the subject of old-age provision. Self-employed and employed people very often put

the issue on the back burner. So old-age provision is such a big topic, where many people still need advice, but put it off.

00:12:09

Hammer: Great, then. Thank you for the good conversation.

00:12:12

Expert 2: You're very welcome.

APPENDIX 17. SPSS Model of statistical Analysis of the 1st Study

Model Summary

Model	R	R-Squared	Korrigiertes R-Quadrat	Standardfehler des Schätzers
1	,161ª	,026	,023	,472

a. Variable: (Constant), Financial Literacy (amount of correct answered financial literacy questions)

Coefficients

Model		Non-standardised coeffcients		standardised coeffcients		
		Regression coefficient	Std.-Error	z	T	Sig.
1	(Constant)	.007	.125		.059	.953
	Financial Literacy	.045	.016	.161	2.801	,005

Notes

Output created	10-FEB-2023 14:01:54
Comments	
Syntax	GRAPH /SCATTERPLOT(BIVAR) =Financial Literacy_coded /MISSING=LISTWISE.
Ressources Processing time	00:00:02,98
Time elapsed	00:00:03,00

Area Under the ROC Curve

Test Result Variable(s): Anzahl der richtigen Finanzfragen

Area
,617

The test result variable (s): Anzahl der richtigen Finanzfragen has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

APPENDIX 18. Python Code of statistical Analysis of the 2nd Study

Python file utilities for data preprocessing

```python
#Importing all relevant APIs
import pandas as pd


#MinMax Scaler for Robustness-Check
#from sklearn.preprocessing import MinMaxScaler


from sklearn.preprocessing import StandardScaler
from sklearn.impute import SimpleImputer
import numpy as np
from matplotlib import pyplot as plt


#Read in data (csv) and data preprocessing
def readSurveyData(file,verbose=0):
    data=pd.read_csv(file)


#Remove the rows with missing values in the second column
    data=data[data.iloc[:,1].notnull()]
#Replacing the gender information with letters
    data = data.replace(['Weiblich'], 'w')
    data = data.replace(['Männlich'], 'm')
    data = data.replace(['Divers'], 'd')
############
    if verbose > 0:
        for i in range(len(data.columns)):
            print(i,data.columns[i])
        for i in range(len(data.columns)):
            print(i,data.columns[i])
        print(len(data.index))
    return data
```

```python
#Output of histograms for an overview of the data
def plotHistograms(data):
    for i in data.columns:
        if i != "ANTWORT ID":
            print(i)
            n, bins, patches = plt.hist(data[i] )
            plt.title(i)
            plt.grid(True)
            plt.show()


#Extract entrepreneur data from data record and return it in "dem".
def splitDataEntrepreneur(data):
    dem = data.iloc[:, [0, 24,25,26,27,28]]
    return dem




#Extract entrepreneur data from dyte record and return it in "data1".
def getDataEntrepreneur(data):
    data=data[data.iloc[:,23] == "Ja"]
    data1 = data.iloc[:, [24, 25, 27, 28]]
    data1.columns=["GrJahr","Branche","MA","Umsatz"]
    return data1


#Split people data
def splitDataPerson(data):
    #Extract the response ID for identification and the responses, NaN values dropping    data1 =
data.iloc[:, [0, 8, 9, 10, 11, 12, 14]].dropna()
    data1.columns=["ANTWORT ID","Q1","Q2","Q3","Q4","Q5","SA"]
    qa=data1.loc[:,["ANTWORT ID","Q1","Q2","Q3","Q4","Q5"]]
    #Using the response ID, merge a participant's responses with the associated self-assessment on
the topic of risk
    selfAssessment=data1.loc[:,["ANTWORT ID","SA"]]
    #Additions of the socio-demographic data on the participants
```

```python
    dem=data.iloc[:,[0,15,16,17,18,19,20,21,22,23]]
    #Output of the values for further processing
    return qa, selfAssessment, dem


#Function to split individuals and entrepreneurs for further processing
def splitDataPE(data):
    private=data[data.iloc[:,23] != "Ja"]
    entrepreneur=data[data.iloc[:,23] == "Ja"]
    return private, entrepreneur


#Function for checking the answers and output in res for further processing
def checkAnswers(qa):
    res=qa.iloc[:,0]
    #Correct is:
    correct = ['Mehr als 102\N{euro sign}', 'Weniger als heute', 'Fallen', 'Richtig', 'Falsch']

    res=[]
    for index,row in qa.iterrows():
        corrcnt=0
        for i in range(len(correct)):
            if correct[i]==row.iloc[i+1]:
                corrcnt=corrcnt+1
        res.append([row.iloc[0],corrcnt/len(correct)])
    res=pd.DataFrame(res)
    res.columns=["ANTWORT ID","Financial Literacy"]
    return res


#Function to check the answers not cumulative form for descriptive analysis and output in res for
further processing
def checkAnswersNonCum(qa):
    res=qa.iloc[:,0]:
#correct=['More than 102\N{euro sign}','Less than today','Fall','True','False','Between 10 and
15 years']
    correct = ['Mehr als 102\N{euro sign}', 'Weniger als heute', 'Fallen', 'Richtig', 'Falsch']
```

```python
    res=[]
    for index,row in qa.iterrows():
        corranswer=[row.iloc[0]]
        for i in range(len(correct)):
            if correct[i]==row.iloc[i+1]:
                corranswer.append(1)
            else:
                corranswer.append(0)
        res.append(corranswer)
    res=pd.DataFrame(res)
    res.columns=["ANTWORT ID","A1","A2","A3","A4","A5"]
    return res


def remove_outliers_zscore(data, threshold=3):
    """
    Remove outliers from numeric data using Z-score test.

    Parameters:
        data (DataFrame): The input data frame.
        threshold (float): The threshold value for detecting outliers based on Z-score.

    Returns:
        DataFrame: The data frame with outliers removed.
    """
    # Filter out non-numeric columns
    numeric_data = data.select_dtypes(include=[np.number])

    # Calculate Z-scores
    z_scores = np.abs(stats.zscore(numeric_data))

    # Remove outliers based on Z-scores
    outliers_removed = data[(z_scores < threshold).all(axis=1)]

    return outliers_removed


#Function for further preparation before performing the statistical procedures, with options for the robustness checks (raw Answers, SACLasses, impude, etc.)
def preprocess(data,norm=True,keepRawAnswers=False,SAClasses=False,impude=True):
```

```python
    qa, sa, dem = splitDataPerson(data)

#Introduction of ISCED education classes
    bild=[]
    for index, row in dem.iterrows():
        if row.iloc[3] in ["Abschluss einer beruflich-betrieblichen Berufsausbildung (Lehre)",
"Abschluss einer beruflich- schulischen Ausbildung (Berufsfach- oder Handelsschule)"]:
            bild.append("ISCED-3 (Mittlere BA)")
        else:
            if row.iloc[3] in ["Abschluss an einer Fachschule, Meister- oder Technikerschule"]:
                bild.append("ISCED-5 (Höhere BA)")
            else:
                if row.iloc[3] in ["Master","Bachelor","Doktortitel"]:
                    bild.append("ISCED-7 (Hochschule)")
                else:
                    if row.iloc[3] in ["(Noch) keinen Ausbildungsabschluss","Keine Angabe"]:
                        bild.append("keine BA")
                    else:
                        if row.iloc[3] == "Sonstiges":
                            print(row.iloc[3],row.iloc[4],"#")
                            if row.iloc[4] in ["Diplom","Diplom ","Diplom (das gab es mal vor
Bachelor, Master & CO.)","2. Juristischen Examen","Diplom Kaufmann ","DIPL.
ING","Dipl Ing ","Hochschule"]:
                                bild.append("ISCED-7 (Hochschule)")
                            else:
                                if row.iloc[4] in ["Abitur"]:
                                    bild.append("ISCED-5 (Höhere BA)")
                        else:

                            print("nix",row.iloc[3],"#")
#Add to data "dem" for further use
    dem = dem.iloc[:, [0, 1, 2, 5, 6, 9]]
    dem["Bildung"]=bild
    dem.columns = ["ANTWORT ID", "Geschlecht", "Alter", "Wissensvermittlung",
```

```python
"Einkommen", "Unternehmer","Bildung"]
#Adding the SA Classes for the Robustness Checks
    if SAClasses:
        sa['SAClasses'] = pd.cut(sa.SA, [0, 2, 7, 10],labels=["Low","Medium","High"])
        sa["SA"]=sa['SAClasses']
        sa=sa.drop(['SAClasses'],axis=1)
        print(sa.columns)
#Normalizing the data and generating the dummy variables for the nominal scaled data.
#Impute the missing values and NaN values, transform the numeric variables.
    if norm==True:
        dem = pd.get_dummies(dem, columns=["Geschlecht", "Bildung"], drop_first=True)
        if SAClasses:
            sa = pd.get_dummies(sa, columns=["SA"], drop_first=True)
        if impude:
            imp = SimpleImputer(missing_values=np.nan, strategy='mean')
            dem['Einkommen'] = imp.fit_transform(dem['Einkommen'].values.reshape(-1, 1))
            imp = SimpleImputer(missing_values=np.nan, strategy='mean')
            dem['Alter'] = imp.fit_transform(dem['Alter'].values.reshape(-1, 1))
        else:
            dem=dem.dropna(axis=0)
#Transfomation of the values (z-standardization)
        scaler = StandardScaler()
        dem[['Alter']] = scaler.fit_transform(dem[['Alter']])
        dem[['Wissensvermittlung']] = scaler.fit_transform(dem[['Wissensvermittlung']])
        dem[['Einkommen']] = scaler.fit_transform(dem[['Einkommen']])
        if not SAClasses:
            sa[['SA']] = scaler.fit_transform(sa[['SA']])
        #dem[['Einkommen']] = np.log(dem[['Einkommen']])


#Creation of the target variable entrepreneur for the statistical procedures anghand of the answer
from the questionnaire

    target = []
    for index, row in dem.iterrows():
        if row["Unternehmer"] == "Ja":
```

```python
        target.append(1)
    else:
        target.append(0)


#Generation of the data sets for further investigation
    temp = dem.drop("Unternehmer", axis=1)


    if not keepRawAnswers:
        fl = checkAnswers(qa)
        ind_var = pd.merge(fl, temp, on="ANTWORT ID")
    else:
        fl = checkAnswersNonCum(qa)
        ind_var = pd.merge(fl, temp, on="ANTWORT ID")


    ind_var = pd.merge(ind_var, sa, on="ANTWORT ID"
    return ind_var, target



if __name__ == '__main__':
    data=readSurveyData("data/results-survey891732.csv", verbose=0)
    ind_var,target=preprocess(data)
    #print(ind_var.mean(),ind_var.median(),ind_var.var())
    #plotHistograms(ind_var)


#Box Tidwell for 2nd study
import numpy as np
import statsmodels.api as sm
import statsmodels.stats as stats

def box_tidwell_test(variable_name, X, y):
    """
    Perform Box-Tidwell test for logit model.

    Parameters:
        variable_name (str): Name of the independent variable.
        X (DataFrame): Independent variables.
```

```python
    y (array-like): Dependent variable.

    Returns:
      p-value of Box-Tidwell test.
    """
    # Add interaction term
    X_copy = X.copy()  # Kopiere das DataFrame, um Änderungen auf einer separaten Kopie
vorzunehmen
    epsilon = 1e-10  # Eine kleine Konstante, um Nullen und Einsen zu vermeiden
    y_modified = np.clip(y, epsilon, 1 - epsilon)  # Vermeide Nullen und Einsen
    X_copy['Interaction'] = X[variable_name] * np.log(y_modified / (1 - y_modified))

    # Fit the logistic regression model with interaction term
    model = sm.OLS(y, X_copy)
    results = model.fit()

    # Get the p-value for the interaction term
    p_value = results.pvalues['Interaction']

    return p_value

def perform_box_tidwell_test(X, y):
    """
    Perform Box-Tidwell test for all independent variables.

    Parameters:
      X (DataFrame): Independent variables.
      y (array-like): Dependent variable.

    Returns:
      Dictionary containing p-values for Box-Tidwell test for each independent variable.
    """
    p_values = {}
    for variable in X.columns:
        p_values[variable] = box_tidwell_test_alternative(variable, X, y)
    return p_values

# Hier definieren wir y basierend auf deinen Daten
y = np.array(target)  # Oder pd.Series(target)

# Hier rufst du die Funktion perform_box_tidwell_test_alternative auf
box_tidwell_results = perform_box_tidwell_test(ind_var, y)
```

```python
print(box_tidwell_results)
```

Python file to analyze the data and create the descriptive statistics

```python
#Import all relevant APIs
import pandas as pd
import utilities
from matplotlib import pyplot as plt
import numpy as np

#Pivot table to output FL results by age group.
def pivot(data):
    data['bin'] = pd.cut(data.Alter, [0, 30, 40, 50, 60, 70])
    print(pd.pivot_table(data=data,index='bin',columns='Unternehmer',values='Financial Literacy',aggfunc='mean'))

#Pivot table to output FL results by mean threshold in binary form (0:low, 1:high) for the different
age groups.
def classEduc(data):
    thresh = ind_var['Financial Literacy'].mean()
    ind_var['FL bin'] = np.array([1 if i >= thresh else 0 for i in ind_var['Financial Literacy'].values])
    data['bin'] = pd.cut(data.Alter, [0, 30, 40, 50, 60, 70])
    print(pd.pivot_table(data=data,index='bin',columns='Unternehmer',values='FL bin',aggfunc='count'))
    print((ind_var.value_counts('FL bin')))

#Output FL results by mean threshold in binary form (0:low, 1:high) for gender and
entrepreneur/non-entrepreneur.
def classSex(data):
    thresh = ind_var['Financial Literacy'].mean()
    ind_var['FL bin'] = np.array([1 if i >= thresh else 0 for i in ind_var['Financial Literacy'].values])
    print(pd.pivot_table(data=data,index='Geschlecht',columns='Unternehmer',values='FL bin',aggfunc='sum'))
    print((ind_var.value_counts('FL bin')))

#Various outputs to check the distribution of variables from the dataset and to generate the
descriptive statistics
def binList(data):
    data['bin'] = pd.cut(data.Alter, [16,34,44,54,64,70])
```

```python
print(pd.pivot_table(data=data,index='Geschlecht',columns='bin',values='SA',aggfunc='count'))
    print(pd.pivot_table(data=data,index='Geschlecht',columns='bin',values='Financial Literacy',aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Geschlecht', values='Financial Literacy', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', values='Financial Literacy', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', columns = "Geschlecht", values='Financial Literacy', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns ="Unternehmer", values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht", values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', columns="Geschlecht", values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Geschlecht', values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', columns="Geschlecht", values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Unternehmer", values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht", values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Unternehmer", values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht", values='SA', aggfunc='mean'))

#Functions for the output of the mean values for the examination groups
def overview(data):
    print("Durchschnitte")

print("\n>>>Mean:",data.mean(numeric_only=True),"\n>>>Stddev:",data.std(numeric_only=True),"\n>>>Min:",data.min(numeric_only=True),"\n>>>Max:",data.max(numeric_only=True))

    print("Durchschnitte Geschlecht")
    for i,r in data.groupby(['Geschlecht']).mean().iterrows():
        print(r)
```

```python
    print("Durchschnitte Unternehmer")
    for i,r in data.groupby(['Unternehmer']).mean().iterrows():
        print(r)

    print("Durchschnitte Unternehmer und Geschlecht")
    for i,r in data.groupby(['Unternehmer','Geschlecht']).mean().iterrows():
        print(r)

#Function to generate percentages for the graphical evaluations
def func(pct, allvals):
    absolute = int(pct/100.*np.sum(allvals))
    return "{:.1f}%\n({:d})".format(pct, absolute)

#Creation of graphical evaluations
    def plotDist(data,col):
    print(col)
    series = data[col].value_counts()
    print("Series",series)
    blah=pd.DataFrame(series)
    blah = blah.reset_index()
    blah.columns = [col, 'Count']
    leg = data[col].unique()
    #blah.reindex(leg)
    ax=blah.plot.pie(y='Count',use_index=False,autopct=lambda cnt: func(cnt,
blah['Count']))
    plt.legend(leg, bbox_to_anchor=(0.88,1.1), title=col,loc="upper left")
    plt.subplots_adjust(left=0.1, bottom=0.1, right=0.75)
    plt.show()

#Creation of graphical evaluations
def plotDist2(data,col):
    print(col)
    series = data[col].value_counts()
    print("Series",series)
    x=series.keys().values
    y=series.values
    plt.pie(y, labels=x, startangle=45,autopct=lambda cnt: func(cnt, y))
    #plt.legend(x, bbox_to_anchor=(0.88, 1.1), title=col, loc="upper left")
    plt.subplots_adjust(left=0.1, bottom=0.1, right=0.75)
    plt.show()

#Output of static values (mean, standard deviation, min, max) for displaying data characteristics
```

```python
def statTable(data):
    print("data=",ind_var.columns)
    data_num=data.drop(["Geschlecht","Unternehmer","Bildung"],axis=1)
    data_cat=data[["Geschlecht","Unternehmer","Bildung"]]
    results=[]
    results.append(data_num.mean())
    results.append(data_num.std())
    results.append(data_num.min())
    results.append(data_num.max())
    data_cat["Index"]=data_cat.index

results.append(data_cat.drop(["Unternehmer","Bildung"],axis=1).groupby(["Geschlecht"]).count())
    results.append(data_cat.drop(["Unternehmer", "Geschlecht"],
axis=1).groupby(["Bildung"]).count())
    results.append(data_cat.drop(["Bildung", "Geschlecht"],
axis=1).groupby(["Unternehmer"]).count())
    results.append(data_cat.drop(["Bildung"], axis=1).groupby(["Unternehmer",
"Geschlecht"]).count())
    return results

#Creation of graphical evaluations
def stats1(data):
    plotDist(ind_var, "Unternehmer")
    res = statTable(ind_var)
    print(res)

#Output of average values/sum of correct answers for the survey groups gender and
#entrepreneur/non-entrepreneur (private person)
def evalAnswers(domean=True):
    ind_var, target = utilities.preprocess(data, norm=False, keepRawAnswers=True)
    ind_var["Unternehmer"] = target
    ind_var = ind_var.drop("ANTWORT ID", axis=1)
    print(ind_var.columns)
    for a in ["A1", "A2", "A3", "A4", "A5"]:
        if domean:
            grpAns = ind_var[["Unternehmer", "Geschlecht", a]].groupby(["Unternehmer",
"Geschlecht"]).mean()
        else:
            grpAns = ind_var[["Unternehmer", "Geschlecht", a]].groupby(["Unternehmer",
"Geschlecht"]).sum()
        print(a)
        print(grpAns)
```

```python
#Reading the data set from the Untilities file
data = utilities.readSurveyData("data/results-survey891732.csv")
ind_var,target=utilities.preprocess(data,norm=False)
ind_var["Unternehmer"]=target
#Omitting the response ID data for the statistical analyses
ind_var=ind_var.drop("ANTWORT ID",axis=1)

#Calling the different functions for generating the data for descriptive statistics
#stats1(ind_var)
#evalAnswers(domean=False)
#overview(ind_var)

#entData=utilities.getDataEntrepreneur(data)
#print(entData.columns)
#plotDist2(entData,"Branche")
#binList(ind_var)
#pivot(ind_var)
#classSex(ind_var)
```

Python file logistic regression

```python
#Import all relevant APIs
import statsmodels.api as sm
import utilities
import RobustnessUtilities

#Loading the data set from the utilities file
data = utilities.readSurveyData("data/results-survey891732.csv")
SAClasses=False
impude=True
ind_var, target = utilities.preprocess(data,SAClasses=SAClasses,impude=impude)

#Deleting the response ID from the data set
ind_var = ind_var.drop('ANTWORT ID', axis=1)

#Robustness tests with 95% percentile to import the RobustnessUtilities file
import RobustnessUtilities
robustnessTest=False
if robustnessTest:
    print("RU")
```

```python
import RobustnessUtilities as rU
low=5
high=95
ind_var['target']=target
ind_var=rU.deleteAllOutliers(ind_var,low=low,high=high)
target=ind_var['target'].values
ind_var=ind_var.drop('target',axis=1)


#Setting up the logistic regression model
logit_model = sm.Logit(target, ind_var)
#Maximal number of iterations=100 and lbfgs-method for optimisation of the regression model
result = logit_model.fit(method="lbfgs",maxiter=100)


#Output of the results
print(result.summary2())

# calculate and print the confusion matrix
y_pred = result.predict(ind_var)
y_pred_binary = [1 if p > 0.5 else 0 for p in y_pred]
cm = confusion_matrix(target, y_pred_binary)
print("Confusion Matrix:")
print(cm)

# calculate and print the AUC
auc = roc_auc_score(target, y_pred)
print("AUC:", auc)


#Calculating VIFs for the variables of the 2nd study
import numpy as np
from scipy import stats

from statsmodels.stats.outliers_influence import variance_inflation_factor

def calculate_vif(X):
    vif_data = pd.DataFrame()
    vif_data["Feature"] = X.columns
    vif_data["VIF"] = [variance_inflation_factor(X.values, i) for i in range(len(X.columns))]
    return vif_data

# Calculating the VIFs
```

```python
vif = calculate_vif(ind_var.drop(columns=["ANTWORT ID"]))
print(vif)
```

Python file Propensity-Score-Matching

```python
#Import all relevant APIs
import pandas as pd
import utilities
import numpy as np
import statsmodels.api as sm
from causalinference.causal import CausalModel
import seaborn as sns
from matplotlib import pyplot as plt
import scipy.stats as stats
from scipy.stats import ttest_ind


#Loading the data set from the utilities file
data = utilities.readSurveyData("data/results-survey891732.csv")
data = data.fillna(data.mean())
ind_var,target=utilities.preprocess(data)

#Convert ind_var and target to dataframe
ind_var = pd.DataFrame(ind_var)
target = pd.DataFrame(target)

#Extract the variable Y for matching
Y = target.to_numpy()

#Determine the classification for high and low financial literacy based on the means and create
variable D for matching.
thresh=ind_var['Financial Literacy'].mean()
print("Thresh",thresh)
D=np.array([1 if i >= thresh else 0 for i in ind_var['Financial Literacy'].values])

print(ind_var.columns)

#Creation numpy array for all variables for further processing
X = ind_var[["Alter", "Wissensvermittlung", "Einkommen", 'Geschlecht_w',"Bildung_keine
BA", "Bildung_ISCED-5 (Höhere BA)","Bildung_ISCED-7 (Hochschule)",'SA']].to_numpy()
```

```python
#t-test for all variables before matching
print("T-Test before Matching")
print("======================")


X = ind_var[["Alter", "Wissensvermittlung", "Einkommen", 'Geschlecht_w',"Bildung_keine
BA","Bildung_ISCED-5 (Höhere BA)","Bildung_ISCED-7 (Hochschule)",'SA']]
colnames=X.columns
print(colnames)
for col in X.columns:
    x1 = X[col][D == 1]
    x0 = X[col][D == 0]
    print(len(x1),np.mean(x1))
    print(len(x0),np.mean(x0))
    t_stat, p_value = ttest_ind(x1, x0)
    print(f"t-statistic for {col}:", t_stat)
    print(f"p-value for {col}:", p_value)

V=Y.reshape(1,-1)[0]

x1 = V[D == 1]
x0 = V[D == 0]
print(len(x1),np.mean(x1))
print(len(x0),np.mean(x0))
t_stat, p_value = ttest_ind(x1, x0)
print(f"t-statistic for Entrepreneur:", t_stat)
print(f"p-value for Entrepreneur:", p_value)

X = X.to_numpy()


#Setting up the CausalModel for matching with the causalinference library.
causal = CausalModel(Y,D,X)
M = CausalModel(Y, D, X)

#Output of the statistics of the matching
print(M.summary_stats)


#Propensity score determination
```

```python
M.est_propensity()

#Trimming of propensity scores with the algorithm trim_s to increase the balance of the matching
and guarantee common support
M.trim_s()

#Execution of the matching and output of the results
M.est_via_weighting()
print(M.summary_stats)
print(M.estimates)

#t-test after the matching has been performed
x_c=M.raw_data['X_c']
x_t=M.raw_data['X_t']
print("T-Test after Matching")
print("=====================")

print(x_c.shape)
for i in range(x_c.shape[1]):
    print(np.mean(x_c[:,i]))
    print(np.mean(x_t[:,i]))
    t_stat, p_value = ttest_ind(x_c[:,i], x_t[:,i])
    print(f"t-statistic for {colnames[i]}:", t_stat)
    print(f"p-value for {colnames[i]}:", p_value)

Y_c=M.raw_data['Y_c']
Y_t=M.raw_data['Y_t']
x1 = Y_c
x0 = Y_t

print(len(x1),np.mean(x1))
print(len(x0),np.mean(x0))
t_stat, p_value = ttest_ind(x1, x0)
print(f"t-statistic for Entrepreneur:", t_stat)
print(f"p-value for Entrepreneur:", p_value)

#Export the propensity scores and attach them to the dataset for further use in the Doubly-Robust
method.
ind_var['ps'] = M.propensity['fitted']

#Performance of the Doubly-Robust method with additional control variable ps (propensity scores
from matching).
X = ind_var[["Financial Literacy","Alter", "Einkommen", "Wissensvermittlung",
```

```python
'Geschlecht_w',
    "Bildung_keine BA","Bildung_ISCED-5 (Höhere BA)","Bildung_ISCED-7
(Hochschule)",'SA','ps']]
logit_model=sm.Logit(target,X)
result=logit_model.fit(method="lbfgs",maxiter=150)
ind_var['FL bin'] = D
ind_var['target'] = Y


#Output of the results of the method
print("DR regression")
print(result.summary2())



#Output of the density plots before and after matching
print(ind_var.shape)
for check in ind_var.columns:

    fig1 = sns.kdeplot(data = ind_var,x=check,hue='FL bin',common_norm = False)
    fig1.set_title("Unmatched")
    fig1.plot()
    plt.show()


    #inverted probability weightings from the matching code to be used for the density plots after
matching (analogous to TheEffect)
    ind_var['ipw'] = ind_var['target']*(1/ind_var['ps']
    ) + (1-ind_var['target'])*(1/(1-ind_var['ps']))



    fig1.get_figure().clf()

    #Density plots after matching
    fig2 = sns.kdeplot(data = ind_var, x = check, hue = 'FL bin', common_norm = False,
weights = 'ipw')
    fig2.set_title("Matched")
    fig2.plot()
    plt.show()
```

Python file robustness utilities

```python
#Import all relevant APIs
import numpy as np
```

```python
#Determination of the interquartile ranges for the robustness checks
def getInterquartileRange(data,column,low=25,high=75):
    q1 = np.percentile(data[column], low,
        interpolation = 'midpoint')
    q3 = np.percentile(data[column], high,
        interpolation = 'midpoint')
    iqr = q3 - q1
    return q1,q3,iqr

#Calculation of the upper and lower limits for the outliers
def getOutlierLimits(data,column,low=25,high=75):
    q1,q3,iqr=getInterquartileRange(data,column,low,high)
    upper = q3 + 1.5 * iqr
    lower = q1 - 1.5 * iqr
    return lower,upper

#Adding the limits to the data and outputting them in "all" for further processing
def getOutlierLimitsMinMax(data,low=25,high=75):
    columns=data.columns
    all=[(getInterquartileRange(data,column,low,high) )for column in columns]
    return all

#Updating the data set with deleted outlier values and output of "data" for further processing
def deleteAllOutliers(data,low=25,high=75,log=False):
    all=getOutlierLimitsMinMax(data,low,high)
    for col,limit in zip(data.columns,all):
        if log:
            print(col,limit[0],limit[1])
        data.drop(data[data[col]<limit[0]].index,inplace=True)
        data.drop(data[data[col]>limit[1]].index,inplace=True)
        if log:
            print(data)
    return data
```

APPENDIX 19. Python Code of statistical Analysis of the 3rd Study

Python file utilities for data preprocessing

```python
#Import all relevant APIs
import pandas as pd

#MinMax Scaler for robustness check
from sklearn.preprocessing import MinMaxScaler

from sklearn.preprocessing import StandardScaler
from sklearn.impute import SimpleImputer
import numpy as np
from matplotlib import pyplot as plt

#Reading in the data set (csv file) and first adjustments
def readSurveyData(file,verbose=0):
    data=pd.read_excel(file)
    #print(">>>>Vorher",data.count)
    data = data.replace('Keine Angabe', np.nan).dropna(axis=0, how='any')
    #data = data.replace('Keine Angabe', "False").dropna(axis=0, how='any')
    #print(">>> Nach drop Keine Angabe",data.count)
    print(data.columns)
    print(data.shape)
#Replacing the gender information with letters
    data = data.replace(['Weiblich'], 'w')
    data = data.replace(['Männlich'], 'm')

############
    if verbose > 0:
        for i in range(len(data.columns)):
            print(i,data.columns[i])
        for i in range(len(data.columns)):
            print(i,data.columns[i])
        print(len(data.index))
    return data




#Extract entrepreneur data from data set of dytes and return it in "dem".
def splitDataEntrepreneur(data):
    dem = data.iloc[:, [0, 13,14,15,16,17]]
    return dem
```

```python
#Extract entrepreneur data from dataset and return it in "data1
def getDataEntrepreneur(data):
    data=data[data.iloc[:,12] == "Ja"]
    data1 = data.iloc[:, [13, 14, 15, 16]]
    data1.columns=["GrJahr","Umsatz","Branche","MA"]
    return data1

#Split person data
def splitDataPerson(data):
    #Extract the response ID for identification and the responses, NaN values dropping
    data1 = data.iloc[:, [0,17, 18, 19, 20, 21, 22, 23, 24, 25, 26]].dropna()
    data1.columns=["Teilnehmer","Q1","Q2","Q3","Q4","Q5","Q6","Q7","Q8","Q9","SA"]
    print(data1.columns)
    qa=data1.loc[:,["Teilnehmer","Q1","Q2","Q3","Q4","Q5","Q6","Q7","Q8","Q9"]]

    #data1 = data.iloc[:, [0,22, 23, 24, 25, 26]].dropna()
    #data1.columns=["Teilnehmer","Q6","Q7","Q8","Q9","SA"]
    #print(data1.columns)
    #qa=data1.loc[:,["Teilnehmer","Q6","Q7","Q8","Q9"]]

    #data1 = data.iloc[:, [0,17, 18, 19, 20, 21, 26]].dropna()
    #data1.columns=["Teilnehmer","Q1","Q2","Q3","Q4","Q5","SA"]
    #print(data1.columns)
    #qa=data1.loc[:,["Teilnehmer","Q1","Q2","Q3","Q4","Q5"]]

    #Based on the response ID, merge a participant's responses with the associated self-assessment
    #on the topic of risk.
    selfAssessment=data1.loc[:,["Teilnehmer","SA"]]
    dem=data.iloc[:,[0,4,5,6,7,8,9,10,11,12]]
    print(selfAssessment)
    return qa, selfAssessment, dem

#Function to split individuals and entrepreneurs for further processing
def splitDataPE(data):
    private=data[data.iloc[:,13] != "Ja"]
    entrepreneur=data[data.iloc[:,13] == "Ja"]
    return private, entrepreneur

#Function for checking the answers and output in res for further processing
def checkAnswers(qa):
    res=qa.iloc[:,0]
    # Correct is:
    correct = ['Mehr als 102 \N{euro sign}', 'Weniger als heute', 'Falsch', 'Richtig', "Besitzt er
```

einen Teil der Firma B", "Lotterie A", "Die selbe durchschnittliche Rendite und ein geringeres Risiko", "Aktien/Aktienfonds", "Kryptowährungen (bspw. Bitcoin)"]

```python
    #correct = ['More than 102\N{euro sign}','Less than today','False','True', "Does he own part
of company B"]
    #correct = ['Lottery A','Same average return and lower risk','Stocks/stock
funds','Cryptocurrencies (e.g. Bitcoin)']
    print(len(correct))
    res=[]

    for index,row in qa.iterrows():
        corrcnt=0
        for i in range(len(correct)):
            if correct[i]==row.iloc[i+1]:
                corrcnt=corrcnt+1
        res.append([row.iloc[0],corrcnt/len(correct)])
    res=pd.DataFrame(res)
    res.columns=["Teilnehmer","Financial Literacy"]
    print(res)
    return res


def remove_outliers_zscore(data, threshold=3):
    """
    Remove outliers from numeric data using Z-score test.

    Parameters:
        data (DataFrame): The input data frame.
        threshold (float): The threshold value for detecting outliers based on Z-score.

    Returns:
        DataFrame: The data frame with outliers removed.
    """
    # Filter out non-numeric columns
    numeric_data = data.select_dtypes(include=[np.number])

    # Calculate Z-scores
    z_scores = np.abs(stats.zscore(numeric_data))

    # Remove outliers based on Z-scores
    outliers_removed = data[(z_scores < threshold).all(axis=1)]

    return outliers_removed
```

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```python
#Function to control the answers not cumulated form for descriptive evaluation and output in res
for further processing
def checkAnswersNonCum(qa):
    res=qa.iloc[:,0]
    #correct=['More than 102\N{euro sign}','Less than today','Falling','True','False','Between 10
and 15 years']
    correct =    correct = ['Mehr als 102 \N{euro sign}', 'Weniger als heute', 'Falsch', 'Richtig',
"Besitzt er einen Teil der Firma B", "Lotterie A", "Die selbe durchschnittliche Rendite und
ein geringeres Risiko", "Aktien/Aktienfonds", "Kryptowährungen (bspw. Bitcoin)"]
    res=[]
    for index,row in qa.iterrows():
        corranswer=[row.iloc[0]]
        for i in range(len(correct)):
            if correct[i]==row.iloc[i+1]:
                corranswer.append(1)
            else:
                corranswer.append(0)
        res.append(corranswer)
    res=pd.DataFrame(res)
    res.columns=["Teilnehmer","A1","A2","A3","A4","A5","A6","A7","A8","A9"]
    #res.columns = ["Teilnehmer", "A6", "A7", "A8", "A9"]
    return res


#Function for further preparation before performing the statistical procedures, with options for the
robustness checks (raw Answers, SACLasses, impude, etc.)
def preprocess(data,norm=True,keepRawAnswers=False,SAClasses=False,impude=True):
    qa, sa, dem = splitDataPerson(data)

    #Introduction of ISCED education classes
    bild=[]
    for index, row in dem.iterrows():
        if row.iloc[3] in ["Abschluss einer beruflich-betrieblichen Berufsausbildung (Lehre)",
"Abschluss einer beruflich-schulischen Ausbildung (Berufsfach- oder Handelsschule)"]:
            bild.append("ISCED-3 (Mittlere BA)")
        else:
            if row.iloc[3] in ["Abschluss einer Fachschule, Meister- oder Technikerschule"]:
                bild.append("ISCED-5 (Höhere BA)")
            else:
                if row.iloc[3] in ["Bachelor Abschluss","Master Abschluss oder früher
gleichwertiger (Diplom, Magister)","Doktortitel (Promotion/Ph.D.)"]:
                    bild.append("ISCED-7 (Hochschule)")
                else:
```

```python
            if row.iloc[3] in ["(Noch) keinen Ausbildungsabschluss","Keine Angabe"]:
                bild.append("keine BA")
            else:
                bild.append("nix")
                print("nix",row.iloc[3],"#")

#Add to dataset "dem" for the further processing
    print("demcol",dem.columns)
    dem = dem.iloc[:, [0, 1, 2, 4, 5, 6, 7, 8,9]]
    #print(len(bild))
    dem["Bildung"] = bild
    dem.columns = ["Teilnehmer", "Alter", "Geschlecht", "Migrationshintergrund",
"Wissensvermittlung", "Wirtschaft", "Erwerbsituation",
"Einkommen","Unternehmer","Bildung" ]
      #print(bild)
#Normalize the data and generate the dummy variables for the nominal scaled data.
#"Imputing"/filling the missing values and NaN values, transforming the numerical variables
    if norm==True:
        if SAClasses:
            sa = pd.get_dummies(sa, columns=["SA"], drop_first=True)
        if impude:
            imp = SimpleImputer(missing_values=np.nan, strategy='most_frequent')
            dem['Einkommen'] = imp.fit_transform(dem['Einkommen'].values.reshape(-1, 1))
            imp = SimpleImputer(missing_values=np.nan, strategy='mean')
            dem['Alter'] = imp.fit_transform(dem['Alter'].values.reshape(-1, 1))
        else:
            dem=dem.dropna(axis=0)
        dem = pd.get_dummies(dem, columns=["Geschlecht", "Bildung",
"Migrationshintergrund", "Wirtschaft", "Erwerbsituation", "Einkommen"],
drop_first=True)
        #dem = pd.get_dummies(dem,columns=["Geschlecht", "Bildung","Migrationshintergrund",
"Wirtschaft", "Einkommen"], drop_first=True)

        #Transfomation of the values (z-standardization)
        scaler = StandardScaler()
        dem[['Alter']] = scaler.fit_transform(dem[['Alter']])
        dem['Wissensvermittlung'] = dem['Wissensvermittlung'].str[0]
        dem[['Wissensvermittlung']] = scaler.fit_transform(dem[['Wissensvermittlung']])
        #dem[['Einkommen']] = scaler.fit_transform(dem[['Einkommen']])
        if not SAClasses:
            sa['SA'] = sa['SA'].str.strip().str[0]
            sa[['SA']] = scaler.fit_transform(sa[['SA']])
        #dem[['Einkommen']] = np.log(dem[['Einkommen']])
```

#Creation of the target variable entrepreneur for the statistical procedures anghand of the answer from the questionnaire

```python
    target = []
    for index, row in dem.iterrows():
        if row["Unternehmer"] == "Ja ":

            target.append(1)
        else:
            target.append(0)
```

#Generation of the data sets for further investigation

```python
    temp = dem.drop("Unternehmer", axis=1)

    if not keepRawAnswers:
        fl = checkAnswers(qa)
        print(fl.columns, temp.columns)
        ind_var = pd.merge(fl, temp, on="Teilnehmer")
    else:
        fl = checkAnswersNonCum(qa)
        ind_var = pd.merge(fl, temp, on="Teilnehmer")

    ind_var = pd.merge(ind_var, sa, on="Teilnehmer")

    return ind_var, target

def plotHistograms(data):
    for i in data.columns:
        if i != "Teilnehmer":
            print(i)
            n, bins, patches = plt.hist(data[i] )
            plt.title(i)
            plt.grid(True)
            plt.show()

if __name__ == '__main__':

data=readSurveyData("data_2/Einfluss_der_finanziellen_Bildung_auf_Unternehmertum_in_Deutschland.xlsx", verbose=0)
    #print(data['Was ist Ihr höchster Ausbildungsabschluss?    [Sonstiges]'])
    ind_var,target=preprocess(data)
    print(data.columns)

    #print(ind_var.mean(),ind_var.median(),ind_var.var())
```

```python
    #plotHistograms(ind_var)
    #plt.show()

#Box Tidwell for 3rd study
import numpy as np
import statsmodels.api as sm
import statsmodels.stats as stats


def box_tidwell_test(variable_name, X, y):
    """
    Perform Box-Tidwell test for logit model.

    Parameters:
        variable_name (str): Name of the independent variable.
        X (DataFrame): Independent variables.
        y (array-like): Dependent variable.

    Returns:
        p-value of Box-Tidwell test.
    """
    # Add interaction term
    X_copy = X.copy()  # Kopiere das DataFrame, um Änderungen auf einer separaten Kopie
vorzunehmen
    epsilon = 1e-10  # Eine kleine Konstante, um Nullen und Einsen zu vermeiden
    y_modified = np.clip(y, epsilon, 1 - epsilon)  # Vermeide Nullen und Einsen
    X_copy['Interaction'] = X[variable_name] * np.log(y_modified / (1 - y_modified))

    # Fit the logistic regression model with interaction term
    model = sm.OLS(y, X_copy)
    results = model.fit()

    # Get the p-value for the interaction term
    p_value = results.pvalues['Interaction']

    return p_value

def perform_box_tidwell_test(X, y):
    """
    Perform Box-Tidwell test for all independent variables.

    Parameters:
        X (DataFrame): Independent variables.
        y (array-like): Dependent variable.
```

```python
    Returns:
        Dictionary containing p-values for Box-Tidwell test for each independent variable.
    """
    p_values = {}
    for variable in X.columns:
        p_values[variable] = box_tidwell_test_alternative(variable, X, y)
    return p_values


# Hier definieren wir y basierend auf deinen Daten
y = np.array(target)  # Oder pd.Series(target)


# Hier rufst du die Funktion perform_box_tidwell_test_alternative auf
box_tidwell_results = perform_box_tidwell_test(ind_var, y)


print(box_tidwell_results)
```

Python file to analyze the data and create the descriptive statistics

```python
#Import all relevant APIs
import pandas as pd
import utils_thomas as utilities
from matplotlib import pyplot as plt
import numpy as np


#Pivot table for output of FL results by age group
def pivot(data):
    data['bin'] = pd.cut(data.Alter, [0, 30, 40, 50, 60, 70])
    print(pd.pivot_table(data=data,index='bin',columns='Unternehmer',values='Financial
Literacy',aggfunc='mean'))


#Pivot table to output FL results by mean threshold in binary form (0:low, 1:high) for the different
age groups
def classEduc(data):
    thresh = ind_var['Financial Literacy'].mean()
    ind_var['FL bin'] = np.array([1 if i >= thresh else 0 for i in ind_var['Financial
Literacy'].values])
    data['bin'] = pd.cut(data.Alter, [0, 30, 40, 50, 60, 70])
    print(pd.pivot_table(data=data,index='bin',columns='Unternehmer',values='FL
bin',aggfunc='count'))
    print((ind_var.value_counts('FL bin')))
```

```python
#Output FL results by mean threshold in binary form (0:low, 1:high) for gender and
entrepreneur/non-entrepreneur.
def classSex(data):
    thresh = ind_var['Financial Literacy'].mean()
    ind_var['FL bin'] = np.array([1 if i >= thresh else 0 for i in ind_var['Financial
Literacy'].values])
    print(pd.pivot_table(data=data,index='Geschlecht',columns='Unternehmer',values='FL
bin',aggfunc='sum'))
    print((ind_var.value_counts('FL bin')))


def crossTable(data):
    data['bin'] = pd.cut(data.Alter, [16, 34, 44, 54, 64, 70])
    print(pd.crosstab(data['bin'],data['Unternehmer']))
    print(pd.crosstab(data['Bildung'], data['Unternehmer']))
    print(pd.crosstab(data['Einkommen'], data['Unternehmer']))


#Various outputs to check the distribution of variables from the dataset and to generate the
descriptive statistics
def binList(data):
    print(data.Alter)
    data['bin'] = pd.cut(data.Alter, [16,34,44,54,64,70])

print(pd.pivot_table(data=data,index='Geschlecht',columns='bin',values='SA',aggfunc='cou
nt'))
    print(pd.pivot_table(data=data,index='Geschlecht',columns='bin',values='Financial
Literacy',aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Geschlecht', values='Financial Literacy',
aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', values='Financial Literacy',
aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', columns = "Geschlecht",
values='Financial Literacy', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns ="Unternehmer",
values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht",
values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', columns="Geschlecht",
values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', values='Wissensvermittlung',
aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Geschlecht', values='Wissensvermittlung',
aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Unternehmer', columns="Geschlecht",
```

```python
values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Unternehmer",
values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht",
values='Wissensvermittlung', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Unternehmer",
values='SA', aggfunc='mean'))
    print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht",
values='SA', aggfunc='mean'))

def blah(data):
    # print(pd.pivot_table(data=data, index='Unternehmer', columns="Geschlecht",
values='Wissensvermittlung', aggfunc='mean'))
    # print(pd.pivot_table(data=data, index='Financial Literacy', columns="Unternehmer",
values='Wissensvermittlung', aggfunc='mean'))
    # print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht",
values='Wissensvermittlung', aggfunc='mean'))
    # print(pd.pivot_table(data=data, index='Financial Literacy', columns="Unternehmer",
values='SA', aggfunc='mean'))
    # print(pd.pivot_table(data=data, index='Financial Literacy', columns="Geschlecht",
values='SA', aggfunc='mean'))

    data=data[["Financial Literacy","Unternehmer","Wissensvermittlung"]]
    data["Index"] = data.index
    with pd.option_context('display.max_rows', None, 'display.max_columns', None):
#more options can be specified also
        print(data.groupby(["Financial
Literacy","Unternehmer","Wissensvermittlung"]).count())
        print(data.groupby(["Financial Literacy", "Unternehmer", "SA"]).count())


#Functions for the output of the mean values for the examination groups
def overview(data):
    print("Durchschnitte")

print("\n>>>Mean:",data.mean(numeric_only=True),"\n>>>Stddev:",data.std(numeric_only=True),"\n>>>Min:",data.min(numeric_only=True),"\n>>>Max:",data.max(numeric_only=True))

    print("Durchschnitte Geschlecht")
    for i,r in data.groupby(['Geschlecht']).mean().iterrows():
        print(r)
```

```python
    print("Durchschnitte Unternehmer")
    for i,r in data.groupby(['Unternehmer']).mean().iterrows():
        print(r)

    print("Durchschnitte Unternehmer und Geschlecht")
    for i,r in data.groupby(['Unternehmer','Geschlecht']).mean().iterrows():
        print(r)

#Function to generate percentages for the graphical evaluations
def func(pct, allvals):
    absolute = int(pct/100.*np.sum(allvals))
    return "{:.1f}%\n({:d})".format(pct, absolute)

#Creation of graphical evaluations
def plotDist(data,col):
    print(col)
    series = data[col].value_counts()
    print("Series",series)
    blah=pd.DataFrame(series)
    blah = blah.reset_index()
    blah.columns = [col, 'Count']
    leg = data[col].unique()
    #blah.reindex(leg)
    ax=blah.plot.pie(y='Count',use_index=False,autopct=lambda cnt: func(cnt,
blah['Count']))
    plt.legend(leg, bbox_to_anchor=(0.88,1.1), title=col,loc="upper left")
    plt.subplots_adjust(left=0.1, bottom=0.1, right=0.75)
    plt.show()

#Creation of graphical evaluations
def plotDist2(data,col):
    print(col)
    series = data[col].value_counts()
    print("Series",series)
    x=series.keys().values
    y=series.values
    plt.pie(y, labels=x, startangle=45,autopct=lambda cnt: func(cnt, y))
    #plt.legend(x, bbox_to_anchor=(0.88, 1.1), title=col, loc="upper left")
    plt.subplots_adjust(left=0.1, bottom=0.1, right=0.75)
    plt.show()

#Output of static values (mean, standard deviation, min, max) for displaying data characteristics
def statTable(data):
```

```python
    print("data=",ind_var.columns)
    data_num=data.drop(["Geschlecht","Unternehmer","Bildung"],axis=1)
    data_cat=data[["Geschlecht","Unternehmer","Bildung"]]
    results=[]
    results.append(data_num.mean())
    results.append(data_num.std())
    results.append(data_num.min())
    results.append(data_num.max())
    data_cat["Index"]=data_cat.index

results.append(data_cat.drop(["Unternehmer","Bildung"],axis=1).groupby(["Geschlecht"]).
count())
    results.append(data_cat.drop(["Unternehmer", "Geschlecht"],
axis=1).groupby(["Bildung"]).count())
    results.append(data_cat.drop(["Bildung", "Geschlecht"],
axis=1).groupby(["Unternehmer"]).count())
    results.append(data_cat.drop(["Bildung", axis=1).groupby(["Unternehmer",
"Geschlecht"]).count())
    return results

#Creation of graphical evaluations
def stats1(data):
    plotDist(ind_var, "Unternehmer")
    res = statTable(ind_var)
    print(res)

#Output of average values/sum of correct answers for the survey groups gender and
entrepreneur/non-entrepreneur (private person)
def evalAnswers(domean=True):
    ind_var, target = utilities.preprocess(data, norm=False, keepRawAnswers=True)
    ind_var["Unternehmer"] = target
    ind_var = ind_var.drop("Teilnehmer", axis=1)
    print(ind_var.columns)
    for a in ["A1", "A2", "A3", "A4", "A5","A6","A7","A8","A9"]:
        if domean:
            grpAns = ind_var[["Unternehmer", "Geschlecht", a]].groupby(["Unternehmer",
"Geschlecht"]).mean()
        else:
            grpAns = ind_var[["Unternehmer", "Geschlecht", a]].groupby(["Unternehmer",
"Geschlecht"]).sum()
        print(a)
        print(grpAns)
        if domean:
```

```python
      grpAns = ind_var[["Geschlecht", a]].groupby(["Geschlecht"]).mean()
    else:
      grpAns = ind_var[["Geschlecht", a]].groupby(["Geschlecht"]).sum()
    print(a)
    print(grpAns)
    if domean:
      grpAns = ind_var[["Unternehmer", a]].groupby(["Unternehmer"]).mean()
    else:
      grpAns = ind_var[["Unternehmer", a]].groupby(["Unternehmer"]).sum()
    print(a)
    print(grpAns)


#Reading the data set from the Untilities file
data =
utilities.readSurveyData("data_2/Einfluss_der_finanziellen_Bildung_auf_Unternehmertu
m_in_Deutschland.xlsx")
ind_var,target=utilities.preprocess(data,norm=False)
ind_var["Unternehmer"]=target
#Leaving out the response ID for statistical evaluations
ind_var=ind_var.drop("Teilnehmer",axis=1)


#Calling the different functions for generating the data for descriptive statistics
#stats1(ind_var)
#evalAnswers(domean=True)
#overview(ind_var)
#print(statTable(ind_var))
```

Python file logistic regression

```python
#Importing all relevant APIs
import statsmodels.api as sm
import utils_thomas
import RobustnessUtilities


#Loading the data set from the utilities file

data =
utils_thomas.readSurveyData("data_2/Einfluss_der_finanziellen_Bildung_auf_Unternehm
ertum_in_Deutschland.xlsx")


#For robustness checks impude and set the SA classes as additional variables
```

```python
SAClasses=False
impude=False
ind_var, target = utils_thomas.preprocess(data,SAClasses=SAClasses,impude=impude)

#Ejecting the response ID from the data set
ind_var = ind_var.drop('Teilnehmer', axis=1)

robustnessTest=False
if robustnessTest:
    print("RU")
    import RobustnessUtilities as rU
    low=5
    high=90
    ind_var['target']=target
    ind_var=rU.deleteAllOutliers(ind_var,low=low,high=high)
    target=ind_var['target'].values
    ind_var=ind_var.drop('target',axis=1)




#Setting up the logistic regression model
logit_model = sm.Logit(target, ind_var)
#  Maximum number of iterations=100 and lbfgs method to optimize the regression model
result = logit_model.fit(method="lbfgs",maxiter=100)

#Output of the results
print(result.summary2())

# calculate and print the confusion matrix
y_pred = result.predict(ind_var)
y_pred_binary = [1 if p > 0.5 else 0 for p in y_pred]
cm = confusion_matrix(target, y_pred_binary)
print("Confusion Matrix:")
print(cm)

# calculate and print the AUC
auc = roc_auc_score(target, y_pred)
print("AUC:", auc)


#Calculating the VIFs for the variables of the 3rd study
from statsmodels.stats.outliers_influence import variance_inflation_factor

def calculate_vif(X):
```

```python
    vif_data = pd.DataFrame()
    vif_data["Feature"] = X.columns
    vif_data["VIF"] = [variance_inflation_factor(X.values, i) for i in range(len(X.columns))]
    return vif_data

# Calculating VIFs
vif = calculate_vif(ind_var.drop(columns=["Teilnehmer"]))
print(vif)
```

Python file Propensity-Score-Matching

```python
#Importing all relevant APIs
import pandas as pd
import utils_thomas as utilities
import numpy as np
import statsmodels.api as sm
from causalinference.causal import CausalModel
import seaborn as sns
from matplotlib import pyplot as plt
import scipy.stats as stats
from scipy.stats import ttest_ind


#Loading the data set from the utilities file
data =
utilities.readSurveyData("data_2/Einfluss_der_finanziellen_Bildung_auf_Unternehmertu
m_in_Deutschland.xlsx")
data = data.fillna(data.mean())
ind_var,target=utilities.preprocess(data)

#Convert ind_var and target to dataframe
ind_var = pd.DataFrame(ind_var)
target = pd.DataFrame(target)

#Extract the variable Y for matching
Y = target.to_numpy()

#Determine the classification for high and low financial literacy based on the means and create
variable D for matching
thresh=ind_var['Financial Literacy'].mean()
print("Thresh",thresh)
```

```python
D=np.array([1 if i >= thresh else 0 for i in ind_var['Financial Literacy'].values])

print(ind_var.columns)

#Creation numpy array for all variables for further processing

X = ind_var [[ 'Alter', 'Wissensvermittlung', 'Geschlecht_w','Bildung_ISCED-5 (Höhere
BA)', 'Bildung_ISCED-7 (Hochschule)','Bildung_keine BA',
'Migrationshintergrund_Nein','Einkommen_> 2.000 - 3.000 €', 'Einkommen_> 3.000 - 4.000
€','Einkommen_> 4.000 - 5.000 €', 'Einkommen_> 5.000 €','Einkommen_bis 1.000 €',
'Einkommen_kein Einkommen', "SA"]]
#t-Test for all variables before matching
print("T-Test before Matching")
print("======================")

X = ind_var [[ 'Alter', 'Wissensvermittlung', 'Geschlecht_w','Bildung_ISCED-5 (Höhere
BA)', 'Bildung_ISCED-7 (Hochschule)','Bildung_keine BA', 'Migrationshintergrund_Nein',
'Wirtschaft_Nein','Erwerbsituation_Teilzeit (20 Stunden)','Erwerbsituation_Teilzeit (21 -
29 Stunden)','Erwerbsituation_Teilzeit (weniger als 20 Stunden)','Erwerbsituation_Vollzeit
(30 - 34 Stunden)','Erwerbsituation_Vollzeit (35 - 39 Stunden)','Erwerbsituation_Vollzeit
(40 Stunden)','Erwerbsituation_Vollzeit (41 - 48 Stunden)','Erwerbsituation_Vollzeit (mehr
als 48 Stunden)','Einkommen_> 2.000 - 3.000 €', 'Einkommen_> 3.000 - 4.000
€','Einkommen_> 4.000 - 5.000 €', 'Einkommen_> 5.000 €','Einkommen_bis 1.000 €',
'Einkommen_kein Einkommen', "SA"]]

colnames=X.columns
print(colnames)
for col in X.columns:
    x1 = X[col][D == 1]
    x0 = X[col][D == 0]
    print(len(x1),np.mean(x1))
    print(len(x0),np.mean(x0))
    t_stat, p_value = ttest_ind(x1, x0)
    print(f"t-statistic for {col}:", t_stat)
    print(f"p-value for {col}:", p_value)

V=Y.reshape(1,-1)[0]

x1 = V[D == 1]
x0 = V[D == 0]
print(len(x1),np.mean(x1))
print(len(x0),np.mean(x0))
t_stat, p_value = ttest_ind(x1, x0)
```

```python
print(f"t-statistic for Entrepreneur:", t_stat)
print(f"p-value for Entrepreneur:", p_value)


X = X.to_numpy()



#Setting up the CausalModel for matching with the causalinference library
causal = CausalModel(Y,D,X)
M = CausalModel(Y, D, X)

#Output of the statistics of the matching
print(M.summary_stats)



#Determination of Propensity Score
M.est_propensity()

#Trimming of propensity scores with the algorithm trim_s to increase the balance of the matching
and guarantee common support
M.trim_s()

#Execution of the matching and output of the results
M.est_via_weighting()
print(M.summary_stats)
print(M.estimates)

#t-test after the matching has been performed
x_c=M.raw_data['X_c']
x_t=M.raw_data['X_t']
print("T-Test after Matching")
print("======================")

print(x_c.shape)
for i in range(x_c.shape[1]):
  print(np.mean(x_c[:,i]))
  print(np.mean(x_t[:,i]))
  t_stat, p_value = ttest_ind(x_c[:,i], x_t[:,i])
  print(f"t-statistic for {colnames[i]}:", t_stat)
  print(f"p-value for {colnames[i]}:", p_value)

Y_c=M.raw_data['Y_c']
Y_t=M.raw_data['Y_t']
x1 = Y_c
```

```python
x0 = Y_t

print(len(x1),np.mean(x1))
print(len(x0),np.mean(x0))
t_stat, p_value = ttest_ind(x1, x0)
print(f"t-statistic for Entrepreneur:", t_stat)
print(f"p-value for Entrepreneur:", p_value)

#--------
#Export the propensity scores and attach them to the dataset for further use in the Doubly-Robust
method
ind_var['ps'] = M.propensity['fitted']

#Performance of the Doubly-Robust method with additional control variable ps (propensity scores
from matching).

X = ind_var [[ "Financial Literacy", 'Alter', 'Wissensvermittlung',
'Geschlecht_w','Bildung_ISCED-5 (Höhere BA)', 'Bildung_ISCED-7
(Hochschule)','Bildung_keine BA',
'Migrationshintergrund_Nein','Wirtschaft_Nein','Einkommen_> 2.000 - 3.000 €',
'Einkommen_> 3.000 - 4.000 €','Einkommen_> 4.000 - 5.000 €', 'Einkommen_> 5.000
€','Einkommen_bis 1.000 €', 'Einkommen_kein Einkommen', "SA", "ps"]]
logit_model=sm.Logit(target,X)
result=logit_model.fit(method="lbfgs",maxiter=500)
ind_var['FL bin'] = D
ind_var['target'] = Y

#Output of the results of the method
print("DR regression")
print(result.summary2())

check='Alter'

fig1 = sns.kdeplot(data = ind_var,x=check,hue='FL bin',common_norm = False)
fig1.plot()
plt.show()

exit()

#Output of the density plots before and after matching
print(ind_var.shape)
for check in ind_var.columns:
```

```python
    fig1 = sns.kdeplot(data = ind_var,x=check,hue='FL bin',common_norm = False)
    fig1.set_title("Unmatched")
    fig1.plot()
    plt.show()


    #inverted probabilty weightings from the matching code to be used for the density plots after
matching (analogous to TheEffect)
    ind_var['ipw'] = ind_var['target']*(1/ind_var['ps']
    ) + (1-ind_var['target'])*(1/(1-ind_var['ps']))


    fig1.get_figure().clf()

    #Density plots after matching
    fig2 = sns.kdeplot(data = ind_var, x = check, hue = 'FL bin', common_norm = False,
weights = 'ipw')
    fig2.set_title("Matched")
    fig2.plot()
    plt.show()
```

Python file robustness utilities

```python
#Importing all relevant APIs
import numpy as np


#Determination of the interquartile range for the robustness checks
def getInterquartileRange(data,column,low=25,high=75):
    q1 = np.percentile(data[column], low,
        interpolation = 'midpoint')
    q3 = np.percentile(data[column], high,
        interpolation = 'midpoint')
    iqr = q3 - q1
    return q1,q3,iqr

#Calculation of the upper and lower limits for the outliers
def getOutlierLimits(data,column,low=25,high=75):
    q1,q3,iqr=getInterquartileRange(data,column,low,high)
    upper = q3 + 1.5 * iqr
    lower = q1 - 1.5 * iqr
    return lower,upper
```

```python
#Adding the limits to the data and outputting them in "all" for further processing
def getOutlierLimitsMinMax(data,low=25,high=75):
    columns=data.columns
    all=[(getInterquartileRange(data,column,low,high) )for column in columns]
    return all


#Updating the data set with deleted outlier values and output of "data" for further processing
def deleteAllOutliers(data,low=25,high=75,log=False):
    all=getOutlierLimitsMinMax(data,low,high)
    for col,limit in zip(data.columns,all):
        if log:
            print(col,limit[0],limit[1])
        data.drop(data[data[col]<limit[0]].index,inplace=True)
        data.drop(data[data[col]>limit[1]].index,inplace=True)
        if log:
            print(data)
    return data
```

APPENDIX 20. Python File – Shearman Coefficient (3rd Study)

```python
#Importing all relevant APIs
import pandas as pd
import utils_thomas as utilities
from matplotlib import pyplot as plt
import numpy as np
from scipy import stats




#Reading in the data
data =
utilities.readSurveyData("data_2/Einfluss_der_finanziellen_Bildung_auf_Unternehmertu
m_in_Deutschland.xlsx")
ind_var,target=utilities.preprocess(data,norm=False)



#Creating res-file and setting income groups for further processing
res=[]
for ind,row in ind_var.iterrows():
    einkommen=row["Einkommen"]
    fl=row["Financial Literacy"]
    print(einkommen)
    if einkommen=="bis 1.000 \N{euro sign}":
        einkommen=1000
    else:
        if einkommen=="> 5.000 \N{euro sign}":
            einkommen=10000
        else:
            if einkommen=="> 1.000 - 2.000 \N{euro sign}":
                einkommen = 2000
            else:
                if einkommen == "> 2.000 - 3.000 \N{euro sign}":
                    einkommen = 3000
                else:
                    if einkommen == "> 3.000 - 4.000 \N{euro sign}":
                        einkommen = 4000
                    else:
                        if einkommen == "> 4.000 - 5.000 \N{euro sign}":
                            einkommen = 5000
                        else:
                            if einkommen == "kein Einkommen":
```

```python
                einkommen = 0
    res.append((einkommen,fl))


#Reading in persons classified as entrepreneurs
entreprens=[]
for t,p in zip(target,res):
    if t==1:
        entreprens.append(p)
e=np.array(entreprens)

print(e.shape)

print(e[:,0])
res = stats.spearmanr(e)


#Giving out the results
print(res.statistic)
print(res.pvalue)


#Giving out the results as graphics
plt.scatter(e[:,0],e[:,1])
plt.show()
```