

ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Bachelor Thesis International Economics and Business Economics

From Classrooms to Startups: Illuminating the Role of Higher Education in German Entrepreneurship

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Date final version: 11-07-2023

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Abstract

This paper examines the impact of higher education on entrepreneurial decisions in Germany. Overall, possessing a higher degree positively influences the choice to become an entrepreneur. However, industry-specific deviations are noted. In the Automotive sector, the effect is negatively skewed, while in the Wholesale and Retail sector, higher education exhibits a significant, positive impact on entrepreneurial activities. When considering different higher education degrees separately, it is observed that obtaining a bachelor's degree increases the propensity to become an entrepreneur, whereas the results for a doctorate degree are insignificant.

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“Few will today deny the importance of the small business sector for the economy at large, and particularly for employment creation and innovation rates. However, relatively little is known about the process leading to the creation of business” (Delmar & Davidsson, 2000).

1. Introduction

Since Delmar and Davidsson's seminal work in 2000, the field of entrepreneurship and business creation has seen extensive research. A prevalent theme across numerous studies is the positive correlation between higher levels of education, future earnings, and success (Card, 1999). Theories such as Lucas's model (1987) and Schultz's human capital theory (1961) suggest that education increases managerial skills, thus increasing the likelihood of pursuing entrepreneurship. However, due to the broad nature of this topic, there is no definitive answer, and research efforts are ongoing. Le (1999), for instance, proposes that higher levels of education generate better outside options, like higher wages or better working conditions. Therefore, this paper aims to examine the effect of higher education on entrepreneurship levels in Germany. Specifically, to address the question:

"What is the effect of higher education on entrepreneurship in Germany?"

Previous studies have examined the relationship between education and entrepreneurship in the broader economy (Van Praag & Van Stel, 2012; Block & Wagner, 2006). This paper also focuses on the Automotive and Wholesale & Retail industries, excluding the Automotive sector, due to their significance to the German economy. To achieve this, the study utilizes linear regression and logit models and delves deeper into the impacts of different education levels (bachelor's and doctorate degrees). Drawing from prior studies conducted in developed nations like Germany, it is anticipated that higher education positively influences the likelihood of becoming an entrepreneur (Shane, 2009). Consequently, the first hypothesis is stated as follows:

Hypothesis 1: Obtaining a higher education degree increases the propensity of individuals to become an entrepreneur in Germany.

To further investigate if this relationship is monotonic the second Hypothesis was formed:

Hypothesis 2: As the individuals gets more educated the propensity of individuals to become an entrepreneur increases in Germany.

Hypotheses 3 and 4 narrow the sample to specific industries investigating the role of higher education in shaping entrepreneurial pursuits within these sectors.

Hypothesis 3: Individuals with a higher education degree are more likely to become entrepreneurs in the Automotive Industry in Germany.

Hypothesis 4: Individuals with a higher education degree are more likely to become entrepreneurs in the Wholesale and Retail Trade industry in Germany.

The findings suggest a positive relationship between obtaining a higher education degree and the probability of becoming an entrepreneur when considering all sectors together. This relationship persists, with a slight decline in the coefficient, for individuals with a bachelor's degree. However, the results for individuals with a doctorate degree are positive but statistically insignificant. In the Automotive sector, the relationship is negative, while in the Retail and Wholesale sector, it remains positive. Thus, policymakers must adopt distinct strategies tailored to each industry. A universal, one-size-fits-all policy approach falls short in addressing the intricate ways in which higher education influences entrepreneurial activity.

2. Background

In Germany, entrepreneurship holds a prominent position both in politics and economics (Bergmann & Sternberg, 2007). According to The Global Entrepreneurship Monitor (2005), Germany excels in government programs, which are considered a critical factor in creating a favorable environment for entrepreneurship. Fritsch and Wyrwich (2014), state that the significance of entrepreneurship in Germany lies in its deep-rooted connection to regional culture, as evidenced by empirical studies. Despite enduring challenging circumstances such as the Second World War and four decades of a socialist regime in East Germany, a resilient entrepreneurship culture has persisted. Thus, there is an influence of regional determinants and the enduring impact of entrepreneurial culture across various regions in Germany.

According to Global Entrepreneurship Monitor (2017), age categories offer valuable insights into the overall entrepreneurial process. Given the shifting demographics in Germany, the older population constitutes a substantial and increasing proportion of the total population. As a result, individuals aged 55-64 have the potential to exert a significant influence on the overall entrepreneurial activity levels within the country. In their study conducted in 2007, Bergmann and Sternberg discovered a distinct relationship between age and the propensity to become an entrepreneur in Germany. Their findings indicate a reversed U-shaped pattern, where the propensity to become an entrepreneur initially rises, peaks, and declines over the remaining working years.

Furthermore, their research on Germany also demonstrates that women tend to exhibit a lower propensity for entrepreneurship when compared to men.

In Germany, government entities allocate funds to stimulate entrepreneurship to address unemployment issues, thereby supporting necessity entrepreneurs (Bergmann & Sternberg, 2007). The concept of nascent necessity entrepreneurship focuses on startup attempts where the lack of alternative employment is the main reason for initiating the business, while nascent opportunity entrepreneurship centers on current startup efforts that arise from identified business opportunities (Bergmann & Sternberg, 2007). According to Block and Wagner (2010), there are differences in terms of human capital between necessity entrepreneurs and opportunity entrepreneurs in Germany. On average, opportunity entrepreneurs tend to capitalize on more advantageous business opportunities compared to necessity entrepreneurs. For opportunity entrepreneurs, general human capital, such as formal education, has a strong explanatory power in their success. In contrast, necessity entrepreneurs benefit more from specific human capital related to their professional expertise, indicating that being educated in the field they pursue as entrepreneurs play a significant role in explaining their outcomes (Block & Wagner, 2010).

The Automotive industry in Germany includes well-known companies like Volkswagen, Daimler, and BMW (Orth, 2023). This industry plays a crucial role in shaping Germany's economic landscape. In contrast, the Retail industry in Germany is a highly dynamic sector that holds great importance due to its size and the impact in the economy (Statista, 2023).

3. Theoretical Framework

Entrepreneurship is a dynamic and complex concept that encompasses the generation of ideas, the establishment of companies, the acquisition of patents, and the nuanced thought process that drive these ventures (Jiménez et al., 2015). Various factors come into play when individuals make the decision to become entrepreneurs. Personal traits such as risk attitude and genetics, along with external factors like access to capital, work experience, and education, can all have an impact (Van Praag & Cramer, 2001). Education is a significant determinant among the multitude of factors that influence entrepreneurial success, as it is a variable that can be easily influenced (Van Praag & Versloot, 2007). There are several mechanisms through which this relationship works. One possibility is that education impacts entrepreneurial decisions through the development of managerial skills, while another possibility is that higher education creates better alternative options (Le, 1999).

Calvo and Wellisz (1980) use Lucas's (1978) model to explain the relationship between education and the decision to become an entrepreneur. According to the model, education increases an individual's managerial abilities, thereby increasing their likelihood of becoming self-employed. Hartog and Oosterbeek (2007) explain the relationship between education and the choice of entrepreneurship through human capital theory. Human capital encompasses the skills and knowledge individuals acquire through various experiences (Schultz, 1961). These experiences include formal education, training, employment history, business venture, business management, family background, skills, knowledge, and related factors (Unger et al., 2011). Through education, individuals are equipped with valuable knowledge that enhances their human capital, enabling them to adapt to and accumulate new knowledge in response to evolving situations (Weick, 1996). Therefore, human capital theory and Lucas' (1978) model emphasize the role of education in not only enriching individuals' capabilities but also facilitating their ability to navigate and thrive in novel entrepreneurial contexts.

However, an alternative perspective stemming from Human capital theory suggests that higher levels of human capital can lead to increased returns from working as a wage employee, thereby reducing the likelihood of choosing self-employment. Le (1999) argues that higher levels of education provide individuals with improved outside options, such as higher wages and better working conditions, which consequently diminishes the inclination towards business ownership. Supporting this notion, Jiménez et al. (2015) observe that tertiary education negatively affects informal entrepreneurship, as individuals with higher education exhibit increased awareness and sensitivity to potential risks associated with starting their own ventures.

In their empirical literature review, Van der Sluis et al. (2008) identify a pattern in studies focusing on Europe. Most of these studies consistently indicate that the returns on education are slightly lower for entrepreneurs when compared to employees. However, a contrasting trend emerges in studies conducted in the United States, where the opposite result is observed. Furthermore, they also conclude that, on average, women tend to benefit more from higher levels of education in terms of their performance in various domains.

The existing theory lacks empirical evidence to support a specific relationship between education and the decision to become an entrepreneur (Van Der Sluis et al., 2008). This uncertainty arises from the conflicting factors that influence the connection between education and entrepreneurship (Le, 1999). Thus, the precise nature of the relationship between education and entrepreneurial choice remains unclear.

Van Praag and Van Stel (2013) cite the works of Shane (2009) and Hartog et al. (2010) as examples that offer unique perspectives on the economic value that entrepreneurs bring to the economy. According to Shane (2009), most of the value creation can be attributed to the most successful segment of entrepreneurs. Thus, he suggests that over time, successful entrepreneurs will stay in the market. Consequently, the correlation between start-up creation and economic growth should not be positive. Examining the correlations between the rates of new firm creation and economic growth in the medium-to-long term reveals that as economic growth increases, the creation of new firms diminishes. Shane (2009) explains, when analyzing regions with a high number of entrepreneurs, such as Africa and South America, a significant relationship emerges between the proportion of a country's gross domestic product derived from agriculture and its level of entrepreneurial activity. Thus, the wealthier countries are wealthier because of the economic growth they have achieved in the past. When countries become wealthier, the rate of start-up

creation tends to decrease since only successful entrepreneurs add value in the long term. In the context of a developed country like Germany, low levels of entrepreneurship are anticipated.

Additionally, Hartog et al. (2010) emphasize that certain individuals within the labor market possess the ability to contribute greater economic value by working as employees for successful business owners, rather than pursuing entrepreneurship themselves. This suggests that individuals with higher levels of education may find more favorable prospects as entrepreneurs compared to others. Therefore, in Germany, an increase in the number of individuals with higher education is also expected to result in a corresponding increase in the number of entrepreneurs.

4. Data & Methodology

4.1. Data

This study utilizes the German Socio-Economic Panel Study (German SOEP), a longitudinal investigation conducted on private households, providing rich data on various socio-economic factors (Siedler et al., 2009). The SOEP data, therefore, guarantees the representativeness of the German population in the sample. Four distinct datasets from SOEP-Core are employed to generate necessary variables: Person Related Meta-Dataset (PPATHL), Generated Individual Data (PGEN), Household Data (HGEN), and Data on significant biographical locations in Germany (BIOREGION). PPATHL comprises all individuals, who have resided in a household participating in SOEP. Each household or individual is represented by a unique record. This database features time-invariant demographic data (e.g., gender, birth year, immigrant status) and possesses requisite identifiers to facilitate data linkage with additional files. PGEN contains individual-level generated data that is keyed on Person ID (PID) and Survey Year (SYEAR). HGEN contains household-level data keyed on Household ID (HID), and Survey Year (SYEAR). BIOREGION contains important biographical data for important places in Germany.

4.1.1. Sample

The final sample combines datasets from PPATHL, PGEN, HGEN, and BIOREGION. Individuals with missing values for occupation, age, and gender were excluded from the sample. Earlier observations were excluded as many individuals obtain their higher education degree immediately after high school, resulting in similar timeframes for degree attainment that do not

contribute valuable information to the research. Additionally, examining changes within individuals who were students before obtaining their higher education degree does not provide meaningful insights. Therefore, the study only includes the most recent observation for each individual, disregarding earlier records.

4.1.2. Outcome Variables

In this study, the dependent variable of interest is "Entrepreneur," a binary variable indicating whether an individual is an entrepreneur. The variable is derived from the "occupational position" variable in the PGEN dataset (see Appendix Table A1). The independent variable, denoted as "Higher Education," is a binary variable that indicates whether the individual has obtained a higher education degree. This variable is derived from the "college degree" variable in the PGEN dataset (see Appendix Table A2).

4.1.3. Control Variables

This study makes use of 5 different control variables that are added one by one with every other model.

Age

This variable, indicating an individual's age at the observation year, accounts for age-related factors such as experience and life circumstances influencing entrepreneurship.

Female

This dummy variable, taking a value of "0" for males and "1" for females, controls for potential gender-related influences and societal norms affecting entrepreneurial opportunities.

Original Household Income

In this study, the absence of data on parental income led to the addition of the income of the original household of the individual as a control variable. The addition of this variable aims to investigate the impact of financial resources on entrepreneurial decisions. To account for the skewed distribution of this variable, its natural logarithm will be employed in the analysis.

Region

The region variable is a categorical variable that takes different values for 16 important regions in Germany (See Appendix Table A3). This variable is later replaced with the East Germany dummy variable, taking a value of 1 for East Germany and 0 for West Germany.

Industry

The industry variable (See Appendix Table A4) provides annual data on the industry of economic activity for all employed individuals based on the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2) (German Socio-economic Panel, 2020).

4.1.4. Descriptive statistics

Table 1 provides descriptive statistics for the variables used in the regression analysis, presenting the total number of observations, mean values, standard deviation, as well as minimum and maximum values.

Table 1

Descriptive Statistics

Variable	Observations	Mean	Std. Deviation	Min	Max
Entrepreneur	32158	.062	.241	0	1
Higher Education	32158	.252	.434	0	1
Female	32158	.5	.5	0	1
East Germany	32158	.198	.398	0	1
Age	32158	46.832	17.624	17	99
Ln Original Household Income	33804	10.417	0.65	2.485	16.831

4.2. Methodology

This study employs regression analysis to investigate the relationship between higher education degrees and the share of entrepreneurs. The analysis utilizes a linear regression model, with “entrepreneurs” in the sample as the dependent variable and the “higher education degree” as

the independent variable. The regression analysis is conducted using the statistical software Stata. The first model estimates the relationship between the dependent variable, Entrepreneurs, and the independent variable, Higher Education. The equation for Model 1 is as follows:

$$\text{Entrepreneurs} = \beta^0 + \beta^1 * \text{Higher Education} + \varepsilon$$

In all the models, coefficient β_0 represents the intercept, while β_1 represents the increase in probability of being an entrepreneur when Higher Education increases from 0 to 1. The error term, ε , encompasses the combined influence of unobserved variables that are not included in the model, capturing both within and between variation in Entrepreneurs that remains unexplained. In all the remaining models, β_2 - β_5 denote the coefficients for the control variables. With every following model there is one control variable added:

Equation for Model 2:

$$\text{Entrepreneur} = \beta_0 + \beta_1 (\text{Higher Education}) + \beta_2 (\text{Age}) + \varepsilon$$

Equation for Model 3:

$$\text{Entrepreneur} = \beta_0 + \beta_1 (\text{Higher Education}) + \beta_2 (\text{Age}) + \beta_3 (\text{Female}) + \varepsilon$$

Equation for Model 4:

$$\text{Entrepreneur} = \beta_0 + \beta_1 (\text{Higher Education}) + \beta_2 (\text{Age}) + \beta_3 (\text{Female}) + \beta_4 (\text{Original Household Income}) + \varepsilon$$

Equation for Model 5:

$$\text{Entrepreneur} = \beta_0 + \beta_1 (\text{Higher Education}) + \beta_2 (\text{Age}) + \beta_3 (\text{Female}) + \beta_4 (\text{Original Household Income}) + \beta_5 (\text{Region}) + \varepsilon$$

4.2.1. Empirical Strategy

Model 5 was initially estimated with 16 different dummies. However, due to an insignificant coefficient for higher education (see Appendix B), it was modified to another region variable, East Germany. After conducting the main regressions, the higher education degree variable was divided into bachelor's degree and doctorate degree categories. This division was implemented to further investigate the potential monotonic relationship between Entrepreneurship and higher education. Model 6 and Model 7 employ the same equation as Model 5, but Model 6

restricts the higher education variable to bachelor's degree, while Model 7 restricts it to doctorate degree.

Furthermore, the sample is restricted to specific industries to study the effect of higher education on entrepreneurship in the Automotive and Wholesale and Retail sectors. Hypotheses 3 and 4, suggesting that the relationship between higher education and entrepreneurship is positive in the Automotive Industry and Wholesale and Retail industry, will be tested, respectively. Models 8 and 9 estimate the same equation as Model 5 for the Automotive Industry and Wholesale and Retail Industry, respectively. The separation of the bachelor's degree and doctorate degree was not implemented in different sectors due to an insufficient number of doctorate students in each sector in the sample.

To control for potential non-linear relationships between entrepreneurship and higher education levels, a logit model is also incorporated.

5. Results

5.1.1. Regression Analysis

The results for all the models are presented in this section. Tables 2 and 3 provide the results that are used to answer Hypothesis 1, which suggests that individuals with a higher education degree are more likely to become entrepreneurs in Germany, and Hypothesis 2, which proposes that this relationship increases as the individual's level of education advances. Table 2 displays equations 1 to 5.

Table 2*Regression Results for Models 1-5*

Entrepreneur	(1)	(2)	(3)	(4)	(5)
Higher Education	0.0705*** (0.003)	0.0671*** (0.003)	0.0654*** (0.003)	0.0458*** (0.003)	0.0454*** (0.003)
Age		0.000911*** (0.000)	0.000935*** (0.000)	0.000913*** (0.000)	0.000898*** (0.000)
Female			-0.0360*** (0.003)	-0.0370*** (0.003)	-0.0371*** (0.003)
Ln Original Household Income				0.0538*** (0.002)	0.0544*** (0.002)
East Germany					0.00934** (0.003)
Constant	0.0440*** (0.002)	0.00218 (0.004)	0.0195*** (0.004)	-0.535*** (0.021)	-0.541*** (0.021)
Observations	32158	32158	32158	32158	32158

Note. Standard errors in parentheses. ***, **, * denote significance levels of 0.001, 0.01, 0.05 respectively. Entrepreneurship is the binary outcome variable. Models are numbered in each column. With every column an additional control variable is added. Model 1 estimates the effect of higher education on entrepreneurship without controlling for any variables. Model 2 controls for Age. Model 3 controls for Age and Female. Model 4 controls for Age, Female, natural logarithm of Original Household Income. Model 5 controls for Age, Female, Ln Original Household Income, and East Germany.

A persistent positive and statistically significant effect of higher education on entrepreneurship is observed across all models. In Model 5, which controls for all variables, a shift from 0 to 1 in the "Higher Education" variable increases the likelihood of entrepreneurship by 0.0454 percent. Age exhibits positive coefficients in all models where it is included, indicating that experience and age-related factors may enhance entrepreneurial propensities. The female variable exhibits a statistically significant negative correlation with entrepreneurship across relevant models, suggesting potential gender-related barriers or societal norms influencing entrepreneurial aspirations. The natural logarithm of Original Household Income, included in Models 4 and 5, has a positive and statistically significant coefficient. This highlights the potential role of financial

resources in entrepreneurial decision-making and outcomes. Lastly, Model 5 introduces the regional variable, East Germany, which exhibits a statistically significant positive coefficient. This indicates a stronger effect of higher education on entrepreneurship in East Germany compared to the West. Furthermore, Table 3 compares Model 5 with Models 6 and 7 which define higher education as bachelor's degree, and doctorate degree respectively.

Table 3

Regression Results for Models 5-7

Entrepreneur	(5)	(6)	(7)
	All degrees	Bachelor's Degree	Doctorate Degree
Higher Education	0.0454*** (0.003)	0.0448*** (0.003)	0.0245 (0.013)
Age	0.000898*** (0.000)	0.000903*** (0.000)	0.000985*** (0.000)
Female	-0.0371*** (0.003)	-0.0375*** (0.003)	-0.0386*** (0.003)
Ln Original Household Income	0.0544*** (0.002)	0.0551*** (0.002)	0.0611*** (0.002)
East Germany	0.00934** (0.003)	0.00935** (0.003)	0.0115*** (0.003)
Constant	-0.541*** (0.021)	-0.548*** (0.021)	-0.604*** (0.021)
Observations	32158	32158	32158

Note. Standard errors in parentheses. ***, **, * denote significance levels of 0.001, 0.01, 0.05 respectively. Entrepreneurship is the binary outcome variable. Models are numbered in each column. All the models show the effect of higher education on entrepreneurship while controlling for Age, Female, natural logarithm of Original Household Income, and East Germany. Model 5 incorporates all the higher education degrees. Models 6 and 7 show the effect of bachelor's degree and doctorate degree on entrepreneurship respectively.

From Model 5 to 6, the influence of higher education on entrepreneurship maintains its positive and significant impact. When the educational attainment becomes more specialized to the Doctorate Degree, the coefficient of the higher education variable decreases to 0.0245 and becomes

insignificant. This suggests that while advanced degrees contribute to the likelihood of entrepreneurship, the incremental effect is ambiguous at the doctoral level. All other control variables – Age, Female, natural logarithm of the Original Household Income, and East Germany – continue to exhibit statistical significance across all models. All the control variables slightly increase in Model 7 which investigates individuals with a doctorate degree.

Table 4 presents the regression results for three different models: Model 5, representing all industries, and Models 8 and 9, representing the Automotive industry and the Wholesale & Retail industry respectively.

Table 4

Regression Results for Models 5, 8, 9

Entrepreneur	(5)	(8)	(9)
	All Industries	Automotive Industry	Wholesale & Retail Industry
Higher Education	0.0454*** (0.003)	-0.0341 (0.02)	0.0808*** (0.02)
Age	0.000898*** (0.000)	0.00201** (0.001)	0.00416*** (0.001)
Female	-0.0371*** (0.003)	-0.00952 (0.02)	-0.0779*** (0.014)
Ln Original Household Income	0.0544*** (0.002)	0.0353* (0.015)	0.0644*** (0.012)
East Germany	0.00934** (0.003)	0.0281 (0.021)	0.00909 (0.018)
Constant	-0.541*** (0.021)	-0.416** (0.155)	-0.738*** (0.128)
Observations	32158	599	1459

Note. Standard errors in parentheses. ***, **, * denote significance levels of 0.001, 0.01, 0.05 respectively. Entrepreneurship is the binary outcome variable. Models are numbered in each column. Model 5 gives the effect of Higher education on entrepreneurship for all industries while Models 8 and 9 represent Automotive, and Wholesale & Retail Industry respectively.

Model 8, which focuses on the Automotive industry, shows a coefficient of -0.0341 for higher education, indicating a negative correlation with entrepreneurship. However, this value is not statistically significant, suggesting that within the automotive industry, higher education may

not have a substantial impact on the likelihood of entrepreneurship. In contrast, Model 9 representing the Wholesale & Retail industry demonstrates a positive and statistically significant correlation between higher education and entrepreneurship. The coefficient for higher education increases to 0.0808, indicating that higher education has a stronger influence on entrepreneurship in the Wholesale & Retail sector. Age consistently exhibits a positive and statistically significant relationship with entrepreneurship across all models, implying that experience, maturity, and possibly broader networks contribute to the likelihood of entrepreneurship. A consistent negative relationship between being female and entrepreneurship is observed across all models, although with variations in significance and magnitude. The natural logarithm of yearly income remains statistically significant in all models, confirming the influence of financial resources on entrepreneurial tendencies. The region variable, East Germany, loses its significance in the Automotive and Wholesale & Retail industry models, suggesting that regional influences may have less impact in these specific sectors.

5.2. Sensitivity Analysis

In this section, a Logit model is applied to analyze the same relationship as estimated with the regression model. This is done to check for the robustness of the results. Thus, table 5 replicates the Models represented in Table 2 for a logit analysis.

Table 5*Logit Results for Models 1-5*

Entrepreneur	(1)	(2)	(3)	(4)	(5)
Higher Education	2.809*** (0.132)	2.685 *** (0.127)	2.598*** (0.123)	1.793*** (0.090)	1.776 *** (0.09)
Age		1.016*** (0.001)	1.016*** (0.001)	1.017*** (0.002)	1.017*** (0.002)
Female			0.529*** (0.026)	0.535*** (0.027)	0.534*** (0.027)
Ln Original Household Income				2.708*** (0.107)	2.749*** (0.109)
East Germany					1.209** (0.072)
Constant	0.046*** (0.031)	0.020*** (0.002)	0.027*** (0.002)	$7.59e^{-07}$ *** ($03.27e^{-07}$)	$6.34e^{-07}$ *** ($2.77e^{-07}$)
Observations	32158	32158	32158	32158	32158

Note. Standard errors in parentheses. ***, **, * denote significance levels of 0.001, 0.01, 0.05 respectively. Entrepreneurship is the binary outcome variable. Table 5 presents the results of a series the logit regression models for Models 1-5, evaluating the impact of higher education and other factors on the likelihood of being an entrepreneur. Each model successively adds more control variables. The estimated coefficients are odds ratios, which represent the factor change in odds associated with a one-unit change in the respective variable. The constant term (intercept) shows the odds ration when all the other variables are zero. When the odds ratio =1, the variable does not affect the odds of outcome. When the odds ratio >1, the variable is associated with higher odds of outcome. When the odds ratio <1, the variable is associated with lower odds of the outcome.

Model 1 establishes a positive and significant association between higher education and entrepreneurship, with an odds ratio of 2.809. This means obtaining a higher education degree increases the odds of being an entrepreneur. Despite the decreasing odds ratio for higher education after the addition of all the control variables, the positive and significant association remains consistent throughout all models. This underlines the influence of higher education on entrepreneurship, even when controlling for other relevant variables. Furthermore, the signs and the significance of the control variable complement the results from Table 2 where the regression

results for the same models were shown. Thus, these findings are in line with the results from the previous regression analysis, further validating the significant role of higher education in entrepreneurship. Table 6 replicates the Models used in Table 3.

Table 6

Logit Results for Models 5-7

Entrepreneur	(5)	(6)	(7)
	All degrees	Bachelor's Degree	Doctorate Degree
Higher Education	1.776 *** (0.089)	1.773*** (0.089)	1.011 (0.176)
Age	1.017*** (0.001)	1.017*** (0.001)	1.019*** (0.001)
Female	0.533*** (0.026)	0.529*** (0.026)	0.518*** (0.025)
Ln Original Household Income	2.749 *** (0.109)	2.794*** (0.110)	3.127*** (0.121)
East Germany	1.209*** (0.071)	1.209*** (0.0716)	1.258*** (0.074)
Constant	$6.34e^{-07}$ *** ($2.77e^{-07}$)	$5.37e^{-07}$ *** ($2.33e^{-07}$)	$1.80e^{-07}$ *** ($7.77e^{-08}$)
Observations	32158	32158	32158

Note. Standard errors in parentheses. ***, **, * denote significance levels of 0.001, 0.01, 0.05 respectively. Entrepreneurship is the binary outcome variable. All the models show the effect of higher education on entrepreneurship while controlling for Age, Female, natural logarithm of Original Household Income, and East Germany. Models 6 and 7 show the effect of bachelor's degree and doctorate degree on entrepreneurship respectively. The estimated coefficients are odds ratios, which represent the factor change in odds associated with a one-unit change in the respective variable. The constant term (intercept) shows the odds ratio when all the other variables are zero. When the odds ratio =1, the variable does not affect the odds of outcome. When the odds ratio >1, the variable is associated with higher odds of outcome. When the odds ratio <1, the variable is associated with lower odds of the outcome.

The results suggest that while higher education in general and a bachelor's degree specifically increase the odds of entrepreneurship, holding a doctorate does not seem to significantly alter these odds. This is consistent across both the logit and regression analyses, further validating these findings. Furthermore, for Age, Original Household Income, and being in East Germany are consistently associated with higher odds of entrepreneurship, while being female is associated with lower odds. The consistency between results shown in Table 2 and Table 6 across the two methodological approaches reaffirms the robustness of these findings. Table 7 replicates the Models used in Table 4.

Table 7

Logit Results for Models 6, 9, 10

Entrepreneur	(4)	(9)	(10)
	All Industries	Automotive Industry	Wholesale & Retail Industry
Higher Education	1.776*** (0.089)	0.260* (0.178)	2.054** (0.485)
Age	1.017*** (0.001)	1.068** (0.022)	1.063*** (0.008)
Female	0.533*** (0.026)	0.792 (0.457)	0.382*** (0.078)
Ln Original Household Income	2.749*** (0.109)	4.834** (2.666)	2.254*** (0.406)
East Germany	1.209 (0.071)	2.090 (1.150)	1.040 (0.277)
Constant	$6.34e^{-07}$ *** ($2.77e^{-07}$)	$8.65e^{-11}$ *** ($5.30e^{-10}$)	0.277 *** ($2.42e^{-06}$)
Observations	32158	599	1459

Note. Standard errors in parentheses. ***, **, * denote significance levels of 0.001, 0.01, 0.05 respectively. Entrepreneurship is the binary outcome variable. Model 4 gives the effect of Higher education on entrepreneurship for all industries while Models 9 and 10 represent Automotive, and Wholesale & Retail Industry except the Automotive Industry respectively. The estimated coefficients are odds ratios, which represent the factor change in odds associated with a one-unit change in the respective variable. The constant term (intercept) shows the odds ration when all the other variables are zero. When the odds ratio =1, the variable does not affect the odds of outcome. When the odds ratio >1, the variable is associated with higher odds of outcome. When the odds ratio <1, the variable is associated with lower odds of the outcome.

In the automotive industry, the logit model suggests that higher education is associated with significantly lower odds of becoming an entrepreneur. This suggests that higher education is negatively associated with being an entrepreneur in the automotive industry. In the Wholesale & Retail industry, the logit models indicates that higher education significantly increases the odds of becoming an entrepreneur. The results for Age, gender Female, and natural logarithm of Original Household Income follow similar patterns across the two methodological approaches used in table 4 and table 7, thus adding credibility to the findings.

6. Discussion & Conclusion

6.1. Summary of findings

All models estimated showed a significant and positive relationship between higher education and entrepreneurship except Models 7 and 8. Model 7 examined the relationship between obtaining a doctorate degree and entrepreneurship and Model 8 restricted the sample to Automotive Industry. With Models 1-5 the inclusion of control variables diminished the coefficient for higher education. Therefore, the integration of these variables enhanced and reaffirmed the significant and positive correlation between higher education and entrepreneurship. This supports the first hypothesis, aligning with the works of Jiménez et al. (2015), Lucas's Model (1987), and the human capital theory (Schultz, 1961).

The coefficient for age and original household income has positive and significant coefficients across all models including the degree specific and the industry specific models. This finding aligns with the common understanding that as individuals age and accumulate work experience, their suitability to become entrepreneurs enhances (Bergmann & Sternberg, 2007). This also indicates that financial resources, possibly inherited from parents or grandparents, can facilitate an individual's entrepreneurial aspirations. In the context of geographical influence, it is noteworthy that the likelihood of an individual becoming an entrepreneur increases in East Germany. The coefficient for females, however, remains negative across all models except the automotive industry specific model potentially due to the sample researched being smaller. This indicates potential gender disparities in opportunities in entrepreneurship in Germany. In the context of geographical influence, the likelihood of an individual becoming an entrepreneur increases in East Germany. This holds true across all models; however, the coefficients lose their

significance when the sample is confined to two industries. The relatively higher entrepreneurial inclination in East Germany could be attributed to lower opportunity costs, implying a potential wage-worker salary may not match the income generated through self-employment. This is supported by Fritsch (2004) who suggests that the enduring impact of four decades of socialist planning in East Germany is evident in these entrepreneurial tendencies. When looked at different types of higher education levels, the effect becomes insignificant for doctorate degree and significant and positive for bachelor's degree.

Diving into the sector-specific analysis, higher education has a negative and insignificant effect on the tendency to become an entrepreneur in the automotive sector; however, the relationship is significant and positive for the wholesale & retail sector. This contrasting effect in the automotive sector could be attributed to the sector's capital-intensive nature, high entry barriers, and dominance by established companies that make use of vertical integration (Schulze et al., 2015). All these factors together elevate the opportunity costs associated with entrepreneurship. Consequently, hypothesis 3, which suggests that higher education levels increase entrepreneurship in the automotive sector, is not supported. Conversely, in the wholesale & retail sector, the coefficient of higher education intensifies, reaffirming the significant positive relationship between higher education and entrepreneurship, as estimated in Model 5. Thus, hypothesis 4, which proposes that higher education levels contribute to entrepreneurship in the wholesale & retail industry, is supported.

6.2. Strengths, Limitations & Recommendations

This study contributes to the literature by examining the relationship between higher education and entrepreneurship in different industries, which is an area that has not been extensively researched. Additionally, it explores whether this relationship exhibits a monotonic pattern by distinguishing between bachelor's and doctorate students. The study incorporates sensitivity analysis to ensure the reliability of the results. The findings of this study provide a broader perspective on entrepreneurial opportunities.

However, there are numerous other potential factors that could influence entrepreneurship, including societal and cultural norms, governmental policies, and the broader economic environment. These additional factors could offer a more comprehensive understanding of the influences on entrepreneurship. Due to the unavailability of relevant variables, they were beyond

the scope of this study. A notable limitation of this study is the reduction in observations when the sample was restricted to specific industries. This reduction in sample size may limit the statistical robustness and reliability of the insights obtained. Furthermore, it is worth noting that this study does not differentiate between necessity entrepreneurs and opportunity entrepreneurs due to the unavailability of data.

Future research could expand the sectoral coverage of this study by including more industries or sectors with varying barriers to entry or industry dynamics. This would provide a more diverse understanding of how higher education impacts entrepreneurship. Additionally, incorporating additional control variables such as economic circumstances and policy environments could contribute to obtaining more accurate results regarding the effects of higher education on entrepreneurship.

6.3. Policy Implications

The findings of this analysis highlight the substantial influence of industry characteristics and specific education levels on entrepreneurial inclinations. The observed variations across different sectors emphasize the importance of implementing targeted policies and support mechanisms to effectively nurture entrepreneurship.

6.4. Conclusion

This study investigates the influence of higher education on an individual's inclination towards entrepreneurship, considering control variables such as Age, Gender, Original Household Income, and regional influences. Additionally, it explores the impact of different levels of higher education separately. The analysis focuses on two sectors, Automotive and Wholesale & Retail, to gain sector-specific insights. Based on the theoretical framework, the hypothesis posits a positive correlation between higher education and the propensity for self-employment. Given Germany's status as a developed country, it is expected that overall levels of entrepreneurship may be lower compared to less developed nations, as not everyone opts for entrepreneurial paths. Instead, individuals with the necessary skills, acquired through higher education or other means, may choose self-employment, while others pursue wage work. The findings of this study support this expectation, affirming that higher education acts as a catalyst for increased levels of entrepreneurship. However, the influence of higher education varies across sectors. In the well-

established Automotive industry, characterized by high entry barriers, the positive impact of higher education on entrepreneurship is mitigated. Conversely, within the Wholesale & Retail sector, the correlation between higher education and entrepreneurship is not only positive but also significantly stronger than the general influence observed across sectors. These results underscore the significance of considering sector-specific dynamics when examining the relationship between higher education and entrepreneurial propensities. Furthermore, the study reveals that as the level of higher education increases, the effect of higher education on entrepreneurship does not proportionally increase within the sample used. This suggests that a one-size-fits-all approach fails to accurately capture the nuanced influence of higher education on entrepreneurship.

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Appendix A

Values for Categorical Variables

Table A1

Values for Occupational Position

Occupational status	Frequency	Percentage
[10] Not employed	3712	10.98
[11] In training, incl. further training, vocational training	1302	3.85
[12] Registered unemployed	2227	6.59
[13] Pensioner / retiree	5687	16.82
[15] Military and civilian service	74	0.22
[120] Apprentices, industrial-technical	691	2.04
[130] Apprentices, commercial	309	0.91
[140] Student trainee, interns	116	0.34
[210] Untrained Worker	1205	3.56
[220] Semi-skilled worker	1433	4.24
[230] Skilled and semi-skilled workers	1284	3.80
[240] Foreman, Column Leader	165	0.49
[250] Master, foreman	81	0.24
[411] Self-employed farmer without employees	33	0.10
[412] Self-employed farmer 1-9 employees	25	0.07
[413] Self-employed farmer 10+ employees	8	0.02
[421] Freelancers, academics without employees	380	1.12
[422] Freelancers, academics, 1-9 employees	172	0.51
[423] Freelancer, academic, 10+ employees	53	0.16
[431] Other self-employed persons, excluding employees	516	1.53
[432] Other self-employed, 1-9 employees	513	1.52
[433] other self-employed, 10+ employees	371	1.10
[440] Contributing family members	56	0.17
[510] Salaried employees, industrial and works foremen	16	0.05
[521] Salaried employees, elementary	2093	6.19
[522] Salaried employees, elementary with training	1918	5.67
[530] Salaried employee, skilled	4653	13.76
[540] Salaried employee, highly skilled or managerial duties	3142	9.29
[550] Salaried employee with extensive managerial duties	275	0.81
[560] Managing partner and similar employees in own business	212	0.63
[610] Civil servants, lower level	28	0.08
[620] Civil servants, middle level	216	0.64
[630] Civil servants, upper level	504	1.49
[640] Civil servants, executive level	333	0.99
Total	33804	100.00

Table A2*Values for College Degree*

University degree	Frequency	Percent
[-2] does not apply	25037	74.07
[-1] not specified	137	0.41
[1] University of Applied Sciences	1844	5.45
[2] University, TH	3453	10.21
[3] University abroad	2129	6.30
[4] Engineering, technical school (East)	357	1.06
[5] University (East)	444	1.31
[6] Doctorate, Habilitation	270	0.80
[7] Doctorate (foreign,east)	61	0.18
[9] Dual study program, university of cooperative education	54	0.16
[10] Other university	18	0.05
Total	33804	100.00

Table A3*Values for Region*

Unique state Location	Freq.	Percent
[1] Schleswig-Holstein	87	2.52
[2] Hamburg	105	3.04
[3] Lower Saxony	284	8.22
[4] Bremen	65	1.88
[5] North Rhine-Westphalia	949	27.46
[6] Hesse	245	7.09
[7] Rhineland-Palatinate	93	2.69
[8] Baden-Wuerttemberg	337	9.75
[9] Bavaria	574	16.61
[10] Saarland	59	1.71
[11] Berlin	300	8.68
[12] Brandenburg	78	2.26
[13] Mecklenburg-Western Pomerania	40	1.16
[14] Saxony	96	2.78
[15] Saxony-Anhalt	67	1.94
[16] Thuringia	77	2.23
Total	3456	100.00

Table A4*Values for Industry*

Industry current occupation (NACE Rev. 2, divisions)	Frequency
[29] Manufacture of motor vehicles and parts of motor vehicles	464
[45] Trade in motor vehicles	135
[46] Wholesale trade (excl. trade in motor vehicles and motorcycles)	203
[47] Retail trade (excluding motor vehicles and motorcycles)	1256
Total	2058

Appendix B

Region Variables

Addition of the region variable that takes 16 different values (See Appendix Table A3) makes the coefficient of higher education insignificant. Thus, the region dummy was replaced with the dummy variable East Germany that takes the value “1” for East Germany and takes the value “0” for West Germany.

Table B1

Regression Results for Models 1-5

Entrepreneur	(1)	(2)	(3)	(4)	(5)
Higher Education	0.0666*** (0.002)	0.0634*** (0.003)	0.0431*** (0.003)	0.0435*** (0.003)	0.00945 (0.005)
Age		0.001000*** (0.000)	0.000961*** (0.000)	0.000969*** (0.000)	0.00128*** (0.000)
Female			-0.0349*** (0.002)	-0.0346*** (0.002)	-0.00225 (0.004)
Ln Original Household Income				0.0528*** (0.001)	0.0249*** (0.003)
Constant	0.0423*** (0.001)	-0.00306 (0.003)	-0.532*** (0.020)	-0.528*** (0.020)	-0.260*** (0.034)
Observations	33804	33804	33804	33804	3456

Note. Standard errors in parentheses. ***, **, * denote significance levels of 0.001, 0.01, 0.05 respectively. Entrepreneurship is the binary outcome variable. Model 1 estimates the effect of higher education on entrepreneurship without controlling for any variables. In Model 2 age is added as a control variable. Model 3 incorporates age and female (gender variable) in the model. Model 4 incorporates age, female, natural logarithm of Original Household Income to the model. Model 5 controls for Age, Female, Ln Original Household Income, and region. Region variable is a dummy variable that consists of 16 different regions. However, it is not included in the table as these values are insignificant.

